

186-PAGE ISSUE

92 PAGE BUYER'S GUIDE
SPECIAL SECTION
YOUR OWN COMPUTER

OCT. 1982 \$1.95

Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

**YOUR OWN
Computer**
92-PAGE BUYERS GUIDE

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Computer Systems
\$100 to \$6000

SOFTWARE

★ Games ★ Telecommunications
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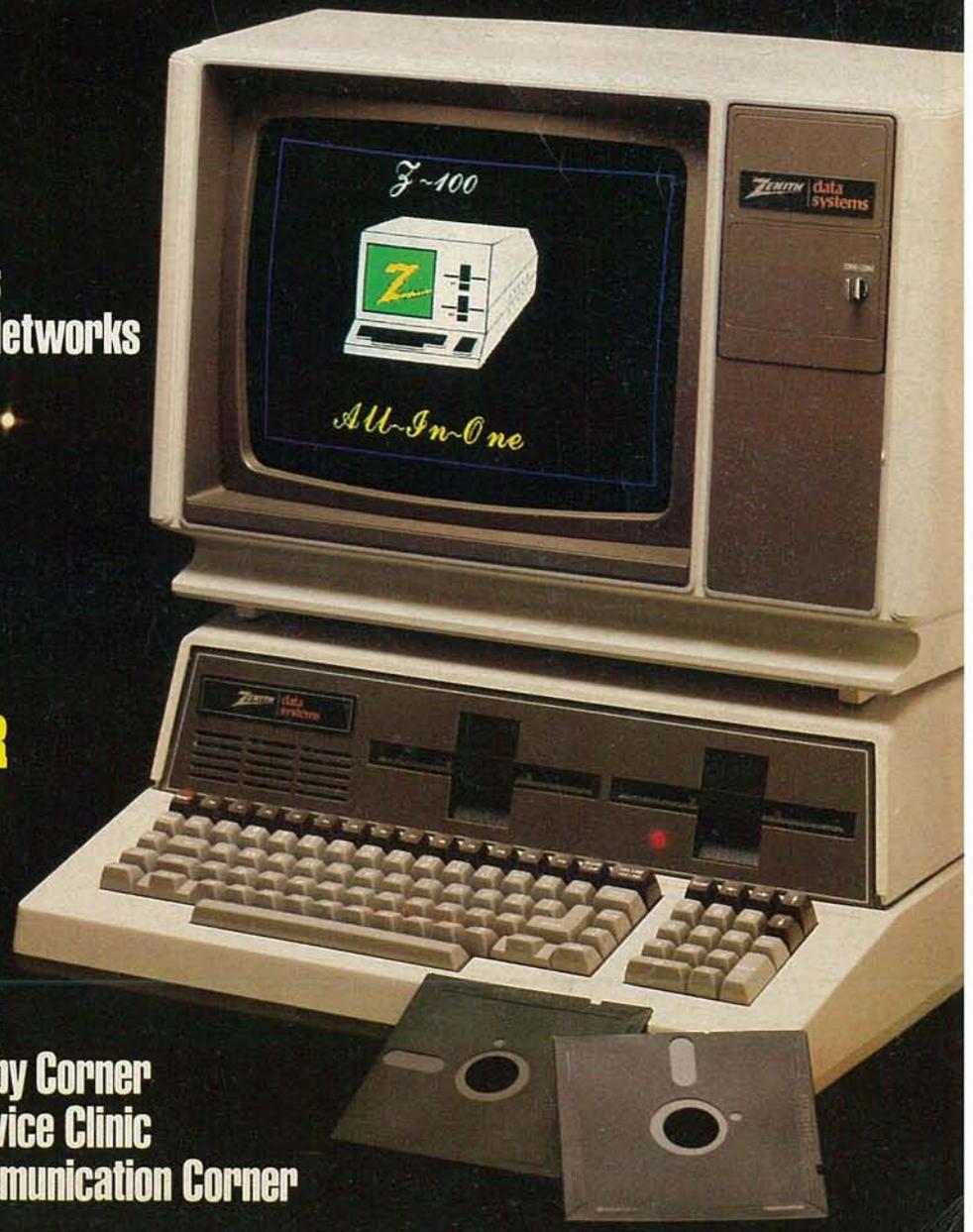
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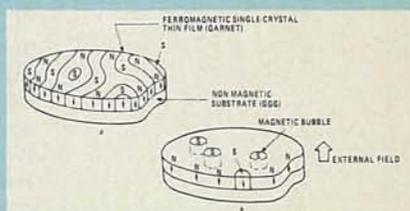
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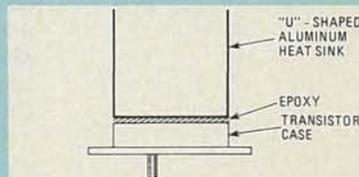
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ON THE COVER

Microcomputers—for the home and for business—come in all sizes and prices. You can pay as little as \$100 (or less!) or as much as \$6000 (or more). To help you make an intelligent choice in selecting a computer that meets both your needs and your budget, our Special Section, "Your Own Computer," groups computers and computer systems by price. Also included are descriptions of software and services that you may find useful. And, to round things out, there's a discussion of 8-bit vs. 16-bit computers. "Your Own Computer" starts on page 43.



BUBBLE MEMORIES COMBINE the read/write features of RAM with the non-volatility of ROM, and approach tape and disk systems in storage capacity. Find out how they work and how they're used starting on page 39.



DERATING CIRCUIT-COMPONENTS can extend their life and make the equipment in which they're used more reliable. This month's Service Clinic covers that topic, beginning on page 150.

Due to lack of space we are unable to include Part 2 of the "Heart-a-Matic" in this issue. It will appear next month.

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ZX81



Introducing the Sinclair ZX81.

If you're ever going to buy a personal computer, now is the time to do it.

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To order.

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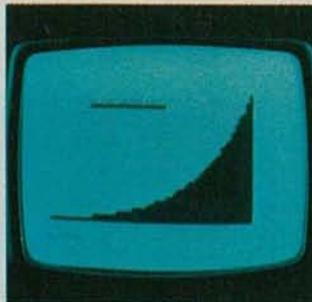
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TOTAL				

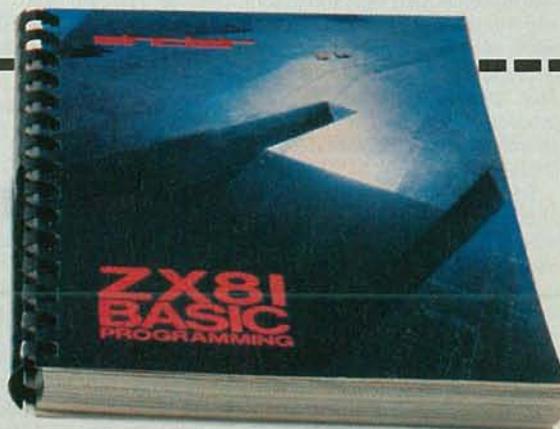
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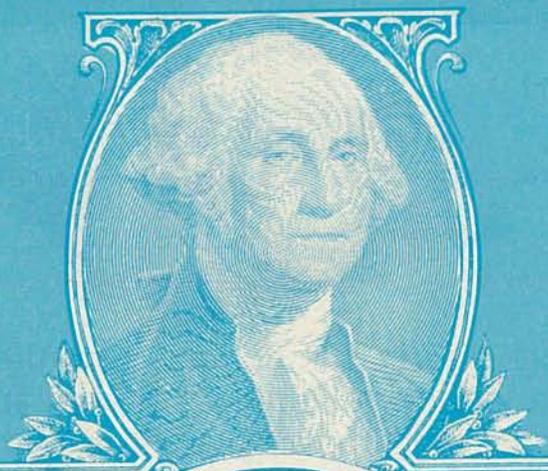
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HARDWARE



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8 bits vs. 16 bits

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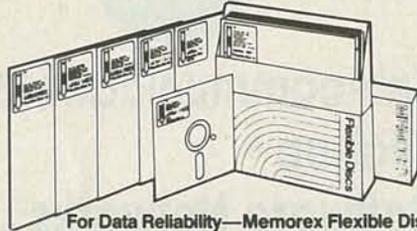
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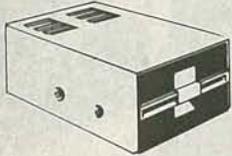
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18-pin	5/1.35	5/2.98	40-pin	5/3.02	5/6.89
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THE SHARP PC-1500 uses an eight-bit CPU. It is shown here with its optional four-color printer/plotter.

TRS-80 Pocket Computer and TRS-80 Pocket Computer-2 (also known as the TRS-80 PC-2). Each computer bears two designations—Sharp's and Radio Shack's—because Sharp makes virtually identical handheld units for itself and for Radio Shack. The lower-priced PC-1211/Pocket Computer demonstrate that not all microcomputers are driven by eight-bit microprocessors. Instead, they use dual four-bit CMOS microprocessors one of which handles the arithmetic functions of the handheld, and the other of which handles the resident BASIC and input.

These handhelds are programmable in Pocket BASIC and feature a 1.9K memory that is automatically partitioned for program and data storage.

A user can load or save programs using an optional cassette interface; there is also a combination printer/cassette interface available to produce hard copy of any program.

The beauty of the handheld microcomputer is that it can be taken anywhere and be used to solve problems and perform calculations in the field. It is useful in engineering, scientific, student, and household applications, and there is software available for all those areas.

The pocket computers are advertised as having a true "QWERTY" (standard typewriter) keyboard. However, you will quickly discover from the size of the keys that if you want to enter data quickly, you had better do it one key at a time. The keys, while they have a positive feel, are a bit on the small side and don't lend themselves to touch typing. Above and to the right of the keyboard is a bank of user-definable keys by which a user can either call a predefined function or routine. Once set up, they are kept in memory for the life of the computer's batteries, so you can recall them at any time at the touch of a button.

The liquid-crystal display (LCD) is limited to one line of 24 characters formed by a 5 × 7 dot matrix. When the line-limit is reached, the remaining characters are automatically dumped to the next line.

As powerful as those microcomputers are, they don't hold a candle to the much more powerful PC-1500 and TRS-80 Pocket Computer-2, both of which feature true eight-bit CPU's. But, then, the (twice) four-bit units are much lower in price, at \$160 and \$149.95, respectively.

Again, the higher-priced—\$300 for the Sharp PC-1500 and \$279.95 for the TRS-80 PC-2—pocket computers are both actually made by Sharp. As mentioned earlier, they use true CMOS eight-bit CPU's. They are fairly fast because they boast

HOW TO USE THIS SPECIAL SECTION

FIFTEEN YEARS AGO YOU NEVER WOULD HAVE BELIEVED IT! WHO would have thought there would be a day when a sophisticated computer would be available for less than a mega-dollar figure? After all, didn't computers require racks upon racks of components, displays, tape drives, card readers, and so on?

But, look at what's happened. Computers are everywhere! Computers have shrunk several orders of magnitude in size and price, and the computing power of a machine that used to occupy an entire room is now available in a device that you can slip into your pocket. Prices have fallen correspondingly, and that handheld computer may cost less than the suit whose pocket it's being carried in.

Responsible for the revolution is the integrated circuit, or IC. Just as transistors replaced vacuum tubes in early mainframe (big) computers, IC's—containing thousands upon thousands of transistors—have replaced those discrete semiconductors. Circuits that used to occupy an entire equipment rack now fit on a "chip" of silicon smaller than your fingernail—and that piece of silicon into a "package" smaller in volume than your thumb.

A whole CPU (Central Processing Unit—the heart of a computer) like the Z80, 6502, or 6800 can be had for under \$7.00; just look at the ads at the back of this magazine! Similarly, computer-memory IC's have dropped tremendously in price, while their capacity has increased dramatically. Just a few years ago, 16K (about 16,000 characters' worth) of memory for Radio Shack's original TRS-80 computer was a *bargain* at \$120.00. Today, the same memory IC's are available for about 1/6 that price. Along the same lines: Not too long ago, the most common memory IC had a capacity of just 1K (1024 bits); eight of them would give your computer 1K of memory. Today, a single IC can provide sixteen times the capacity of the older ones, at less than half the price—and the trend continues.

Price decreases brought about by advances in technology, together with the fact that computers are now *mass-produced* rather than built individually, have made small computers for

the home and business an affordable reality.

In this, the hardware portion of the "Your Own Computer" supplement to **Radio-Electronics**, we'll look at small-computer systems in order of increasing price—from \$100 (or less) to over \$4500. Within each price category we'll describe the equipment available, based on information supplied by manufacturers. You should bear in mind that options other than those shown exist for almost all systems, and that the prices shown in the tables apply specifically to the items described there. If a printer is mentioned, its price is included in the total shown. If a printer is *not* mentioned, that does not mean it is unavailable; such devices as printers and disk drives, known as *peripherals*, are generally available from a number of sources other than the computer manufacturer. Before we plunge into descriptions of the computer systems themselves, let's consider how a system can be configured—either by a manufacturer or by you.

Peripherals in general

Many—but not all—computers can be purchased ready to plug in and run. They will usually come with a certain (minimal) amount of memory, and have provisions for a video display and for storing programs and data on audio cassettes or floppy disks. The display and storage devices may or may not be included in the purchase price (check the tables carefully when you're making price comparisons). While printers may be offered by a manufacturer, they generally are not included in the price of the computer system.

Regardless of whether or not a particular device is included in the entire system package, the computer can usually be purchased without it and, in many cases, you will want to do that and then add the peripherals that will best meet your needs.

Computers and memory

Without memory, a computer is useless—it has no place to store a program or to manipulate data. Most computers come

1.3-MHz clock speeds; in fact, their speeds are comparable to those of some full-featured personal computers. These second-generation devices recognize 42 statements, 34 functions and 6 commands, which are accessible from the 65-key keyboard.

They are able to handle complex programs thanks to an Extended Pocket BASIC language that is resident in ROM. In fact, the user has direct memory access and these machines can easily handle maskable and timer interrupts. Just those functions, alone, give you an idea of the power of the computers. More is added by their string-handling capabilities. They are able to handle 80-character, two-dimensional arrays and will recognize such commands as LEFT\$, MID\$, RIGHT\$, LEN, VAL, CHR\$, and STR\$ (refer to a good text on BASIC to see how valuable those can be).

The keyboard, also set up along "QWERTY" lines, but which really isn't suitable for fast data entry due to its small keys, features 18 programmable keys, 18 "softkeys" and 10



THE RADIO SHACK TRS-80 Pocket Computer uses two, four-bit, micro-processors.

with a minimal amount of memory, usually ranging from 4K to 16K. While that is adequate for game-playing and simple home applications, a computer used for more serious purposes will generally require at least 48K of memory. Most of the computers mentioned here can be expanded to that point, or beyond.

A few computers—the "micro-mainframes," which are used in high-end microcomputer systems—are available with no memory or CPU at all. Some of them are shown in the low-end tables, but you should bear in mind that the price shown is for just the skeleton of the system—a chassis, power supply, and motherboard (the board that carries the bus signals); everything else is extra. The same, or a similar, mainframe will normally be found with add-ons in a higher-level table.

External data-storage

Every computer comes with either a cassette interface or a disk drive (or drives) to allow programs and data to be stored for future use. The tables shown a typical configuration for the price range in question. In almost every case there are options available to the user—either from the computer manufacturer or from outside suppliers—to permit the addition or expansion of disk facilities. Those, of course, will increase the price of the overall system. Add-on floppy-disk drives start at about \$500.00 and can cost several thousand dollars for a dual, double-sided, double-density eight-inch system capable of storing about two megabytes (two million bytes = 16 million bits).

Winchester disk systems, capable of storing five megabytes and more, start between \$2000 and \$3000 but—at least these days—are used mostly for "serious" applications.

If you can afford it, you should have a two-drive system. Not only will you enjoy a greater storage capacity, but you will also find it much easier and faster to copy files from one disk to another. Perhaps more important is the fact that, if the capacity of a single disk is rather small (100K or less), it may not be possible for it to hold the DOS (Disk Operating System), program(s), and the data you will require. It's better to use the first drive of a dual-drive system for the DOS and program, and the second for data.

HARDWARE

\$100-\$500

preprogrammed command keys.

These computers are easily able to handle such tasks as process control, data logging, and instant monitoring via an add-on RS-232C serial port. A communications package that will allow a person to use the computers as intelligent terminals for phone line access (electronic mail is also a possibility) is scheduled soon.

Through the 60-pin connector on the side, these units can be connected to either a cassette interface or a combination color printer-plotter cassette interface. That gives the user access to already existing cassette-based software and allows him to create and save his own programs and data files. The mass storage is only limited by the length of the cassette tape, and a short tape will hold plenty!

Printers

When a printer is shown as part of a system in one of the tables, it is usually a medium-priced model, and is included to give you an idea of what the entire system-price would be.

Printers are available starting from about \$300 and going up to more than \$3000. Generally the print quality improves as the price increases; sometimes speed is also a factor tied into price. The recent introduction of several letter-quality daisy-wheel printers for under \$1000 is something that has long been waited for, and should make putting together a system able to provide typewriter-quality output a much less expensive proposition than it has been until now. The quality is achieved at the expense of speed, but the sacrifice should be worth it to many.

Input/output devices

Most computers require a keyboard for input and some kind of video display for output. Inexpensive computers usually have a built-in keyboard or keypad and provisions for connection to a video monitor or TV receiver. In the case of the latter, an RF modulator will be required if it is not built into the computer. Some computers, like Commodore's *CBM* line, and the *Osborne I* have everything built in. Others, primarily the "micro-mainframes," supply nothing; a terminal—a combination keyboard and display unit—must be added. Terminal prices start at around \$600.

We've tried to indicate what the situation is with regard to each computer, but bear in mind that some, like the *Apple II*, may offer you several options for a display device.

How to read the tables

The tables included with each price-category section show which computers, features, and accessories you can expect to find in a typical system within that price range. If a system has been upgraded from a previous table, the new information appears in color. The tables will give you an idea of what you can get for a given price; a local computer store will be able to answer your questions and tailor a system to your specific requirements.



A COMBINATION computer, video game, and music synthesizer, the *MAX Machine* is Commodore's least expensive model.

Furthermore, the printer/cassette interface, allows two cassette recorders to be connected to make file handling simpler and to provide greater storage capacity.

Admittedly, the 4K of RAM that comes with these computers isn't very much, but it can be expanded to 16K through a plug-in module.

Again, the displays are LCD's with 7-by-156-dot resolution. Special alphanumeric or graphics characters can be user-

defined—a further indication of the power of these units. That isn't all that is user-definable, though. The size of the printer characters, as well as their color (there are four to choose from), can also be defined. The printer can be used for plotting as well as for hard-copy backup of any programs you may have written.

Commodore

Leaving the handheld microcomputers and returning to the computer-in-a-keyboard types, we find they are offered by some famous names in the computer and home-entertainment fields. One such company is Commodore Business Machines—originators of the *PET* computer.

Commodore manufactures several keyboard-only (the entire computer is housed inside the keyboard enclosure) machines. Perhaps you have heard of the *VIC 20*. It is one of theirs, as well as is another under-\$500 unit known as the *MAX Machine*.

At one time, the *VIC 20* was the low end of the CBM lineup; at \$295, it certainly is inexpensive. However, it has been replaced as Commodore's least expensive model by the *MAX Machine*, which has a price tag of \$179.95. What is common to both units, and the rest of the Commodore lineup (except for the very-top-of-the-line model), is an eight-bit microprocessor. All CBM machines are driven by one form or another of the 65xx (6502, 6509, 6510, etc.) family of CPU's.

TABLE 1—\$100-\$500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 400	\$299	6502B	8 bits	N/A	BASIC assembly, Pilot
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	VIC 20	\$295	6502	8 bits	N/A	BASIC
Commodore Business Machines	CBM MAX	\$179	6510	8 bits	N/A	BASIC
Heath Co. Benton Harbor, MI 49022	H-8	\$350 (kit)	8080	8 bits	N/A	BASIC
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI Superboard	\$350	6502	8 bits	N/A	BASIC
Netronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 85	\$129.95	8085	8 bits	N/A	machine
Netronics Research	ELF II	\$99.95	1802	8 bits	N/A	machine
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Pocket Computer (PC-1)	\$149.95	2 custom CMOS	4 bits	N/A	BASIC
Radio Shack	TRS-80 Pocket Computer 2 (PC-2)	\$279.95	CMOS		N/A	BASIC
Radio Shack	TRS-80 Color Computer	\$399.00	6809	8 bits	N/A	BASIC
Sharp Electronics 10 Keystone Pl. Paramus, NJ 07652	PC-1211	\$160	custom CMOS	2 × 4 bits	N/A	BASIC
Sharp Electronics	PC-1500	\$300	custom CMOS	8 bits	N/A	BASIC
Sinclair Research Ltd. 50 Staniford St. Boston, MA 02114	ZX Spectrum	under \$300	Z80A	8 bits	N/A	BASIC
Sinclair Research	ZX81	\$99.95 (\$79.95 kit)	Z80A	8 bits	N/A	BASIC
Timex 1579 Straits Tpke. Middlebury, CT 06762	Timex 1000	\$99.95	Z80A	8 bits	N/A	BASIC

The *MAX Machine* is a three-in-one computer. It is a computer, a game machine, and a music synthesizer, all in one package. It has a membrane keyboard but, rather than being completely smooth, the keyboard has indentations where the keys are. That should make it much more convenient to use. It's a compromise between a full-keyboard, such as the one found on the *VIC 20* and the flat membrane-type keyboard used by the *ZX81*.

The CPU in the *MAX Machine* is a 6510. It differs from other 65xx-series CPU's in that it has more input and output lines. It can "play" not only arcade-type games, but also educational and musical ones. The firmware—program-containing IC's within the machine—is capable of generating 16 colors and 3 independent, 9-octave voices for 3-part musical harmony.

You don't have to rely on pre-programmed game cartridges for this computer. Instead, you can write your own programs, creating your own characters and games, and then save them on cassette tape for future use.

But, the *MAX* isn't just a game machine. It is also a home computer, capable of being programmed in BASIC (or as CBM calls it, "MAX Machine BASIC"). The *MAX Machine* is capable of nine-digit numeric accuracy and features a range of built-in math functions. It can handle both words and math strings, and its BASIC can be translated for use with other CBM



HARDWARE

\$100-\$500

computers.

There are several peripheral devices available, not the least of which is the sophisticated Sound Interface Device. With that unit, the *MAX Machine* can produce music and sound effects which may rival those of other music synthesizers now on the

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette interface		57 keys, membrane	4 serial,		
5K/cassette interface		66 keys, 4 user-programmable	serial, parallel		
N/A/cassette interface		64 keys, 4 user-programmable	N/A		
		16-key keypad	N/A	N/A	micro-mainframe
4K/cassette interface		standard	serial		
256 bytes/cassette interface			serial		
256 bytes/cassette interface		hex keypad	N/A		
1424-step/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
4K/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
4K/cassette interface		53 button-type keys	serial	8 colors, 192 × 256	
1424-step/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
3.5K/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
16K/cassette interface		standard	serial	32 × 24 text	
1K/cassette interface		membrane	N/A	32 × 24 text	
1K/cassette interface		membrane	N/A	32 × 24 text	



ANOTHER INEXPENSIVE MACHINE from Commodore, the VIC 20's memory can be expanded to 32K.

market. You can create not only three-part harmony over nine octaves, but can also program the attack, decay, sustain and release times through an ADSR (Attack, Decay, Sustain, Release) generator. The sound section also has a programmable filter and offers variable resonance.

The computer has a built-in RF modulator so it can be used with an ordinary color (or black-and-white) TV receiver. Mass storage is via a cassette recorder.

The other under-\$500 CBM unit is the VIC 20 mentioned previously. Driven by an 8-bit 6502, the VIC 20 is a powerful home/game computer. It comes with 5K of RAM, but that is probably insufficient for most operating tasks so it is advisable to obtain one of the plug-in memory expansion modules, available in 3K, 8K, and 16K sizes; thus, it is possible to increase the amount of RAM to 32K. The system language is ROM-resident Pet BASIC.

This is a good system on which to learn programming—CBM supplies a very good BASIC primer that leads you step-by-step through the language.

Although the system is aimed at the low-end market, it is capable of being expanded into quite a powerful one. The 66-key keyboard has a number of dual function keys (the alternate functions are indicated on the fronts of the keys).

While the keyboard is more-or-less standard, some of the keys seem out of place when compared to other layouts. For example, the colon/semi-colon functions are on two separate



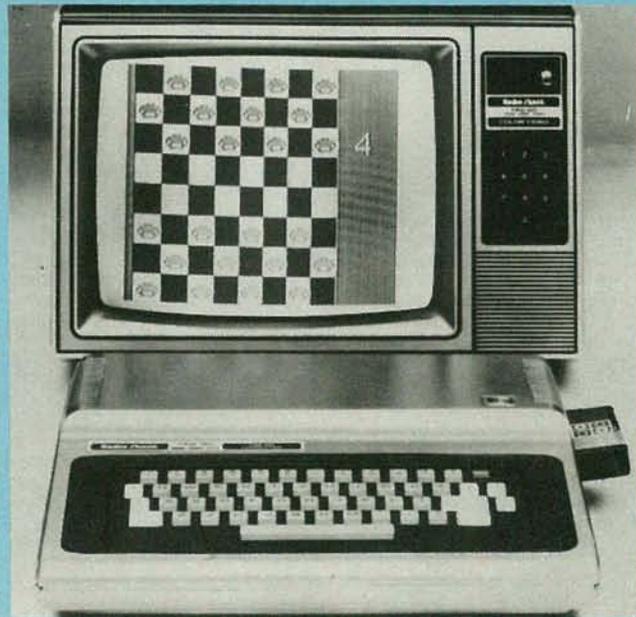
THE MEMORY CAPACITY, and the sophistication, of the Sinclair ZX81 can be increased by adding a 16K memory-expansion module.

AS WE GO TO PRESS

M/A-COM-OSI has announced that it is discontinuing many of its personal computer lines. The only systems that will remain in production are the C4P-MF-48K, which has been renamed the C100; the C2-OEM, now the 220C; the C2D, now the 220E; the C3-OEM, now the 240C; the C3D, now the 230E; the C3C, now 250I, and the C3B, now the 250J. Be aware that while the other OSI systems mentioned in this section may remain available for some time, the availability of future support for those systems is highly questionable.

keys, and they are not located—as is usually the case—under the right hand. That may prove awkward for someone used to programming on a typewriter-style keyboard, as may "out of place" quotation marks.

This computer, too, has a built-in RF modulator for use with a TV set. The display is a double-sized 22 characters by 23 lines, which is about one-quarter that of other, more expensive personal computers. Graphics resolution is a respectable 176 by 184 pixels (*P*icture *E*lements) and the user has 16 colors from which to choose.



A WIDE VARIETY of peripherals are available for upgrading the Radio Shack TRS-80 Color Computer.

The expansion capabilities of the VIC 20, though, compensate greatly for the shortcomings of the keyboard and display. After more memory is added, system expansion can continue with the addition of a single, double-density 5¼-inch floppy-disk drive. That adds 170K of mass storage to the system. As with most Commodore equipment, an IEEE-488 interface is provided; an RS-232C serial port can be added.

For hard-copy backup, an 80-column dot-matrix printer is available, which does make this system a complete home-computing system. For telecommunication applications, it is capable of interfacing with other computers via the phone lines through the use of the VICMODEM.

Not only is the VIC 20 a learning tool, but it is also capable of doing word processing with the additional of the VICWriter cassette. And, if that's not enough, it can also generate music through four tone-generators and games can be played using joystick controllers.

Radio Shack

Another of the keyboard-type computers on the market is the TRS-80 Color Computer, manufactured by Radio Shack. At \$299 for a 4K unit, it is not expensive, but it does pack quite a lot of potential.

In its most basic version, this 6809E-driven computer has 4K

of RAM, which, admittedly, is a bit limited for serious computer work. However, the situation can be corrected with the addition of plug-in RAM. The *Color Computer* can have its RAM expanded to 32K this way. In fact, to advance from the more limited Color BASIC programming language to the more powerful Extended Color BASIC, you need a minimum of 16K of RAM. Both BASIC's are ROM-resident.

The number-crunching (calculating) capabilities of this system are slowed by its low clock-speed of .894 MHz, although it should be perfectly adequate for the many videogames available for this unit.

The *Color Computer* features a respectable resolution of 192 × 256 pixels and it is capable of generating up to 8 colors. With the extra RAM and the Extended Color BASIC installed, it is also capable of handling some fairly sophisticated tasks. For instance, not only is it capable of data and string handling, but it can also handle dimensional arrays and has nine-place accuracy in its math functions. The Extended Color BASIC also provides for sophisticated graphics, allowing such character generation as creating circles, drawing figures, or screen painting.

String arrays of as much as 255 characters in length are also allowable, as is user-definition of memory content through the use of PEEK and POKE commands. Machine-language routines can be called from BASIC for use in programs that are written in that language.

Although the system is capable of expansion into a fairly powerful home computer due to the large number of peripherals available, the display-limit of 32 characters by 16 lines, which seems adequate for game playing and some programming, would seem to be restrictive for word processing.

A wide variety of peripherals is available, including a color receiver, cassette recorder, joystick controllers, 16K RAM upgrade, 32K RAM upgrade, Extended Color BASIC, modem, Editor/Assembler module, printer, mini-floppy disk drives and plug-in controller pack.

The 53-key keyboard is another of the button-types and it seems to have found a comfortable niche in this computer. As you can see, this unit can be made into quite a powerful system, and we'll look at it more fully further on.

Atari

The last of the computers-in-a-keyboard is the Atari 400. Perhaps Atari is best known to you as an electronics game specialist, but it's a short step from providing high-level-graphics video games to providing home computing power, and Atari has now made it with its \$299 Atari 400.

This computer is another one using a membrane keyboard, which is a plus where children or coffee spills abound, but which can slow down a touch typist.

Unlike other keyboard-computers on the market, the 400 seems to lack a one-key function option. Where other computers, like the Sinclair, allow a user to have single-stroke access to a programming function and the keyboard is labeled as such, the keyboard of the Atari 400 has no such provision.

Its primary strength seems to lie in its educational value. There is a large amount of cassette-based educational software available for this unit, as well as games and communications software. Additionally, there is a BASIC-programming course available.

Peripherals available include a cassette recorder and a communications interface, which allows you to connect to various databases, such as The Source and the Dow Jones Information Services. The "Communicator" package includes the phone-interface module, acoustic modem, and the Atari Telelink firmware that makes it all work.

M/A COM OSI

The M/A COM-OSI *Superboard* is a building-block type of personal computer that starts out as a complete computer on a board. What that means is that the board contains the CPU, memory, and all the I/O lines needed to make it a working unit. All that has to be added is a 5-volt DC power supply and a video



display. Included in this \$350 unit are 4K of RAM, expandable to 8K, along with 8K of ROM-resident BASIC. The unit also contains video-output circuitry, a cassette interface, and an integral keyboard.

Netronics

Continuing in this vein, we come to the venerable epitome of the "roll your own" computers, the \$99.95 *Elf II* from Netronics. It is one of the oldest single-board computer kits on the market and is based on the RCA 1802-series CPU. For the record, it is one of the last computers on the market to make use of Tiny BASIC.

The *Elf II* is constructed on a small PC board, and uses a hex (hexadecimal) keypad for programming in machine language. A composite-video signal is also generated for display on a monitor or on a TV receiver equipped with an RF modulator. RAM is a rather limited 256 bytes, but that is expandable to 64K. (The *Elf II* is very expandable for a single-board machine—about half the board area is reserved for that purpose.) A full keyboard is available as an option. Another peripheral is a A/D-D/A converter board.

A far more complete "roll your own" personal computer is Netronics' *Explorer 85*. It can be built into a rather powerful system. A two- or six-slot S-100-bus (more about the S-100 bus later) can be added, and from there, expansion is virtually unlimited. There are many expansion peripherals available, including RAM boards, of course, which can turn this system into a powerful eight-bit machine. They include keyboards, CRT, eight-inch disk drive, floppy-disk controller, audio board, light pen, hex keypad, cabinetry and the CP/M disk-operating system.

Micro-mainframes

The final under-\$500 category consists of the micro-mainframes—bare-bones computers (sometimes without even a CPU)—that can be expanded into extremely complex and capable systems. They usually use the S-100 bus, an arrangement that uses 100 lines to carry address, data, and control information to and from the various boards that are plugged into it. The S-100 bus was the first microprocessor bus, and is still going strong, especially in high-end computers.

Among computers that can be considered micro-mainframes, are the Heath *H8*, and the IMSAI *8080* and *8015*.

The *H8*, in its basic form for \$350 (kit), provides you with a power supply, motherboard, CPU and monitor ROM, an octal keypad, and a 7-segment LED display.

The IMSAI's, and others like them, in their least-expensive kit version, give you an enclosure, motherboard (usually S-100), and power supply. Everything else is optional, but because there are several hundred boards available for the S-100 bus, the sky's the limit when it comes to putting together a complete system.

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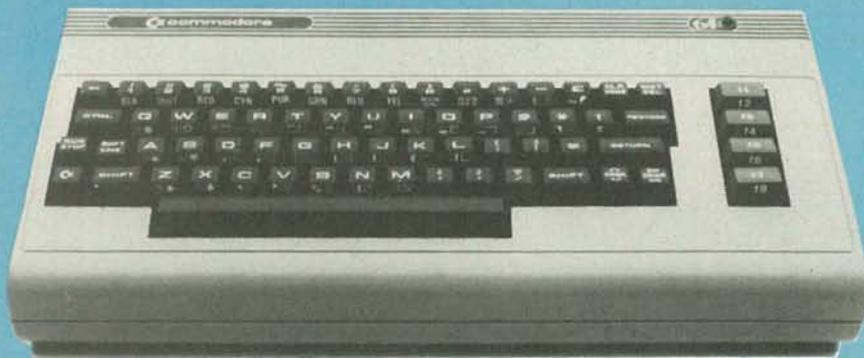
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MARC STERN

You might be surprised at how much computing power you can get at a modest cost. Here's a look at what's available in this price range.

IF YOU THINK THE LEVEL OF SOPHISTICATION AMONG THE \$100 TO \$500 microcomputers is high, then that of those in the \$500 to \$1000 range is truly amazing.

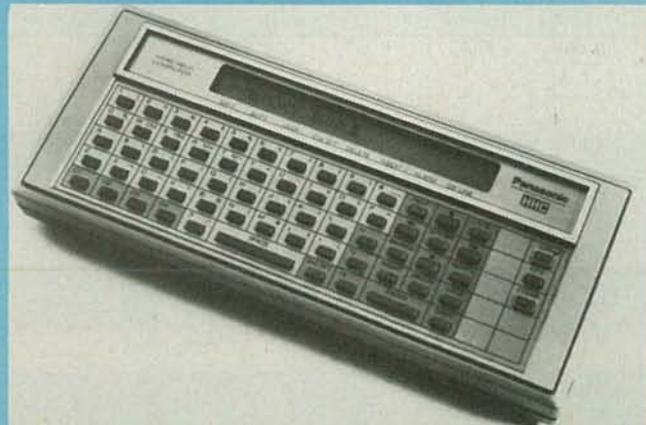
One thing that becomes apparent looking at the variety of microcomputers in this category is that the dominant CPU choice of the computer industry is the eight-bit microprocessor. In fact, it is still the king of the home computer realm, although the 16-bit micro is beginning to make its presence felt.

In this price category, we find both handheld and desktop computers. For instance, both the Radio Shack and Sharp handhelds have peripheral equipment that can put them into this segment. The printer/cassette interface available for both costs nearly \$250 and pushes both Radio Shack's *PC-2* and the Sharp's *PC-1500* over \$500. Opting for the cassette interface only will keep the price below \$500, though.

Panasonic

And, speaking of handheld computers, we now come to the Panasonic *RL-H1000* and *RL-H1400*. Though their CPU's are not specifically identified, it looks as if they are eight-bit devices. These two computers are building blocks for a true briefcase-portable microcomputer system. Though the \$500 *RL-H1000* comes with only 2K of RAM, and the *RL-H1400* only 4K, these are amazing units.

Both use the SNAP operating system, which is derived from the FORTH language. Among the programming languages the



ONCE A DREAM, hand-held computers, such as this one from Panasonic, are readily available at a relatively low cost.

computers recognize is BASIC, and you can work in BASIC using the 65-key keyboard, which is laid out in typewriter fashion. (Although it is arranged in the "QWERTY" pattern, like the other handhelds, the small size of the keys seems to preclude touch typing.)

