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VOLUME 160 NUMBER 2 AUGUST 1983

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE

ON THE COVER
The ParaPlane, test-piloted by PM Outdoors Editor Ray Hill, is the latest in ultrasimple, ultrasafe ultralight flying. Read about this exciting new license-free sport in the story beginning on page 66.
—PM photo by Howard Levy

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NEIL SHAPIRO

PM ELECTRONICS MONITOR

Cutting off a nose?

When the Texas Instruments TI-99/4 computer arrived on the scene, it was handicapped by a poor keyboard and didn't gain the proper respect in the marketplace. But reworked with a new keyboard and low price and designated the 99/4A, its sales have begun to soar. However, we wonder if TI's latest ploy will clip the wings again on this silicon bird.

The TI-99/4A is one of the many home computers which accepts programs in cartridge form. Just plug in the cartridge and go. No waiting for a tape to load, no hoping your 5-year-old doesn't flop your disks to death.

Other computers which use cartridges, such as the Atari 400/800/1200XL series, have begun to attract the attention of outside manufacturers. These secondary sources already are releasing their own brands of cartridges to run on these machines. And the computer doesn't care who made them. It just accepts the programs. Because of this, the market for Atari cartridges is heating up, with lots of competition. And the consumer benefits from the larger choice.

That's how Atari is handling things. But the folks at Texas Instruments want to keep the 99/4A's cartridge market all to themselves. They've redesigned the innards of TI cartridges and won't license the new design to any other manufacturer.

A spokesman for TI maintained that the company is doing this to "preserve our image." By limiting all cartridge manufacture to itself, TI feels it can make certain only worthwhile games and other programs are published in cartridge form, though it still has no control over tape or disk. The same spokesman pointed out that it makes "attractive" offers to programmers.

This is the first time a computer company has modified its machine's design in order to *limit* the marketplace. Usually, things are the other way around, with the computer manufacturers actually courting the software makers.

Because of the way computers are designed, any manufacturer could do what TI is doing. It would even be possible to limit a machine's access to tapes and disks to specific brands.

Will this strategy pan out, as TI obviously hopes it will, into a gold mine for them and quality assurance for their customers? Or will it backfire and leave the TI computer stranded on a lonely island of its own devising? It will be an interesting experiment to watch.

VHS sounds off

With the announcement of Beta Hifi, it seemed that videotape format might be one up on its VHS-format competition. After all, the new Beta-style tapes delivered super sound, just about as good as digital.

Recently, Matsushita (Panasonic) announced VHS Stereo High-Definition Sound. Basically, it's a means of running videotape through the machine faster to achieve just about top-of-the-line, audio-equipment sound.

The only drawback seems to be that a fast High-Definition Sound tape only plays on a specially equipped VHS machine. The Beta method, on the other hand, is compatible with older models, at least on the picture side. As usual, no one in the industry has even thought of standardization.

Power to the chip

Most chips—integrated circuits—hook up to power levels of around 5 v. The voltages that they switch are usually present just to run the chip itself. But now there are chips capable of handling very high voltage levels.

These new chips don't carry computer data. Instead, they replace full-size transformers. And, as amazing as that sounds, these super chips may bring about a future even more amazing.