As with other handheld computers in this price range, you can both perform immediate arithmetic calculations and run programs on these units because a calculator function is built in.

It is in the system's expansion capabilities that their real power can be seen. Not only are they interfaceable with a video display via a video/RF adaptor (RF modulator), but they also have an RS-232C interface, along with a programmable modem, plus an I/O adapter for those and other peripherals. There are also, of course, RAM expansion modules.

You can take the systems into the field and use them as remote terminals to communicate with a computer at another location or you can use them as full stand-alone systems to solve problems on the spot.

Although both basic units fit into the under-\$1000 price category, a little memory expansion is enough to push them into the next higher one.

Other systems

Carryover exists not only among the handheld computers, but also among the home/game computers, too. For instance, even though the Atari 400 has a base price of \$299, it isn't inconceivable that by adding the telephone interface and modem, plus a couple of program cartridges and the game controllers, that the price of the unit could rise well above \$500. The same is true of the Commodore *MAX Machine* and *VIC 20*, which have a broad range of peripherals available.

Look at the Radio Shack *Color Computer*. A 16K cassette-based system (as opposed to the now-discontinued 4K system) with Extended Color BASIC costs \$499.95; increase the RAM to 32K and the price rises to \$649.95. A cassette recorder, needed for program and data storage (unless you have a more expensive disk-based system) costs an additional \$60.

But, the added capabilities you gain from any of the expanded systems more than outweigh the extra expense.

Radio Shack

The \$500-\$1000 price category is not only the home of the expanded handheld and home/game computers, but is also the starting point for other, more powerful systems. For instance, a

4K, cassette-based *TRS-80 Model III*, an important personal and small-business computer (particularly when expanded) is priced at \$699.

Yet, look at what you get for the money. You get a self-contained 12-inch black-and-white CRT with a 65-key keyboard. There's also a 12-key keypad for rapid numerical entry. The display is memory-mapped, which means that you can define various graphic elements and also instruct the computer to arrange its display exactly to your liking. The display size is

slightly smaller than usual, at 64 characters by 16 lines but allows the use of a double-sized display (32 by 16), which can be useful in some cases.

From this modest starting point a very powerful system can grow. The *TRS-80 Model III* can easily be fitted with an RS-232C serial board, so communications potential, important for many applications, is already there.

The Level I machine is no slouch when it comes to work. Its BASIC is capable of supporting a 48 by 128 graphics display,

TABLE 2—\$500-\$1000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 800	\$899	6502B	8 bits	N/A	BASIC
Commdore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	Commdore	\$595	6510	8 bits	N/A	BASIC
Commdore Business Machines	Commdore P128	\$995	6509	8 bits	N/A	BASIC
Commdore Business Machines	VIC 20	\$769	6502	8 bits	N/A	BASIC
Cromemco, Inc. 280 Bernardo Ave. Mtn. View, CA 94043	System Zero	\$995	Z80A	8 bits	N/A	BASIC
Formula Int'l. 12603 Crenshaw Hawthorne, CA 90250	Pineapple	\$645	6502	8 bits	N/A	BASIC
Imsai Comp. Div., Fischer-Freitas Corp. 910 81st Ave., Oakland, CA 94621	I-8080	\$799	8080	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	I-8080K	\$599	8080	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	I-8085	\$950	8085	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	PCS-8015	\$750	8080	8 bits	N/A	
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI C1P	\$565		8 bits	N/A	BASIC
NEC Home Elec. 1401 Estes Ave. Elk Grove, IL 60007	NEC PC-8001	\$995	uPD 780 c-1 (Z80-like)	8 bits	N/A	NBASIC
Newtronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 85	\$886	8085	8 bits		BASIC
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-H1000	\$500		8 bits	N/A	BASIC
Panasonic	RL-H1400	\$600		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$700	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$699	Z80	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$999	Z80	8 bits	N/A	BASIC
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$525	TMS9900	16 bits	N/A	BASIC
Texas Instruments	TI-99/4	\$450	TMS9900	16 bits	N/A	BASIC

single dimension arrays and limited string variables. All that isn't bad in a machine which has only 4K of RAM, but it also points out the need for the next step up in the Radio Shack line, the \$999 TRS-80 Model III. Model III BASIC, 16K machine, which has much greater capabilities.

For instance, the Model III BASIC that works with this system is far more extensive in scope than the Level I BASIC. It has an extensive command set, and permits multidimensional arrays and comprehensive string variables. It also allows auto-

matic line numbering when writing programs. The Model III BASIC also supports a TRACE mode of program debugging and also allows the use of the PEEK and POKE commands so you can not only have direct access to specific memory locations, but can also look at the contents of a given memory location. This greatly enhanced version of BASIC will also support machine-language subroutine calls, and provides 16-digit accuracy—that high degree of accuracy can prove to be particularly valuable in accounting applications.

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K RAM/cassette		61 keys, 4 special function	serial, parallel	320 × 192, 16 colors, 40 × 25 text	
64K/cassette		65 keys, some user definable	serial, parallel		
128K/cassette		94 keys, some user-definable	serial	320 × 280, 40 × 25 text, 16 colors	
5K/cassette	printer/cassette	66 keys, 4 user-programmable	serial, parallel		
1K		N/A	N/A	N/A	micro-mainframe, 3 slots
64K		N/A	N/A	N/A	kit
		front panel	N/A	N/A	micro-mainframe, 20 slots
		front panel	N/A	N/A	micro-mainframe, 20 slots, kit
		front panel	N/A	N/A	micro-mainframe, 20 slots
			N/A	N/A	micro-mainframe, 20 slots
8K/cassette		full keyboard	serial	24 × 24 or 48 × 12 text	
32K/cassette		84 keys, 12-key keypad	serial, parallel		
8K/cassette	memory expands, CRT/cassette				
2K		65-key mini-keyboard	N/A	24-character LCD	
4K		65-key mini-keyboard	N/A	24-character LCD	
4K/cassette	joysticks, Videotex pak, modem, appliance control	53 button-type keys	serial,	256 × 192, 8 colors, 32 × 16 text	
4K		65 keys, 12-key keypad	parallel	64(32) × 16 text	integral display
16K/cassette		65 keys, 12-key keypad	parallel	64(32) × 16 text	integral display
16K/cassette		standard	serial	16 colors	
16K/cassette		standard	serial	16 colors	

Texas Instruments

It is into this area that the name of another giant of the industry enters, Texas Instruments. It recently enhanced its *TI-99/4* home computer into the *TI-99/4A*.

The basic *TI-99/4A* is driven by a Texas Instruments 16-bit TMS9900 CPU, as is the *TI-99/4*. No, that's not a typographic error—TI uses a powerful 16-bit microprocessor in its home computers and has finally unleashed some of the potential power of that processor in the enhanced machine.

One of the early criticisms raised about the *TI-99/4* was that, although a 16-bit processor was used, computerists couldn't access its potential power. The reason was that all of the programming was ROM-resident, and inaccessible to the potential programmer. There was no way for an individual user to work in machine language, and no way to save high-level language programs except on cassette. Unfortunately, that is still true to a great extent. Most of the programming for TI's home computer is still ROM-based in the form of cartridges, but now, at least, a disk-based editor/assembler allows you to write machine-language programs.

What does the \$525 basic keyboard unit contain? It contains the CPU and 16K of RAM. There is also a substantial amount of ROM that contains the TI operating system and BASIC.

In a more powerful version of this system, a user can link BASIC and machine-language for direct access to lead system features. That is done by using the call commands *LOAD*, *LINK*, *PEEK*, *POKE V*, *PEEK V*, and *CHARPAT*. Thus, a user can call machine-language subroutines and expand his computing power.

The basic unit contains the connector needed to support system expansion, but it must be initialized and driven by a separate RS-232C card.

It also contains the 48-keyboard and cartridge connector. The keyboard has 6 dual-function keys that are accessed via a *FUNCTION* key.

Commodore

Commodore Business Machines has two more entries in this price category, the *P128* and the *64*, at \$595 and \$995, respectively.

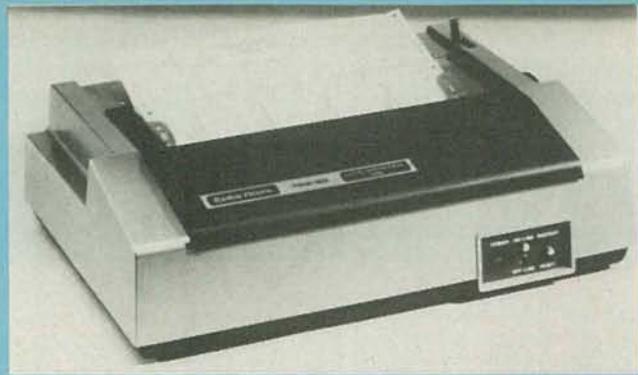
Although it resembles the *VIC 20*, the Commodore *64* is a far more powerful machine. For starters, it has 64K of RAM and can handle programs written for the Commodore *PET* series of computers through the use of a *PET* emulator.

The basic unit includes a 65-key keyboard and an 8-bit 6510 CPU (which is like the 6502 pioneered by CBM, but which has more I/O lines). The *64* is capable of using all of the *VIC 20* peripherals, which is very convenient if you've invested in the *VIC 20* and are upgrading to the *64*.

The *64* can generate 64 characters and 256 moveable sprites (graphics elements). It is also capable of screen magnification



THE BASIS FOR A POWERFUL SYSTEM, the Radio Shack TRS-80 Model III can be purchased for as little as \$699.



AMONG THE ADVANTAGES of the Radio Shack TRS-80 family of computers is the wide range of peripherals available for them, such as the printer shown here.

(doubling the size of the display), and the display is memory-mapped, which enables you to place picture elements on the screen according to their memory locations (each screen-memory location in a memory-mapped system corresponds to a specific position on the display). This is a handy feature for computer-driven graphics.

The computer can be connected to other peripherals through either a parallel or serial port.

The *P128* is a far more powerful system. Driven by an eight-bit 6509, it has been called the third-generation *PET* series by the company. It connects directly to a television set via a built-in RF modulator.

The power of the *P128* becomes apparent when you consider the amount of built-in RAM, 128K. That is more than enough to handle almost any function, program, or language. The computer's power is also evident from its graphics capabilities. It can generate 16 colors, and the screen resolution is 320 by 200 pixels, which means high-level graphics. The standard alphanumeric display is 40 by 24 lines.

The standard language is still *PET* BASIC.

Again, this is only the starting level of this system. A Z80 board can be added for access to CP/M, and there is a variety of printers and disk options available for it.

One last comment about the keyboard: it includes 10 user-definable special function keys. This is *in addition* to the graphics capabilities of these keys.

CBM also has another entry in this price range, the *PET 4016*. At \$995, this 16K basic computer has graphics capabilities built into its keyboard and, like the *P128*, it also has a numeric keypad built into its keyboard for quick data entry. It is driven by an eight-bit CPU.

Imsai

As noted earlier, not all home computers come equipped with the familiar CRT, keyboard, and cassette or disk drives. Some of them are, little more than the heart of a system—an enclosure, motherboard, CPU board (sometimes), and power supply—to which you have the option of adding your own memory and peripherals.

One such system is offered by Imsai. It is a totally bus-oriented system to which the user adds whatever boards and peripherals will best suit his needs. As such, it offers an enormous amount of flexibility and potential for expansion.

Available either as a kit—the *I-8080K* at \$599—or as an already-assembled unit—the *I-8080* at \$799—the *8080* uses an eight-bit 8080 (an 8085 can be supplied as an option). The standard *8080* comes with a 22-slot S-100 motherboard and a 28-amp power supply—enough to support a very powerful system, and Imsai offers a number of options which we'll discuss later. No memory is included in the base price, but it is readily available from Imsai and from other manufacturers of S-100 bus products.

An important *8080* feature is its front panel. With its paddle switches and LED's, it makes the computer the idea tool for data

acquisition and process control in areas where a dedicated device is required—and where a terminal and other peripherals would be wasted. The front panel can even be used for machine-language programming, if desired.

Furthermore, the front panel is an invaluable debugging tool. You can work your way through a program step-by-step and see which data, address, and control lines are active at any point. For the experienced programmer, this feature can be more useful than a software debugging-program.

Finally, the front panel can be used to evaluate and debug S-100 hardware, such as interface or memory boards. A memory-test program may tell you which part of memory is bad, but the front-panel LED's will show you exactly what is—and isn't—happening.

The beauty of this type of system is its expandability. Since the system card cage has so many slots (board connectors), a user has many installation choices. He can install more memory via 32K and 64K—or larger—RAM cards or he can install a disk-controller board and, with CP/M, can run any number of languages and programs.

A faster system offered by the same manufacturer, the *I-8085*, is available for \$950. It is identical to the *8080*-series except for the fact that it uses an eight-bit 8085 CPU, rather than the 8080.

The *Imsai PCS-8015*, available for \$750 (less memory), is similar to the *I-8085*, but has no front panel. It is well suited for use in a turnkey business system.

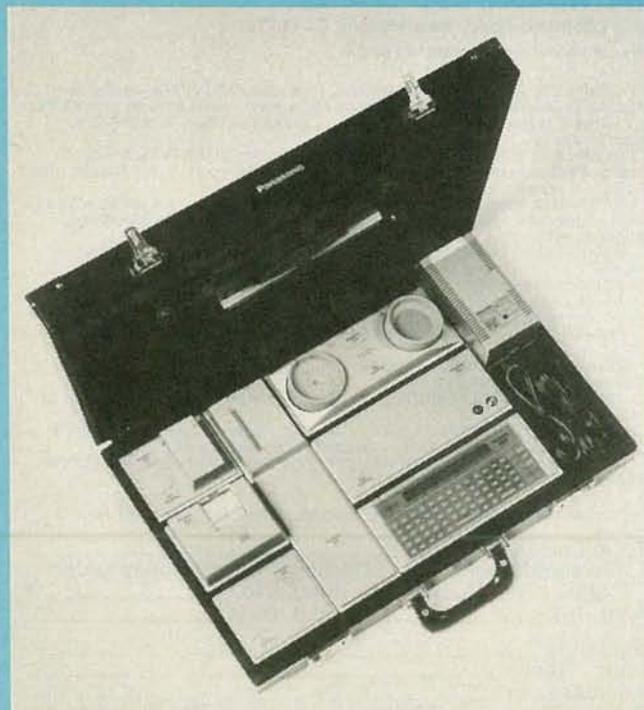
Formula International

One segment of the market which seems to be generating a great deal of controversy is the *Apple II*-like computer. There is one in the \$1,500 to \$2,000 price category, and there is one in this segment of the market, too, called the *Pineapple*.

Offered by Formula International, it is a kit which must be put together. The CPU is an eight-bit 6502, like the one in the *Apple II* itself, and it is compatible not only with the *Apple II* operating system, but also with its peripherals and programs. (This was confirmed by a spokesman for Formula International.) The price of the *Pineapple* is \$645.

M/A COM OSI

M/A-Com-OSI also has an entry in this price category, the *CIP*. It uses a 6502 CPU and includes a full keyboard.



SYSTEMS IN A BRIEFCASE, the Panasonic hand-held computers can be upgraded to form a complete, portable, computer system.



HARDWARE

\$500-\$1000

Like other types of keyboard computers, this one, offers both alphanumeric and graphics video displays. The display can be set up as either 24 by 24 or 12 by 48. The computer includes a cassette interface and a serial port for use with a modem or printer. This \$565 machine comes standard with 8K or RAM.

Atari

Another keyboard-computer is the \$899 Atari *800*. Unlike its less-expensive relative, the *400*, this one sports a typewriter-style keyboard, rather than a membrane type.

Driven by an eight-bit 6502B CPU, the Atari *800* features 16K or RAM as standard and includes a 10K ROM operating system. BASIC is supplied in the form of a plug-in ROM pack.

The system is quite powerful. The computer can generate inverse video (as can most other systems on the market) and offers full screen editing. The basic system includes a built-in RF modulator that will turn any television set into a display for the computer. When connected to a color receiver, the *800* can display 16 colors in 16 intensities. It also features four independent sound-synthesizers for musical tones or game sounds. They cover four octaves, and there is internal volume control for each one.

The display, which has a resolution of 320 columns by 192 rows for graphics work, will display three text modes: 40 by 24 lines, double-width, and double-height characters. There are also *nine* graphics modes.

The power of the Atari *800* system is demonstrated by its BASIC. Atari BASIC is an 8K floating-point language with 9-digit precision. The BASIC interpreter allows access to both the graphics and sound features of the computer, and allows calls of machine-language subroutines. The user has access to memory and its contents through the *PEEK* and *POKE* commands. Also available is a more powerful Microsoft BASIC. It offers a greater range of commands and has 14-digit floating-point accuracy. The disk-equipped version of this system with 32K of RAM is required for this option.

Other languages and programming aids available include *PILOT*, an assembler/editor, a macro assembler, and a program text editor.

Cromemco

Rounding out this price category is the *System Zero* at \$995, from a manufacturer known for business systems, Cromemco.

Using a Z80A with a speed of 4 MHz, that single board computer with three expansion slots is the basis of a powerful system. It comes with 64K of RAM, although all peripherals are extra. Since it is an S-100-bus computer, it can be expanded greatly using boards from Cromemco or other manufacturers.

Though this rounds out our look at specific systems in this category, remember that most of the inexpensive systems mentioned in the previous category, like the *Explorer 85*, can easily reach this price level when peripherals are added.

R-E

GLOSSARY OF COMMONLY USED COMPUTER TERMS

For those readers unfamiliar with computer terminology, we have included the following glossary of some commonly used computer terms.

Address—The label or number identifying the register or memory location where a unit of information is stored.

Applications software—Software written to do a specific job, such as solve a mathematics problem, play a game, etc. See **systems software**.

ASCII BASIC—Acronym for American Standard Code for Information Interchange. A seven-bit code used to represent alphanumeric characters. It is useful for such things as sending information from a keyboard to the computer.

Assembly language—A machine oriented language in which mnemonics are used to represent each machine-language instruction. Each CPU has its own specific assembly language. See **CPU** and **machine language**.

Binary—Refers to the base 2 number system in which the only allowable digits are 0 and 1.

Bit—Acronym for *Binary digit*. The smallest unit of computer information, it is used to represent either a binary 0 or 1.

Bootstrap—A program that starts the computer and prepares it to load other programs into memory.

Bus—Parallel lines used to transfer signals between devices. Computers are often described by their bus structure (i.e.—S-100-bus computers, etc.).

Byte—A group of eight bits.

CPU—Acronym for *Central Processing Unit*. The part of the computer that contains the circuits that control and perform the execution of computer instructions.

Data base—A large amount of data stored in a well-organized manner. A data-base management system is a program that allows access to the information.

Disk—A circular device with a magnetic surface used to store data, programs, etc. Floppy (flexible) disks can store between approximately 100 to 1000 kilobytes, depending on their size (5¼ or 8 inches), recording density and whether both sides of the disk are used. Hard (rigid) disks can store upwards of 5 megabytes.

Disk operating system—Program used to transfer information to and from a disk. Often referred to as a DOS.

EPROM—A PROM that can be erased by the user, usually by exposing it to ultraviolet light. See **PROM**.

File—A collection of data that is treated as a unit.

Hardware—The physical components that make up a computer.

Hexadecimal—Refers to the base-sixteen number system. Machine language programs are often written in hexadecimal notation.

Machine language—Instructions, written in binary form, that a computer can execute directly. Also called machine code or object code.

Microprocessor—A one-IC CPU. One common microprocessor often used in personal computers is the Zilog Z80.

Modem—Acronym for *MOdulator/DEModulator*. A device that transforms electrical signals into audio tones for transmission over telephone lines, etc.

Octal—Base-eight number system.

PROM—Acronym for *Programmable Read Only Memory*. A semiconductor memory whose contents cannot be changed during normal computer operations, but that can be programmed under certain special conditions.

RAM—Acronym for *Random Access Memory*. A semiconductor memory that can be both read and changed during computer operation. Unlike other semiconductor memories, this one is volatile—if power to the RAM is cut-off for any reason, all data stored in the device is lost.

Register—A storage location inside the CPU.

ROM—Acronym for *Read Only Memory*. A semiconductor memory containing fixed data—the computer can read the data but cannot change it in any way.

Software—programs.

System software—Software that governs the computer's operation or aids in developing other programs.

Word—Number of bits that are treated as a single unit by the CPU. In an eight-bit machine, the word length is eight bits; in a sixteen-bit machine, it is sixteen bits.

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\$1000 to \$1500

If you don't think it's possible to get a powerful system at a modest cost, take a look at what is available in this price range.

MARC STERN

IT'S STILL AMAZING TO MANY PEOPLE THAT SO MUCH COMPUTING power can be purchased as inexpensively as it can. As we saw in the first part of this survey, there's quite a lot of power packed into personal computers that are priced under \$1000. This also holds true between \$1000 and \$1500.

Apple

The *Apple II* and *Apple II+*, with eight expansion slots, are the basis for a very powerful home or business system, indeed. For a base price of \$1330 (for either version of the computer—the main difference between the two is in the mathematical

capabilities of their BASIC's) you can start with a 6502-based machine with 16K of RAM, expandable to 64K. Both can generate color or black-and-white graphics, with a maximum resolution of 192 by 280 (192 by 140 in color) and include D/A converters for game paddles or other external devices.

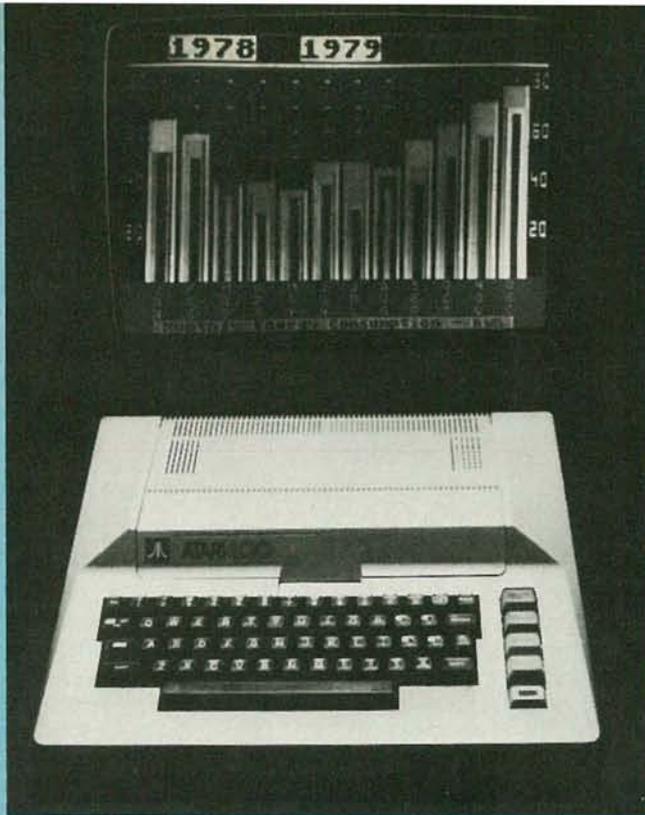
We'll cover the Apple computers much more thoroughly later on.

Texas Instruments

Look at the Texas Instruments *TI-99/4A*. It is driven by a 16-bit CPU, the TMS-9900. Quite a bit of power is locked into

TABLE 3—\$1000-\$1500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II, Apple II+	\$1330	6502	8 bits	N/A	BASIC
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 400	\$1172	6502B	8 bits	N/A	BASIC, assembly, Pilot
Atari Home Computers	Atari 800	\$1294	6502B	8 bits	N/A	BASIC, assembly Pilot
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	VIC 20	\$1293	6502	8 bits	proprietary	BASIC
Commodore Business Machines	Commodore 64	\$1065	6510	8 bits	N/A	BASIC
Commodore Business Machines	Commodore 64	\$1194	6510	8 bits	proprietary, CP/M(optional)	BASIC
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI, C1P	\$1465	6502	8 bits	N/A	BASIC
M/A COM OSI	OSI C4P	\$1025	6502	8 bits	N/A	BASIC
NEC Home Electronics 1401 W. Estes Ave. Elk Grove, IL 60007	PC-8001	\$1205	μPD 780 c-1	8 bits	N/A	BASIC, COBOL, FORTRAN, Pascal
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-1000	\$1103		8 bits	N/A	BASIC
Panasonic	RL-1400	\$1203		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$1002	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Color Computer	\$1401	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$1196	Z80	8 bits	N/A	BASIC
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$1475	Z80A	8 bits	N/A	BASIC
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$1373	TMS9900	16 bits	N/A	BASIC editor/assembler



HARDWARE

\$1000-\$1500

this unit. The software for the computer is supplied by TI on ROM (Read Only Memory) cartridges. The software that is available includes BASIC, the high-level programming language.

In this price range, the user has a pretty good home system. For \$1373, using a cassette recorder for mass storage, the user has access to not only network communications—The Source, Comp-U-Serve, etc.—through the RS-232C interface and software, but the user also gains color capabilities through the high-resolution color monitor. Hard copy is available with a

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette interface		standard		40 × 24 text, up to 192 × 140 graphics	
16K/cassette		57 keys, membrane	serial, parallel	40 × 24 text, up to 320 × 192 graphics	printer RS-232C
16K/cassette		61 keys, 4 special-function	serial, parallel	40 × 24 text, up to 320 × 192 graphics	printer
5K/5¼-inch floppy disk		66 keys, 4 user-programmable	serial, IEEE-488	22 × 23 text, 176 × 184 graphics	
64K/cassette interface		64 keys, 4 user-programmable	serial	40 × 25 text, 190 graphics characters	printer
64K/5¼-inch floppy disk		64-key, 4 user-programmable	serial	40 × 25 text, 190 graphics characters	
8K		standard	serial	24 × 24 or 48 × 12 text	
19K				32 × 64 text, 256 × 512 graphics	
32K/cassette interface	monitor	84 keys, 12-key keypad	serial, IEEE-48	80 × 25 text, 160 × 200 graphics	12-inch green monitor
2K	RS-232C, video package	65-key mini-keyboard	serial	16 × 32 text, 48 × 64 graphics	Video/RF adapter
4K	RS-232C, video package	65-key mini-keyboard	serial	16 × 32 text, 48 × 64 graphics	Video/RF adapter
16K/cassette interface	16K, printer	53 button-type keys	serial	8 colors, 192 × 256 graphics	
16K/cassette interface	16K, printer	53 button-type keys	serial	8 colors, 129 × 256 graphics	12-inch color CRT
4K/cassette		65 keys, 12-key keypad	parallel, serial	12-inch B&W, 64 (32) × 16 text	printer
64K/cassette interface		72 keys, 5 programmable	serial, parallel		
cassette		standard		32 × 24 text, up to 192 × 256 graphics	printer, RF Adapter, 10-inch color CRT

solid-state printer. Please refer to the previous discussion for a full description of the basic system.

NEC

The buyer and user of the NEC *PC-8001* will also have a pretty powerful home computer system.

This system includes 32K of RAM and a 12-inch green phosphor monitor, but uses a cassette recorder for mass storage. All of this comes in a package that costs \$1205.

Panasonic

Handheld computers can gain a lot of power through expansion and these appear in this price range. The price of the Panasonic *RL-1000* rises to more than \$1000 with just the addition of communications capability and video display capability. For \$1103, the 2K version can be equipped with serial communications ability via an RS-232C package. It also gains the capability for interfacing with a video display with the inclusion of a video-RF package. The more powerful 4K RAM *RL-1400*, with the same capabilities, has a price of \$1203.

Radio Shack

When the *TRS-80 Color Computer*, also using a cassette recorder system for mass storage, is configured as a "student" system, its cost rises to \$1002. This system includes 16K of RAM, Extended Color BASIC, and line printer, but the user must provide his own color monitor. These additions drastically increase the capabilities of this system. And, if the user opts for the Radio Shack monitor, the price of the complete package rises to \$1401.

Atari

Both Atari systems, the *Atari 400* and the *Atari 800*, have configurations that appear in this price range. When the *Atari 400* is equipped with communications capability via the complete communications package (including modem and communications software), and with printer capability, its cost rises to \$1172.50. A standard TV receiver is used for display purposes. The same is true of the more expensive *Atari 800*.

However, the *800's* capabilities aren't as great in this price segment. When equipped with only a printer, the price of the *Atari 800* rises to \$1294. It has no communications ability. Both systems, incidentally, use cassette mass storage in this price range.

Commodore

Even the small *VIC-20* system takes on some very sophisticated capabilities in this price range. When a user equips this system with a 5¼-inch minifloppy disk drive for mass storage, gives it communications capability with the addition of the RS-232C serial package, and gives it hard-copy output capability with the addition of a printer, then the price of this expanded system rises to \$1403.

The *Commodore 64*, is compatible with all the *VIC-20* periph-



POTENTIALLY A POWERFUL SYSTEM, the price of the base *Apple II* from Apple falls in this range.

eral equipment. After all, both systems are made by the same manufacturer and both are in the same relative price range, so one can expect this to be true. So, when the *Commodore 64*, which comes with 64K of RAM, is equipped with a cassette recorder for mass storage and a printer for hard copy output, the price of this system rises to \$1065. If you equip this system with a 5¼-inch minifloppy disk drive for mass storage, but delete the printer, then the price of this system rises to \$1194.

Radio Shack

Another system that begins its upgrading in this price spectrum is the *TRS-80 Model III*. The "Starter" system, which includes 4K of RAM and a line printer, but uses a cassette recorder for mass storage, is priced at \$1196. The *TRS-80 Model III* is a Z80-driven all-in-one personal computer that combines the CRT, keyboard, and CPU into one terminal-like housing.

M/A-Com-OSI

M/A-Com-OSI has two entries in this price range. The *C4P*, the starting point of many of this company's systems, is priced at \$1,025. That system, as with all of this company's other systems, use a 6502 microprocessor.

That price will bring the user 19K of memory as standard and disk storage capability. Built into this system are the needed video outputs, plus interface capabilities for either a modem or printer.

The system language of the *C4P* is a BASIC interpreter. The operating system for this machine is the company's proprietary OS-65D.

The second system offered by M/A-Com-OSI is the more complete *CIP-MF-20K*. Costing \$1465 and driven by the same type of processor, this system features a full built-in keyboard and 8K of RAM. This system, programmable in BASIC, can be expanded to include dual, minifloppy disk drives and 32K of RAM. This system includes interface capabilities for a printer, cassette and CRT.

Sony

Not all the systems appearing in this price range are only system upgrades, some are the foundation upon which very powerful systems will be built in the higher price categories.

The *Sony SMC-70*, which eventually becomes a very powerful system as it moves through our pricing categories, has its roots here at \$1475.

The *SMC-70* is another of the keyboard-computers on the market. In this form, it includes nothing more than the keyboard and computer with 64K of RAM. As you can see, it's a powerful system from the start. It is driven by a high-speed Z80A processor with clock speed of is 4.028 MHz. Though the high-level language Sony BASIC, this system will also recognize and run the industry standard CP/M operating system. This is an attractive feature because it puts many CP/M-based software packages at the user's fingertips.

R-E



THE *SMC-70* from Sony is supplied with 64K of RAM memory. It is shown here with optional 3.5-inch disk drives and RS-232C interface.

\$1500 to \$2000



HARDWARE

\$1500-\$2000

Among the highlights of this price range are fully configured versions of low-end computers and basic versions of high-powered systems.

MARC STERN

ONE THING A LOOK AT THE PRICES OF PERSONAL COMPUTERS will tell you is there a lot of them in the low-to moderate price-range and a lot in the upper price ranges, but the middle ground, starting around \$1500 is relatively empty.

It is in this area, though, that some very powerful systems have their origins and some very powerful computer firms enter the competition. It is also here that lower-end computer systems begin to stretch their legs.

The name IBM first makes its appearance here with its \$1565 *Personal Computer*. Yes—IBM sells a computer for less than \$1600.

In its standard configuration, the *Personal Computer*, or *PC*, consists of a 16-bit, 8088-based computer with 16K of RAM. In this entry-level version, it is possible for a user to load and save BASIC programs using a cassette recorder. Those programs are entered through an 83-key detachable keyboard, which also has a 10-key keypad for rapid data entry, and 10 function keys.

The system has 40K of ROM, which contains the operating system, BASIC, and instructions for performing complex graphics functions. It can generate 16 foreground colors and eight background colors. There is also a built-in speaker for sound generation.

The *Personal Computer PC* is a modular unit, and a user is able to expand it extensively in building-block fashion, as we shall see later.

Olivetti

Another noted equipment-manufacturer has also entered the personal/home/business-computer field—Olivetti, with its *M-20*. This microcomputer is also a modular unit.

What you get for an investment of \$1988 is a 16-bit machine, driven by a Z8001 microprocessor. This is one of the first personal computers on the market to make use of this powerful CPU.

What's the attraction of a 16-bit over an 8-bit CPU? One of the key answers is speed. A 16-bit CPU can access data and process it much more quickly than an 8-bit processor (see the separate piece on 8-bit vs. 16-bit computers in this section). Sixteen-bit machines also tend to run at fairly high speeds, and the *M-20* is no slouch in that department.

Straight out of the carton, this is a powerful unit, even with

few peripherals attached. To give one example, it comes already equipped with 128K of RAM.

The computer runs Olivetti's proprietary PCOS and recognizes only programs written under that operating system. The use of a proprietary operating system can be a drawback for the potential user because, unless he opts for the CP/M emulation disk, which will allow him to run CP/M 2.2, or the soon-to-be-available soft card, which will allow him to run CP/M or MS-DOS, he will be limited to programs written specifically for this computer.

The BASIC language in this machine is the powerful BASIC



THE *M-20*, from Olivetti, is one of the first personal computers to use the powerful Z8001 16-bit microprocessor.

80 and the computer is capable of 256 commands and functions. Memory is expandable to 512K through the use of plug-in expansion boards; there are five slots on the motherboard for this and other purposes.

The display capabilities of the *M-20* are very good. It can display either 80 by 25 lines or 64 by 16. The resolution level for a color monitor is 512 by 256 pixels, which makes this machine capable of high-level graphics.

PCOS is a powerful operating system for the computer's dual quad-density floppy-disk system. PCOS monitors and manages the total system's resources. Not only does it catalogue and

execute commands and procedures, but it also executes the system utilities and calls machine-language routines. It can also provide security for data via passwords and can "window" the display so only a small portion can be viewed at a time.

Micro Technology Unlimited

Micro Technology Unlimited's *MTU-130* uses a 6502 microprocessor and comes with 80K of built-in RAM.

It is a truly modular system that begins with little more than the system box and 96-key keyboard. In that configuration, external data and program storage is provided by a cassette recorder.

TABLE 4—\$1500 -\$2000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II	\$1530	6502	8 bits	N/A	BASIC
Atari Home Computers 1265 Borregas Sunnyvale, CA 94086	Atari 800	\$1552	6502	8 bits	N/A	BASIC
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	Commodore B128	\$1695	6509	8 bits	proprietary	BASIC
Commodore Business Machines	CBM 4032N	\$1295	6502	8 bits	N/A	BASIC
Commodore Business Machines	CBM 8032B	\$1495	6502	8 bits	N/A	BASIC
Commodore Business Machines	Commodore 64	\$1589	6510	8 bits	proprietary	BASIC
Commodore Business Machines	CBM 8032N	\$1995	6502	8 bits	N/A	BASIC
Commodore Business Machines	SuperPET SP9000	\$1995	6809/6502	8 bits	N/A	APL, BASIC, Pascal, FORTRAN, COBOL assembler
Commodore Business Machines	CBM 4016	\$1690	6502	8 bits	proprietary	BASIC
Franklin Computer Corp. 7030 Colonial Hwy. Rennsauken, NJ 08109	Ace 1000	\$1595	6502	8 bits	N/A	BASIC
Heath Co. Benton Harbor, MI 49022	H-89	\$1895	Z80	8 bits	HDOS, CP/M (optional)	BASIC, other CP/M compatible
International Business Machines Box 1328 Boca Raton, FL 33432	IBM Personal Computer	\$1565	8088	16 bits	N/A	BASIC
MicroTechnology Unlimited , Box 12106 Raleigh, NC 27605	MTU 100	\$1549	6502	8 bits	N/A	
MicroTechnology Unlimited	MTU	\$1699	6502	8 bits	N/A	
MicroTechnology Unlimited	MTU 130	\$1999	6502	8 bits	N/A	
Netronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 85	\$1530	8085	8 bits	CP/M	CP/M compatible
Non-Linear Systems 533 Stevens Ave. Solana Beach, CA 92075	Kaypro II	\$1795	Z80	8 bits	CP/M	SBASIC
Olivetti Corp. 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$1988	Z8001	16 bits		BASIC
Osborne Computer 26500 Corporate Ave. Hayward, CA 94545	Osborne I	\$1795	Z80A	8 bits	CP/M	CBASIC, MBASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$1601	6809	8 bits		BASIC

The *MTU-140's* operating system is called CODOS, and it recognizes UCSD-p-System Pascal, the high-level FORTH language, BASIC, and supports an assembler. The video display is bit-mapped which makes complex graphics relatively easy. Input and output are via two parallel ports and a serial port.

The *MTU-130* can be upgraded while still staying within this price range by adding a 12-inch green-screen CRT (the base price is \$1549; the monitor increases that to \$1699).

Franklin

A computer in this category that is the subject of much

controversy is the Franklin *ACE 1000*. At \$1595 it isn't much more expensive than the *Apple II...* and it's another of the *Apple* look-alikes.

The *ACE 1000* comes equipped with 64K of RAM. Its typewriter-style keyboard has 72 keys, and there is also a 12-key keypad for number entry. Because of its resemblance to the *Apple*, it is reasonable to assume that hardware and software for that computer will also work in the *ACE 1000*.

Heath/Zenith

Heath/Zenith also has an offering in this price category, the

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette		53 keys	serial, parallel	40 × 24 text, 280 × 192 graphics	
16K/cassette		61 key, 4 special function	RS-232C interface		printer
128K/dual 5¼-inch double-density floppy disk		92-key keyboard, 10 user-program- mable keys, 19-key keypad	IEEE-488, serial	80 × 25 text, up to 320 × 200 graphics	integral display
32K/cassette		standard, numeric keypad	IEEE-488	40 × 25	integral display
32K/cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
64K/5¼-inch floppy disk		64 keys, 4 user-programmable	RS-232C interface	40 × 25 16 colors	printer
96K/cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
96K/cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
16K 5¼-inch floppy disk		standard, numeric keypad	IEEE-488	40 × 25	integral display
64K/cassette		72 keys, 12-key keypad		40 × 24 text, 280 × 192 graphics	Apple- compatible
48K/5¼-inch floppy disk		84 keys, 12-key keypad	3 serial, 1 parallel	80 × 25	integral display
16K/cassette		83 keys, 10 key keypad, 10 special- function keys	serial, parallel	80 × 25 text, up to 640 × 200 color graphics	
80K/cassette		96 keys	2 parallel, 1 serial		terminal only, upgradable
80K/cassette		96 keys	2 parallel, 1 serial	12-inch	green CRT, terminal only, upgradable
80K/disk controller only		96 keys	2 parallel, 1 serial		12 inch green CRT, terminal only, upgradable
32K 8-inch floppy disk			serial		
64K/dual 5¼-inch double-density floppy disks		62 keys, 14-key keypad	serial, parallel	80 × 24	9-inch integral green CRT
128K/cassette		72 keys	parallel serial	80 × 25, up to 512 × 256 graphics	
64K/dual 5¼-inch floppy disk		81 keys, 10-key keypad	serial, parallel		5-inch integral CRT
16K/5¼-inch floppy disk		53 keys, button-type	serial	32 × 16 8 colors, 192 × 256 capability	

entry-level *H-89* (from Heath)/*Z-89* (from Zenith). Like the Radio Shack *TRS-80 Model III*, this all-in-one unit houses the CRT, keyboard, CPU, and 48K of RAM. At \$1895 as a kit from Heath, it's quite a bargain. Fully assembled and tested, it is called the *Z-89* and costs about \$1,000 more.

The computer uses two Z80 microprocessors—one for computing purposes, and the other to handle display functions. The second Z80 allows the first to perform its task more efficiently. The *H/Z-89* comes with an 84-key keyboard that includes a 12-key keypad.

Also included is a single 5¼-inch disk drive. The operating system is Heath's own HDOS, but the computer can also run CP/M, which opens the door to a wealth of software.

Although a black-and-white CRT is standard, an anti-glare green (or black-and-white) one is available for an additional \$30. The display is 80 by 24, with an optional 25th status line. There are also three RS-232 serial ports to allow the connection of a printer, modem, etc.

Commodore

Commodore Business Machines also has a number of computers in this price class. For instance, we find the 32K *PET 4032N*. It features a built-in 12-inch, 40 character display, and includes a keyboard with both alphanumeric and graphics characters, and numeric keypad. With a single disk drive, the system sells for \$1695; without, it sells for \$1295.

Also in this price range is the Commodore 64 which, with a dot-matrix printer and a single floppy-disk drive costs \$1,589.

Another entry is the \$1500 *CBM 8032B*, which features a typewriter-style keyboard, numeric keypad, built-in CRT with an 80 column by 25-line display, and 32K of RAM. ROM-based BASIC 4.0 is also standard.

Like all CBM machines, the \$1695 *B128* uses an 8-bit microprocessor—in this case a 6509. The Commodore "B"-series computers are aimed at the business market and this one comes with 128K of RAM—more than enough memory for just about any business application. It is another of Commodore's all-in-one machines and, as such, includes an integral 80-column by 25-line CRT.

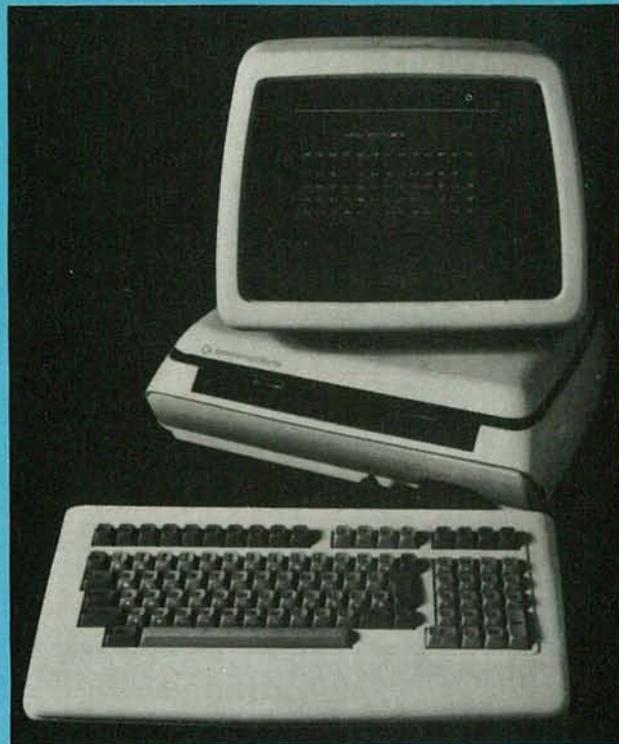
While the computer uses Commodore's own DOS, CP/M can be run by adding a plug-in card option.

Osborne

An interesting phenomenon in this segment of the microcomputer market is the all-in-one, truly portable unit. One such is the *Osborne 1*, which carries a pricetag of \$1795.

What sets this system apart from the others we've discussed so far is that there is no need to purchase either peripherals or add-on software. A CRT and dual 5¼-inch floppies are built in, and a comprehensive software package is included (see below).

If the name "Osborne" sounds familiar, it should. Adam Osborne is one of the wizards of the microcomputer revolution and not only manufacturers computers, but has also for a long time been a successful author and publisher of articles and books



THE COMMODORE "B" series of personal computers, such as the *B128*, are aimed primarily at the business market.

on microcomputers and the microcomputer industry. Apparently, what Osborne felt the world was ready for was a low-priced, full-service computer, so he developed the *Osborne 1*.

A CP/M-based unit the computer weighs only 23 pounds and is small enough to fit under an airline seat. For truly portable field use, it can't be beat. Not only does it have built-in dual 5¼-inch, single-density floppy disks—there is a double-density option available for increased mass storage—but it also comes with a powerful software package that includes *WordStar/MailMerge*, *Supercalc*, *MBASIC*, and *CBASIC-2*.

Each single-density floppy can hold 100K, and there is a 5-inch high-resolution CRT. That CRT is excellent for field work, but for home or office use you might be better advised to purchase the optional 9-inch green-phosphor monitor. The full 81-key keyboard has a 10-key keypad for quick numeric data entry. The *Osborne* also has an IEEE-488 port (popularized by Hewlett-Packard and used by Commodore) for interfacing with test equipment.

Perhaps the most important thing about this system is its completeness. With it, a user really has little need of anything else, save, perhaps, a printer. In fact, some observers have said that what a buyer gets when he puts down his money is the software—hardware is free.

Non Linear Systems

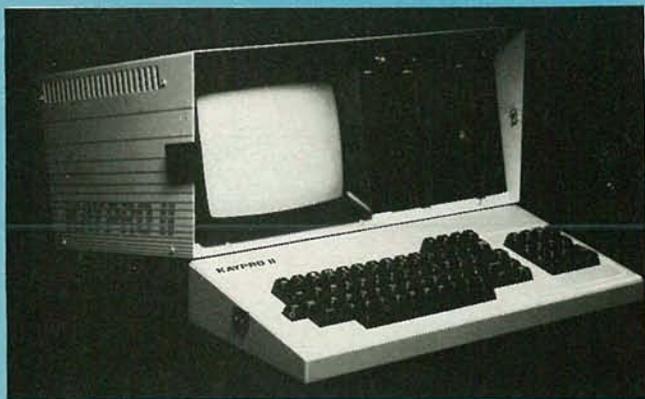
The \$1795 *Kaypro II* is quite similar to the *Osborne 1*. Its manufacturer, Non Linear Systems, is noted for its test equipment and is a newcomer to the computer field.

The key difference between this and the Osborne unit is the size of the display—9-inches is standard—and the mounting of the disk drives (vertically, rather than horizontally).

Like the Osborne machine, the *Kaypro II* uses a Z80A microprocessor and is CP/M-based. It has two single-sided, double-density 5¼-inch disk drives, and, like the Osborne, has a serial port for peripherals.

Instead of using *WordStar* for word processing, Non Linear Systems has opted for *Select*, and also includes a spelling checker, *SuperSpeller*. *MBASIC* is also among the software supplied.

The success of the *Osborne 1* indicates that a market exists for such a system and the arrival of the *Kaypro II* shows that



A FULL FEATURED, truly portable computer, the *Kaypro II* from Non Linear Systems features a nine-inch display.

manufacturers are filling the void. There are sure to be more computers of this sort to come.

Upgrades

This sector of the price spectrum also contains various system upgrades. For instance, Radio Shack's *TRS-80 Model III* is available for \$1995 with one 5¼-inch disk drive and 48K of RAM.

Even the *Explorer 85* is here, in its near-fully configured state with the addition of a floppy disk for mass storage and with CP/M. That system prices out at \$1530.

System expansion continues even in the CBM lineup with the *PET 4016N*. By adding one disk drive to the *4016N*—giving 170K of on-line storage, the price is raised to \$1690.

Adding 64K of memory to the *CBM 8032B* raises its price to \$1995, but that gives a total of 96K of RAM, which is more than



adequate for just about any task that can be imagined.

And, speaking of Commodore, a new system makes its appearance in this category, too, the *SuperPET SP9000*, priced at \$1995. This is an enhanced *8032* with a second processor, an 8-bit *6809*. The *SuperPET SP9000* is a very capable unit with 96K of RAM. The languages it recognizes include Waterloo's microBASIC, or microAPL, microPascal, and microFORTRAN; it can also be programmed in *6809* assembly language. That gives this machine a great deal of computing power.

System expansion continues even with the *Atari 800* home computer. When this system is fleshed out with a cassette recorder, the modem-expansion unit, and a printer, the cost rises to \$1552.

Even the Radio Shack *TRS-80 Color Computer* has an entry in this price category for home use. With 16K, one disk drive, printer, and color receiver the price is almost \$1900. **R-E**



IN ITS NEARLY FULLY CONFIGURED FORM, the Netronics *Explorer 85* includes a floppy-disk drive and CP/M.

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THE MICRO SOURCE M6000P is a portable computer that can be configured for almost any application.

higher-power disk BASIC.

With this system, a user can handle such tasks as word processing and some business information handling. All that is missing from this picture to make this a fully configured system is a printer and perhaps a communication interface such as a modem. The capability for communications is built in through the RS-232C serial I/O port.

NEC

For \$2375, a PC-8001 buyer gains much more capability. The extra money brings 32K of RAM, enough to handle the CP/M operating system, and 286K of mass storage. It also brings a 12-inch green monitor with a standard 80 × 25-line display format.

With this type of system a user should be able to handle word

processing and information-handling chores. And, as you can see, the system has started to become much more powerful, as have the others so far described.

At this level, too, the PC-8001 buyer will gain access to such high-level languages as COBOL, FORTRAN, Pascal and BASIC. In this 32K configuration, this personal computer is able to handle far more complex tasks, much more quickly than the less expensive version.

Sony

Sony's SMC-70 is another example of a system that has gained a great deal of power with the addition of relatively little money.

What does the buyer gain for his \$2125? The answer to this one is more RAM and greater mass storage. However, it's mass



THE APPLE II PLUS from Apple is shown here with its accessory Monitor III and two disk drives.

TABLE 5—\$2000-\$2500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II	\$2495	6502	8 bits	DOS 3.2	BASIC, Pilot Pascal, FORTRAN
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	CBM 8032B	\$2190	6502	8 bits	proprietary	BASIC
Hewlett-Packard 1000 N.E. Circle Dr. Corvallis, OR 97330	HP-85	\$2495	Z80	8 bits	proprietary	BASIC
Imsai Comp. Div., Fischer-Freitas Corp. 910 81st Ave. Oakland, CA 94621	Imsai PCS-42	\$2490	8085	8 bits	IMDOS, CP	CBASIC, other CP/M compatible
Intertec Data Systems 2300 Broad River Road Columbia, SC 29210	Superbrain Jr.	\$2494	Z80	8 bits	CP/M	BASIC, other CP/M compatible
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI-C4P-MF-24K	\$2050	Z80	8 bits	OS-65D	BASIC
Micro Source 595 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$2195	Z80	8 bits	proprietary	BASIC
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	NEC PC8001	\$2379	uPD 780 c-1 (Z80-like)	8 bits	proprietary	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$2495	Z80	8 bits	TRSDOS, NEWDOS, CP/M	BASIC, other CP/M-compatible
Radio Shack	TRS-80 Color Computer	\$2500	6809	8 bits		BASIC
Sony 7 Mercedes Dr. Montvale, NJ	SCM-70	\$2125	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Texas Instruments PO Box 22501	TI-99/4A	\$2324	TMS9900	16 bits	proprietary	BASIC, editor/assembler

storage with a twist, as we shall see.

In this configuration, the Sony *SMC-70* has 32K of built-in RAM. This should be more than enough to handle any system-related tasks and it gives the user access to the higher-level Pascal programming language. The user already has access to BASIC. In this configuration, too, the user gains 280K of mass storage on a single double-sided, double-density micro—yes, that's micro—floppy disk drive.

Rather than relying on the industry standard 5¼-inch disk, Sony has opted for its own 3½-inch micro disks. In truth, they have as much mass storage capability as larger disks, but a user is locked into the Sony system for his disks, which can be somewhat of a drawback. On the plus side, though, if this system becomes widely accepted in the personal computer market, then it is likely there will soon be micro disks from many aftermarket sources. In fact, with the amount of space they save, it is possible the rest of the industry could move in this direction. But, who knows what the future will bring?

M/A COM OSI

Even M/A COM OSI's system continues building in this building block manner. Its *C4P-MF-24K* system builds on the *C4P* computer and adds some very functional features. For starters, there's more built-in RAM, with 24K. This should give the user enough RAM to support the OS-65D operating system. This system includes color video output, AC control interfaces; D/A converter, and music output.

At this level, the buyer will also gain a 5¼-inch minifloppy disk, which provides greater mass storage. It will also speed system time because of quicker data access. This system also includes a security interface and a 16-line I/O port.

Imsai

Imsai also has an entry in this price category, and, to be honest, for the person looking for a good micro-mainframe

computer, any of the Imsai products is a good choice; in this price segment, there's Imsai's *PC-42*. It handles system expansion to the tune of 10 slots on the motherboard, and, in the correct configuration, it should be able to handle multiusers.

This computer is driven by an 8085 CPU with a clock speed of 3 MHz. It also features dual 5¼-inch minifloppies that have multi-format recognition capabilities. A Z80 board is also listed among the option for this microcomputer.

The beauty of this system is its ability to address different floppy disk densities. This should give the user the ability to install higher-density disks. It features both serial and parallel ports for interfacing.

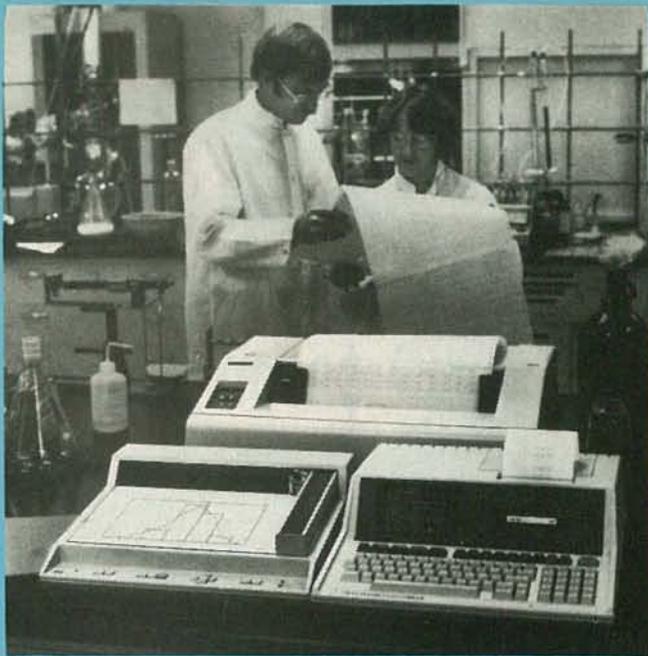
Interestingly, this is a dual operating system machine. It will recognize the company's proprietary IMDOS operating system or the industry standard CP/M. The BASIC it uses is CBASIC, which is a compiler version and allows for flexibility in string or



HARDWARE

\$2000-\$2500

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
48K/5¼-inch floppy disk		standard		40 × 24	12-inch green CRT
32K/5¼-inch floppy disk		standard, numeric keypad	IEEE-488	80 × 25	12-inch integral display
64K/cartridge		94 keys, 14 programmable	IEEE-488	32 × 16 text, 192 × 256 graphics	integral 5-inch display & printer
32K/dual 5¼-inch floppy disks		N/A	serial parallel	N/A	micro-mainframe
64K/5¼-inch double density floppy disk		80 keys, 18-key keypad	serial	80 × 25	12-inch green integral display
24K/5¼-inch floppy disk		standard	serial, 16-I/O lines		color-video output
64K		standard		80 × 24	
32K/dual 5¼-inch floppy disks		84 keys	serial parallel	80 × 25	12-inch green CRT
48K/dual 5¼-inch floppy disks		65 keys, 12-key keypad	parallel serial	64 (32) × 16	integral 12-inch display
32K/5¼-inch floppy disks		53 button-type keys	serial	8 colors, 192 × 256	printer
32K/3½-inch micro-floppy disks		72 keys, 5 programmable	serial parallel	80 × 24 text, up to 640 × 400 graphics	
40K/cassette		standard	serial	32 × 24 text, 192 × 256 graphics	printer, 10-inch color monitor



A POWERFUL COMPUTER IN ITS BASIC FORM, the power of an HP-85 from Hewlett-Packard can be increased with the addition of a printer and plotter.

file-handling. Since it is also a compiler language, it also tends to have a faster run time.

At \$2490, this system packs a lot of potential and it makes sense for the potential buyer looking for a micromainframe-type computer with its associated versatility in configuration and expansion. Since this system is contained in a system box, the user has the flexibility of obtaining his own peripherals.

Commodore Business Machines

With the addition of a single minifloppy disk drive to CBM's all-in-one 8032B, the price of this system rises to \$2190. This gives the user of this system access to more mass storage—170K. The minifloppy disk drive also increases the system speed because of faster data access.

Texas Instruments

Texas Instruments is another computer manufacturer whose upgraded personal computer falls into this category. At \$2324, a user can have a pretty complete system, with the exception of disk drives. Mass storage is still cassette-based, and the system still has only 16K of RAM, but a printer and 10-inch color monitor has been added.

Radio Shack

Even the Radio Shack TRS-80 Color Computer is upgraded to a complete, powerful system in this price category. For \$2500, its RAM memory is increased to 32K and this provides the user with access to the much more powerful Extended Color BASIC language, with its powerful data-handling capabilities.

This system also has more than 300K of mass storage on dual, single-sided, double-density 5¼-inch minifloppy disk drives. It also includes a dot matrix line printer. Thus, it is a full-featured system with considerable graphics power.

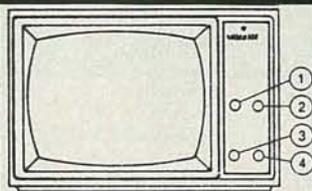
Hewlett-Packard

The \$2495 HP-85 is a powerful computer system right out of the box. A slim-line, all-in-one computer, it combines powerful graphics capability with expandability into a trim package.

Like many other personal computers on the market, the HP-85 uses a Z80 processor. It features a built-in CRT.

The 94-key keyboard of this portable personal computer contains a numeric keypad for rapid data entry and contains a built-in thermal printer for hard-copy output.

R-E



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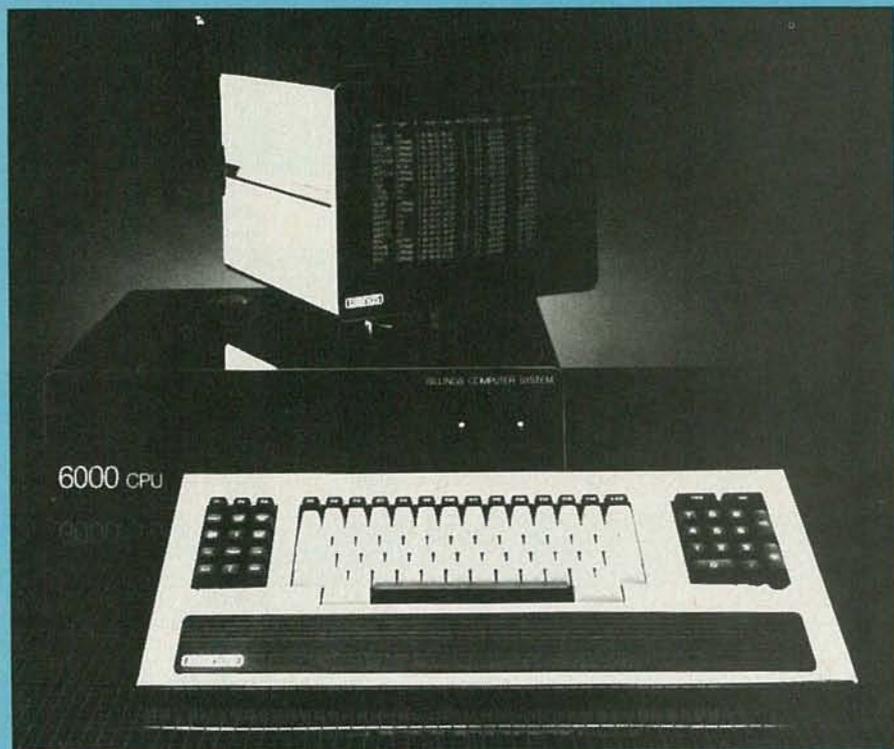
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HARDWARE

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MARC STERN

IN THE PERSONAL COMPUTER MARKETPLACE, THERE'S AN INTERESTING phenomenon taking place. Slowly, but surely, 16-bit CPU's are beginning to make their presence felt in more and more systems. It's not that the eight-bit CPU is going to become obsolete overnight, it's just that 16-bit machines offer more powerful system architecture and faster system operating time.

Eight-bit machines will likely be around for many years to come because they offer a wide range of capability. However, the 16-bit machines offer far more flexibility and power and they are likely to become the dominant machines of the future.

We've already seen how there are now 16-bit CPU's already being used in the lower price-range personal computers. Both IBM and Olivetti use 16-bit CPU's and other systems make use of them as peripheral processors (MTU-130, but we'll get to that). And, in the \$2500 to \$3000 price range, the 16-bit computer from Commodore Business Machines makes its appearance.

Commodore Business Machines

The BX256 from CBM is part of their enhanced "B" series personal computer line. In reality, this computer is aimed at the business segment of the microcomputer market.

Like another entry in the personal computer market from Digital Equipment Corp. (we'll get to it a little later in our survey), the BX256 is a dual-processor personal computer. This might lead one to believe that it contains a pair of Z80A's or 8080's, but this isn't the case. Instead, it contains a 16-bit 8088 and an eight-bit 6509.

Although Commodore provides very little information about how the computer functions internally, we would assume that the dual-processors function something like this: When one processor is tied up, the other processor will handle system "house keeping" functions, keyboard I/O and display functions. Conversely, when the second CPU is processing, the first must act in a like manner.

Thus, the user gains the full speed and power of both CPU's independently. For instance, this system will recognize CP/M-86, the 16-bit version of the standard CP/M. It will also run the standard 8-bit version of CP/M. The software activates the correct CPU.

Thus, 16-bit software will run on the 16-bit processor, while the eight-bit processor handles the "house keeping" chores, and 8-bit software will run on the eight-bit CPU while the 16-bit CPU handles the chores.

Rather than having to work through a master eight-bit CPU, which addresses a peripheral 16-bit processor, the programming accesses either one directly and the user gains all the power and speed built into the system. It's a good feature for the buyer interested in upgrading to 16-bit power while retaining the investment in eight-bit software.

The BX256 is a potent system in its own right. It comes with 256K of standard RAM, which is quite a bit of memory in a \$2995 machine. This means this system has more than enough internal memory to handle whatever tasks a user or system may ask of it. It will easily work with either the standard version of CP/M or CP/M-86.

Like other all-in-one CBM personal computers, this one comes with a standard 12-inch green phosphor CRT with an 80-column x 25-line display. It also features dual built-in quad density (double-sided, double-density) 5¼-inch minifloppy disk drives.)

The 94-key keyboard can be detached from the system unit and can be lap-held, a convenience that allows the user to find the most comfortable work position. This keyboard includes a separate keypad for numeric data entry and it has 10 user-programmable keys, another good feature. Interestingly, this keyboard also has a double-zero key and while CBM doesn't explain its function clearly, it is likely this key has to do with the display's memory and graphics capability.

TABLE 6—\$2500-\$3000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1265 Borregas Ave. Sunnyvale, CA 94086	Atari 800	\$2685	6502B	8 bits	proprietary	BASIC
Billings Computer Corp. 18600 East 37th Independence, MO 64057	Billings 100	\$2995	Z80	8 bits	proprietary	BASIC
Commodore Business Machines 487 Devon Park Dr. Wayne, PA 19087	CBM 4032	\$2590	6502	8 bits	proprietary	BASIC
Commodore Business Machines	BX256	\$2995	8088/6509	8/16 bits	proprietary, CP/M	BASIC, Pascal, other CP/M compatible
Commodore Business Machines	CBM 8032B	\$2690	6502	8 bits	proprietary	BASIC
Heath Co. Benton Harbor, MI 49022	H11A	\$2595	KD-11HA	16	HT-DOS	FORTTRAN, BASIC
Heath Co.	H-89	\$2520 (kit)	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTTRAN, UCSD p-Pascal, other CP/M compatible
Heath Co.	H-89	\$2790 (kit)	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTTRAN, UCSD p-Pascal, other CP/M compatible
Hewlett Packard 1820 Embarcadero Rd. Palo Alto, CA 94303	HP-87	\$2750	Z80	8 bits	proprietary, CP/M	
IBM Information Systems Baco Raton, FL 33432	PC	\$2665	8088	16 bits	PCDOS, (optional)	BASIC, UCSD Pascal IV, COBOL
Imsai Corp., Div., Fischer-Freitas Corp. Oakland, CA 94521	PCS-42	\$2640	8085	8 bits	IMDOS, CP/M	CBASIC, other CP/M compatible
Intertec Data Systems 2300 Broad River Rd. Columbia, SC 29210	Superbrain QD	\$2995	Z80	8 bits	CP/M	BASIC, other CP/M compatible
Micro Technology Box 12106 Raleigh, NC 27605	MTU 130-10	\$2999	6502	8 bits	CODOS	BASIC, UCSD Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	PC8001	\$2849	uPD780 c-1 (Z80-like)	8 bits	proprietary	BASIC
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$2965	Z8001	16 bits	PCOS	BASIC
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-1000	\$2879		8 bits	N/A	BASIC
Panasonic	RL-1400	\$2979		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$2557	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTTRAN
Radio Shack	TRS-80 Model III	\$2932	Z80	8 bits	TRSDOS	BASIC, COBOL, FORTTRAN
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$2950	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Sony	SMC-70	\$2500	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$2824	TMS9900	16 bits	proprietary	BASIC, editor/assembler
Zenith Data Systems 1000 Milwaukee Ave. Glenview, IL 60025	Z-89	\$2895	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTTRAN, UCSD p-Pascal, other CP/M compatible
Zenith	Z-90	\$2895	Z80	8 bits	HDOS, CP/M	BASIC, FORTTRAN, UCSD p-Pascal, other CP/M compatible

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/dual 5¼-inch floppy disks		61 keys, 4 special function	serial, parallel	40 × 24 text 320 × 192 graphics	printer, color output to TV set
64K/dual 5¼-inch floppy disks		94 keys, 16 special-function	80 × 24		
32K/dual 5¼-inch floppy disks		standard	IEEE-488	40 × 24	
128K/dual 5¼-inch floppy disks		94 keys, 10 programmable	IEEE-488, serial	80 × 25	
96K/5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 24	
64K/dual 8-inch floppy disks			serial		
48k/dual 5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor
64K/dual 5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor
64K/dual 5¼-inch floppy disks		standard	serial,	80 × 24 text 544 × 240 graphics	
64K/5¼-inch floppy disk		83 keys, 10-key keypad, 10 special-function keys	serial, parallel	80 × 24	11½-inch green CRT
64K/dual 5¼-inch floppy disks		N/A	serial, parallel	N/A	micro-mainframe
64K/dual 5¼-inch floppy disks		80 keys, 18-key keypad	serial	80 × 25	12-inch B&W monitor
80K/8-inch floppy disk		96 keys, 8 programmable	serial, parallel	80 × 24 text, 480 × 256 graphics	Light pen
64K/dual 5¼-inch floppy disks		84 keys	serial, parallel	80 × 25 text	12-inch B&W monitor
128K/5¼-inch floppy disk		72 keys	serial, parallel	80 × 25 text, 512 × 256 graphics	12-inch B&W monitor
36K/cassette		65 keys	serial	video package	modem, I/O adaptor, system case
36K/cassette		65 keys	serial	video package	modem, I/O adaptor, system case
16K/cassette		65 keys, 12-key keypad	serial, parallel	64 (32) × 16 text, 64 graphics characters	printer, graphics plotter
48K/5-inch floppy disk		65 keys, 12-key keypad	serial, parallel	64 (32) × 16 text, 64 graphics characters	printer
64K/dual 3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × 24 text, 640 × 230 graphics	
64K/3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × 24 text, 640 × 230 graphics	
48K/5¼-inch floppy disk		standard	serial	32 × 24 text, 192 × 256 graphics	high level graphics option
48K/5¼-inch floppy disks		84 keys, 12 special-function	serial	84 × 24 text, 33 graphics characters	integral monitor
64K/5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor



ADDING A DISK DRIVE to the Intertec *Superbrain QD* greatly increases its storage capability.

While this machine is aimed at the serious business user, it still retains sound synthesis capabilities. It is capable of three-part harmony over nine octaves, something you won't find in many business computers.

On the whole, this is a powerful machine in its own right, but its capabilities can be further expanded with the addition of a hard disk and printer. However, this raises the system's price considerably.

There are other CBM entries in this price class, too. For instance, by adding dual floppy-disk drives to the *PET 4032N* and increasing the mass storage capacity to a total of 340K on single-sided double-density disks, the cost of this system rises to \$2590. And, by adding 64K of RAM memory to the *CBM 8032B*, along with a single disk drive with its 170K of mass storage, then the price will rise to \$2,690.

Panasonic

Believe it or not, even a fully-configured handheld system's price can reach this region. Look at the *Panasonic H1000* and *H1400*. When this system is fully configured with a video interface, 36K of RAM (which must be daisy-chained), an I/O adapter for peripherals and an attache case into which this system fits, the price rises to \$2979 for the *H1400* and \$2879 for the *H1000*.

Fully equipped the whole system is known as *The Link* and it makes a handheld microcomputer into a full-featured portable terminal. The features and peripherals added should make this system very attractive for the business traveler, especially one who must communicate with a mainframe or electronic mail system.

NEC

In this price range, we also find many systems beginning to take on a great deal of computing power. For example, the \$2849 *NEC PC-8001* now has 64K of RAM and it gains its true potential as a system. In this configuration, this system can run CP/M, as well as the high-level Pascal language. The other languages that can also run on this machine include FORTRAN, as well as COBOL, NBASIC (also the system language) and CBASIC, the faster compiled BASIC.

In this configuration, the system has also gained dual 5¼-inch minifloppy disk drives that provide up to 280K of mass storage. Its potential for further expansion is increased with the addition of an expansion interface box that offers card slots and the potential to increase the system's RAM to 128K. This is a modular system and in this configuration, NEC's 12-inch green phosphor monitor has been added. It features the industry-standard 80 × 25 display. In reality, in most systems the 25th line of the display is reserved for status use, so it is really a 24-line display for text. Please refer to the previous discussion of the basic system.

Intertec

Another system upgraded is available from Intertec Data Systems. It is the \$2995 *Superbrain QD* and it is a step up from the *Superbrain Jr.* The essential difference in this all-in-one computer is the amount of mass storage. Where the *Superbrain Jr.* offers mass storage of 350K on one quad-density minifloppy disk drive, the *Superbrain QD* offers 750K. This additional mass storage greatly increases the capability of this dual-processor system.

Unlike a 16-bit/8-bit dual processor unit, this one uses dual eight-bit Z80's with a high clock speed of 4 MHz. This allows for much more rapid data access and use. Since it is a dual-processor system, the speed is enhanced because one processor handles the data processing, while the other handles the "house-keeping."

The standard operating system of this and other Intertec offerings is CP/M 2.2. It also comes equipped with 12-inch green CRT and keyboard.

Heath/Zenith

Another dual eight-bit microprocessor system is the *H89* from Heath. This is one of the few computers that are available in kit form. This is also sold fully-assembled as the *Z89* by Zenith. Please refer to the previous discussion for a full description of this system.

The *H89*, in this configuration, has been upgraded by the addition of dual 5¼-inch floppy disk drives with a mass storage capacity of 200K. This \$2525 all-in-one computer in kit form comes with a standard 84-key keyboard and 12-inch black and white CRT. The computer is driven by a pair of Z80's with a clock speed of 2.048 MHz. Its 48K of RAM is enough to work with its HDOS operating system and CP/M. A user is also capable of using BASIC, FORTRAN and UCSD-p-Pascal programming languages.

This isn't the only Heath/Zenith entry in this price category. An upgrade *H89* kit is available. In this \$2790 configuration the standard amount of RAM is increased to 64K.



The *H89* FROM HEATH is one of the few computers available in kit form. It is also available fully assembled as the *Z89* from Zenith.

IBM

IBM's *Personal Computer* also gains a great deal of power in this price range. The basic system was described previously, so here we will concentrate on what has been added.

Specifically, this system gains about 320K of mass storage through the addition of one double-sided, double-density disk drive. Its RAM has also been increased from 16K to 64K, which allows this system to work with the high level BASIC compiler, UCSD-p-Pascal and COBOL. Its price is now \$2665.

The other addition to this system has been the 11½-inch green CRT that has the standard 80 × 25 display.

Sony

Sony's *SMC-70* upgrades twice in this price range. In its first upgrade, which increases the price to \$2500, the amount of RAM has grown to 64K, while one 3½-inch microfloppy disk drive has been added. This gives this system 280K of mass storage. Another enhancement to this system is the addition of a 12-inch green CRT. Please refer to the previous discussion for a full description of the basic system.

The second *SMC-70* upgrade consists of adding a second microfloppy drive for a total of 560K of mass storage. This gives this system far more power and makes it a better buy for the \$2950 price tag.

Olivetti

Still a further system upgrade in this price category comes from Olivetti, whose \$2965 *M-20* gains 320K of mass storage with the addition of one double-sided double-density disk drive. Also added to this system is the standard black-and-white CRT.

This system, thanks to its 16-bit processor, has quite a bit going for it and, as you can see, its potential power is now capable of being used.

Micro Technology

The same can be said for Micro Technology's *MTU-130*. In its \$2999 configuration, this system gains 1 megabyte of mass storage through the addition of one quad-density eight-inch floppy disk drive. When this is combined with the system's standard 80K of RAM, one can see the power built into this system.

Atari

Even some of the lower-priced home computers have system upgrades that bring their price into this category. For instance, when you add two disk drives for mass storage to the *Atari 800* system, plus a dot matrix printer, the system's price easily rises to \$2685. It is also quite a powerful system in this advanced version.

The *Atari 400* system can also be configured into a level that brings its prices into this spectrum. When this system is equipped with dual, 5¼-inch minifloppy disks, modem and communications software, and a printer, the system cost rises to \$2572.

Radio Shack

Radio Shack also has an entry in this category. It is an expansion of its 16K *TRS-80 Model III*, but it still relies upon a cassette recorder for mass storage. The additions to this system—aimed at engineers—consist of a graphics plotter and a printer and its price increases to \$2557.

Another expansion of the *TRS-80 Model III* results in what Radio Shack calls their "Complete World Processing System." This time, the RAM memory is increased to 48K and the expansion includes a dot-matrix line printer, a disk drive and word processing program. At \$2932 it is quite a package.

Texas Instruments

The same is true of the Texas Instruments *TI-99/4A*. When you expand its RAM to 32K and add a drive, video controller and a 10-inch monitor (a pretty complete system for both home and business use), then you find the price rising to \$2824.

Billings

Here's a newcomer to this price range. Although the Billings Computer Co. has been selling computers to businesses for the last five years, this is their first entry into the lower-priced microcomputer market.

Although this company makes several microcomputer-based systems, their *100 Series*, priced at \$2995, is their entry-level machine.

Based on an eight-bit Z80 CPU, this system features a high-contrast green CRT screen and a detachable keyboard with 16



HARDWARE

\$2500-\$3000

function keys, a numeric keypad and eight cursor control keys. It also sports a standard typewriter keyboard for a total of 94 keys.

Mass storage is via dual, single-sided, single-density 5¼-inch minifloppy disk drives which provides about 100K of storage for a user.

Imsai

Micromainframe-type systems still abound in the microcomputer world and in this price range we find two, one from Imsai, the second from Heath.

Imsai's *PCS-42* micromainframe-type of computer benefits from the addition of 32K of RAM in this \$2640 configuration. This gives this system the potential of taking full advantage of either the IMDOS operating system or CP/M 2.2. Mass storage is provided by dual 5¼-inch single density disks. With these drives, 100K of mass storage is provided.

Heath

A very powerful system is the Heath *H-11A* kit. It is powered by a custom-made KD-11HA CPU. Equivalent to a 16-bit system, it is capable of acting as a mainframe for several terminals.

The CPU itself recognizes the DEC *PDP 11/34* instruction set and HT-DOS. Thus you can see the potential power built into the machine. It is capable of running FORTRAN. At \$2595, the buyer is gaining a great deal of potential computer power for the money.

In its standard configuration, this microcomputer is capable of addressing 64K of memory, which includes 56K of RAM and 8K of system ROM. It is capable of further expansion thanks to the eight expansion slots on the S-100 motherboard. It packs a great wallop for the money.

Hewlett-Packard

The \$2750 Hewlett-Packard *HP-87* is an all-in-one computer. This is a dual-processor system that is driven by an eight-bit Z80 CPU and an eight-bit 80-series CPU. The user is able to take advantage of the wide variety of software available that runs under these processors. He is also able to take full advantage of the power built-into the Z80 because of the dual nature of this unit.

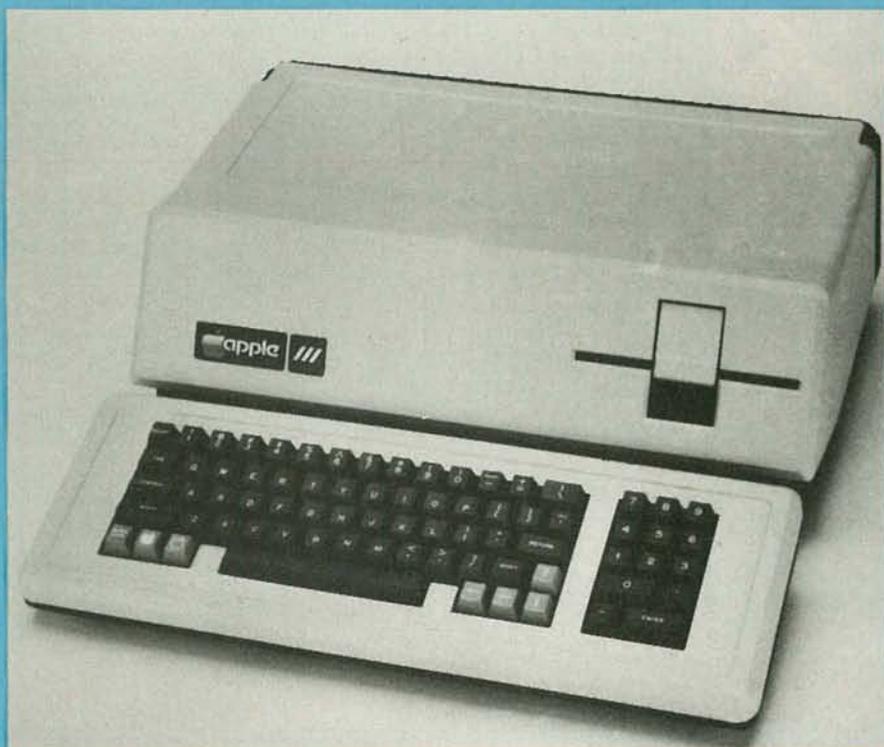
The basic system consists of a 94-key keyboard that is contained in a slim-line terminal-type housing with 64K of RAM that is available to the Z80 and 48K that is available to the 80-series CPU. This system, via its high-resolution built-in CRT, also has high-level graphics capability.

The system language is BASIC and it will run under either CP/M or H-P's own disk operating system.

Another \$2750 system is Hewlett-Packard's *HP-125*. Also driven by an eight-bit Z80, this system has 64K of RAM standard. This is more than enough RAM memory and when interfaced with dual minifloppy disks, this system provides 500K of mass storage.

R-E

\$3000 to \$3500



HARDWARE

\$3000-\$3500

There's quite a bit to choose from in this price range. Among what you'll find are both basic systems and upgraded versions of less expensive machines.

MARC STERN

WHEN YOU LOOK AT WHAT'S AVAILABLE FOR BETWEEN \$3000 and \$3500, one thing immediately hits you—the number of systems on the market. Those are split just about 50-50 between upgrades of lower priced systems and sophisticated machines that were intended to sell for that price in their basic form. Among the ones in the later category are computers from giants Xerox and Digital Equipment Corporation (DEC).

Another thing that is apparent is that 16-bit machines are still not that common. True, there are a few, such as the one put out by DEC, but most are still 8-bit machines.

Xerox

Let's begin by looking at the Xerox 820II. The microprocessor used here is a Z80A. The microprocessor and the 12-inch, black-and-white monitor are housed in a single case; that monitor can display up to 24 lines of 80 characters each. The system also comes with a 96-key keyboard that includes a 10-key keypad for rapid numeric data entry. (That type of keypad, included on so many keyboards, is a blessing, especially when a user is working with long arrays of numbers. The absence or presence of such a keypad is something that should be considered when comparing personal computers.)

As you would expect with a computer at this price level and sophistication, it comes with 64K of RAM standard and two 5¼-inch disk drives; those drives are capable of handling either single- or double-sided, double-density disks. The operating system is an enhanced version of CP/M. Eight-inch drives could also be used with the machine if desired. Two RS-232C serial ports and two parallel ports are provided for expansion.

Among the nice features of this machine is its user friendliness. For example, a menu-driven system is provided to help users over the rough spots. If you've ever used something like that, you know how much help it can be.

This computer, which sells for \$3295, is an enhanced version of their 820. Among the improvements offered by the newer

system is a faster microprocessor, an enhanced CP/M, and better use of memory space. The older version, which sells for \$2995, will still be available for a short time. Incidentally, Xerox will upgrade the older 820 to the 820II for \$400.

DEC

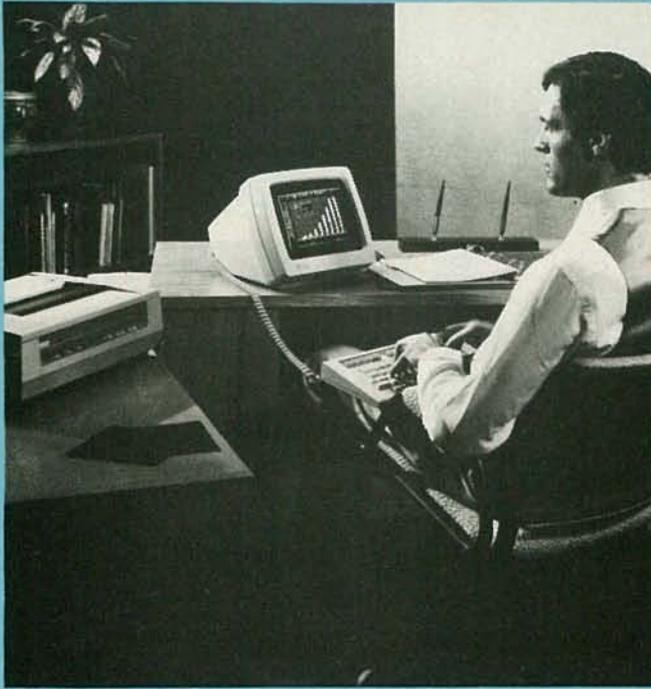
Digital Equipment Company (DEC), a giant in the mini- and small-mainframe-computer field, has entered the microcomputer market with the introduction of three new personal-computer systems. One of those that falls within this price category is the Rainbow 100; it sells for \$3495, complete with its special operating system (more on that later).

That all-in-one system consists of a 103-key keyboard, 12-inch monochrome CRT monitor, and dual, double-density, 5¼-inch disk drives; those drives have a total storage capacity of 800K. It also includes 64K of RAM. The lightweight 103-key keyboard is a separate unit and can be positioned for maximum user comfort. Some users have commented that they don't like the feel of the keyboard, but that may be because it is fairly sensitive and requires just a light touch.

What sets that unit apart, however, is that this is a 16/8-bit dual microprocessor machine. It works much like other dual processor machines on the market—but with one major difference. As the machine uses both a Z80 (8-bit) and an 8088 (16-bit), it will run programs written for either of those microprocessors.

The idea of using dual microprocessors is not new. Formerly, however, two 8-bit microprocessors would be used—one would do the actual processing while the other handled the keyboard, display, etc. That effectively speeded up system access and function time because it eliminated the need for having a single CPU handle all the tasks.

The same thing happens here too—one microprocessor handles the processing while the other take care of the housekeeping. The special CP/M-86/80 operating system determines whether a



DEC'S RAINBOW 100 personal computer is compact and can run either 8-bit or 16-bit software.

program is in 8- or 16-bit-wordlength form and invokes the appropriate microprocessor to run the program, with the other acting as a controller and handling the housekeeping. Thus, a user has access to the full capabilities of either a Z80 or 8088 microprocessor. One big advantage to this scheme is that the user gains access to the latest 16-bit software without making obsolete his existing 8-bit CP/M software; that existing software often represents a considerable investment and would be very costly to replace. The *Rainbow 100* can also run under Microsoft's MS/DOS, a 16-bit operating system.

Apple

Apple, one of the best known names in personal computers, also has a system in this price category. That system, the *Apple III* was developed to meet the needs of business as well as for the advanced computer user. It sells for \$3495

Like the *Apple II Plus*, the *Apple III* is driven by an 8-bit 6502 microprocessor. The chief advantage of this system is its large amount of built-in RAM. At 128K, it is among the leaders in memory capacity. If you wish, that RAM can be expanded to 256K.

The system comes with one built-in single-sided, double-density disk drive. If desired, up to three additional drives could be daisy-chained for a total of 560K of storage. For massive storage requirements, a 5 megabyte hard disk is available.

Unlike the *Apple II's* 53-key keyboard, the integral 74-key keyboard here includes a numeric keypad. Such a keypad greatly speeds and simplifies the entry of long numbers.

TABLE 7—\$3000-\$3500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95105	Apple III	\$3495	6502	8 bits	SOS 1.1	BASIC, Pascal
Apple Computer	Apple II	\$3020	6502	8 bits	DOS 3.2	BASIC, Pilot, Pascal, FORTRAN
Digital Equipment Corp. Maynard, MA 01754	DEC 100	\$3495	8088	8/16 bits	CP/M-86, MS-DOS	MBASIC, C
Heath Co. Benton Harbo, MI 49022	Z-90	\$3345	Z80	8 bits	MDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p-Pascal
Heath Co.	Z-90-82	\$3191	Z80	8 bits	HDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p-Pascal
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI 220C	\$3150	6502	8 bits	OS-65D	FORTRAN, BASIC, Pascal
M/A COM OSI	OSI C100	\$3285	6502	8 bits	OS-65D	FORTRAN, BASIC, Pascal
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$3472	Z80	8 bits	TRSDOS, CP/M (optional)	COBOL, BASIC, FORTRAN, editor/assembler
Sony Corp. 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$3470	Z80A	8 bits	CP/M	BASIC, Pascal
Sony Corp.	SMC-70	\$3020	Z80A	8 bits	CP/M	BASIC, Pascal
TeleVideo Systems 1170 Morse Ave. Sunnyvale, CA 94086	TeleVideo TS801	\$3295	Z80A	8 bits	MmmmOST, CP/M	BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Forth
TeleVideo Systems	TeleVideo TS802	\$3495	Z80A	8 bits	MmmmOST, CP/M	BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Forth
Xerox-Office Products Div. 1341 W. Mockingbird Lane, Dallas, TX 75247	820II	\$3295	Z80	8 bits	CP/M	MBASIC, CBASIC, COBOL

The high-resolution 12-inch green phosphor CRT is capable of displaying up to 24 lines of 80 characters each. In the graphics mode, the resolution is 280 × 192 pixels, which is good. The system can also drive almost any black-and-white or color monitor; 16-color graphics capability is standard.

One of the beauties of this system is its expandability—eight expansion slots are provided. Even when the RAM is expanded to its full 256K, four slots remain for expansion. Apple manufactures a full line of peripherals including printers, color plotters, and modems.

For present owners of *Apple II* systems, the *Apple III* has an emulation mode that will permit you to run your *Apple II* software. That is a big plus for those who already own a large inventory of Apple software—that software can be run on the new machine.

Televideo

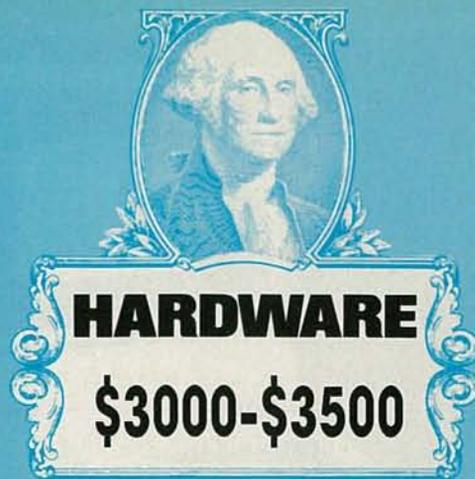
Televideo has two systems in this price category, the *TS801* and the *TS802*. Those are essentially the same system—the only difference between them is that the *TS801*, which sells for \$3295, has a separate keyboard, monitor, and system box, while the *TS802*, which sells for \$3495, features an integrated unit with a detachable keyboard. Since those two systems are so much alike, let's treat them as one in our description.

The heart of the system is a Z80 microprocessor. The unit comes with 64K of RAM standard. For mass storage, two double-sided, double-density, 5¼-inch disk drives are provided. With those drives, a total of 1 megabyte of storage is

available. That gives the buyer quite a bit for his money.

The CRT is a green-phosphor-type and is capable of displaying 25 lines of 80 characters each. The keyboard is a 97-key typewriter-style unit. As it is housed in a separate case in the *TS801* and detachable in the *TS802*, the keyboard can be easily positioned for comfortable operation.

One interesting feature of this system is the addition of a 4K EPROM. A user can format and program a specific routine or routines into the EPROM; those can be changed whenever the user wants because the EPROM is, of course, erasable.



Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
128K/5¼-inch floppy disk		74 keys, 13 key keypad	serial	80 × 24 text, up to 180 × 192 graphics	12-inch green monitor
48K/dual 5¼-inch floppy disks		53 keys	serial, parallel	40 × text, 280 × 192 graphics	12-inch green monitor
64K/dual 5¼-inch floppy disks		103 keys	serial	80 × 24	12-inch B&W monitor
64K/5¼-inch floppy disk		84 keys, 12 key keypad	3 serial,	80 × 24	12-inch B&W CRT, multi-mode interface card
64K/5¼-inch floppy disk		84 keys, 12 key keypad	3 serial,	80 × 24	12-inch B&W
48K/dual 5¼-inch floppy disks			serial		
48K/dual 5¼-inch floppy disks			serial		
48K/5¼-inch floppy disk		65 keys, 12 key keypad	serial, parallel	64 (32) × 16	integral display, printer
64K dual 3½-inch micro-floppy disks		72 keys, 5 programmable	serial, parallel	up to 840 × 230	12-inch color monitor
64K/3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	up to 840 × 230	12-inch color monitor
64K/dual a5¼-inch floppy disks		97 keys	2 serial, 1 parallel	80 × 24	green CRT
64K/dual 5¼-inch floppy disks		97 keys	2 serial	80 × 24	green CRT, satellite port
64K/dual 5¼-inch floppy disks		96 keys, 14-key keypad	2 serial, 2 parallel	80 × 24	12-inch B&W monitor



THE APPLE III with Silentype printer.

On the software end, two operating systems are available. Those are CP/M and MmmOST Service Operating System, a Televideo proprietary operating system. Also, nine high-level programming languages are available—BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Fortran, and C.

Other systems

The other systems available in this price range are upgrades of lower-priced systems; in general, those upgrades increase the power and/or flexibility of the basic system. For instance, the *Apple II Plus* reaches this price level if it is equipped with a second double-density 5¼-inch disk drive. Doing so increases the formatted mass storage capacity to 280K, and the price to \$3020.

Adding a high-resolution (650 × 230 or 250 × 300 pixels) color display increases the price of the Sony *SMC-70* to \$3020. Doing so allows you to make maximum use of the system's eight-color capability. For a total system price of \$3470 you can also add a second 3½-inch disk drive. That drive increases the storage capacity by 280K for a total system capacity of 560K.

Radio Shack's *TRS-80 Model III* system can also be upgraded into this price range. For \$3472, you can purchase what Radio Shack calls its Manager's System. That includes 48K of RAM, one double-density 5¼-inch disk drive, a line printer, and appropriate software including the VisiCalc spreadsheet program and SCRIPSIT word processing. Also included is a computer work desk.

At \$3195, an upgraded version of the Zenith *Z89* (also available in kit form from Heath as the *H89*) is available. That version includes one soft-sectored 5¼-inch disk drive for a storage capacity of 160K, and 64K of RAM.

M/A-Com-OSI also has two offerings in this category. For \$3150, you can purchase the *C20EM*. That system consists of the 6502-based computer, 48K of RAM, OSI's OS-65U operating system, and two single-sided, double-density disk drives each allowing 275K of storage.

The *C4P-MF-48K*, with a price of \$3000, offers 48K of RAM and two eight-inch disk drives. Those drives should give the user about 550K of total system storage capacity. That 6502-based system features color-video output and comes with modem, cassette, printer, and AC-control interfaces. **R-E**

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74LS20N	25 2114	2 24	280A S1D	21 95	2716-1	8 95	FD500 801
74LS22N	29 2114L 300ms	2 50	8212	1 85	2716-1	8 95	FD503 510
74LS23N	25 2114L 450ms	2 57	8214	3 75	2716-1	8 95	FD500 801
74LS24N	25 4116 200ms	2 35	8216	3 75	2716-1	8 95	FD503 510
74LS25N	55 8415E 200ms	1 75	8224	2 50	2716-1	8 95	FD500 801
74LS38N	55 8415E 200ms	3 00	8251	4 95	2716-1	8 95	FD503 510
74LS47N	45 8415E 200ms	1 95	8278	4 95	2716-1	8 95	FD500 801
74LS49N	60 8415E 200ms	5 94	8253	6 95	2716-1	8 95	FD503 510
74LS59N	60 8415E 200ms	8 05	8255	4 75	2716-1	8 95	FD500 801
74LS69N	60 8415E 200ms	11 50	8257	6 75	2716-1	8 95	FD503 510
74LS93N	60 8415E 200ms	11 50	8259	6 75	2716-1	8 95	FD500 801
74LS161N	40 8415E 200ms	10 00	8262	11 95	2716-1	8 95	FD503 510
74LS162N	40 8415E 200ms	10 00	8264	11 95	2716-1	8 95	FD500 801
74LS163N	40 8415E 200ms	10 00	8266	11 95	2716-1	8 95	FD503 510
74LS164N	40 8415E 200ms	10 00	8268	11 95	2716-1	8 95	FD500 801
74LS165N	40 8415E 200ms	10 00	8270	11 95	2716-1	8 95	FD503 510
74LS166N	40 8415E 200ms	10 00	8272	11 95	2716-1	8 95	FD500 801
74LS167N	40 8415E 200ms	10 00	8274	11 95	2716-1	8 95	FD503 510
74LS168N	40 8415E 200ms	10 00	8276	11 95	2716-1	8 95	FD500 801
74LS169N	40 8415E 200ms	10 00	8278	11 95	2716-1	8 95	FD503 510
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74LS174N	40 8415E 200ms	10 00	8288	11 95	2716-1	8 95	FD500 801
74LS175N	40 8415E 200ms	10 00	8290	11 95	2716-1	8 95	FD503 510
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74LS177N	40 8415E 200ms	10 00	8294	11 95	2716-1	8 95	FD503 510
74LS178N	40 8415E 200ms	10 00	8296	11 95	2716-1	8 95	FD500 801
74LS179N	40 8415E 200ms	10 00	8298	11 95	2716-1	8 95	FD503 510
74LS180N	40 8415E 200ms	10 00	8300	11 95	2716-1	8 95	FD500 801
74LS181N	40 8415E 200ms	10 00	8302	11 95	2716-1	8 95	FD503 510
74LS182N	40 8415E 200ms	10 00	8304	11 95	2716-1	8 95	FD500 801
74LS183N	40 8415E 200ms	10 00	8306	11 95	2716-1	8 95	FD503 510
74LS184N	40 8415E 200ms	10 00	8308	11 95	2716-1	8 95	FD500 801
74LS185N	40 8415E 200ms	10 00	8310	11 95	2716-1	8 95	FD503 510
74LS186N	40 8415E 200ms	10 00	8312	11 95	2716-1	8 95	FD500 801
74LS187N	40 8415E 200ms	10 00	8314	11 95	2716-1	8 95	FD503 510
74LS188N	40 8415E 200ms	10 00	8316	11 95	2716-1	8 95	FD500 801
74LS189N	40 8415E 200ms	10 00	8318	11 95	2716-1	8 95	FD503 510
74LS190N	40 8415E 200ms	10 00	8320	11 95	2716-1	8 95	FD500 801
74LS191N	40 8415E 200ms	10 00	8322	11 95	2716-1	8 95	FD503 510
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74LS200N	40 8415E 200ms	10 00	8340	11 95	2716-1	8 95	FD500 801
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74LS229N	40 8415E 200ms	10 00	8398	11 95	2716-1	8 95	FD503 510
74LS230N	40 8415E 200ms	10 00	8400	11 95	2716-1	8 95	FD500 801
74LS231N	40 8415E 200ms	10 00	8402	11 95	2716-1	8 95	FD503 510
74LS232N	40 8415E 200ms	10 00	8404	11 95	2716-1	8 95	FD500 801
74LS233N	40 8415E 200ms	10 00	8406	11 95	2716-1	8 95	FD503 510
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74LS244N	40 8415E 200ms	10 00	8428	11 95	2716-1	8 95	FD500 801
74LS245N	40 8415E 200ms	10 00	8430				

\$3500 to \$4000



HARDWARE

\$3500-\$4000

Systems in this price range consist mainly of upgraded versions of more basic systems. But for the added cost, you get versatility.

MARC STERN

IF THERE'S ONE THING CERTAIN ABOUT THE COMPUTER MARKET, it's that: the higher in price you go, the more systems seem to be available. It's especially noticeable if you take a close look at the personal computer marketplace. And, no matter how high you go into the price spectrum, two other certainties also stand out: The eight-bit processor is still the champ, without a doubt, and CP/M is still the leading operating system.

Yes, it is true there are some systems taking advantage of the new generation of 16-bit CPU's, but there aren't that many. In this price category, there are only two systems that take advantage of it, while a third takes advantage of a proprietary 12-bit CPU.

But, speaking of specific systems themselves, it is in this price segment of the marketplace that many computer systems really begin to mature into truly powerful machines. It is also in this part of the spectrum that several new machines make their appearance and we will look at them first.

Three new names join the list at this juncture; those are Vector, North Star Computers, and Hitachi.

Vector

The \$3995 Vector 1600 is a very powerful system. Its high-speed Z80B crunches data at the super-high clock speed of 6 MHz. This system also features bank-switched RAM in 64K chunks. What this means is that while the operating system is resident in one 64K chunk of memory, the user can have another bank of 64K available for processing. This effectively reduces disk access time and it will allow for some spooling functions—using part of the memory for printing while the rest of the system is doing other tasks.

Clearly designed for business applications, the Vector 1600 is CP/M-dedicated. Its operating system is CP/M 2.5, one of the latest releases. Thus, this system will support BASIC 80, BASIC Compiler, FORTRAN, COBOL and Pascal. It also supports a RAID debugging program and ZSM Assembler, as well as a powerful business-accounting/word processing package.

The bank-switched memory also allows additional operating commands and new utilities to be added. User access to these functions is via a 72-key keyboard of which 10 keys are used as a numeric keypad for rapid numeric data entry.

This S-100 bus system has six card slots open on its motherboard and it will support a parallel printer without an optional interface. In fact, the three parallel ports are fully configurable by the user.

Mass storage is available in two standard quad density (double-sided, double-density) 5¼-inch minifloppy disks. This gives the user a total of 630K of potential storage. It also means there's more than enough storage for any task a user would like the system to tackle.

The CRT is a 12-inch bit-mapped unit, capable of the industry standard 80-character by 24-line display. The bit-mapping is also attractive because it will allow the user to directly address screen memory and move the cursor any screen location.

North Star

From North Star Computers of San Leandro, CA, comes the dual-processor *Advantage*. This system is another of a number on the market that takes advantage of a secondary processor which handles such routine "housekeeping" chores as servicing the keyboard and floppy disk drive control functions. This allows the Z80A to perform its processing function unhindered. It also means the user gets the advantage of the CPU's 4 MHz clock speed for quick data access and retrieval.

The operating system of this computer is North Star's CP/M-compatible Graphics BASIC/Graphics DOS (GDOS) for high-level graphics functions.

One of the prime aims of this system seems to be at those industries or users needing powerful graphics capabilities. The operating system allows the user to take advantage of the high-level bit-mapped graphics capability of the *Advantage*. Resolution of this system is 640 × 240 pixels, which will allow high-level graphics resolution. In the graphics mode, the *Advantage* will support both geometric and graphics functions. The four functions POLYGON, RECTANGLE, ELLIPSE, and SPECIAL LINE enable the drawing of points, lines and many two-dimensional figures. Other commands such as CLEAR, BLOCK, and CHAR are used to control the display operation.

The *Advantage* is another of the all-in-one computers on the market. It includes a standard green phosphor CRT that is

capable not only of high graphics resolution, but also the industry standard 80×24 display

This system has an 87-key keyboard that includes 15 function keys and 14 numeric/cursor controls on a separate keypad. It will also support system expansion through six bus slots for such expansions as serial or parallel I/O interfaces or North Star's Floating Point Board.

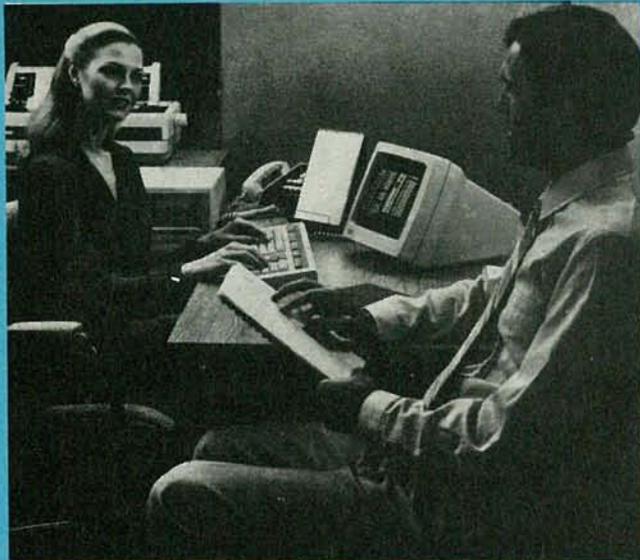
Dual quad-density $5\frac{1}{4}$ -inch minifloppy disks provide a user with up to 360K of mass storage per drive or with up to 128 files per drive.

Not only will the GDOS operating system support high-level graphics functions, it will also support the use of such high-level languages as CBASIC, MBASIC, FORTRAN, or COBOL. The operating system is a superset of the industry-standard CP/M. Not only does the *Advantage* include a standard 64K of RAM, but it also has a separate 20K of display RAM, so the user can take advantage of the full-power of the bit-mapped screen.

Altogether, the \$3999 North Star *Advantage* is quite a powerful personal computer system that should be useful in the office, a laboratory, or at home.

Hitachi

Another new name also appearing in this segment is Hitachi, which has long been known in the consumer electronics field. Hitachi's entry is the \$3500, 16-bit *MB16001* personal computer. The new Hitachi system is still another entrant in the



DEC's *DECmate II* computer is primarily targeted for office management applications.

burgeoning 16-bit processor segment of the personal computer market.

Like other 16-bit systems on the market, a user is able to address a standard 128K of RAM—expandable to about 348K because of the amount of address space available in the 8088 microprocessor. This processor provides enhanced, high-resolution multi-colored graphics and text displays. The computer has a graphics display resolution of 640×400 pixels in eight different colors. The text and graphics can be overlaid while each is being individually colored.

A modular system, the *MB16001* has a separate system box, keyboard and CRT. If the buyer opts for the color CRT, it can display 2,000 characters in 15 different textual colors.

The 96-key keyboard features a numeric keypad for quick numerical data entry and 16 special function keys.

Quite a capable system, mass storage is via quad-density $5\frac{1}{4}$ -inch minifloppy disk drives. This gives this personal computer the potential of nearly 700K of mass storage. This feature permits large amounts of storage for data processing.

The *MB16001* is equipped with one parallel printer port and

will support communications (or other serial peripherals) through an RS-232C serial port. It comes equipped with a light pen as part of this MS/DOS machine. Under this DOS, the system will run a BASIC interpreter, FORTRAN, COBOL, Pascal or assembler software. Five built-in slots on the motherboard provide for further system expansion.

New systems appearing from manufacturers already mentioned in this supplement include another two from Digital and one from Radio Shack, the *TRS-80 Model II*.

Digital Equipment Corp.

DEC's \$3740 *DECmate II* is actually an update and upgrade of an existing word processing system. This is one of the computers that makes use of something other than an eight-bit CPU, in this case a proprietary 12-bit CPU, the 6102. It also uses Digital's proprietary COS as its operating system.

One of the three modular systems released in the middle of this year, the *DECmate II* can easily interchange system pieces with either the *Rainbow 100* or the *Professional* series, which will be described shortly.

Because it is now limited to using DEC's operating system, this system can't take advantage of the many CP/M-based software packages on the market. However, this should soon be remedied as DEC has plans for a Z80 upgrade.

Since this is a modular system, the buyer will find a separate system box, display and keyboard. The 103-key keyboard includes special function keys and a keypad for rapid numerical data entry. This system also includes a bootstrap diagnostic routine that will inform the user of trouble in any area of the system on power-up.

This 12-bit system has 64K of standard RAM. This should be more than enough for any task this system will be called upon to perform.

Mass storage is via dual quad-density $5\frac{1}{4}$ -inch minifloppy disks. This allows the user to have access to nearly 800K of mass storage. It should also work well with this proprietary 12-bit processor in allowing the user to do a great deal of work.

Quite frankly, this system was designed for professional word processing applications and in those applications this system should easily fill the bill, especially with the amount of mass storage available. However, this business orientation does limit programming language availability to DIBOL, DEC's own business oriented language.

The standard CRT is a high-resolution black and white monitor that is easily detached from the system and can be placed wherever the operator feels most comfortable. This is a good feature.

DEC's other system in this price range is the *Professional 325*. That unit sells for \$3995.

The *Professional 325* is driven by a 16-bit proprietary CPU called the F-11. As an example of its potential power, its instruction set is actually that of DEC's powerful PDP-11/23 series. Thus, this system is easily able to work as a standalone or as part of a wider DEC-based system. It will easily recognize and work with other DEC systems.

Quite frankly, according to the manufacturer, the *Professional 325* is aimed at the small business or office. In light of this, it's easy to understand why DEC chose to give the user the greatest amount of RAM available as standard on the market, 256K. This three-piece, modular system is quite capable of multitasking.

Standard mass storage is 800K on dual-density $5\frac{1}{4}$ -inch floppy disk and there is a Winchester $5\frac{1}{4}$ -inch hard disk drive available that will provide 5 megabytes.

This computer probably has the best graphics capability on the market. It has a display resolution of 960×240 pixels and will generate eight basic colors, or a total of 256 shades. The cursor is addressable.

Both of the DEC systems can interface with peripheral equipment through either serial or parallel ports.

An interesting feature of this series is the HELP key. This allows the user to address a ROM-resident HELP program and

menus. The DO key executes a function without the need to return to the special function keys. Also ROM-resident is a bootstrap diagnostic program that will tell the user if any part of the system has failed.

The operating system of this system is the company's proprietary P-OS. With this operating system, the user is able to run such high-level languages as the MBASIC Compiler and the Mark Williams' Co. C Compiler. It will also address FORTRAN and UCSD-p-Pascal. The keyboard is the same one common to the DEC personal computers.

Radio Shack

From Radio Shack comes the *TRS-80 Model II*, with two versions available in this price category, the 48K, one disk-drive model for \$3450 and the 64K, one disk-drive model for \$3899.

Driven by a 4 MHz Z80A, this system is powerful even in its most basic configuration. In that standard configuration, this system comes equipped with 48K of standard RAM, but this can be upgraded to 64K.

It is capable of creating the industry standard IBM-3741-format single-density disks with a Reformatter software package. However, to use this software, the system requires 64K of RAM and two or more drives. Under the TRSDOS operating system, this computer is capable of supporting a 17K disk-based BASIC interpreter that features detailed error flagging and quick editing.

This language is capable of advanced string handling and full editing, as well as multidimensional arrays and error trapping. It is also capable of program line renumbering and hex and octal conversion, as well as direction and sequential access to data in disk files. It also has the ability to execute TRSDOS commands and then return to BASIC with the program and variables intact. It is also capable of calling machine language subroutines.

Among the basic features of the *TRS-80 Model II* are a 76-key keyboard that includes a numeric entry keypad. Keyboard keys include HOLD, ESCAPE, BREAK, CTRL, CAPS and REPEAT.

This is another of the all-in-one computers on the market and it includes a standard, 12-inch black and white CRT that is capable of displaying either the industry standard 80 × 24 lines or double-sized characters at 40 × 24-lines.

Mass storage is provided by a single, built-in double density eight-inch floppy disk drive. The disk is capable of holding 416K.

System expansion is aided by a parallel port and two RS-232C serial ports. This will allow system expansion to include print-

ers, plotters, and digitizers. These ports also support communication with other computers. This computer also includes four bus slots for future expansion or for adding memory.

Intertec

The next system which makes its appearance in this category is Intertec Data System's \$3500 *SuperBrain SD*. In reality, this is a system upgrade of the *SuperBrain* line. This system, too, is another of the all-in-one computers on the market.

The key difference between this *SuperBrain* and the others in the lineup is the amount of mass storage. Though this computer also uses 5¼-inch minifloppy disks, the drives are configured for 1.5 megabytes of storage using dual quad-density.

Still a dual-processor personal computer, this unit is driven by dual Z80's with clock speeds of 4 MHz. System RAM is a standard 64K, which is more than enough for speedy operation of the system's CP/M operating system. The system's high-level language is BASIC.

Like other dual-processor personal computers, the *SuperBrain SD* uses one CPU for system work, while the other handles "housekeeping" chores such as the display and keyboard. This permits the primary CPU to devote all its capacity to processing data.

And, like the other *SuperBrain* models, the *SD* has a built-in 76-key keyboard and 18-key numeric keypad for quick data entry. The keyboard is also capable of generating the full 128 character ASCII set.

The standard 12-inch green phosphor CRT is capable of the industry standard 80 × 24-line display, and it interfaces with peripherals or can be used for communications via two built-in serial ports.

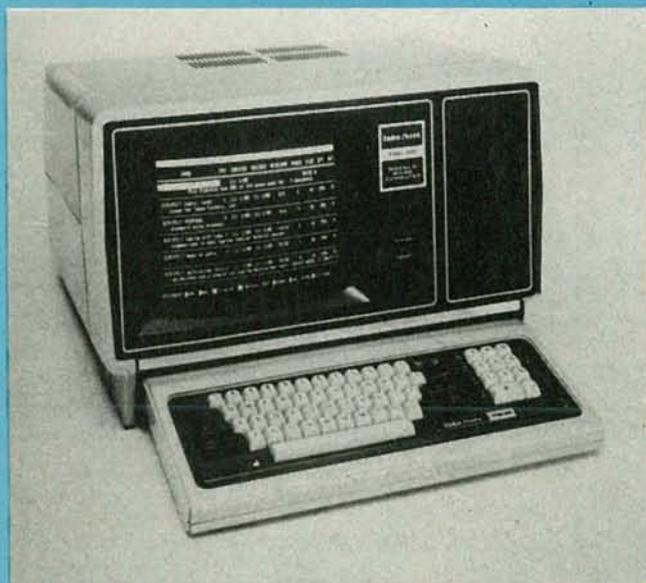
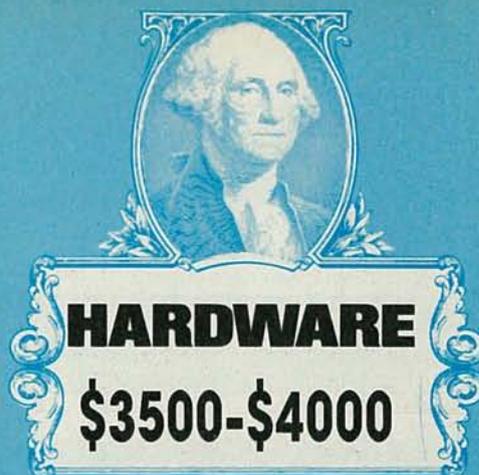
Cromemco

Micromainframe computers are available in all price categories, and \$3500 to \$4000 is no exception. From Cromemco comes the *System One* or *CS-1* for \$3995. Driven by a 4-MHz Z80 CPU, the *System One* is meant for either single or multi-users. It is expandable and comes with an eight-slot card cage so a user can easily expand the basic system.

Dual quad-density 5¼-inch floppy disk drives provide a user with 780K of mass storage. This feature alone makes this system powerful for either the single-user or in a multi-user environment.

The standard 64K of RAM is easily able to run the company's proprietary RDOS. Word-processing software is available with *Writemaster*. Software is also available for interfacing a light tablet and pen. There is also a database management system available. The *CS-1* will interface with a printer via a parallel port.

The power of this system is evident in the languages it is capable of supporting. A long list, those languages include Structured BASIC, FORTRAN, COBOL, C, RatFor and Lisp. This system can also support the UNIX-like CROMIX multi-user operating system.



IDEAL FOR BUSINESS APPLICATIONS, the Radio Shack *TRS-80 Model II* is powerful in even its basic configuration.

continued on page 102

TABLE 8—\$3500-\$4000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple III	\$3990	6502A	8 bits	SOS 1.1	BASIC, Pascal
Cromemco 280 Bernardo Ave. Mountain View, CA 94040	CS-1	\$3995	Z80A	8 bits	RDOS	COBOL, C, CROMIX, Structured BASIC, RATFOR, FORTRAN, LISP
Digital Equipment Corp. Maynard, MA 01754	Professional 325	\$3995	F-11 (PDP 11/23)	16 bits	P/OS	BASIC-Plus-2 FORTRAN, DIBOL UCSD p-Pascal
Digital Equipment Corp.	DECMate II	\$3740	proprietary	12 bits	CP/M, COS310, WPS8	DIBOL
Hitachi Sales Corp. 401 W. Artesia Compton, CA 90220	MB16001	\$3500	8088	16 bits	MS/DOS	BASIC, FORTRAN, Pascal, assembler
Intertec Data Systems 2300 Broad River Road Columbia, SC 29210	SuperBrain SD	\$3500	Z80	8 bits	CP/M	BASIC, other CP/M compatible
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI C4P-DF-HR	\$3615	6502	8 bits	OS-65D	BASIC
M/A COM OSI	OSI C8P-DF-48K	\$3640	6502	8 bits	OS-65D	BASIC
M/A COM OSI	C8P-DF-HR	\$3850	6502	8 bits	OS-65D	BASIC
Micro Source 595 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$3900	Z80	8 bits	CP/M	BASIC, UNIX, other CP/M compatible
MicroTechnology Unlimited Box 12106 Raleigh, NC 27605	MTU 130-2D	\$3599	6502	8 bits	CODOS	BASIC, UCSD p-Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	NEC PC-8001	\$3740	uPD 780 c-1 (Z80-like)	8 bits	CP/M	BASIC, FORTRAN, Pascal, COBOL
NEC Home Elec.	NEC PC-8001	\$3984	uPD 780 c-1 (Z80-like)	8 bits	CP/M	BASIC, FORTRAN, Pascal, COBOL
North Star Computers 1440 Catalina San Leandro, CA 94577	North Star Advantage	\$3999	Z80	8 bits	CP/M, G-DOS	GBASIC, other CP/M compatible
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$3560	Z8001	16 bits	PCOS	BASIC
Olivetti	M-20	\$3789	Z8001	16 bits	PCOS	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$3972	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Radio Shack	TRS-80 Model II	\$3450	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Radio Shack	TRS-80 Model II	\$3899	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$3675	Z80A	8 bits	CP/M	BASIC, Pascal
Vector Graphics Inc. 500 N. Ventu Pk. Rd. Thousand Oaks, CA 91320	1600	\$3995	Z80	8 bits	CP/M	BASIC, FORTRAN, COBOL, other CP/M compatible

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
128K/dual 5¼-inch floppy disks		74 keys, 13-key keypad	serial	80 × 24 text, 280 × 192 graphics, 16 colors	12-inch green CRT
65K/dual 5¼-inch disks			parallel		
256K/dual 5¼-inch floppy disks		103 keys	serial, parallel	80 × 24	12-inch display
96K/dual 5¼-inch floppy disks		103 keys	serial	80 × 24	12-inch display
128K/dual 5¼-inch floppy disks		96 keys	serial, parallel	80 (40) × 24 text, up to 640 × 400 graphics	12-inch monochrome or color display
64K/dual 5¼-inch floppy disks		80 keys	2 serial	80 × 24	12-inch green display
24K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	
48K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	
48K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	8-slot mother board
64K/dual 5¼-inch floppy disks		standard	serial, parallel	80 × 24	9-inch display
80K/dual 8-inch floppy disks		96 keys, 8 programmable	1 serial, 2 parallel	80 × 24	12-inch green display
64K/dual 5¼-inch floppy disks		84 keys, 5 user-definable	serial, parallel		12-inch color display
96K/dual 5¼-inch floppy disks		84 keys, 5 user-definable	serial, parallel	80 × 24 text, 160 × 100 graphics	12-inch color display
64K/dual 5¼-inch floppy disks		87 keys	serial, parallel	80 × 24	integral green display
128K/dual 5¼-inch floppy disks		72 keys	serial, parallel	80 × 25 text, 512 × 256 graphics	12-inch B&W display
160K/dual 5¼-inch floppy disks		72 keys	serial, parallel	80 × 25 text, 516 × 256 graphics	12-inch B&W display
48K/dual 5¼-inch floppy disks	printer & stand	65 keys, 12-key keypad	serial, parallel	64 (32) × 16	integral B&W display
48K/8-inch floppy disk		76 keys, 2 programmable	serial, parallel	80 (40) × 24	integral B&W display
64K/8-inch floppy disk		76 keys, 2 programmable	serial, parallel	80 (40) × 24	integral B&W display
64K/triple 3½-inch micro-floppy disks		73 keys, 6 programmable	serial, parallel	80 × 24 text, up to 640 × 230 graphics	12-inch color display
64K/8-inch floppy disk		72 keys	serial, parallel	80 × 24	integral display

Other systems

System upgrades show the power that is built into personal computers. For instance, the *TRS-80 Model III*, when equipped with dual 5¼-inch drives that provides the user with up to 306K of mass storage (single-sided double-density) and a *Line Printer VI* printer, costs \$3655. This price, however, doesn't include a RAM upgrade from 48K to 64K.

MicroSource's *M6000P* portable, fully configured but without a Winchester hard disk, tops out at \$3900. This configuration includes 368K of mass storage on dual, single-sided, double-density minifloppy disks, and a CRT and keyboard.

The Olivetti *M-20* is now reaching its fully configured state. With the addition of a second dual quad-density 5¼-inch minifloppy disk, this 16-bit CPU-driven system costs \$3,560. This gives the user the potential of 640K of formatted storage. It also gives the user the full advantage of the 16-bit CPU.

System upgrades continue with MicroTechnology Unlimited's *MTU-130*. When this system is equipped with dual, eight-inch quad-density floppies, the mass storage of this system becomes 2 megabytes, quite a large amount of space. This amount of storage helps to make up for any shortcomings in the processing speed of its 1 MHz, 6502 CPU. The system now includes 80K of RAM, five expansion slots on the motherboard, 96-key keyboard, 12-inch green monitor, 2 parallel ports, and one serial port. It is now nearly fully configured, except for the MC68000 processor board option or a hard disk drive.

With the addition of a second single-sided, double-density 5¼-inch minifloppy disk, the price of the 128K RAM *Apple III* system rises to \$3990. The standard CPU on this system, as described earlier in this supplement, is a 1.8-MHz 6502A.

NEC's *PC-8000* upgrades twice in this price range. For \$3734, the buyer gets the Z80-like μ PD 780 C-1 processor with a 4 MHz clock speed. This version of the system includes 64K of RAM, dual single-sided, double-density disks for 280K of mass

storage, expansion slots, 84-key keyboard, and parallel and serial I/O ports. The key addition to this system is the high-resolution, 12-inch color monitor. Increasing the amount of RAM to 96K on the *PC-8000A*, the user will spend \$3984, but will also gain more power in the system.

With three microfloppy disk drives, the Sony *SMC-70* has its amount of mass storage increased to 840K. In the S3675 version, the third drive has been added for greater storage. The basic system includes 64K of RAM, CP/M, a 73-key keyboard and five expansion slots.

M/A-COM-OSI has three system upgrades in this price range. The *4P-DF-HR* at \$3615 offers the buyer a 1 MHz eight-bit 6502 CPU with a slow 1-MHz clock speed. (This CPU is common to all OSI products.) This system features 24K of RAM, but 550K of mass storage on dual eight-inch floppy disks. The potential is there for a color video output, and the company provides interfacing capabilities for a cassette recorder, modem, and D/A converter. This system is capable of supporting a display resolution of 512 x 256.

OSI's *C8P-DF-48K* provides the same basic features as the *C4P*, but the amount of internal RAM is expanded to 48K. It is priced at \$3640.

And, the OSI *C8P-DF-HR*, at \$3850, is an upgrade of the *C8P-DF-48K* with the addition of an eight-slot bus for system expansion.

Even the Texas Instruments *TI-99/4A* has an entry in this price category at \$3524. This version of the 48K system includes a speech synthesizer module.

When you add a printer to the 64K, dual Z80 driven Heath/Zenith *Z90*, the cost of this system rises to \$3590. The *Z90* is one of the many all-in-one systems on the market. It includes a full keyboard and 12-inch black-and-white CRT in the same housing. It looks like the traditional computer terminal with which nearly everyone is familiar. **R-E**

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24	74LS04	80	74LS170	1.35	8728	1.20	
24	74LS08	85	74LS171	1.35	8038	2.75	
24	74LS10	60	74LS172	1.35	806CA	3.75	
24	74LS12	60	74LS173	.65	8155	10.50	
24	74LS13	80	74LS174	.65	8255	4.65	
24	74LS14	80	74LS175	.65	MC1330	1.15	
24	74LS15	80	74LS176	.65	MC1350	1.50	
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24	74LS36	80	74LS197	.65	LM380S	1.10	
24	74LS37	80	74LS198	.65	LM380T	1.10	
24	74LS38	80	74LS199	.65	LM380U	1.10	
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24	74LS103	80	74LS264	.65	LM380J	1.10	
24	74LS104	80	74LS265	.65	LM380K	1.10	
24	74LS105	80	74LS266	.65	LM380L	1.10	
24	74LS106	80	74LS267	.65	LM380M	1.10	
24	74LS107	80	74LS268	.65	LM380N	1.10	
24	74LS108	80	74LS269	.65	LM380P	1.10	
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24	74LS110	80	74LS271	.65	LM380R	1.10	
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24	74LS112	80	74LS273	.65	LM380T	1.10	
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24	74LS120	80	74LS281	.65	LM380B	1.10	
24	74LS121	80	74LS282	.65	LM380C	1.10	
24	74LS122	80	74LS283	.65	LM380D	1.10	
24	74LS123	80	74LS284	.65	LM380E	1.10	
24	74LS124	80	74LS285	.65	LM380F	1.10	
24	74LS125	80	74LS286	.65	LM380G	1.10	
24	74LS126	80	74LS287	.65	LM380H	1.10	
24	74LS127	80	74LS288	.65	LM380I	1.10	
24	74LS128	80	74LS289	.65	LM380J	1.10	
24	74LS129	80	74LS290	.65	LM380K	1.1	

\$4000 to \$4500



Systems in this price range consist mainly of upgraded versions of basic systems. But for the added cost, you get versatility.

MARC STERN

FOR ONE REASON OR ANOTHER, IT SEEMS THAT THERE ARE relatively few computers priced between \$4000 and \$4500—most are either priced higher or lower. What's more, most of what's available are simply upgrades of lower priced systems.

One system that fits into this category is the Sharp YX3200, another of the many Z80-based personal computers on the market. That system sells for \$3495.00; adding the companion 80-column, bidirectional, dot-matrix printer, which sells for \$895.00, brings the price up to \$4390.00 for a fully configured system.

The YX3200 comes with 64K of RAM; ROM is expandable to 72K. Mass storage is handled using two double-sided, double-density 5¼-inch floppy-disk drives; those allow a potential of 284K of storage per drive. The computer uses either Sharp's own FDOS (FLOPPY Disk Operating System) or CP/M; both come standard with the system.

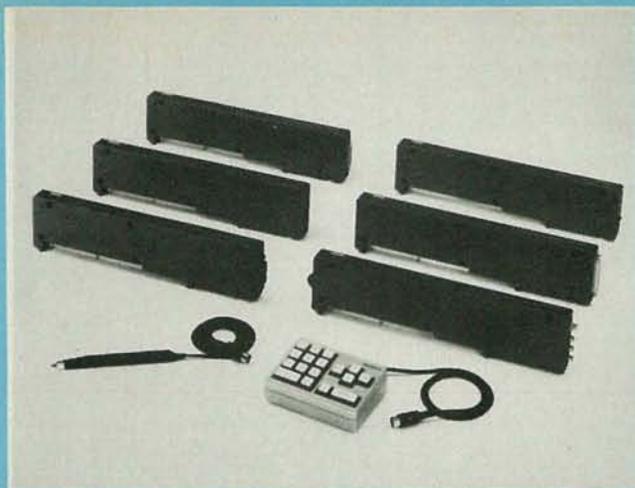
Included in the unit's 92-key keyboard are 10 user-definable keys and a numeric keypad for rapid data entry. Although we've commented on numeric keypads briefly in other parts of this section, their importance can't be underestimated. If you've ever had to enter long lists of numbers, you know what I mean. You certainly could do it using the numbers found on a standard typewriter-style keyboard, but the procedure is cumbersome when compared to using a numeric keypad. The keyboard, incidentally, is capable of producing the full ASCII character-set.

Standard with the system is a 12-inch green CRT display. The display can show up to 24 lines (actually 25, but one is a status line) of 80 characters each.

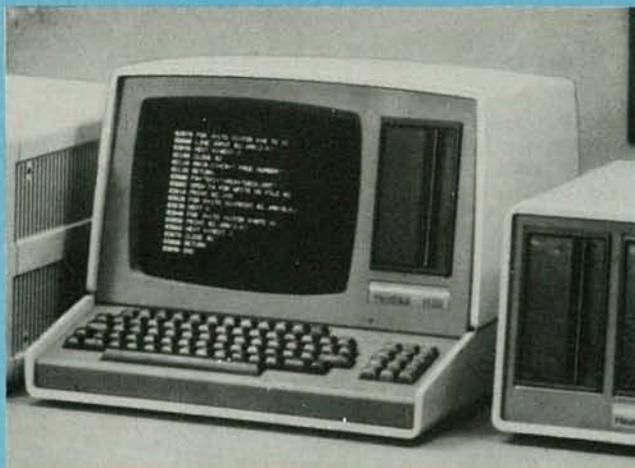
The unit also has five I/O ports to facilitate system expansion. Those can be used to add additional drives, for RS232C communications (the interfaces are included with the system), etc. A parallel port is provided for the printer.

TABLE 9—\$4000-\$4500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	CBM 8032	\$4084	6502	8 bits	proprietary	BASIC
Commodore Business Machines	SuperPET 9000	\$4085	6809/6502	8 bits	proprietary	APL, BASIC, Pascal, FORTRAN, assembler
Zenith Data Systems 100 Milwaukee Ave. 1 Glenview, IL 60025	Z90	\$4190	Z80	8 bits	HDOS, CP/M (optional) other CP/M compatible	BASIC, UCSD p-Pascal, FORTRAN,
IBM Information Systems P.O. Box 1328 Boca Raton, FL 33432	PC	\$4425	8088	16 bits	PCDOS, CP/M (optional)	BASIC Compiler, UCSD-Pascal IV, COBOL
Sharp Electronics 10 Keystone Pl. Paramus, NJ 07652	YX3200	\$4495	Z80A	8 bits	FDOS, CP/M	BASIC, other CP/M compatible
Sony Corp. 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$4195	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$4174	TMS9900	16 bits	proprietary	BASIC



EXPANSION MODULES for the Sony SMC-70. Along with the modules, the light pen and numeric keypad are shown.



THE ZENITH Z90 is an upgrade of the Z89. The terminal-type housing looks identical for both computers.

This system is designed with the user in mind. In addition to FDOS and CP/M, the system price includes CBASIC and Sharp BASIC programming languages. In addition, the YX3200 boasts what it calls "Automatic Program Generation." That allows a user with no knowledge of programming to create business forms in three steps. A series of prompts leads the user through

the creation of the program with a series of graphics displays and yes/no answers—sort of a spreadsheet program with a built-in helping hand.

Other systems

The fully configured IBM *Personal Computer* (the more basic versions are described elsewhere in this section) also reaches this price level. At \$4425, the system includes a 16-bit 8088 CPU, 280K of disk storage, a 12-inch green CRT, and 128K of RAM. The key difference in this system is that the amount of RAM has been doubled.

Another system whose highest price falls in this range is the Sony SMC-70. In its maximum configuration, this system sells for \$4195.00 and includes three disk drives and 64K of RAM, permitting over 840K of mass storage. It also includes a 12-inch, high-resolution color monitor for color graphics.

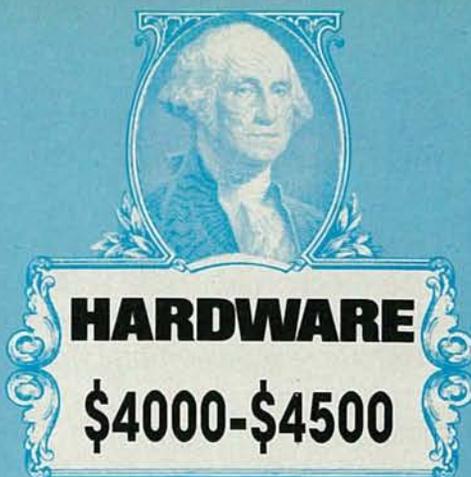
The Texas Instruments TI-99/4A can also reach this range by adding a disk drive to the 48K system. That system, which also includes a printer, speech synthesizer, modem, and communications program package, sells for \$4174.00.

When you upgrade the Commodore Business Machines' 8032B business system to 96K of RAM and add a printer, its price rises to \$4085. Adding a printer to their *SuperPET SP9000*, which has 96K of built-in RAM, also increases the price to that figure. Complete descriptions of those systems can also be found elsewhere in this section.

And, by adding the \$995 printer to the Zenith Z90, the price of this system come up to \$4190. That computer is a dual processor Z80-based unit and features an integral keyboard and 12-inch monitor.

R-E

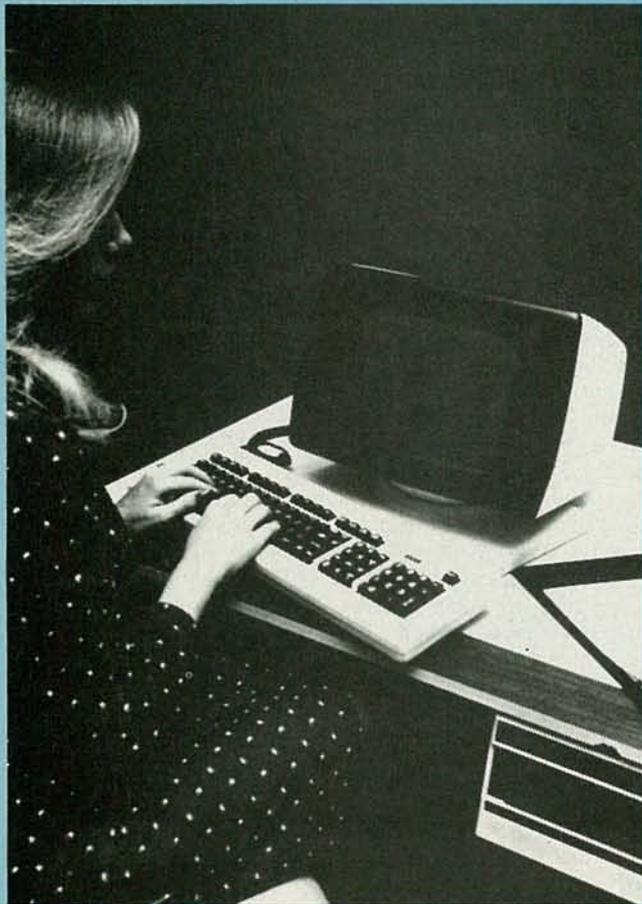
Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
96K/dual 5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 25	printer, integral 12-inch B&W monitor
96K/dual 5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 25	printer, integral 12-inch B&W monitor
64K/8-inch floppy disk		84 keys, 12 function keys	serial,	80 × 24 text, 33 graphics characters	printer, 12-inch B&W monitor
128K/dual 5¼-inch floppy disk		83 keys, 10-key keypad, 10-special-function keys	serial, parallel	80 × 24	11½-inch green CRT
64K/dual 5¼-inch floppy disk		92 keys, 10 programmable	serial,	80 × 24	
64K/triple 3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × text, 640 × 230 graphics	
48K/5¼-inch floppy disk		standard	serial	32 × 24 text, 192 × 256 graphics	printer



\$4500-\$6000

There are many computers to choose from in this price range. Many new systems make their first appearance here and many systems reach their maximum expansion and full potential.

MARC STERN



WHEN YOU REACH THE HIGH END OF THE PERSONAL COMPUTER spectrum, the competition really begins to get lively. Many new computer systems make their first appearance in this category. Also included in this category are those systems that have been steadily improving in power and performance as they have become more expensive.

A minimum of 10 new systems make their first appearance in this price category, with the names of such computer manufacturers as Altos, Vector Graphic and Zenith joining the list of manufacturers offering high-end systems. (Zenith is the parent of Heath, which offers the Heath/Zenith series.) Canon, long known in the consumer photography and electronics fields, has also brought out its own computer system, while Hewlett-Packard's HP-87 series reaches its most powerful level in this spectrum.

Canon

Taking a look at the \$4995 Canon CX-1, we find it is driven by an eight-bit 6809 CPU. The system comes with 64K RAM as

standard, which is more than enough user memory to allow this system to access and retrieve data quite quickly. This operating system is Canon's proprietary Floppy Disk Operating System and it supports the BASIC, Assembler and ANSI COBOL programming languages.

This system is frankly aimed at the business market and because it is it comes as an all-in-one unit. The terminal contains an 84-key keyboard, that includes a 14-key function/numeric keypad, dual 5¼-inch minifloppy disk drives and a 12-inch green phosphor CRT.

Interestingly, the keyboard is a dual-mode unit. In one mode it is a full ASCII keyboard, capable of generating the entire 96-character ASCII set, while in the other mode it is a programming keyboard with one-key functions for such BASIC language programming commands as GET, PUT, GOSUB, CLOSE, DIM. Those functions are spelled out on legends on the front of the keys.

Mass storage is accomplished via dual double-sided, double-density minifloppy disks that are capable of storing up to 320K per disk.

The CRT's display is the industry-standard 80 columns (characters) by 24 lines and the system is capable of displaying 32 graphic characters and special symbols.

Hewlett-Packard

Hewlett-Packard's HP-87 personal computer becomes quite a powerful system in this price category. Like other personal computers, this one has its origins in the sub-\$2500 category. However, as it climbs through the price spectrum its power builds until it reaches \$5190.

At this price level, the system includes an 80-series 8-bit processor, along with the CP/M operating system. This means the user has access to the wide variety of software available that runs under CP/M, while, at the same time, having access to software which runs solely under Hewlett-Packard's proprietary operating system.

This system has a total of 112K of system RAM, which is more than enough to allow this system to take advantage of the full power and speed of both the 80-series CPU and the Z80 CPU and CP/M. A total of 540K of mass storage is available on two 5¼-inch double-density minifloppy disks.

Vector Graphics

The Vector Graphics 2600 is another system that makes its first appearance in this price category. At \$5195, this system packs a great deal of power. For starters, this system uses a fast clock speed of 6 MHz to drive its eight-bit Z80 CPU. This means it can handle just about any task thrown at it with high speed. When this is combined with the bank-switched 64K of standard RAM, you can see this system has a great deal of capability.

The reason that bank-switched memory is attractive is because the computer's operating system is loaded into one bank of memory, leaving the second bank of memory nearly free for user access. (This reduces the amount of disk access time and allows

printing while the system is handling other functions.)

This system operates under one of the later versions of CP/M, version 2.5. Because it does, the user has access to the many programs written for this nearly universal operating system. The user also has access to such high-level programming languages as a BASIC Compiler, which runs more quickly than a BASIC Interpreter program, FORTRAN, COBOL, Pascal, RAID (a program debugger), Scope (a word processor) and BASIC 80. As you can see, this system is equipped to handle just about any task a user may think up.

The key upgrade in the Vector 2600 is the increase in the amount of mass storage. Still residing on two 5¼-inch minifloppy disks, mass storage now rises to 1.2 MB on 80-track dual quad-density disks. This amount of storage is ideal for business, scientific or personal computer applications.

Equipped with a standard 72-key keyboard, this system also includes a 10-key numeric pad for rapid data entry. It interfaces with peripherals via three parallel or one serial port. The 12-inch CRT is capable of the industry standard 80 × 24 display. This display is bit-mapped which allows a user to have direct access to the display memory and allows the use of customized graphics.

The Vector 2600 is another of the all-in-one personal computers on the market. It includes the keyboard, CRT and system box in one terminal.

Zenith

Zenith has a new entry in this price category, its new Z-100, another of the 16/8-bit dual-processor personal computers now appearing on the market. It is also an all-in-one personal computer. The Heath Company will also be offering a kit version of this computer.

This new system gives the user the advantage of both eight-bit and 16-bit power with an 8085 eight-bit CPU and a 16-bit 8088. The operating systems to which the user has access are CP/M and Z-DOS. This system is compatible with the IBM's PC-DOS operating system. In addition, the floppy disk format is also compatible with IBM's format so that floppy disks containing software for the IBM computer will run directly on the new Z-100 and thus providing access to the rapidly expanding domain of IBM personal computer software.

The under-\$5000—pricing hadn't been established at press time—Z-100 system is full-featured, with 128K of standard RAM, or more than enough for all but the most ambitious data base management or spreadsheet routines. This RAM is expandable to 192K on the main processor board and will expand to 768K through the use of the built-in expansion slots in the system area.

Standard mass storage is via dual quad-density 320K built-in 5¼-inch minifloppy disks. Eight-inch floppies and a Winchester hard-disk drive with 5 megabytes of storage will be available as options.

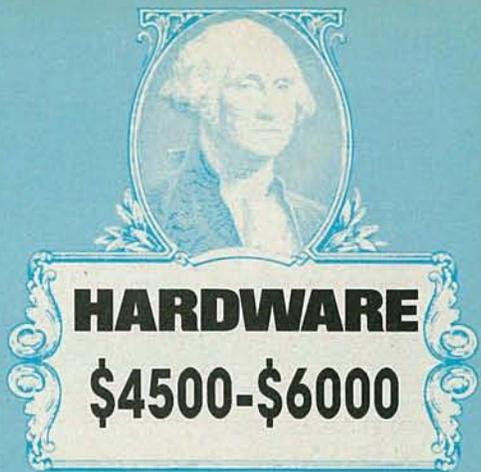
The system offers two versions of BASIC—BASIC-85 and Z-BASIC. The Z-BASIC is an enhanced version that includes many color-graphic commands. The 108-key keyboard includes 13 user-definable special-function keys.

The standard monochromatic screen is capable of the standard 80 × 24 display, while an optional color monitor is also available. This system is capable of generating high-level color graphics with a resolution of 225 lines × 640 dots. It is also capable of resolution of up to 500 lines. An RGB color signal is available at the rear panel.

The Z-100 is capable of both asynchronous and synchronous (as well as half- and full-duplex) communications and the system will interface with peripherals via either two serial ports or one parallel port.

Billings

The \$4700 Billings 500-series is another new entry from the Billing Computer Corp. This all-in-one system is also equipped with an eight-bit Z80 CPU. Mass storage is via either 5¼-inch



minifloppy disks or eight-inch floppies. The minifloppies are quad-density and are capable of up to 360K of storage per drive. Standard RAM for this system is 64K and it is capable of either acting as a stand-alone computer or part of a computer network.

This is a user-friendly system that practices what is called by the company "Computamatics." Under this system, a series of English language prompts and menus, combined with function keys, will guide the user through the system's operation.

Those 16 function-keys are included on the detachable 94-key keyboard that also includes a numeric keypad. The system interfaces with peripherals via either serial or parallel ports.

CMC International

CMC International Corp.'s *SuperFive* is, in reality, based on Intertec Data Systems' *SuperBrain* series mentioned previously. In fact, it is the equivalent of the *SuperBrain Sr.*, which includes a single, quad-density 5¼-inch minifloppy for mass storage and a 5¼-inch mini-Winchester hard drive for another 5 megabytes of storage. This comes standard in CMC's *SuperFive I*.

Quasar Data Products

Micromainframes systems still abound in this category realm with the \$4695 Quasar Data Products *QDP-100*. This Z80-driven, 4-MHz system supports CP/M (multi-user) and will support the Oasis operating system (multi-user, multi-tasking). The standard RAM for this system is 64K of bank-selectable RAM. This is included on a board with a second clock speed of 5 MHz.

Since this is the heart of an expandable system, there are two serial and two parallel ports to interface with such user options as the CRT or printer. Storage is via dual quad-density, 5¼-inch minifloppy disks.

Altos Computers

One Altos *ACS 8000-2* makes its debut in this category. Although it is still a micromainframe system—a standalone system box with the user supplying accessory expansion cards and other peripherals such as CRT's and printers—when configured with the Altos *I* smart terminal, the cost of this system is \$4645. In this configuration, the user has a full-featured, very powerful system.

Driven by an eight-bit Z80 CPU, this system recognizes the industry-standard CP/M operating system. Its standard RAM of 64K is capable of supporting not only that operating system, but also the languages this system is capable of running—FORTRAN-80, COBOL, PASCAL, APL, and PL/1. Those are high-level systems-oriented programming languages and display the power of this system.

This system is capable of 1 megabyte of storage via a pair of single-sided, double-density integral floppy disks and it interfaces with its peripherals via either a pair of fully implemented, RS-232C serial ports or one programmable eight-bit port.

The keyboard of the smart terminal linked to this system is a

TABLE 10—\$4500- +

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Altos Computers 2360 Bering Dr. San Jose, CA 95131	ACS 8000-2	\$4645	Z80	8 bits	CP/M	FORTRAN-80, APL, COBOL, Pascal, PL/1, other CP/M compatible
Billings Comp. Corp. 18600 E. 37th Independence, MO 64057	Billings 500	\$4700	Z80	8 bits	proprietary	N/A
Canon USA One Canon Plaza Lake Success, NY 11042	CX-1	\$4995	6809	8 bits	proprietary	BASIC, assembler COBOL
Hewlett-Packard 1820 Embaradero Rd. Palo Alto, CA 94303	HP-87	\$5190	Z80	8 bits	proprietary, CP/M	BASIC, CP/M compatible
IBM PO Box 1328 Boca Raton, FL 33432	IBM Personal Computer	\$5196	8088	16 bits	DOS 1.1, CP/M (optional)	BASIC, other CP/M compatible
Im sai Computer Div. Fischer-Freitas Corp. 910 81st Ave. Oakland, CA 94621	PCS-4410	\$5250	8085	8 bits	IMDOS, CP/M	BASIC, other CP/M compatible
IMS Internat'l 2800 Lockheed Way Carson City, NV 79701	5000SX	\$5170	Z80A	8 bits	CP/M, MP/M, TurboDOS	
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	230C	\$4890	6502	8 bits	OS-65	N/A
Micro Computer Technology 3304 W. MacArthur Blvd. Santa Ana, CA 92704	Model III	\$5399	Z80	8 bits	LDOS, DOS, TRDOS, NEWDOS 80	
MicroSource 395 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$4795	Z80	8 bits	CP/M	BASIC, UNIX
MicroTechnology Box 12106 Raleigh, NC 27605	MTU-130-2D	\$4598	6501	8 bits	CODOS	BASIC, UCSD Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	PC-8001	\$4814	uPD 780 c-1 (Z80-like)	8 bits	proprietary	BASIC, COBOL, FORTRAN, Pascal
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$5489	Z8001	16 bits	PCOS	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model 16	\$5798	MC68000	16/ 8 bits	proprietary/ TRSDOS	
Smoke Signal Broadcasting 31336 Via Colinas Westlake Village, CA 91362	Chieftain 9524	\$5229	6809	8 bits		
Systems Group 1601 W. Orangewood Orange, CA 92668	System 2814	\$5609	Z80	8 bits	CP/M, MP/M, Oasis	
Vector Graphic 500 N. Ventu Pk. Rd. Thousand Oaks, CA 91320	Vector 2600	\$5195	Z80	8 bits	CP/M	BASIC, FORTRAN, COBOL, Pascal, other CP/M compatible
Xerox 1341 Mockingbird La. Dallas, TX 75247	820II	\$4895	Z80	8 bits	CP/M	CBASIC, MBASIC, COBOL, other CP/M compatible
Zenith Data Systems 100 Milwaukee Ave. Glenview, IL 60025	Z-89	\$4890	Z80	8 bits	HDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p- Pascal, CP/M compatible
Zenith Data Systems	Z-100	under \$5000	8088	16 bits	MS-DOS, CP/M-86	BASIC

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
64K/dual 8-inch disks-1MB		105 keys, 8-special function	serial, parallel	80 × 24	12-inch green display
64K/dual 5¼-inch floppy disks			serial, parallel	80 × 24	green display
64K/dual 5¼-inch floppy disks		standard, numeric keypad	serial, parallel	80 × 24 text, 32 graphic symbols	
112K/dual 5¼-inch floppy disks					Z80 card added
256K/dual 5¼-inch floppy disks					other features unchanged
64K/5¼-inch floppy disk, 10 MB hard disk					see PCS-42
64K/dual 5¼-inch floppy disks					
48K/dual 8-inch floppy disks			serial		
48K/5¼-inch floppy disks, 5.7 MB hard disk				64 (32) × 16	
64K/dual 5¼-inch floppy disk, 5 MB hard disk		standard	serial	80 × 24	9-inch green display
80K/dual 8-inch floppy disks	MC68000 card adds 256K RAM	96 keys, 8 programmable	2 serial, 1 parallel	80 × 24	12-inch green display
160K/dual 5¼-inch floppy disks		84 keys	serial, parallel	80 × 24 text, 160 × 100 graphics	12-inch color display
160K/dual 5¼-inch floppy disks		72 keys	serial, parallel	512 × 256 graphics	12-inch color display
128K/dual 8-inch floppy disks		76 key keypad, special-function keys	serial, parallel	80 (40) × 24	12-inch green display
64K/dual 5¼-inch floppy disks					micro-mainframe
64K/dual-quad-density floppy disks			4 serial, 2 parallel		
64K/dual 5¼-inch floppy disks		72 keys, 10 key keypad	3 serial, 1 parallel	80 × 24	12-inch display
64K/dual 8-inch floppy disks		96 keys	2 serial, 2 parallel	80 × 24	12-inch display
48K/dual quad-density 5¼-inch floppy disks		84 keys, 12 key keypad	3 serial, 1 parallel	80 × 24	integral display
108K/dual 5¼-inch floppy disks		108 keys, 13 special function, 12-key keypad	serial, parallel	80 × 24 text, 640 × 500 color graphics	

105-key unit with eight function-keys. The display is a 12-inch green phosphor CRT capable of generating the industry-standard 80 × 24 display.

Systems Group

Two computer systems similar to the Altos system are offered by the Systems Group, the \$3035 *System 2812* and the \$5,609 *System 2814*. Both computers contain an eight-bit Z80 CPU that is driven by a 4-MHz clock signal and both computers are capable of operating under CP/M, MP/M and Oasis. Two single-sided, double-density or double-sided, double-density disks provide up to 1.2 megabytes of mass storage. This system interfaces with peripherals via either parallel or serial ports. In such a system, the user provides the optional peripherals.

Imsai

The same is true of the Imsai series available at this price level. These computers are micromainframes driven by 2-MHz eight-bit 8080 CPU's, the \$4850 *PCS-4450*, the \$5250 *PCS-4410* and the \$5750 *PCS-4418*, provide system upgrades over the basic Imsai systems. The key upgrades for the *4450* is the addition of a 5-megabyte 5¼-inch Winchester hard disk, while the *4410* upgrades with a 10-megabyte Winchester hard disk. The *4418* has a 5¼-inch, 18-megabyte Winchester drive.

M/A Com OSI

Another micromainframe system that also appears in this price category is the M/A Com-OSI *230C/0*. Driven by a 1 MHz, eight-bit 6502 CPU, this \$4890 micromainframe computer is also the heart of a system. In the system box is 48K of RAM and dual, single-density eight-inch floppy disks that are capable of 275K of storage. The operating system is the company's proprietary OS-65.

Radio-Shack

In this price category appears Radio-Shack with its *Model 16*, the most powerful computer Radio-Shack has ever introduced. This is another of the combination 16/8-bit systems that have recently come onto the market. And, it seems that each one has a different 16-bit CPU and a different eight-bit CPU.

Making early use of the 16-bit MC68000 CPU, Radio-Shack's *Model 16*, also uses an eight-bit Z80. Both are high-speed processors with the 68000 running at 6 MHz and the Z80 running at 4 MHz.

As in other systems, the 8-bit processor—the Z80—handles the "housekeeping" for the 16-bit CPU. These chores include I/O and this design permits the *Model 16* to use much more money and to process data at much higher speeds than other eight-bit micros on the market.

This system comes with 128K of standard RAM that can be expanded in 128K increments to 512K, and it is software compatible with the existing *Model II* system. This is especially important for the Radio Shack *Model II* owner who may be upgrading his system to the *Model 16* and may have a sizeable investment in a *Model II* software library.

Along with being software compatible with the *Model II*, the *Model 16* operating system includes an editor/assembler software package for assembly language program development. The editor allows extensive and sophisticated editing techniques and it is both line and character-oriented. The editor/assembler package is supplied on the system disk and includes an editor, micro-assembler, linking loader, cross-reference and debugger.

The keyboard is a 76-key professional unit and includes a numeric keypad. The display is a 12-inch standard green CRT that is capable of the industry standard 80 × 24 or double-sized 40 × 24 lines. Mass storage is available on one or two built-in quad-density eight-inch floppy disks. In the one-disk version with 1.2 megabytes of mass storage, the price is \$4999 and in the two-disk version, the price is \$5798. This system will interface with peripherals via a standard parallel port or two serial RS-232C ports.

Other systems

Into this price category also fall many other systems that reach their fully configured state. For instance, the Heath-Zenith Z-89's price climbs to \$4890 when it is equipped with dual double-density 8-inch drives. It still retains its 48K of internal RAM. However, when this system upgrades to 64K and becomes the Z-90, the price increases to \$5190. (A full description of this system was given earlier.)

When two 8-inch disks are added to the Xerox *820 II*, the system's price rises to \$4895, while when a 5-megabyte 5¼-inch Winchester disk drive is added to the MicroSource *M6000P*, the price rises to \$4795. (Please refer to previous description of these systems.)

Olivetti's *M-20*, the first system to make use of the 16-bit Z8001 CPU, also reaches its nearly fully \$5480 configured state with the expansion of system RAM from 128K to 160K. And, it is even further expandable. This system includes dual quad-density 5¼-inch minifloppy disks for mass storage. (Please refer to the previous description of the basic system.)

The \$4598 MicroTechnology *MTU-130-2D* is the fully configured system with the addition of 256K of RAM and an 8-MHz MC68000, 16-bit processor board. This gives this 1-MHz, 6502 system 16/8-bit capability. However, it should be noted the 68000 must interface with the relatively slow 6502, so processing time may be slowed.

Even Digital Equipment Corp. has a system upgrade in this price spectrum, the *Professional 350*. This is an upgrade of the *325* and adds an internal 5¼-inch Winchester hard disk drive as well as improved graphics.

In its fully configured state, the Commodore *CBM 8032*, with dual disk drive and a dot matrix printer costs \$5040, as does the *CBM SuperPet SP9000* in the same configuration.

And even the Texas Instruments *TI-99/4A* tops out at a price of \$5074 with two disk drives, 48K of RAM, a printer and both communications, voice and high-level video output. (Please refer to the earlier descriptions of these systems.)

These aren't all the systems available for under \$6000, our cutoff point. For instance, A.B. Dick's *Magnawriter* is listed at \$5995 and it is driven by an eight-bit 8085 CPU. Then there's Alpha Microsystem's personal, also driven by an MC68000 16-bit processor.

The Archives Inc.'s *Model I*, driven by an eight-bit Z80A, is priced at \$5500, while the California Computer Systems' *System 300-3*—with terminal—costs \$5450. The *964 Plus* by Columbia Data is also driven by a Z80A eight-bit CPU and includes dual 5¼-inch minifloppy disk storage at \$4995. The Corvus' *Concept*—one of the few MC68000 driven systems that has 512K of RAM and 2.4 megabytes of mass storage on quad-density eight-inch disks is bargain priced at \$5000. This is also one of the most powerful personal systems to date on the market.

The Dynabyte model *5305*—another micromainframe—is priced at \$5690 with two eight-inch double-density floppy disk drives. The Fortune Systems' *32/16*, MC68000 16-bit CPU system, is priced at \$5995.

In its maximum configuration, the IBM *Personal Computer*, is priced at \$5196. This price includes maximum RAM expansion to 256K and dual double-density minifloppies.

Another system which reaches full power in this price range is the \$5170 IMS International *5000SX* with terminal. Another of the Z80A-driven systems, this one includes dual 5¼-inch minifloppies and 64K of RAM.

Micro Computer Technology Inc. takes the Radio Shack *Model III* and increases the mass storage capacity by several orders of magnitude. For \$5399, a buyer gets the 48K *Model III* and a 5¼-inch Winchester hard disk which yields 5.7 megabytes of storage. This is combined with a quad-density 5¼-inch minifloppy.

In its maximum configuration, the NEC *PC8001* reaches a powerful level. For \$4814, the user gets 160K of RAM, 320K of storage on dual, double-density 5¼-inch minifloppies and the high-resolution color monitor. R-E

8-bits

vs.

16-bits

HARDWARE

8 bits vs. 16 bits

JOSEF BERNARD
TECHNICAL EDITOR

YOU'VE CERTAINLY READ OR HEARD OF 8-BIT OR 16-BIT COMPUTERS, but what exactly do the terms mean? Let's start at the beginning.

A *bit*, if you're not already familiar with its definition, stands for a *Binary* digit, the presence or absence of an electrical signal within a logic or computer circuit, and represents a "yes" or "no," "on" or "off," "logic-1" or "logic-0" condition. By itself, a bit can convey little information—it's either there or it isn't. Collections of bits, however, with the bits lined up "side-by-side," can do a lot more.

Two bits, in their various on/off combinations, can represent four numbers: zero, one, two or three. Add another bit, and you have eight different combinations available to give you the numbers zero through seven. Eight bits will give you 256 possible combinations; sixteen bits, 65,536 combinations.

Since each bit can represent only one of two values—zero or one—we are restricted to working with the numbers that can be built using *powers of two*. That's where the word "binary" comes in—it refers to the two states that a bit can be in. If we liked, we could consider each bit to have a value of either zero or two, and add them together in longer and longer strings to get the values we needed. It makes a lot more sense, though, to allow each bit-position to represent a power of two (see Fig. 1). Thus, the first bit-position represents either zero or 2^0 , or 1. The second position would be 2^1 , or 2 (for now we'll ignore the cases where no bit is present—that's always zero).

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1
128	64	32	16	8	4	2	1

FIG. 1—LOGIC-HIGH BITS are traditionally represented by "1"s; logic-lows by "0"s. Binary numbers are read from right to left; the digit with the lowest value is at the right.

The third bit would represent 2^2 , or 4, and the fourth 2^3 , or 8. If we had a 4-bit number where all the bits were "high" (present), that number would be equal to 15, the sum of $2^0 + 2^1 + 2^2 + 2^3$. Of course, not all the bits have to be high. If bit-2 were "low" (equal to "zero"), the sum of the binary digits would be 13, and so on.

In computers, and other logic circuits, a "high" bit is usually represented by an electrical value of close to five volts; a "low" bit is close to zero volts. A microprocessor is set up to look for a specific number of bits. An eight-bit microprocessor will have eight lines available for binary data. It will always look for eight bits, arranged side-by-side. If some of those bits are zeroes, it will take that into account and count only the "high" ones but, nonetheless, it will still have to account for all eight bits. A sixteen-bit microprocessor will always look for a string of sixteen bits.

The latest upheaval in the microcomputer revolution is the introduction of 16-bit computers. What makes them different, and are they for you?

The important thing to remember is that a microprocessor is always looking out of a window that's so-many-bits wide; an eight-bit microprocessor will always look for the combined value of eight bits at once—whether they're high or low—and a sixteen-bit one will do the same for a sixteen-bit *word* (a word is a binary number made up of a fixed number of bits—that's why we speak of eight- or sixteen-bit-word systems).

To finish up this discussion of terminology, a 4-bit word is called a *nybble*, an 8-bit word a *byte*, and a 16-bit word is...well...a 16-bit, or double-byte, word.

Microprocessors and word-lengths

The first microprocessors, like the 4004, 4040, and SC/MP were 4-bit devices—not really useful for practical computing. In fact, they were originally designed for use in programmable calculators...but for various reasons that plan was never completed. Some simple computers were built using them, but they found their greatest use in microprocessor-controlled appliances and in other applications that could benefit from a microprocessor, but that required only a limited amount of "smarts."

The 4-bit devices were quickly followed by much more sophisticated 8-bit microprocessors such as the 8008 and 8080 (used in such computers as the *Altair* and *Imesai*) and the 6800, which was adopted by SWTP (Southwest Technical Products) and Midwest Scientific, among others. A second generation of 8-bit devices followed close on their heels; included in that group were the 6502, used in the *Apple II* and many Commodore computers, and the Z80, used by—to name only one of many—Radio Shack's *TRS-80*.

Among the most popular microprocessors were the 8080 and the Z80, and a powerful disk operating-system, *CP/M*, which was developed to run on systems using those microprocessors, gained popularity. (It is compatible with both microprocessors because the Z80 "understands" all the instructions used by the 8080. The same holds for the 8085, an enhanced version of the 8080.)

For a long time—as microcomputer history goes—those 8-bit

microprocessors dominated the market. There were a couple of 16-bit CPU's (Central Processing Units—another term for "microprocessor") around—Texas Instruments' TMS9900 and Western Digital's WD16—but they found limited use because most microcomputers were set up to handle only 8-bit devices.

Then, in 1978, announcements were made of a number of new 16-bit microprocessors—the 68000 from Motorola, the Z8000 from Zilog and the 8086 (and later the 8088) from Intel. Potential microcomputer owners began asking themselves whether they shouldn't wait until computers using them became available; after all, they would be much more powerful.

8-bit computers

As we mentioned earlier, computers using 8-bit microprocessors turned out to dominate the market. The main reason for that was that, as the microcomputer market was exploding, the most powerful CPU's were the 8-bit units—16-biters were still on the drawing board or in the testing stage.

Consequently, languages, operating systems, and programs all were written using 8-bit words. A tremendous library of 8-bit material grew up and, as time went on, the 8-bit languages and programs became more and more sophisticated (a term frequently used in "computerese" to mean "complex and versatile"), and there arose a number of extremely useful programs (and even more next-to-useless ones).

There are programs written for 8-bit computers that will do almost anything you need your computer to help you with. (This article was written on an 8-bit computer running a word-processing program). Some programs are more efficient than others, but that is due mainly to the skills the programmer applied to his work and, perhaps, to the languages in which they were written.

If 8-bit software (programs) and hardware (computers) are capable of so much, then, why then do we need 16-bit machines?

8 bits vs. 16 bits

Mainframe computers—the big ones—use word lengths of 16 bits, 32 bits, or greater and, we must admit, are more powerful than our 8-bit micros. What makes them more powerful? There are several factors.

The first is that while an 8-bit microprocessor can recognize a maximum of 256 different instructions (they're never all used—the Z80, which probably has the most comprehensive instruction-set, uses only 158), a 16-bit CPU can recognize over 65,000 instructions (also not all used). Many of the instructions for 8-bit computers, though, require several 8-bit words, one after the other. That requires the computer to go through several cycles to perform a single operation.

In a 16-bit machine, multiple-byte instructions can be presented to the computer all at once, which means that several time-consuming (even when you're working in microseconds—millionths of a second—time continues to fly) instructions can be swallowed all in one gulp, and the computing process speeded up considerably.

At the other end of the microprocessor, where data is transferred to and from memory, again, a longer word length makes for more efficiency. Possibly even more important is the fact that, while 8-bit processors can directly address 65,536 memory locations, 16-bit processors can directly address *millions* of memory locations.

That means that, as programs become more complex, and require more storage space for themselves and for the data they process, a computer using a longer word-length can operate more quickly. There's the real reason for interest in 16-bit computers—*speed!*

To take advantage of the best of both worlds, a number of recent computers contain both 8-bit and 16-bit microprocessors (see Fig. 2). That generally means that they can run both "old" (but valuable) programs written for 8-bit computers as well as new 16-bit releases.

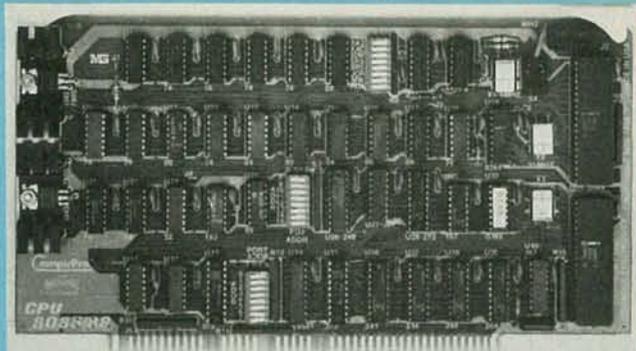


FIG. 2—A DUAL-PROCESSOR board, such as this one from CompuPro, allows the use of both 8-bit and 16-bit software.

Do you need sixteen bits?

We always like to think that more or faster is better. The Concorde will get us to London in less than half the time that it would take on a 747. But is there any reason for most of us to pay the price to save those extra few hours?

Similarly, eight bits are better than four and sixteen bits are better than eight. But is that really the case? My 8-bit computer can manipulate the words I am setting down more rapidly than I can think of them or enter them from my keyboard. Do I need a computer that will work still faster, even though I can't? The answer is an obvious "no."

I don't even need a faster computer to run an action-game program if my reflexes are slower than the computer's. What good, then, is a faster computer? The first modern computers—vintage World War 2—were created to calculate the trajectories of artillery fire. Obviously, the faster and more accurately those could be determined, the better the results.

The performance of difficult and complex calculations, like those just mentioned, or even of simple but repetitive ones, is called *number crunching*. And number crunching is not restricted to just military applications.

For example, there are programs for home or commercial use that require the solving of complex equations or the performance of the same type of calculations over and over (like calculating payroll deductions). Obviously, the faster the computer can perform the task, the more work it can do in a given time—and the sooner the results will be obtained. While that may not have a great impact on your personal life, in business, time is money. Also, very large numbers can be handled more easily and accurately by a 16-bit machine than by an 8-bit one because of the longer word-size.

Furthermore, since computers are frequently used to store and rearrange other types of data than numbers—mailing lists, for example—the speed and efficiency that the 16-bit computers provide make it possible for those lists to be searched through and sorted faster.

(Consider the addition of just one name to a mailing list. When it's added, everything else on the list has to be moved to make room for it, and, possibly—if the program requires it—rearranged. A 16-bit computer will perform a task such as that much more rapidly than an 8-bit one.)

High-resolution computer graphics are more and more in demand, and the only way to generate them efficiently and quickly is through the use of computers using longer word-lengths and able to access more memory more rapidly.

If your applications call for tasks where heavy number-crunching (including that which has to be performed in simulations—graphic and otherwise), complex data manipulation, or a very high degree of accuracy are required, a 16-bit computer could well be worth the investment. If, on the other hand, you will be using your computer for less complicated jobs, or if a few more seconds are not a critical factor for you, then a good old, tried-and-true, 8-bitter is probably what you should be looking for. As long as your computer can keep up with your demands, there's no real need to look for a bigger one. **R-E**

Games and Leisure Time

STRIKE	BALL	STRIKE	OUT
1	2	2	0
1	2	3	4
5	6	7	8
9	F	H	

KILLERS	WHIFFERS	PITCHES	BB	SO	ERA	MEN ON BASE
0	0	7	0	2	0	1-1-2-0-0
0	0	14	0	3	0	

SOFTWARE



Games and Leisure Time

Once you've balanced your company's budget, completed your design project, and checked the late stock-market prices, it's time to give your computer—and yourself—a break.

HERB FRIEDMAN

WILLIAM F. BUCKLEY, JR., THE SYNDICATED COLUMNIST, PUBLISHER, and TV personality, recently complained in his newspaper column that he had never read a good reason for owning a personal computer for the home—other than for playing games.

Actually, games *are* an important part of personal computing. While I seriously doubt whether anyone ever spent several thousand dollars on a full-blown personal computer system just to play games, the ability to play games is inherent in all personal computers—so why not play them? There is nothing wrong with blasting a few Klingons after a three-hour stint building a *VisiCalc* or *SuperCalc* model of your company's financial situation for the next thousand years. And there's no reason why the programmer working on a computer design for a perpetual-motion widget can't relax with a challenging game of computer chess, or by zapping another hundred Klingons.

The truth is that personal-computer games are so popular that several manufacturers offer plug-in ROM (Read Only Memory) game cartridges for their more-or-less-conventional computers; that way, the engineer can switch from designing a missile defense system to zapping space invaders with the flick of the wrist, and without waiting minutes or even just seconds for the game to load from tape or disk.

Some game history

The very first computer game I came across was supplied with my Radio Shack *TRS-80 Model I* computer. It was a blackjack game written in BASIC, and typical of BASIC programs, it was s-l-o-w. The program was supplied on a cassette tape along with a computer version of backgammon. It took almost a minute to load, assuming the level from the recorder was correct; actually, it often took two or three tries to get a perfect load.

The program would deal a hand by having the CRT screen s-l-o-w-l-y trace each card's rectangular outline on the screen, and then identify the card within the rectangle as "8 CLUBS," "KING HEARTS," and so on. Watching the computer play blackjack was a new and exciting experience—the first hundred times. Then the novelty wore off; after the initial thrill of getting the computer to "do something useful" I would get restless waiting for the display to create the cards—but that was a fault of BASIC, the language used to write the program. Graphics produced by interpreted BASIC's are slow, and there's no way

to get around the problem. (Compiled BASIC's are a lot faster, but that's an entirely different subject.)

For the first few years of personal-computer history, games weren't much better than blackjack. The "biggies" were endless versions of nim, electronic dice, and a host of other math-based programs you could just as easily write or type in yourself as purchase in prerecorded form. In fact, most of the early game cassettes were nothing more than a collection of simple, math-oriented BASIC programs that high school kids used to run on their school's time-sharing computers.

But things have changed. While simple games written in BASIC are still sold, personal computers have available almost every conceivable type of game, including some rather good simulations of standard arcade games.

There are auto races and galactic wars; baseball, football, basketball, and other sports—and more galactic wars; superb chess and checkers, and still more galactic wars; *Pac Man* and its innumerable imitators, and still *more* galactic wars; endless versions of "Breakout," and maze-type games; and—the latest craze—the adventure games where the player must figure out a means to bypass the dragons, spacemen, soldiers, creatures, pits, poisons, and passions, in order to: a) find the treasure, b) find the girl, c) just plain escape, d) do anything else he can possibly imagine.

A variety of games

There are "intellectual" games where you can plan a new world, "brain-teaser" or "brain-buster" games, and even computer versions of *Monopoly*, including *Monopoly*-type games of the "Wall Street wheeler-dealer" sort (complete with robbing widows and orphans—just like real life); and of course, the very popular galactic-war games.

While personal-computer versions of arcade games such as *Pac Man* and *Galaxian* are the hottest things going in games, there are high-resolution arcade-type games using color that have been written specifically for personal computers, such as the *Eliminator* game for the *Apple II*. *Eliminator*, which is typical of the latest personal-computer color arcade-type games, uses high-resolution graphics, and its characters and action are as detailed as you're likely to get from the arcade games at your local video-game emporium.

Of course, not all arcade-type games are high resolution. Radio Shack's computers, in particular, simply don't have inherent hi-res (high-resolution) capability, but they get along quite nicely with a little less resolution by creating plenty of exciting graphics. In particular, the *Chess* software for the *Color Computer* uses color for added excitement, and the game itself is rated by knowledgeable players to be superior in both action and presentation to the chess games offered for use with the home

videogame consoles.

While we're on the subject of high-resolution graphics, the new versions of blackjack give you a good idea of what you can expect from current software. A few paragraphs back I referred to the rectangles in "ancient" software that represented playing cards with their values printed within them. Well, the new hi-res versions of blackjack actually duplicate the playing cards you might find in a realtime deck. ("Realtime" is computerese for

TABLE 1—DIRECTORY OF INDEPENDENT GAME SOFTWARE SUPPLIERS

Game software is available from computer manufacturers, and in addition, from many independent suppliers, such as the ones listed below.

AARDVARK SOFTWARE, INC.

783 N. Water Street
Milwaukee, WI 53202

ACCENT SOFTWARE

3750 Wright Blvd.
Palo Alto, CA 94306

ACORN SOFTWARE PRODUCTS

634 N. Carolina Ave. S.E.
Washington, DC 20003

ADVENTURE, INTERNATIONAL

507 East Street
Box 3435
Longwood, FL 32750

ALPHA PRODUCTS

79-04 Jamaica Ave.
Woodhaven, NY 11421

ALPHA QUEUE SYSTEMS

PO Box 20885
Dallas, TX 75220

ALTERNATE WORLD SIMULATIONS

PO Box 941
Milpitas, CA 95035

AMBER SOFTWARE

170 Parsippany Rd.
Parsippany, NY 07054

ARCADE PLUS

5276 Hollister Ave.
Santa Barbara, CA 93111

ARTWORX SOFTWARE CO.

150 N. Main Street
Fairport, NY 14450

ATKIN RESOURCES

1693 Merribee Way
Salt Lake City, UT 84121

AUTOMATED SIMULATIONS

1988 Leghorn
PO Box 4247
Mountain View, CA 94043

AVALON HILL GAME COMPANY

4517 Hartford Rd.
Baltimore, MD 21214

AVANT-GARDE CREATIONS

PO Box 30161
Eugene, OR 97403

BARCLAY BRIDGE, INC.

8 Bush Ave.
Port Chester, NY 10583

BARGAINBYTE

PO Box 23195
Harahan, LA 70183

BASICS AND BEYOND, INC.

Box 10
Amawalk, NY 10501

BERLINERSOFT

102 Jericho Turnpike
New Hyde Park, NY 11040

BIG FIVE SOFTWARE

14619 Victory Blvd. No. 1
Van Nuys, CA 91411

BRODERBUND SOFTWARE

2 Vista Wood Way
San Rafael, CA 94901

BUDGECO

428 Pala Ave.
Piedmont, CA 94611

BULLSEYE SOFTWARE

PO Drawer 7900
Incline Village, NV 89450

BUSINESS AND PLEASURE SOFTWARE

6011 San Felipe
Houston, TX 77057

BYTE-A-BIT COMPUTING CO.

PO Box D
Levittown, NY 11756

CAVALIER COMPUTER

PO Box 2032
Del Mar, CA 92014

CE SOFTWARE

801 73rd St.
Des Moines, IA 50312

THE CODE WORKS

PO Box 550
Goleta, CA 93116

COMPUGAMES

19 Booth Street
Enfield, CT 06082

COMPUTER CONSULTING

6723 E. 66th Place
Tulsa, OK 74133

COMPUTER LEARNING CONNECTION

One Boston Place
Boston, MA 02108

COMPUTERWARE

Box 668
1512 Encinitas Blvd.
Encinitas, CA 92024

COMPUTRONICS

50 N. Pascack Road
Spring Valley, NY 10977

COMTRONIC SYSTEMS

PO Box 3325
Kent, WA 98031

CONTINENTAL ADVENTURES

4975 Brookdale Street
Bloomfield Hills, MI 48013

THE CORNSOFT GROUP

6008 N. Keystone Ave.
Indianapolis, IN 46220

CREATIVE SOFTWARE

201 San Antonio Circle No. 270
Mountain View, CA 94040

CRYSTAL COMPUTER

17120 Monterey Road
Morgan Hill, CA 95037

CYBERTRONICS INTERNATIONAL

999 Mt. Kemble Ave.
Morristown, NJ 07960

DAKIN5 CORPORATION

PO Box 21187
Denver, CO 80221

DATAMOST

9748 Cozycroft Ave.
Chatsworth, CA 91311

DYNACOMP

1427 Monroe Ave.
Rochester, NY 14618

ECHELON

6513 Lankershim Blvd., No. 2212
N. Hollywood, CA 91606

EDU-WARE SERVICES, INC.

PO Box 22222
Agoura, CA 91301

EL COMP PUBLISHING

53 Redrock Lane
Pomona, CA 91766

EN-JOY COMPUTER PRODUCTS

PO Box 1535
Goleta, CA 93116

FANTASTIC SOFTWARE

PO Box 27734
Las Vegas, NV 89127

"the world as we know it," as opposed to "the world as represented by a computer program.") Within the rectangle on the screen is a reasonable facsimile of actual cards; the queen of diamonds will show the queen along with the diamond suite. The same goes for the king and jack; while the ace of spades would really look like an ace of spades. This enhances the "playability" of the game.

The newer games, written specifically for personal comput-

ers, are often spectacular, with an almost artistic use of color (for color computers). Many are licensed versions of arcade games, and, as such, have a certain air of quality (and a price to match). On the other hand, many of the less expensive older games were originally written for mainframe (giant-size) computers and have been scaled down for personal computers. Many scaled-down games are strictly second-rate by my standards; others might claim that they are prime junk.

WILLIAM A. FINK

PO Box 5912
Lighthouse Point, FL 33074

FUTUREVIEW

PO Box 101
Joplin, MO 64802

GEBELLI SOFTWARE, INC.

1791 Tribure Road No. E1
Sacramento, CA 95815

HAYDEN

50 Essex Street
Rochelle Park, NJ 07662

HIGHLANDS COMPUTER

14422 S.E. 132nd
Renton, WA 98055

HORIZON SIMULATIONS

7561 Crater Lake Highway
White City, OR 97503

I.D.S.I.

PO Box 1658
Las Cruces, NM 88004

IMB

PO Box 289
Williamstown, MA 01267

INFOCOM, INC.

6 Faneuil Hall Marketplace
Boston, MA 02109

INSOFT

10175 Barbar Blvd., Suite 202B
Portland, OR 97219

INSTANT SOFTWARE

Peterborough, NH 03458

K-BYTE

1705 Austin
Troy, MI 48099

KRELL SOFTWARE

21 Millbrook Dr.
Stony Brook, NY 11790

MACROTRONICS, INC.

1124 N. Golden State Blvd.
Suite G
Turlock, CA 95308

M.A.C. SOFTWARE

PO Box 27
Chillicothe, OH 45601

MARK DATA PRODUCTS

23802 Barquilla
Mission Viejo, CA 92961

MED SYSTEMS SOFTWARE

PO Box 2674
Chapel Hill, NC 27514

MEGASOFT, INC.

31 East 31st Street
New York, NY 10016

MELBOURNE HOUSE SOFTWARE

6917 Valjean Ave.
Van Nuys, CA 91406

MERRY BEE COMMUNICATIONS

815 Crest Dr.
Omaha, NE 68046

METPHORIC ASSOCIATES

PO Box 6346
Pittsburgh, PA 15212

MICROLAB

2310 Skokie Valley Road
Highland Park, IL 60035

MUSE SOFTWARE

347 N. Charles Street
Baltimore, MD 21201

NELSON SOFTWARE SYSTEMS

PO Box 19096
Minneapolis, MN 55419

ON-LINE SYSTEMS

36575 Mudge Ranch Road
Coarsegold, CA 93614

ORION SOFTWARE

147 Main St.
Ossining, NY 10562

PICCADILLY SOFTWARE

89 Summit Ave.
Summit, NJ 07901

POWERSOFT, INC.

PO Box 157
Pitman, NJ 08701

QUALITY SOFTWARE

6660 Reseda Blvd., No. 105
Reseda, CA 91335

RAINBOW COMPUTING, INC.

9719 Reseda Blvd.
Northridge, CA 91324

RIVERBANK SOFTWARE INC.

Smith's Landing Road
PO Box 128
Denton, MD 21629

ROCKROY, INC.

7721 East Gray Road, Suite 103
Scottsdale, AZ 85260

ROGO COMPUTER PRODUCTS

4752 DeBeers Drive
El Paso, TX 79924

ROKLAN CORP.

10600 West Higgins Road
Rosemont, IL 60018

SENTINENT SOFTWARE

PO Box 4929
Aspen, CO 81612

SIRUS SOFTWARE, INC.

10364 Rockingham Drive
Sacramento, CA 95827

SIR-TECH SOFTWARE, INC.

6 Main Street
Ogdensburg, NY 13669

SOFT SECTOR MARKETING

6250 Middlebelt
Garden City, MI 48135

THE SOFTWARE EXCHANGE

6 South Street
Milford, NH 03055

SOFTWARE TOOLWORKS

14478 Glorietta Drive
Sherman Oaks, CA 91423

SPECTRAL ASSOCIATES

141 Harvard Ave.
Tacoma, WA 98466

SPECTRUM SOFTWARE

142 Carlow
Sunnyvale, CA 94087

STONEWARE MICROCOMPUTER PRODUCTS

50 Belvedere Street
San Rafael, CA 94901

STRATEGIC SIMULATIONS

465 Fairchild Drive
Suite 108
Mountain View, CA 94043

SUBLOGIC COMMUNICATIONS

713 Edgebrook Drive
Champaign, IL 61820

SUPERIOR SOFTWARE, INC.

PO Box 11676
Kansas City, MO 64138

SYNERGISTIC SOFTWARE

5221 120th Ave. S.E.
Bellevue, WA 98006

VERSA COMPUTING, INC.

3541 Old Conejo Road, Suite 104
Newbury Park, CA 91320

VILLAGE SOFTWARE

31220 La Baya Drive, Suite 110
Westlake Village, CA 91362

VOYAGER SOFTWARE

PO Box 15-518
San Francisco, CA 94118

ZETA SYSTEMS INC.

1725 Adelaide Blvd.
Akron, OH 44305

Game types

The really successful games—in the sense that they will keep you interested—are those specifically written for personal computers, and not some scaled-down mainframe software that someone wrote at a university umpty-ump years ago. The games come in two principal types: the “thinking” game and the “action” game.

An example of a “thinking” game is one of the many variations on the “Star Trek” theme, where in order to fight the Klingons you must keep track of your ship’s propulsion energy, its phasor (gun) energy, force shield energy, and—in some versions—even food for the crew.

Speaking of food, in “Hammurabi” you’re the ruler of an ancient kingdom that must ration grain to get the people through a period of drought. You have to decide how much grain to plant, how much to use as food, and, you have to control the rats that can devour the grain you store. It’s another excellent “thinking” program that can keep your mind percolating. It’s probably good training if you ever become the despotic ruler of some backward desert country.

“Adventure” games also provide food for thought. An intriguing variation on the “adventure” theme is Infocom’s *Deadline*, the first of a series to be marketed under the *Interlogic* name, that asks you to solve a murder mystery. Naturally you have to ask questions and search for clues, but in addition you receive a sealed folder with police reports, photographs, a coroner’s report, etc. That information is an integral part of the game, and you probably won’t be able to find out “whodunnit” without it.

Depending on the program, the “thinkers” may have extensive graphics, or no graphics at all. Radio Shack’s version of “Star Trek,” called *Invasion Force* (Fig. 1) gives you a map of an area out in space, while The Software Toolworks’ *Airport*, for the Heath/Zenith computers, puts you in the position of an air-traffic controller, displays the airways and beacons on the screen, along with an ever-lengthening list of planes entering and leaving your airspace.

The “action” games are primarily arcade-type games, where you must blast a series of space invaders, monsters, or planets from the screen; race a car (or box) across a screen filled with two-way traffic; demolish a wall of bricks, boxes, or whatever; defend a city (another galactic war), or do just about anything that will produce exploding colors and great sound effects. In action games almost anything goes. If a Pac Man eats “energy dots,” a “Scarfman” will “scarf” energy food. (Does that sound familiar?)

What to look for

One of the problems in selecting games is the “comic book” hype for the new action games. If you’re old enough, you may remember the combat-oriented men’s action magazines from the 1950’s and early sixties. Their covers featured “boiler plate” (every rivet showing) drawings of diving planes with machine guns and cannons blazing, destroyers under kamikaze attack with 40-mm ack-ack cannon blazing trails in the sky, and marines storming some Pacific Ocean rock with flames spouting from the muzzles of their guns. Well, the same type of artwork is now used to sell personal-computer action software.

But, while the illustrations in the old magazines had some relation to real combat, you are simply not going to see that kind of stuff on your screen. Oh, there will be cute little shapes that you can accept as basketball players dribbling down the court, and other funny looking shapes that will charge the line in football, but don’t expect a reasonable facsimile of Darth Vader’s Death Star on the computer’s screen—the screen can’t duplicate the advertising artwork—yet!

Another thing the programs can’t duplicate are the scantily clad girls who look like Raquel Welch in the movie *One Million B.C.* Oh yes, on the software packaging there’s our girl in a patch of fur from some intergalactic monster, and our muscular hero is dressed in a slightly larger piece of the same monster’s



INVASION FORCE is Radio Shack's version of *Star Trek*. This is an example of a thinking game rather than an “action” game. Notice the complexity of the screen display and the number of factors you must keep track of to kill the invading Klingon force.

fur, but that’s about as far as it goes. You may never even see the characters on your computer screen, and if you do, they’ll just be peculiar little shapes.

Buying games

While quite a few computer games are sold by mail order, a surprising number are sold through local computer stores. There are several reasons for that, and you should consider them when adding to your games-software collection.

First off, unless you are already familiar with a game, you are buying a pig in a poke (whatever that means). The magazine ad showing some cute girl draped over Mr. Musclebound’s shoulder doesn’t insure a fun program. If you know the program—say, your friend has a version for his computer—and you like it, then you know what you’re getting. But, if you know nothing about the software, it may turn out that the drawing is the best thing going for it.

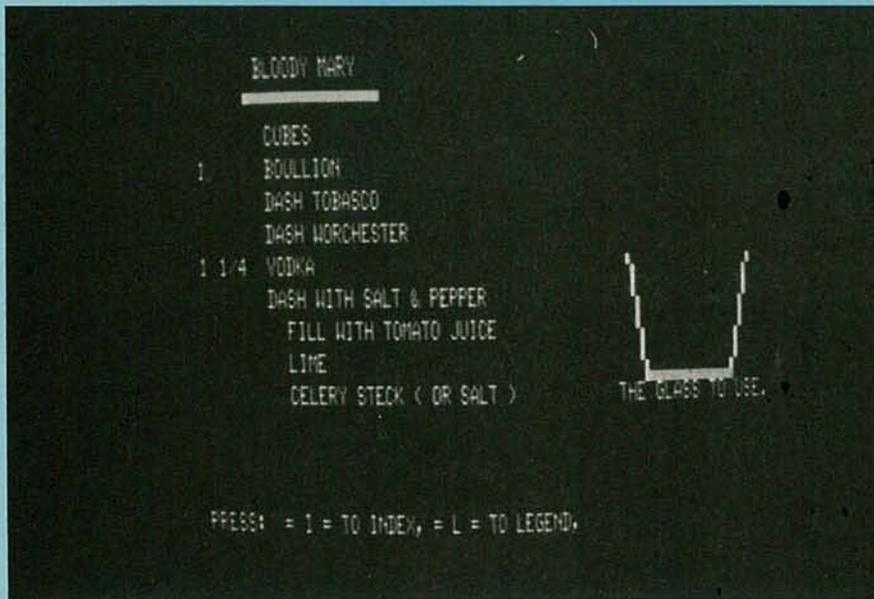
Next, a good computer store offers you the opportunity to try out an assortment of games before making the decision to buy. Many of the really good game-software houses don’t advertise; they simply send their entire production to local stores. I once watched seven people try *Eliminator* (a “shoot-’em-out-of-the-skies” game) on an *Apple II* during a one-hour session and every one of them purchased a copy at \$30 apiece. I also saw the same people reject several other game programs as “too simple,” or “not having enough action,” or “too repetitive.” You really should try before you buy, especially when software starts to cost more than a night on the town for two.

Finally, a few words about computer manufacturers’ own software. Game software is available on cassette tapes, on disks, and in plug-in ROM modules. All low-cost computers can accommodate game software supplied on cassette tape. If the computer is also equipped with a disk system, disk-based games can also be used, though much disk-type software is initially supplied on cassette, with the changeover to disk made by the user. Some of the low-cost computers such as the *VIC 20*, Radio Shack’s *Color Computer*, and the Atari’s have a socket for game software available on plug-in ROM cartridges. Frequently, the plug-in modules are licensed versions of games specifically modified for a particular computer. Virtually all of the low-cost personal computers announced for future production also provide a special socket for the plug-in ROM modules.

Though most of the plug-in module software is presently supplied by the computer manufacturer, a broad aftermarket is fast developing for computers such as the *VIC 20* and the Atari’s, which are often sold through appliance stores. It really makes no difference who supplies the software as long as you enjoy it.

R-E

Software for the Home



Whether it's balancing your checkbook, keeping track of your coupons, or helping your children learn, your computer can be quite a help around the house—if you have the right software. Here's a look at what's available.

HERB FRIEDMAN

BACK IN THE EARLY DAYS OF PERSONAL COMPUTING (A COUPLE of years ago) we frequently heard and read of how the new computers would make our lives easier by lowering our energy costs, keeping burglars out of our homes, insuring perfect records for an IRS audit, and so on. It turned out, though, that there was a larger and more lucrative market for business-oriented software than there was for software for personal use. As a result, somewhere along the line the "home and family" got lost—at least as far as the major software suppliers were concerned. Most of the home-and-family software that was available came from computer hobbyists, and consisted of spruced-up editions of old games and various versions of checkbook-balancing programs.

But while the business-software industry grew, a quiet revolution was taking place in software design specifically for the home and family. Imaginative programmers discovered there was money to be made in software for the home. More important, it was easier to sell far-out ideas for a modest price than to compete head-on with the major software houses.

Today, home-and-family software is no longer another version of some card game, or a checkbook-balancer, or another mailing list, or text editor, or word processor, or a way to convert the navy's recipe for 5000 portions of chipped-beef-on-toast to four family servings. Home-and-family software can now teach office skills, overcome reading disabilities, improve SAT (Scholastic Aptitude Test) scores, provide easy access to information sources, and...well, the best way to illustrate the revolution in home-and-family software is to show some practical examples. Bear in mind the fact that some of the home-and-family software mentioned here may not be available for the particular computer you own; but, as a general rule, similar software is available for all popular personal computers.

Home-and-family software covers a very broad range of applications. Some—perhaps most—is inexpensive, lightweight fluff that will make a routine task more fun, provide an evening's entertainment while it accomplishes a routine task, or uses a new method to do an old chore. For example, there's a program from Cottage Software that simply prints labels for cassettes. If you have a large cassette-library it's a great program. That type of software generally costs little more than pocket change, so don't expect to be overwhelmed when you run it.

Improving reading skills

Other home-and-family software offerings are real heavyweights and are priced accordingly; but they do something important, something you usually can't get done any other way within the normal constraints of your budget, time, or lifestyle. For example, when I went to school a child who couldn't learn to read was considered a "dummy," or worse. Usually, he or she was the butt of a teacher's insensitive remarks. Today, we realize that many children who can't read suffer from the disability known as dyslexia; they don't perceive letters and numerals, or even whole words or phrases, the same way that you and I see them. There were also the slow readers: I was one of them. I simply did not see multiple phrases and/or sentences; I had to read everything two or three times to get an idea of what was being said. (Many years later, as an adult, I took a speed-reading course, and, after a few sessions, was able to read and comprehend at normal speed.)

Today, we have the opportunity to nip that type of reading problem in the bud, at an early age and right in the home, with a program called *SpeedRead+* from Optimized Systems Software, Inc. Presently available for Apple and Atari computers, the program teaches speed reading and comprehension by allowing the user to program the phrasing, speed, and organization of standard text on the computer's screen. As the user's ability improves he or she can reduce the display time (flash rate) of each phrase, group of phrases, or paragraph, restructure the display, or do whatever else is needed to push on to faster reading and better comprehension. The program even comes with "tests."

While the program obviously isn't for everyone, consider that, today, schools have reading specialists who have ways to uncover reading programs at an early age. We no longer call the child with a reading program a "dummy" and sit him or her in a corner. Perhaps convenient, flexible, reading-practice with a computer program in the home has greater value than the few minutes a day the child might spend with a reading specialist in the school. Again, I'm not advocating that specific type of software for everyone with reading difficulties; but I think it's an excellent example of the quality and importance of much of the home-and-family software available today.

Obviously, home-and-family software covers a rather broad range of interests. As a general rule, the type of software we'll

discuss either meets the criteria for reasonable performance from a low-cost computer system, or unusual value (in some areas) for the family, even if a full-blown, business-type system is required.

Personal finance

Let's start out with our old friend the checking-account program. Early versions simply took the place of check stubs; you could balance your monthly or quarterly bank statement, and maybe "pull out" checks of a specific type. Modern checkbook programs, such as *Money Manager* from Acorn Products, keep track of all your expenditures on a monthly basis. They can "split" a check, or payments—for example, allocating \$40.67 of a \$100 check to pay the phone company and the remaining \$59.33 for the supermarket. They can even take into account automatic withdrawals (such as a monthly mortgage payment), provide subtotals in various categories, allow you to extract tax-deductible expenditures, and provide formatted printouts by category and date. While that may sound like a "business" database, it's not; it is intended for home-and-family expenses and is easier to use than a business-oriented program.

Many software houses provide checking-account software similar to Acorn's, but few that are so extensive in coverage and so easy to use. One of the other "easy" home money-managers is Radio Shack's *Budget Management*. It is somewhat different in that it concentrates primarily on providing great detail about exactly how your money was spent. Speaking from personal experience, I was absolutely astounded to discover how seemingly insignificant daily expenses can add up.

Other home-and-family money-manager programs are those such as *Koupon Keeper* from Kensoft, that keep track of the cents-off and refund coupons you get in newspapers and junk mail. The exact functions of those programs vary somewhat but they all work in a similar manner to help you stretch the shopping budget. Daily, weekly, or whenever you have time, you enter the information from the cents-off and refund coupons into the computer: their values, expiration dates, and most important, the types of food or products they're for. Before you go out for the next big family shopping-expedition you enter your shopping list in the computer. The program then compares your coupons against your shopping list and lets you know what coupons are available for specific items or brands. For example, if your list contains the entry "coffee," the computer will tell you which brands you have coupons for, and how much of a discount each offers; you then decide which to use. You can also call for a listing of coupons for a specific brand, or for coupons with a certain expiration date. If you're a dedicated coupon-clipper the software can really help you save!

The cassette label-maker software from Cottage Software that I mentioned earlier isn't a money-saver but it's sure to be valuable for someone. That one prints cassette labels, the kind you stick to both sides of the cassette. It prints on labels supplied on a tractor-feed paper carrier (a strip of paper with holes punched on both sides). If you have an extensive cassette collection you'd like to label in library style, or you're into making recordings and copies for the local rock bands, or reading for the blind, or even distributing your own computer programs, it's a great way to give your cassette tapes the "pro" look, as well as putting a lot of data on the labels automatically. Unfortunately, Cottage supplies only a sample strip of the labels with the software; additional labels are available from them.

Until they start itemizing their possessions, few people have any idea of what they really own, or how much it's worth. A home-and-family program that could help you if you were burglarized is Hayden's *Personal Property Inventory*. It does exactly what its name implies—it keeps a record of each item you own with a description, serial number, and value. While you can keep all that information on paper, it's much easier to update alphabetically or chronologically if it's in the computer.

One modification I'd like to see in "personal inventory" programs is the use of one of the fields to accommodate a "purchase number" for the purchase receipt or sales slip. That



would make it easier to find the actual record when it was needed. Each time an item was entered into the inventory, its sales slip would be given a purchase number. Assume, for example, that your home was robbed and you lost a valuable camera. When you ran the inventory program to find its value, it might also show that the sales receipt was numbered 1364. If you filed the sales slips in order—as you should have—it would be easy to find the original sales slip for the insurance company.

The same applies to repairs. If your TV set broke down and your warranty required you to present the sales slip to get it fixed, it would be easier to locate a numbered sales slip than to search through a stack of them going back several years.

Self improvement

Education is a category in which just about everyone has an entry; unfortunately, much of what there is has little value. You do not really need a computer to teach a four-year-old that if you take two purple boxes from four purple boxes you are left with two purple boxes (but it looks good on a color computer).

When I think of educational software I much prefer to think of materials that will actively assist someone to pursue an interest in a manner, or to a level, not normally available; or of software that will train someone—such as a teenager, a housewife ready to return to the work force, or a college student needing summer employment—for tomorrow's skills.

Today, most entry-level white-collar jobs require touch typing. College students, and others, stand a poor chance of finding the sort of part-time or summer employment that used to be called a "file clerk's" job if they can't type. Computers make fantastic typing teachers. Most typing programs flash a series of letters on the screen which student must match in sequence by typing on the keyboard. The computer keeps track of errors and finger motion, and provides a readout of the student's "effective speed" after the errors are factored in. As the student progresses, the complexity of the exercises can be increased.

In the field of computer-aided instruction, or C.A.I. as it is more commonly called, the sky appears to be the limit on what's offered for home-and-family use. But you must always ask yourself: "Does it really do anything for me?" Or, better still, "Is this C.A.I. program worth anything?" There's a lot of worthless stuff around.

Consider for a moment learning a language by computer. Why bother? In addition to the program, you will need an audio cassette to teach pronunciation. And if there is no such tape, how are you supposed to learn pronunciation from the screen? (And, indeed, there is a program teaching a foreign language—one of the most difficult to learn—that has no accompanying pronunciation tape.)

Then there are programs that will translate a limited foreign-language vocabulary to English. Supposedly, that will teach you to read, if not speak, that language. What a waste of good computer time! There's a 30-dollar handheld device that will do the same thing...for what it's worth.

But don't get me wrong—there *is* good C.A.I. for the home.

TABLE 1—INDEPENDENT HOME AND FAMILY SOFTWARE SUPPLIERS

Home and family software is available from computer manufacturers, and also from many independent suppliers such as the ones listed below.

ACORN SOFTWARE PRODUCTS INC.

634 N. Carolina Ave. S.E.
Washington, DC 20003

ACTIVITY RESOURCES INC.

PO Box 4875
Hayward, CA 94540

ADDISON-WESLEY PUBLISHING COMPANY

2725 Sand Hill Road
Menlo Park, CA 94025

ADVANCED OPERATING SYSTEMS

450 St. John Road
Michigan City, IN 46360

ADVENTURE INTERNATIONAL

507 East Street
Box 3435
Longwood, FL 32750

APPLE-CATIONS

21650 W. Eleven Mile Road
Suite 103
Southfield, MI 48706

ARTWORX SOFTWARE CO.

150 N. Main Street
Fairport, NY 14450

AVANT-GARDE CREATIONS

PO Box 30161
Eugene, OR 97403

BARGAINBYTE

PO Box 23195
Harahan, LA 70183

BASICS AND BEYOND, INC.

Box 10
Amawalk, NY 10501

BELL AND HOWELL

7100 N. McCormick Road
Chicago, IL 60645

BLUEBIRD'S COMPUTER SOFTWARE

2267 23rd Street
Wyandotte, MI 48192

BRAIN BOX

601 W. 26th Street
New York, NY 10003

BUSINESS AND PLEASURE SOFTWARE

6011 San Felipe
Houston, TX 77057

CALIFORNIA SOFTWARE

PO Box 275
El Cerrito, CA 94530

CLASS 1 SYSTEMS

17909 Maple St.
Lansing, IL 60438

COMM DATA SYSTEMS

PO Box 325
Milford, MI 48042

COMMSOFT

665 Maybell Ave.
Palo Alto, CA 94306

COMPUMAX, INC.

PO Box 1139
Palo Alto, CA 94301

COMPUTER-ADVANCED IDEAS, INC.

1442A Walnut St.
Suite 341
Berkeley, CA 94709

COMPUTER AIDED & MANAGED INSTRUCTION

PO Box 2030
Goleta, CA 93118

COMPUTER-ED

1 Everett Rd.
Carmel, NY 10512

COMPUTER INFORMATION EXCHANGE

PO Box 159
San Luis Rey, CA 92068

COMPUTER LEARNING CONNECTION

One Boston Place
Boston, MA 02108

COMPUTER SHACK

1691 Bason
Pontiac, MI 48054

THE COMPUTERIZED SHOPPER

3545 El Camino Real
Palo Alto, CA 94306

COMPUTRONICS

50 N. Pascack Rd.
Spring Valley, NY 10977

COOK'S COMPUTER COMPANY

1905 Bailey Dr.
Marshalltown, IA 50158

COTTAGE SOFTWARE

614 N. Harding
Wichita, KS 67208

CREATIVE COMPUTING

39 E. Hanover Ave.
Morris Plains, NJ 07950

CREATIVE SOFTWARE

201 San Antonio Circle #270
Mountain View, CA 94040

CYBERTRONICS INTERNATIONAL

999 Mt. Kemble Ave.
Morristown, NJ 07960

DR. DALEY'S SOFTWARE

Water St.
Darby, MT 59829

DRESEN ASSOCIATES

PO Box 248
Dresen, ME 04342

DYNACOMP

1427 Monroe Ave.
Rochester, NY 14618

EDUCATIONAL ACTIVITIES

1937 Grand Ave.
PO Box 87
Baldwin, NY 11510

EDUCATIONAL MICRO SYSTEMS

PO Box 471
Chester, NJ 07930

EN-JOY COMPUTER PRODUCTS

PO Box 1535
Goleta, CA 93116

ENTELEK

Ward-Whidden House
The Hill
PO Box 1303
Portsmouth, NH 03801.

ETRONIX

14803 NE 40th St.
Redmond, WA 98052

EZ SOFTWARE

PO Box 591
Novato, CA 94947

FUTUREVIEW

PO Box 101
Joplin, MO 64802

GOOTH SOFTWARE

931 S. Bemiston
St. Louis, MO 63105

J.L. HAMMETT COMPANY, INC.

Hammett Pl.
PO Box 545
Braintree, MA 02184

HARTLEY SOFTWARE

PO Box 431
Dimondale, MI 48821

HAYDEN

50 Essex St.
Rochelle Park, NJ 07662

HIGH TECHNOLOGY SOFTWARE PRODUCTS INC.

PO Box 14665
8001 N. Classen Blvd.
Oklahoma City, OK 73113

HOWE SOFTWARE

14 Lexington Rd.
New York, NY 10956

INFORMATION UNLIMITED SOFTWARE

281 Arlington Ave.
Berkely, CA 94707

INSTANT SOFTWARE

Peterborough, NH 03458

INTELLIGENT INVESTOR

810 Camelview Plaza
6900 E. Camelback Rd.
Scottsdale, AZ 85251

**INTERNATIONAL SOFTWARE
MARKETING, LTD.**

120 E. Washington St.
Syracuse, NY 13202

INTERPRETIVE EDUCATION

2306 Winters Dr.
Kalamazoo, MI 49002

INVESTOR SOFTWARE

48 Iron Ship Plaza
San Francisco, CA 94111

J & S SOFTWARE

140 Reid Ave.
Port Washington, NY 11050

KATE'S KOMPUTERS

PO Box 1675
Sausalito, CA 94965

KENSOFIT

2102 50th St.
Kenosha, WI 53140

KRELL SOFTWARE

21 Millbrook Dr.
Stony Brook, NY 11790

LEARNING TOOLS INC.

4 Washburn Pl.
Brookline, MA 02146

LEVEL IV PRODUCTS INC.

32461 School Craft
Livonia, MI 48150

THE LIBERTY SOFTWARE CO.

635 Independence Ave. SE
Washington, DC 20003

LIGHTNING SOFTWARE

PO Box 11725
Palo Alto, Ca 94306

LITTLE GENIUS

34-38rd St.
Jackson Heights, NY

L & S COMPUTERWARE

1589 Fraser Dr.
Sunnyvale, CA 94087

MACROTRONICS, INC.

1125 N. Golden State Blvd.
Suite G
Turlock, CA 95380

MANHATTAN SOFTWARE

PO Box 1063
Woodland Hills, CA 91365

MASTERWORKS SOFTWARE INC.

1823 W. Lomita Blvd.
Lomita, CA 90717

MED SYSTEMS SOFTWARE

PO Box 2674
Chapel Hill, NC 27514

MENTOR SOFTWARE

Box 791
Anoka, MN 55303

MERCER SYSTEMS INC.

87 Scooter Lane
Hicksville, NY 11801

MERRY BEE COMMUNICATIONS

815 Crest Dr.
Omaha, NE 68046

META SOFTWARE ENGINEERING

4737 Trumbull SE
Albuquerque, NM 87108

MICROGNOME

5843 Montgomery Rd.
Elkridge, MD 21227

MICROLAB

2310 Skokie Valley Rd.
Highland Park, IL 60035

MICRO LEARNINGWARE

PO Box 2134
N. Mankato, MN 56001

MICROMATIC PROGRAMMING CO.

PO Box 158
Georgetown, CT 06829

MICRO POWER & LIGHT CO.

12820 Hillcrest Rd., No. 224
Dallas, TX 75230

MONUMENT COMPUTER SERVICE

Village Data Center
PO Box 603
Joshua Tree, CA 92252

MUSE SOFTWARE

347 N. Charles St.
Baltimore, MD 21201

**NATIONAL SOFTWARE MARKET-
ING**

4701 Mckinley St.
Hollywood, FL 33021

OCO, INC.

1001 J. Bridgeway, Suite 128
Sausalito, CA 94965

OPTIMIZED SYSTEMS SOFTWARE

10379 Lansdale Ave.
Cupertino, CA 95014

OPTIONS-80

PO Box 471
Concord, MA 01742

OSBORNE/McGRAW-HILL

630 Bancroft Way
Berkeley, CA 94710

PCD SYSTEMS

PO Box 143
Pen Yan, NY 14527

PEAR SYSTEMS CORP.

27 Briar Brae Rd.
Stamford, CT 06903

POWERSOFT CORP.

PO Box 157
Pitman, NJ 08071

PRACTICAL PROGRAMS

1104 Aspen Dr.
Toms River, NJ 78377

PRENTICE HALL

Sylvan Ave.
Englewood Cliffs, NJ 07632

PRESCRIPTION LEARNING

1301 S. Wabash Ave.
Chicago, IL 60605

PROGRAM DESIGN, INC. (PDI)

11 Idar Court
Greenwich, CT 06830

THE PROGRAMMER'S INSTITUTE

PO Box 3191
Chapel Hill, NC 27514

PROGRAMS FOR LEARNING

PO Box 954
New Milford, CT 06776

**PROGRAM RESEARCH AND SOFT-
WARE CORP.**

257 Central Park West
New York, NY 10024

QUALITY EDUCATION DESIGN

PO Box 12486
Portland, OR 97212

QUALITY SOFTWARE

6660 Reseda Blvd. No. 105
Reseda, CA 92335

RELL

1145 Stanford Ave.
Redondo Beach, CA 90278

**RESOURCE SOFTWARE IN-
TERNATIONAL**

140 Sylvan Ave.
Englewood Cliffs, NJ 07632

RIGHT ON PROGRAMS

PO Box 977
Huntington, NY 11743

SCOTT, FORESMAN & CO.

1900 East Lake Ave.
Glenview, IL 60025

SERENDIPITY SYSTEMS INC.

225 Elmira Rd.
Ithaca, NY 14850

SILWA ENTERPRISES, INC.

PO Box 400
Big Flats, NY 14814

SOFTBYTE COMPUTING

Box 217
Wallingford, CT 06492

THE SOFTWARE CONNECTION

10703 Meadowhill Rd.
Silver Spring, MD 20901

THE SOFTWARE EXCHANGE

6 South St.
Milford, NH 03055

SOFTWARE HOUSE INC.

695 East 10th North
Logan, UT 84321

SOFTWARE RESOURCES, INC.

286 Alewife Brook Pkwy.
Suite 310
Cambridge, MA 02138

SOLARTEK

PO Box 298
Guiderland, NY 12048

SOUTHFORK SOFTWARE

68 Fairlake Dr.
Hattiesburg, MS 39401

SOUTHWEST EDPSYCHE SERVICES

PO Box 1870
Phoenix, AZ 85001

SPECTRUM SOFTWARE

142 Carlow
Sunnyvale, CA 94087

STANDARD AND POORS CORP.

25 Broadway
New York, NY 10004

STEKETEE EDUCATIONAL SOFTWARE

4639 Spruce St.
Philadelphia, PA 19139

STERLING SWIFT PUBLISHING CO.

1600 Fortview Rd.
Austin, TX 78704

STORYBOOKS OF THE FUTURE

527 41st Ave.
San Francisco, CA 94121

TARA

PO Box 118
Selden, NY 11784

TERRAPIN, INC.

678 Massachusetts Ave.
Cambridge, MA 02139

T.H.E.S.I.S.

PO Box 147
Garden City, MI 48135

3 R SOFTWARE

PO Box 3115
Jamaica, NY 11431

TIME SHARE CORP.

Hanover, NH 03755

TYC SOFTWARE

40 Stuyvesant Manor
Geneseo, NY 14454

TYCOM ASSOCIATES

63 Velma Ave.
Pittsfield, MA 01201

MAX ULE AND CO., INC.

6 E. 43rd St.
New York, NY 10017

UNICOM

297 Elmwood Ave.
Providence, RI 02907

VERSA COMPUTING, INC.

3541 Old Conejo Rd. Suite 104
Newbury Park, Ca 91320

WE SOFTWARE

800 Greenwich Dr.
Chico, CA 95926

WINDOW INC.

469 Pleasant St.
Watertown, MA 02172

XPS INC.

323 York Rd.
Carlisle, PA 17013

For example, Atari has a lovely reading-comprehension program for youngsters ages 8 and up, and nicely structured basic and advanced vocabulary builders. If you have a youngster with some reading and vocabulary problems in school a good, fun-filled, home-and-family program can be a decided asset. It works because the computer is doing what it does best—patiently repeating itself, over and over, without becoming bored or tired. (Others besides Atari offer reading and vocabulary builders, but some are better than others. Take a look at the software before you buy; make sure it's suitable for your child.)

As for unusual education, consider a map of the heavens. There are probably ten programs that print a map of the U.S. and ask the child to indicate the state capitals. But what about the budding astronomer in your family? For him or her, high adventure might be a trip to the local planetarium; but imagine a planetarium—actually a map of the heavens—on your home computer! The *Star Search Astronomy Guide* from Softbyte Computing will display a map of the overhead skies for north and south of the equator, with double stars, galactic and planetary nebula, open and globular clusters, and the external galaxies all shown to scale according to their polar coordinates for any 24-hour period of any day in the year. The screen also displays a lot of information such as the Messier number (if assigned), magnitude, right ascension, etc. It's pure gold to an amateur astronomer, and it costs only \$20 for the cassette version.

Speaking of gold, one of the hot commercial databases is the one supplied by Dow Jones for the professionals who wheel and deal in stocks and bonds. The problem for the amateur dabbler in the market is that the professional databases aren't cheap. There's lots of home-and-family software around, though, specifically intended for those who think they can outperform the professional money-managers. There's software that lets you create bar charts of trading prices on a daily, weekly, monthly or yearly basis, create comparison charts, and construct any model that you think will outperform the Dow Jones averages. If you have the time to fuss with those programs—meaning loading them with data—you probably could play the market with some reasonable degree of computer-aided expertise.

For those who don't want to develop new ways to gamble in the stock market, but who own stocks and bonds, there are several programs—at least one for every model computer—that simply keep track of your investments, income, sales, etc.

Recreational programs

Getting away from the serious end of personal computing for the home and family, do you know who your ancestors are, how

they interrelate, and where you and yours stand in the order of things? Well, a program such as *Your Family Tree* from Acorn Software traces your ancestry, shows who is related to whom, and might even show that you are ninety-sixth in line to the English throne. Naturally, the more data you can locate and feed into the program, the more detailed the results will be. While the family tree might not be your cup of tea, there are many good people who get a lot of pleasure out of discovering who married whom—and who didn't.

And when you finally assemble the living members of the family tree and get them together for a family blow-out, how will you fare when you serve the libations—otherwise known as drinks? Are you the type who serves whiskey sours in a wine glass? Do your pina colodas look more like brandy alexanders? If you want to make like a pro bartender at the family feast, but can't tell a cocktail glass from a wine decanter, there's a program especially for you called *Bartender*, from En-Joy Computer Products that lists 84 different drinks. It tells you the recipe and gives a graphic display of the correct glass to serve it in. You can either run through the entire list alphabetically to learn the craft, or call up a specific drink. It sure makes for great conversation to have your computer on the bar and let the guests watch you prepare drinks according to its instructions.

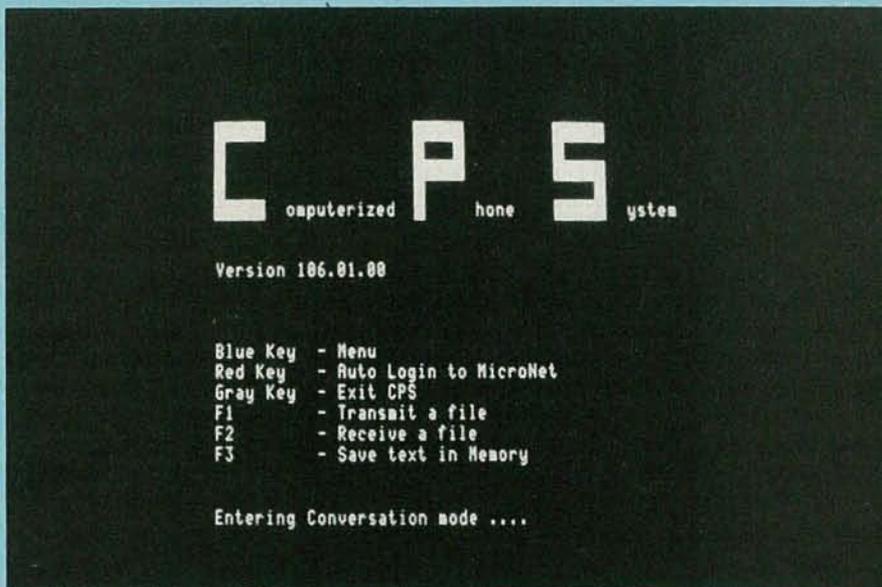
Got a yen to make like the folks who created the computer graphics in *TRON*? *Sketch-80* from Quality Software will let you draw figures on the computer screen, move them around, enlarge and shrink them. In short, you enter the world of computer art. Who knows; the next call from Hollywood might be for you.

Are you a coach in Little League or Midget football, or do you help run the PAL (*Police Athletic League*) basketball program? Your local computer shop will probably have a goodly assortment of computer scoring-systems that will determine each player's performance for various skills for each game, or cumulatively for all games played. It's a heck of a way to run a kids' team, but if you're one of those coaches out to win at any cost, there's a team-performance program just made for you.

As you can see, there's home-and-family software for just about any application, and at just about every intellectual level. We've only looked at the tip of the iceberg to give you an idea of the large subject-range available for personal computers.

While not every program we've mentioned is available for every personal computer, as we stated way back at the beginning, there is similar software for the most popular models. Write to the companies mentioned here and in Table 1, read the ads, and—of course—check with your local computer store to see what they have or can get for you.

R-E



Hook your computer into a vast network of resources and information. All you need is a modem, software, and a telephone

HERB FRIEDMAN

IN THE EARLY DAYS OF COMPUTING THERE WAS NO SUCH THING as a personal computer. There were mainframe computers and minicomputers, which were sort of scaled-down mainframes. Users generally accessed the computers through terminals that consisted of essentially two devices in a common cabinet: a keyboard that sent signals entered by the user to the computer, and a display that displayed the information the computer sent back to the user. Depending on the particular terminal, the display generated either a "hard copy," meaning it was printed on paper, or a "soft copy," meaning it was displayed on a CRT screen.

If the terminal was located close to the computer, it was usually directly connected through wires. If the terminal was remote from the computer, it was normally connected through some form of telephone circuit—either a dedicated high-speed line, or the slower (usually 110 to 300 baud) voice-grade dial-up telephone system.

Naturally, if one can feed information in and out of a computer through a terminal, it's almost as easy to have computers talk to each other, passing data back and forth even when no one is around. Any of the mainframe computers can be instructed to automatically dial-up or interconnect with another computer to swap data.

The terminal system was adequate for many, many years, particularly for "time-sharing" systems. In time-sharing, the computer automatically samples the input from many terminals, all feeding in at the same time. It samples information in the correct order, maintains the input/output from each terminal independently, and automatically holds up input from the terminals if necessary; in effect, time-sharing makes it appear as if each terminal user is the only one using the computer. Another feature of time sharing systems is that they usually provide access to several programming languages, data storage and processing, and special services. The system works well, except for the fact that the printers and all other peripherals are usually located at the computer, miles away from the terminal.

Now, thanks to the personal computer, all of that has changed. The user can have everything at his or her fingertips: tape or disk storage, printers, card readers, and the like. He or she also can use many programming languages, including extended MicroSoft BASIC, a powerful high-level language.

Even somewhat decent versions of Fortran, Cobol, and Pascal are available for personal computers.

Personal computers do have one major limitation, however: They can not access the major databases, or software written for other machines, very easily. For example, if your friend on the other side of town has written exactly the software you need to run your bowling league, but his version is written for a Commodore or Atari computer and you have an Apple, there's no way you can run his software directly, even if he gives you a copy of his disk or tape.

Then again, there are many people writing good software they are willing to share at little or no charge if you can access their computer through a CBB (Community Bulletin Board). That, in its most basic form, is simply a personal computer that can be accessed by anyone by simply placing a telephone call. There are also commercial databases, such as The Source and CompuServe Information Service, which provide various services, including stock data, newspaper and magazine articles, forums for computer user groups—the list is almost endless. All of that, and more, can be accessed directly by a personal computer, if the computer could be made to "think" that it is a terminal. That is easy enough to do because there is software for that purpose available for virtually any personal computer. Some can even be obtained from CBB's or user groups, again at little or no cost; we'll look at the commercially available terminal programs later in this article.

Before we confuse the subject, let's take time out to explain the difference between a terminal and something called a "host." A host is simply the computer that is accessed by a terminal or another computer. In our example of the early mainframe computer and time-sharing systems, the computer was the host.

There was no problem here because it was the only host. But personal computers are something else. Load one with one type of software and it serves as a terminal. Use other software and it serves as a host to which other terminals or computers can be connected. For example, assume you have created a database of all the articles in **Radio-Electronics** for the past 20 years. Your buddy on the other side of town wants to locate an article on the invention of the transistor. If he programs his Commodore computer to function as a terminal, and you have programmed

your computer to serve as a host (sometimes it doesn't even need a special program), he can dial your phone, your computer will answer and download the data from your **Radio-Electronics** database—your computer serves as the host. Got the picture? If not, read it again because it's important if you're to understand the rest of this article.

When computers talk to each other or to terminals, that is called telecommunications, and all that is ever meant when someone refers to "personal computer telecommunications" is that a personal computer is being used to exchange data or software with another computer or terminal.

Modems

Two things make personal computer telecommunications possible: the *modem* and the software. The term modem is an acronym derived from *MOD*ulator/*DEM*odulator. It's a device that converts the electrical signals of a computer to audio signals that can be transmitted over the telephone line.

For personal computers, modems are usually Bell-103 compatible, meaning they're compatible with the type-103 modem used to transmit data at up to 300 baud over the voice-grade telephone system. (For commercial use, especially when the computers are mainframes, there are modems that can transmit at 9600 baud, but those require the use of a special dedicated telephone hook-up.)

Modem technology was originally developed for use with mainframe computers and the technical terms used to describe modem operation are left over from those days. Since the access to the computer originated at the terminal, the modem used at the terminal was called an originate modem, transmitting to the computer on 1270 and 1070 Hz and receiving from the computer on 2225 and 2025 Hz. Since the computer answered the terminal, the modem used at the computer—or host—end of the circuit was called an answer modem; it transmits on 2225 and 2025 Hz and receives on 1270 and 1070 Hz, the exact reverse of the answer modem. For many years the only modem commonly available to users of personal computers were originate-only, because "home" computers only served as terminals. With few exceptions, there was very little thought given to providing a way for personal computers to "converse" with other personal computers.

But the modern user of personal computers finds there is often a need for his computer to converse with another, such as when swapping software or data. The way that is done is to provide one terminal with an answer modem; it doesn't matter which computer has the answer modem as long as the telecommunications circuit consists of one answer and at least one originate modem. Because of the considerable interest that is developing in telecommunications between personal computers, many low-cost modems are now available with switch-selected or automatic originate and answer operating modes. The user with the double-function switch-selected modem flips the selector to the opposite of that being used by the other computer. If it is an automatic modem, it senses the frequencies of the received tones and automatically shifts to the required operating mode (originate or answer).

There are several types of modems available for personal computers, with new ones seemingly appearing every month or so. The most basic models are the manually switched originate and originate/answer modems. Personal-computer modems have an RS-232 input/output. (Commercial modems can also include a 20 mA current drive, or TTL, or whatever; but modems for personal computer use always have, at the very least, an RS-232 I/O.)

If the computer doesn't have an RS-232 interface it must be added to the computer. For example, the RS-232 interface is optional on the Radio Shack *TRS-80 Model I* and *Model III* computers. Commodore computers require a special interface to convert their IEEE-488 I/O to RS-232. In addition, there are two very popular non-RS-232 modems. One is from the Microperipheral Corp.; it connects directly to the *TRS-80 Model I* keyboard, eliminating the expense of the expansion and RS-232

TABLE 1—UNITERM COMMAND LISTING

A	- ACTIVATE AUTO BUFFER OPEN/CLOSE FEATURE
B	- LOAD AND SAVE BINARY FILES
C	- CLOSE BUFFER
D	- DISPLAY OR PRINT BUFFER
E	- EXIT TO DOS
H	- SELECT HALF OR FULL DUPLEX
I	- DEFINE INITIALIZATION PARAMETERS
L	- LOAD ASCII FILE TO BUFFER
M	- CHANGE MODEM PARAMETERS
O	- OPEN AND ZERO BUFFER
P	- TRANSMIT BUFFER IN PROMPT FORM
R	- TRANSMIT BUFFER WITH AUTO OPEN/CLOSE BUFFER CODES
S	- SAVE BUFFER IN ASCII FORMAT
T	- TRANSMIT BUFFER (NORMAL)
W	- SET SCREEN WIDTH
X	- TYPE TO BUFFER

interfaces. Another variation is the D.C. Hayes *Micromodem II* modem for the Apple computer. It plugs directly into one of the slots in the Apple computer and does not require an RS-232 I/O.

There are modems that automatically dial a telephone number from a disk directory, or from the computer keyboard, and models that automatically answer the telephone and connect the computer when a "carrier" tone from another is received. But all that is a subject for another time, so let's move along to using the modems for telecommunications, and the special software necessary.

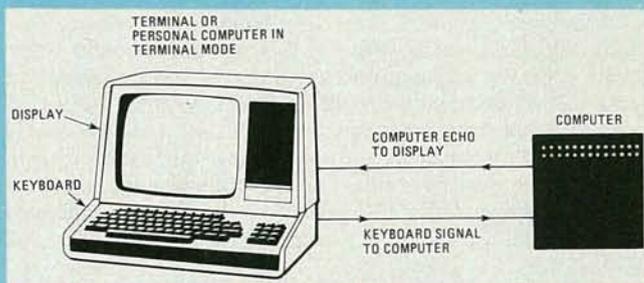


FIG. 1—IN FULL DUPLEX operation, the keyboard sends a character to the computer and the computer "echoes" the character back to the display.

The standard modem circuit used for terminals, and personal computers functioning as terminals, is "full duplex", meaning that the terminal functions as a separate keyboard and display, as shown in Figure 1. The keyboard transmits a character to the computer. The computer echoes the character back to the display, confirming that the transmission is correct. If the character displayed doesn't match what was sent to the computer, the user knows that he has big problems somewhere in the circuit. The echo is usually instantaneous, and it is often assumed by newcomers to personal computing that the display shows what the keyboard is sending. Not true. It shows what the computer assumes it has received; it's confirmation from the computer.

Some modems can also operate in what is called half-duplex, which has two operating modes. Generally, the display shows what is sent by the keyboard and then the echo from the computer. For example, the transmission *HELP* would appear in half-duplex as *HHELLPP*. Some so-called half-duplex modems actually cancel the echo, displaying only the keyboard entry. *HELP* would appear as *HELP*; it looks correct but it is not a computer confirmation. While that system has its applications, it is not particularly good for use with personal computers.

Terminal software

None of the popular personal computers can operate directly as a terminal. At the very least they require some "terminal" software, if not some special hardware in addition to the modem itself. Selecting the appropriate terminal software is important,

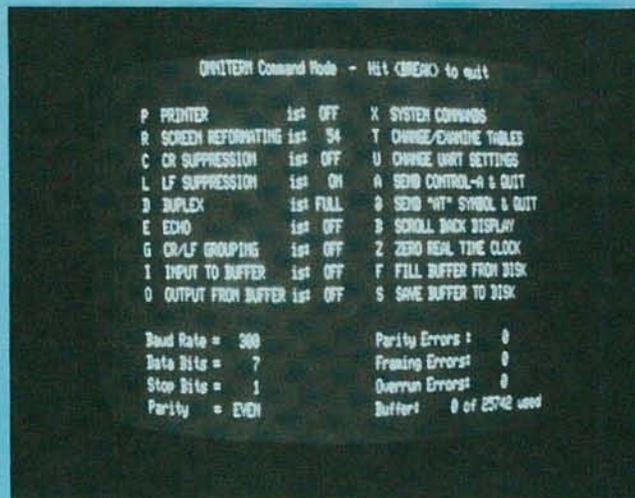
as it is the software that determines how much flexibility you can get from your personal computer.

The terminal software is of two varieties: dumb and smart. A dumb terminal is the functional equivalent of the basic terminal consisting of the keyboard and the display. Your computer might have four disk drives, and many-thousand bytes of memory, but if it functions as a dumb terminal all you can use is the keyboard and the display. Smart terminals, depending on the particular software, can use the disk and tape storage systems as well as all memory and external peripherals. They also can exchange software with other computers, and some even automatically convert the peculiarities of one computer system for another. For example, most personal-computer terminals output data in ASCII, but mainframes often use EBCDIC (*Extended Binary Coded Decimal Interchange Code*). If your personal computer is "talking" to a mainframe, the proper software will convert the incoming EBCDIC code to ASCII, and the outgoing ASCII to EBCDIC. Or, it can automatically correct for whatever the user wants, substituting different characters for standard codes.

The exact terminal features provided by your personal computer will depend on the type of terminal software you purchase, and its price. As a general rule, the more you pay the more you get. For example, the original terminal software for the *TRS-80* was very basic, providing the standard full duplex configuration but leaving a few non-standard codes in place of standard ASCII characters. On the other hand, The Microperipheral Corporation's basic *TRS-80* software, which is supplied with their modems for the *TRS-80* computer, provides the special ASCII symbols required by some time-sharing services that are not inherent in the *TRS-80*; and the software provides a notable "extra" feature—a screen print feature that allows whatever is displayed on the screen to be printed (provided, of course, that you have a printer).

To use all the capabilities of your personal computer for telecommunications you need smart terminal software, and here the sky's the limit as to functions and price. On the surface it seems that every software writer has his own idea of what is important and desirable. Some inexpensive smart software provides the most commonly desired features, has but a few commands, and is extremely easy to use. Other smart terminal programs are loaded with every conceivable feature, and are so difficult to use that the casual user must often make frequent references to the documentation in order to perform what should be an insignificant procedure.

How smart you want your computer to be, and the number of desired functions, will determine the complexity of the particular software you need. For example, a universal terminal pro-



OMNITERM, from Lindbergh Systems, is a smart-terminal program that displays the command list on your computer's screen.

gram from BT Enterprises called *Uniterm* can automatically configure itself for one of four possible computer/modem combinations. It can accommodate a variety of printers, be configured in different "permanent" versions for various host computers, and accommodate different screen widths. It can also upload or download software in both ASCII and binary, transmit automatic sign-on-messages, and—well, the list is seemingly endless, because *Uniterm* was intended to accommodate almost every possible desired or necessary smart-terminal procedure. It can even skip over the perforations on continuous-form paper (tractor feed or web-mounted single sheets) used with friction feed printers.

Documentation is notably good (not excellent—very little software documentation can be accurately described as excellent), going into specific details on using several popular brands of modems. One of the really nice features is that the screen will display the command list, as shown in Table 1, which the user can access directly.

Another smart-terminal program that displays the command list on the screen is *Omniterm* from Lindbergh Systems. It has many similar features and functions as *Uniterm*. A major difference is that *Omniterm* is very heavy into special character configurations (conversions). It can be reconfigured to receive and transmit virtually any deviation from standard ASCII, even the complete code if necessary.

A much more basic smart-terminal program, also much less

TABLE 2—DIRECTORY OF INDEPENDENT MODEM MANUFACTURERS

In addition to computer manufacturers, modems are available from many independent manufacturers, such as the ones listed below.

APF ELECTRONICS, INC.

1501 Broadway
New York, NY 10036

BIZCOMP

Box 7498
Menlo Park, CA 94025

HAYES MICROCOMPUTER PRODUCTS

5385 Peachtree Corners East
Norcross, GA 30092

LEXICON CORPORATION OF MIAMI

1541 NW 65th Avenue
Plantation, FL 33313

LIVERMORE DATA SYSTEMS

2050 151st Place NE
Redmond, WA 98952

THE MICROPERIPHERAL CORP.

2643 151st Place NE
Redmond, WA 98052

MULTI-TECH SYSTEMS, INC.

82 Second Avenue SE
New Brighton, MN 55112

NOVATION

18664 Oxnard St.
Tarzana, CA 91356

OMNITECH DATA

2405 South 20th St.
Phoenix, AZ 85034

QUEST ELECTRONICS

P.O. Box 4430E
Santa Clara, CA 95054

RACAL-VADIC INC.

222 Caspian Drive
Sunnyvale, CA 94086

TNW CORP.

3351 Hancock St.
San Diego, CA 92110

US ROBOTICS

203 N. Wabash, Suite 718
Chicago, IL 60601

UNIVERSAL DATA SYSTEMS

5000 Bradford Drive
Huntsville, AL 35805

TABLE 3—INDEPENDENT TERMINAL SOFTWARE SUPPLIERS

In addition to computer manufacturers, terminal software is available from many independent suppliers, such as the ones listed below.

ACE COMPUTER PRODUCTS OF FLORIDA

1640 NW 3rd Street
Deerfield Beach, FL 33441

APPARAT, INC.

4401 S. Tamarac Parkway
Denver, CO 80237

B.T. ENTERPRISES

171 Hawkins Road
Centereach, NY 11720

CAWTHON SCIENTIFIC GROUP

24224 Michigan Ave.
Dearborn, MI 48124

DYNACOMP, INC.

1427 Monroe Ave.
Rochester, NY 14618

EIGEN SYSTEMS

PO Box 10234
Austin, TX 78766

INSTANT SOFTWARE

Peterborough, NH 03458

MICROCOM

1400A Providence Highway
Norwood, MA 02062

MICROSTUF, INC.

1900 Leland Dr.
Suite 12
Marietta, GA 30067

MUMFORD MICRO SYSTEMS

Box 400-E
Summerland, CA 93067

NELSON SOFTWARE SYSTEMS

PO Box 19096
Minneapolis, MN 55419

SMALL BUSINESS SYSTEMS GROUP

6 Carlisle Road
Westford, MA 08166

SOUTHWESTERN DATA SYSTEMS

PO Box 582
Santee, CA 92071

VISICORP

2895 Zanker Road
San Jose, CA 95134

expensive, is *Telcom* from Mumford Micro Systems—a nice program to use between two personal computers because it has programmable echo, will exchange both ASCII and binary data, and is fuss-free. It also has a very simple printer control that prints both the incoming and outgoing characters. It has an associated spooler that will store up to 256 characters if the printer should be slower than the information input to it. Unlike the super-smart terminal programs that can redefine virtually every code, *Telcom* provides up to ten special characters and can store eight custom messages. There is no on-screen command display, but the documentation supplied with the program is good.

A somewhat unusual smart-terminal program for personal computers is the Heath/Zenith *CPS* (Computerized Phone System) for their H8 and H89/Z89 computers. *CPS* is configured specifically for use with CompuServe and other Heath/Zenith computers, and it uses the special-function keys found on the H89/Z89 computer. It will automatically log the user on to CompuServe at the touch of a single function key (though many other smart terminals can be programmed to do the same thing). It has the automatic protocols for transmitting files (from disk) through CompuServe's Micronet, or another Heath/Zenith computer (or it will operate with no protocols), and it has most of the other smart-terminal features such as a resettable clock and echo (when serving as a host or for computer-to-computer communication).

One very nice feature is that text can be saved in memory. Everything coming in can be saved in memory automatically, as it appears on the screen, or just selected portions can be saved by turning the buffer on and off from the terminal's keypad without entering the command mode. A count of available bytes in the buffer is continuously displayed. Finally, the memory can be dumped to disk under a specific file name, to be printed or edited at a future time. It's all very similar to what's available with other smart-terminal software, but what sets this software apart is that it is considerably more convenient to use; that is mainly because the operating functions of the terminal's special-function keys are always displayed in reverse video on the bottom line.

One notable difference between *CPS* and other smart-terminal software is that *CPS* can handle data files only in ASCII form; the presently available version does not accommodate the transfer of binary files.

Virtually all other terminal software for personal computing is similar to those that we have already covered. It is logical to

assume, however, that many personal computers will also be used for business applications, and the casual user in the home might want or require access to the Western Union Telex II (TWX) network. For them, there is software such as *TXL Telex Link* from the Cawthon Scientific Group. *TXL* allows the personal computer to function as an intelligent telex station, replacing the conventional paper-tape telex machine. With a paper-tape telex machine, the outgoing message is first punched on a paper tape, which allows correction of typing errors. When the tape is "perfect", it is passed through a paper-tape reader that transmits the message from the tape. With the *TXL* software, the user prepares the message using a text editor; then *TXL* automatically formats the text for telex and transmits the file. Incoming telex messages are received and displayed, the date and time is added to them, and they are then written to disk storage. Essentially, *TXL* is smart-terminal software tailored for a specific kind of telecommunications.

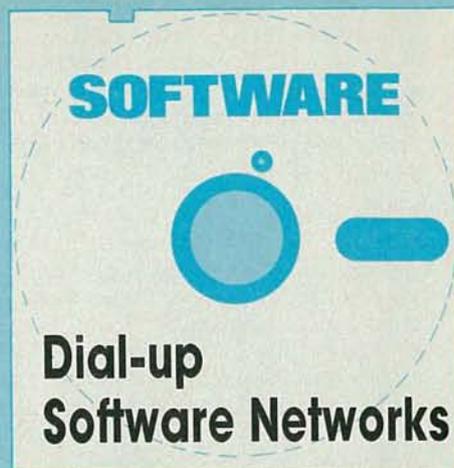
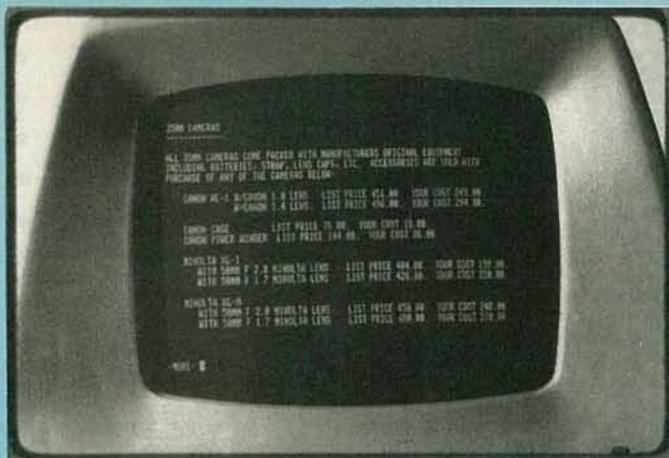
From one computer to another

Finally, let's close with an unusual application of smart-terminal software. I have several different personal computers at the office. Often, I find that software I have written in BASIC for one computer might be better running on another system, or a department with a different computer asks for a copy. What I do in that instance is to load one computer with elementary smart-terminal software.

The other computer is loaded with smart-terminal software that permits extensive reconfiguring of the ASCII codes, and it is reconfigured for the first computer. For example, when feeding *TRS-80* BASIC programs to a *Heath H89*. The RS-232 I/Os of the computers are connected together with the send and receive connections at one computer reversed. Press the buttons and the program goes hassle-free from one system to another. About the only remaining problems would be to clean up a few syntax errors caused by the different versions of BASIC so that the program runs correctly.

That is exactly the same procedure you would use to exchange programs between different computers via a telephone link; the only major difference is that I have substituted a direct-wire connection for the modem-based telecommunications circuit. Obviously, a link between different computers must be done in ASCII; for personal computers, binary files can be transmitted only between the same type of computers, using smart-terminal software that specifically allows binary upload and download of the memory.

R-E



The large databases offer a vast array of information and services, but just how useful or necessary are they for the personal computer user?

Dial-up Software Networks

HERB FRIEDMAN

THE WORLD AT YOUR COMMAND! TOMMOROW'S NEWS TODAY! Weather reports from around the world! Advice by experts on everything—from what's new in electronics and photography to advice to the lovelorn! Stock market information that will make you an instant millionaire—assuming you started with \$2 million (that's a stock trader's joke)! More information than was stored in the legendary great library at Alexandria.

And where is this fountain of information? It is in the databases of The Source (1616 Anderson Road, McLean, VA 22102) and the CompuServe Information Service (5000 Arlington Centre Blvd., Columbus, OH 43220)—at least that's what's implied by the claims made by both.

From humble beginnings

CompuServe, which is owned by H & R Block (the tax people), and The Source, now owned by Reader's Digest, both started out primarily as a way for computer hobbyists with "home" computers to obtain mainframe computer services at moderate cost. This included better programming languages (such as advanced version of BASIC, APL, FORTRAN, and now Pascal), text editors, disk storage, and even printouts of their work. (Remember, that was back in the days when a disk system for personal computers was extremely rare, and printers cost almost as much as the computer.) Both provided electronic mail delivery between their subscribers, a national bulletin board for users, and electronic versions of CB radio that members could use for "on air" (or is it "on computer?") meetings of user groups (The CompuServe Apple user group is one of the most famous).

The original concept behind all of that was to sell the computer hobbyist—the forerunner of the personal computerist—mainframe computer time and data services at a very attractive rate during time periods the computers normally weren't used—the off-peak periods. The idea was to make the off-peak rate so low that the typical hobbyist would be inclined to use The Source or CompuServe, thereby producing revenue from the

computers during those hours. But the personal computer explosion—or revolution, depending how it appears to you—almost instantly eliminated the appeal of programming on those services; as a result, their primary use now is as an "information database," providing access to many varied information services.

Both The Source and CompuServe offer many similar information services; even their operating prices are similar after the initial membership fee. CompuServe is sold (at the time this article was prepared) as part of Radio Shack's videotex package for \$29.95 or \$19.95, depending on whether you use a computer as a smart terminal or are using a dumb terminal. Standard service is billed at \$5.00 per hour of connect time between 6 pm and 5 am local time. Prime time service from 8 am to 6 pm is \$22.50 an hour. CompuServe assigns a local phone number for you to use. If they don't have one in your area you must connect through Tymnet; the surcharge for that is \$2.00 per hour in the contiguous 48 states. CompuServe membership includes 128K of disk storage, with additional memory available for a small charge. But, the storage must be accessed monthly; you can run up charges just to keep the disk storage active. Many services are free, though there are surcharges for stock market quotes, a computer buying service, billing details, etc. The monthly charges can be billed to Visa, MasterCard, or directly billed for an extra \$3.00 per statement surcharge.

Membership in The Source, available through local computer stores, costs \$100.00. Connect time charges are \$5.75 per hour during the evening, weekdays and a few holidays, and \$4.25 per hour midnight to 7 am daily. Prime time (7 am to 6 pm) charges are \$18.00 per hour. The special features that would usually require selective surcharges (as with CompuServe), such as stock quotes, legislative reports, and the like, are rolled into a basic package called SOURCE PLUS; that package has flat per hour connect time fees of \$15.00, \$10.00, and \$40.00, corresponding to the basic service hours. The user can purchase disk storage at prices ranging from \$.50 to \$.05 per 2K of memory.

depending on the total order. (20K and more is \$.05-per-2K). There are, however, some additional small monthly charges for account maintenance and for each connect. The Source assigns a local access telephone number, usually through the Telenet or Tymnet systems, whose cost is included in the basic fees; there is no extra charge.

Is it for you?

Both The Source and CompuServe are jam-packed with database services. Virtually anything you can imagine is available. If you just can't wait to see the news headlines you can get them through your computer: The Source has UPI. CompuServe has AP. You can even read the syndicated features: The Source will tell you this Tuesday what columnist Jack Anderson will say next week. Need stock market information? Both will give it to you. Want to read what's new in anything? *Popular Science* has an information service on CompuServe. Looking for financial aid for a college student? Both services claim to provide the information. The list of information that's available is almost endless. Much of it comes from the information services of other sources, such as the *New York Times* and other newspapers. Value Line (for the stock market's outlook), Dittler Bros., Inc. (for flight information), and so on. (There is generally a surcharge for financial and legislative reports.) Both services feature an electronic shopping service called Comp-U-Star, which sells goods at discount prices through the personal computer. The cost is charged to your credit card. That also has a surcharge in the form of a membership fee.

Another popular feature of those services is that you can play

```
>INFO BLACKJACK
BLACKJACK

DESCRIPTION
-----
You are at odds with a computer dealer in a game of blackjack. Both you
and the dealer try to get the number sum on your cards as close to 21 as
possible without going over (Busting). You will automatically lose if
you bust. Make a wager for each hand if you want. The honest dealer will
keep a running tally of your winnings.

INSTRUCTIONS
-----
To Execute: HPLAY BLACKJACK

The computer will start each hand by printing 'WAGER:'. Type the amount
you wish to bet on the next hand. If you want to stop the game type
'D' for your wager, or depress the 'BREAK' key at any time.

Remember, in the game of Blackjack all face cards count as 10, and
Aces can be worth 1 or 11 points as desired.

All of your responses should be numbers. In a yes/no-type question
a response of '1' signifies yes and a '0' signifies no.

SAMPLE OUTPUT
-----
>PLAY BLACKJACK

WAGER: 5

1 SHOW          3 OF HEARTS
FIRST CARD IS  2 OF HEARTS
NEXT CARD IS   7 OF DIAMONDS
HIT? YES
INPUT data error
HIT? 1
NEXT CARD IS   3 OF SPADES
HIT? 1
NEXT CARD IS   JACK OF DIAMONDS
YOU BUSTED, YOUR TOTAL IS 22
MY HOLE CARD IS 9 III SPADES
YOU'RE BEHIND $ 5

WAGER: 5

1 SHOW          7 OF CLUBS
FIRST CARD IS  QUEEN OF CLUBS
NEXT CARD IS   ACE OF SPADES
***BLACKJACK***
MY HOLE CARD WAS JACK OF HEARTS
YOU'RE AHEAD $ 2.5

WAGER: 10

1 SHOW          4 OF DIAMONDS
FIRST CARD IS  7 OF SPADES
NEXT CARD IS   2 OF CLUBS
HIT? 1
NEXT CARD IS   2 OF SPADES
HIT? 1
NEXT CARD IS   3 OF CLUBS
HIT? 1
NEXT CARD IS   JACK OF SPADES
YOU BUSTED, YOUR TOTAL IS 24
MY HOLE CARD IS KING OF HEARTS
YOU'RE BEHIND $ 7.5
```

A SAMPLE RUN of Blackjack, one of the many casino-style games available on The Source.

```
>DATA GAMMOP
*** GAMES LIBRARY - NO PRINTER REQUIRED ***

ADVENTURE-EXPLORE COLOSSAL CAVE (SUPER GAME!!!)...PLAY ADVENTURE
BACKGAMMON.....PLAY BACKGAMMON
CASINO STYLE 21.....PLAY BLACKJACK
CIVIL WAR SIMULATION AGAINST THE COMPUTER.....PLAY CIVILWAR
CHECK CHECKERS CHALLENGE.....DATA CHECK
COIN FLIPPING.....PLAY COIN
SHOOT CRAPS.....PLAY CRAPS
STATISTICS CONCERNING A PARTICULAR DATE.....PLAY DATES
TIC TAC TOE IN SPANISH.....PLAY ESTIC
GET THE FARMER, FOX, CHICKEN, AND GRAIN ADDRESS.....PLAY FARMER
MONDAY NIGHT FOOTBALL.....PLAY FOOTBALL
GOLF FOR ONE OR MORE PLAYERS.....PLAY GOLF
GUESS THE COMPUTER'S NUMBER.....PLAY GUESS
HANGMAN WORD GAME.....PLAY HANGMAN
GOVERN ANCIENT SUMERIA.....PLAY HRRABI
HORSE RACE GAME.....PLAY HORSE
10 GAME OF SKILL.....PLAY IOTEST
GOVERN THE ISLAND OF SETTLE DETINU.....PLAY KING
LARGE GAME OF GOLF.....PLAY LGOLF
LIFE (COLONY GENERATION).....PLAY LIFE

LUNAR LANDING SIMULATION.....PLAY LUNAR
COMPANIES COMPETE TO SELL A PRODUCT.....PLAY MARKET
MATHS MIND.....PLAY MIND
ANCIENT GAME OF NIM.....PLAY NIM
ANOTHER NIM.....PLAY NIM2
CARE TO TRY YOUR LUCK ON THE SLOT MACHINE?.....PLAY ONEARM
PICA-CENTRE (NUMBER GUESSING GAME).....PLAY PICA
A NEW ADVENTURE GAME.....PLAY PITS
RANDOM POETRY.....PLAY POKER
POKER AGAINST THE COMPUTER.....PLAY POKER
SCORE FOUR AGAINST THE COMPUTER.....PLAY SCOREFOUR
RANDOM SHAKESPERIAN SONNETS.....PLAY SONNET
FILL IN THE MISSING LETTERS.....PLAY SPELL
STAR TREK (SUPER VERSION!!!).....PLAY *TREK
PLAY THE STOCK MARKET.....PLAY STUCKS
RULE ANCIENT SUMERIA (A DIFFERENT ONE).....PLAY SUMER
TARGET PRACTICE AS WEAPONS OFFICER ON THE ENTERPRISE.....PLAY TARGT2
TIC TAC TOE.....PLAY TICTACOE
A REGULAR CASINO OF GAMES FROM LAS VEGAS.....PLAY VEGAS
ROULET FOR UP TO SEVEN PEOPLE.....PLAY WHEEL
PATROL THE CITY STREETS.....PLAY WATCHMAN
HUNT THE WUMPUS.....PLAY WUMPUS

NOTE:
FOR INFORMATION ON ANY GAME TYPE.....INFO (GAMENAME)
I.E., INFO ADVENTURE; TO VIEW A DEMONSTRATION OF CERTAIN
OF THE MORE COMPLEX GAMES, TYPE DEMO (GAMENAME).
```

GAMES OF EVERY DESCRIPTION are among the many services available on The Source and CompuServe. This listing is from The Source.

games, or chat through the CB-type simulators. You can have an entire lifetime of entertainment through The Source and CompuServe.

Now is all of that information and are all of those services worthwhile for the non-commercial user? We gave both a work-out using the services that we thought might appeal to the average home user of a personal computer: someone without a business expense account to refund the charges incurred.

First off, getting anything is slow. Except for special localities and a substantial surcharge for 1200 baud service, both services run at a top speed of 300 baud. That might sound fast if you're trying to follow it on your screen, but it is deadly slow. Both systems come up on an initial menu that directs the user to a particular area. In both systems the user can access a specific subject through a sub-menu—usually a chain of sub-menus (I have gone as high as five). The user also can move directly to the desired page from the main menu if he is familiar with the direct access codes; those are provided by both services, although it is done a lot more clearly by The Source. I'm certain there is someone out there who remembers every page of both services and can punch up anything in seconds, but there are so many codes and so many different access menus, that everything is extra slow if you don't use the services frequently.

Also, the systems are wordy. Almost everything is spelled out in great detail, and CompuServe goes in for a lot of double spacing and scroll pauses when the screen fills. It's little bits and pieces of time but it adds up to big dollars when spread out over thousands of users; it is also frustrating. Accessing Comp-U-Star to see what bargains might be available used up 18 minutes of connect time, and that's a lot of time and access charge to see what's on "special sale."

And when we finally did get to the computerized buying service, it left something to be desired. For example, we were offered a well-known camera with a "standard" lens, unspecified electronic flash, gadget bag, and an unknown wide angle lens. The lens could be the polished bottom of a milkbottle for all we know, as no other information is provided. A similar offer was made for a Nikon EM camera: The standard package

plus an unknown electronic flash for almost \$200. The prices might be terrific for the equipment offered, but precisely what equipment is being sold? A list of sewing machines featured some remarkably good prices. But, I have had many years of experience with sewing machines that don't work when unpacked. Do you suddenly become a shipper if the thing doesn't work right?

Moving along, I looked for some financial aid for a college student. Not one meaningful word on loans or scholarships. Instead, a long printout of the general statements provided by every high school to students and their parents, the same material provided by every college to prospective students, and extensive detail on some special government co-op program that after 15 minutes of connect time still hadn't said what the program was or which schools or agencies were making the offer. It was endless fluff, which is one of the major problems with much of the "free" information. Most of it chews up connect time without providing anything of substance. There are long introductions and special items of news. Even attempting direct access usually puts the user in a menu that flows into another menu.

Since much fanfare had accompanied *Popular Science* joining the CompuServe database I figured I'd give that a try. What could be better than reading a review of personal computer software. In most publications the term "review" means someone actually tried something. If it's equipment they really turned the power on. If it's a computer program I assume someone ran it. But what did I get for my money? Fluff—there was no user report or opinions, just short descriptions that read like they came straight from the manufacturer's brochure. The same stuff I read in the advertisements in the computer magazines.

Surely there must be something of value for the personal

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>
>DUPT N G DEBAGAN
ENTER STARTING & ENDING DATE -- OR PRESS RETURN FOR TODAY

PICK A STARTING STORY NUMBER -- FROM 1 (THE EARLIEST)
TO 13 (THE LATEST).
13

READ FORWARD IN TIME (RF), READ BACKWARD (RB),
SCAN FORWARD (SF) OR SCAN BACKWARD (SB)?
SF

13 07-03 03:00 ned+

(9 graf lead, pickup 4th graf: the trip xxx _ carter attacks reagan tax
cut)

PICK A STARTING STORY NUMBER -- FROM 1 (THE EARLIEST)
TO 13 (THE LATEST).
13

READ FORWARD IN TIME (RF), READ BACKWARD (RB),
SCAN FORWARD (SF) OR SCAN BACKWARD (SB)?
RB

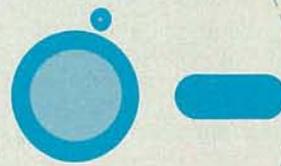
13 07-03 03:00 ned+

(9 graf lead, pickup 4th graf: the trip xxx _ carter attacks reagan tax
cut)
urgent
previous washington
Carter attacks Reagan tax proposal
By HELEN THOMAS
UPI White House Reporter
LOS ANGELES (UPI) President Carter today attacked Ronald Reagan's
tax cut proposal as irresponsible, inflationary and impossible to carry
out without cutting federal social services.
For his first public comment on the tax-reduction proposal made by
his probable Republican opponent for the presidency in November, the
president flew to the former California governor's home state.
He told a meeting of the National Education Association, which has
strongly supported Carter's campaign, that Reagan's suggested $30
billion tax cut is "a classic free lunch -- something for nothing.
That kind of hasty offer can only be called by one word --
irresponsible," the president said.
"It is sheer deception to promise the American people that we can
have this enormously expensive and unfair tax cut -- that we can
dramatically increase defense spending" and still maintain social
programs, he said.
Carter did not mention Reagan by name but press secretary Jody
Powell made it clear the president was directing his remarks at Reagan
and other GOP tax-cut proponents.
Powell also told reporters Carter has not made up his own mind
about a tax cut, but has agreed to work with House and Senate Democrats,
who want to pass their own -- lesser -- tax cut to rival the Republican
proposal.
Carter was met at the airport by California Gov. Edmund Brown Jr.,
a former rival for the Democratic presidential nomination. Brown praised
Carter's cooperation with California officials and said there is no
hostility between the two men.
Brown has not endorsed Carter. Asked whether he would, Brown
replied: "Not this morning ... It's not the appropriate forum for
that."
The trip, which will be partly paid for by the Carter-Mon
WE ARE IN STORY 13
TYPE "R" "N" "SF" OR "G" AND A STORY NUMBER
QUIT

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GET UP-TO-THE-MINUTE news stories from the wire services on either database. UPI is available on The Source; AP on CompuServe.

SOFTWARE



Software for the Home

computer user. How about The Source's airline schedules? I was about to visit my family in Rochester and a schedule would help. The schedule included everything I wanted to know about all the flights leaving New York for Rochester, except three things: which flights had the special discount fare (there most always is one); what were the requirements for the discount, and which flights had open seats. I had a beautiful print of the schedule and no important information. A three minute call directly to the 800 number of the airline gave me all the information I needed free (except for the price of the toll-free phone call), and in a lot less time than it took the computer. Maybe a businessman who flies First Class on an expense account might be interested solely in what time the plane leaves, but as a family user I'm more interested in the important things, like what's the cheapest way to fly, and do my children get a discount. That information just wasn't in the computer.

About this time my son came home from school, announced he was going on vacation and would buy a used car when he got to his destination. What an opportunity to test computerized classified ads. Since he was headed for Washington, DC, I checked the classified ads in the *Washington Post*. Now that worked just great. There I was in New York checking out used cars in Washington, DC—a perfect use for a computerized information service. I punched in the type of car my son wanted, how much he had to spend, the equipment he wanted, and we got a print of cars for him to inquire about when he got to Washington. The system worked flawlessly and with virtually no fluff: it went right into the classified ads with a minimum of unusually clear instructions—someone did a superb job with this database. It was certainly worth the \$1.00 or so in computer time.

Flushed with success I figured I'd try the database on how to purchase a used car. It was full of the usual platitudes we've heard for years: "Have an expert check the car..." "It's someone else's problem..." and junk like that. It was on such a low level I kept expecting a recommendation to kick the tires. One would figure that if it's worthwhile putting the information on a computer there'd be something new and substantial—but no such luck.

Another area that proved valuable when doing some research was the New York Times Consumer Database (NYTCD), which consists of abstracts from the *New York Times* and sixty other publications. It's undoubtedly valuable for business people wanting to do some research on a subject, but it's also great for students or anyone else needing generalized information. It's possible to pick up a story or subject and then trace it backwards or forwards to see how it developed. That is another no-fluff database that gets right into the meat of things.

Quite possibly, the NYTCD is a precursor of what to expect if the *Encyclopedia Britannica* or the *World Book Encyclopedia* ever gets on The Source or CompuServe. If that should happen, it will be a fantastic breakthrough for young schoolchildren. Many will have access to a personal computer, which in turn would give them access to most of the information they'll need for school through a computerized encyclopedia and a database

such as the NYTCD.

Deciding to try something different, I looked into a demonstration of electronic banking. It was rather interesting! Aside from the fact there was apparently no hard copy of any payments—my records being only what was entered on my disk storage—I wondered how many people would get access to my entire financial and personal life through electronic banking. In this day and age it appears nothing is sacrosanct, and many organizations exist for the sole purpose of selling all the personal information they can get their hands on; my state even sells the names and addresses of everyone that holds a driver's license. I just wonder how long it would take before all that computerized banking information—information on everything I purchased, every doctor I visited, every lawyer I paid, every debt I owed—was sold to the highest bidder?

Computing services

While both The Source and CompuServe are presently concentrating on information, they do offer something else—mainframe computer services for personal computer owners. Both permit the subscriber to create files of the type used in mainframe data processing. For example, on The Source you can activate a file automatically each time you sign on. The files can be "mailed" to other subscribers, and the electronic mail service will even inform you when you sign on that you have mail waiting. Your files can be personal or public—that is, you can permit anyone to peek at them.

Of course, if you can create files you must have some way to edit them, and an editor is provided. It has more or less standard advanced editing features such as "global change," section moves, tabulation, sorting, and automatic spelling checking.

The services also offer a super timeshare BASIC, FORTRAN, and Pascal. If you're into FORTRAN and Pascal, you most likely will end up with more powerful versions than you

can purchase at reasonable cost for your personal computer. The Source also provides INFOX, a business database manager that can generate special forms. INFOX has its own manuals and those can be purchased, if you wish. Essentially, both The Source and CompuServe provide a lot of computing power. If you're into self-development in the programming area (remember, we're not covering business here) you probably can't get a better dollar value than from The Source and CompuServe. But don't expect to get off cheap. FORTRAN and Pascal are very time consuming when you're first learning.

I am certain that everyone can find something of value on The Source or CompuServe. In the area of computer services it's everyone for themselves, only you know how much computer power you need or could use. In the area of information, however, I feel the most valuable data of any kind was from the professionals who have spent years accumulating and dispensing information in a highly competitive market—newspapers, stock/commodity news services, and the wire services.

For the first few months it's a lot of fun trying out the varied information services of The Source and CompuServe, not to mention the assortment of games, but if you have no specific or frequent need for "hard information," it's questionable whether a permanent commitment or the monthly expense is justified for "just fooling around."

Obviously, there are many personal computerists who find The Source and/or CompuServe an important part of their lifestyle—especially if they are into user groups of any kind. And certainly, for business applications the databases can be important tools, but we are talking about personal computing, and that means primarily home and family. Before putting any money on the line, a logical question to ask is 'After the initial fun and excitement, do I have any real need for or interest in any of the services offered? It's a question everyone must answer for themselves.

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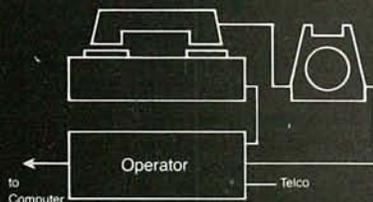
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