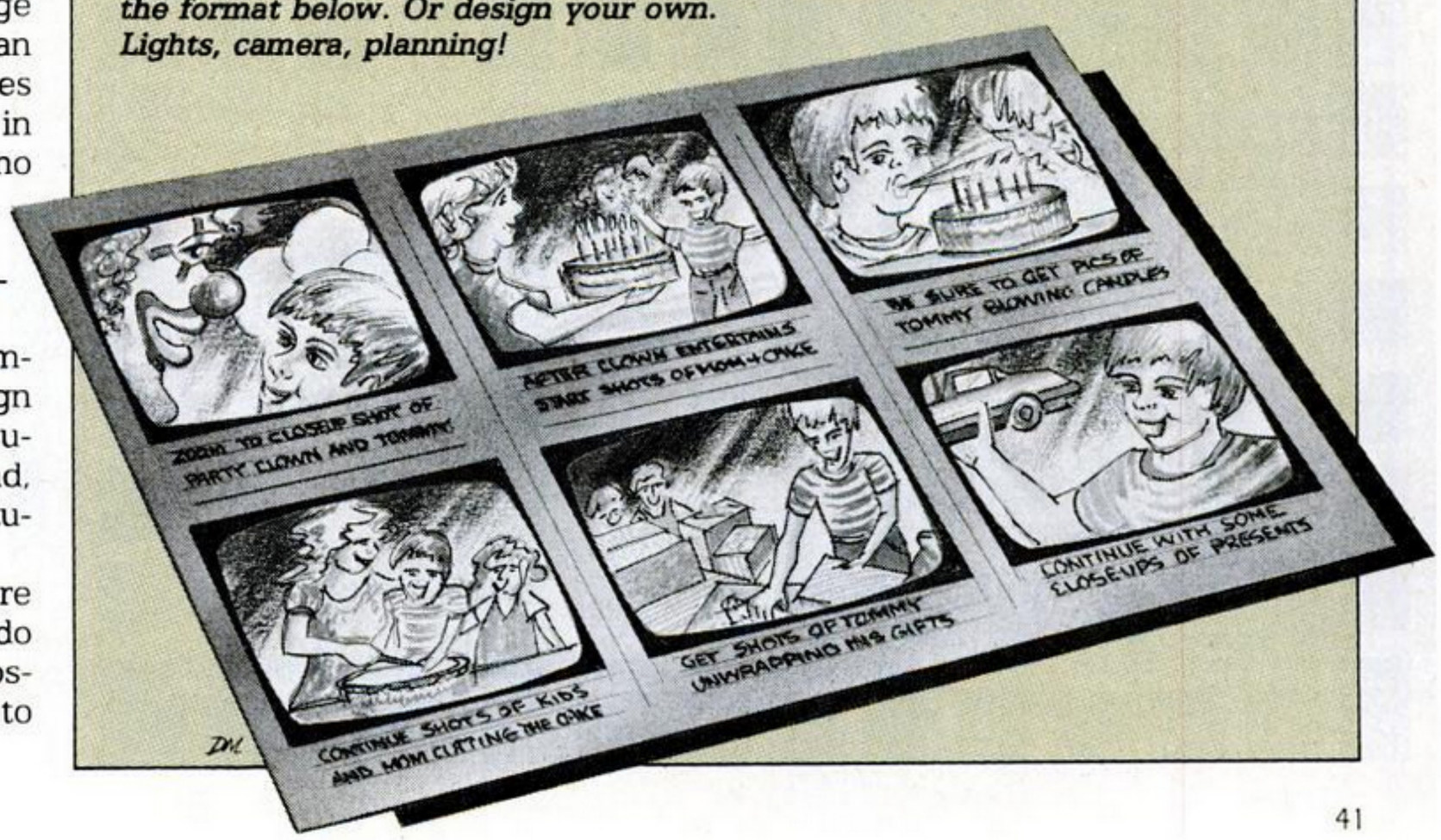
Inside the power chips (designed by Siliconix Inc.) are thousands of microscopic, insulated metal forks, each with two tines. These tiny forks are interspaced so that they spread the power and heat over a large area and can handle voltages high enough to run a toaster or small stove.

But the real applications for these power-switching chips may be found in such things as wall-size and flat-screen TVs, wrist transmitters with power to reach a satellite, and computers far smaller and cheaper than they are now.

The transistor was a revolutionary development. We can't say if the power chip will be in the same class, but it wouldn't be a surprise. PM

Scripting Words And Pictures

When you're shooting a three-minute Super-8 movie, you can usually get away with shouting instructions: "Come on guys, do something." But a half-hour videotape may require you to do a storyboard. Just sketch out scenes and suggested action, even dialogue, in the format below. Or design your own. Lights, camera, planning!



COMPUTER HARDWARE

Choosing The Computer That's Right For You

There are so many computers on the market, at so many prices, that it's easy to get lost in a storm of claim and counterclaim. Here's straight talk on how to buy a computer that's right for you.

Everyone wants you to get personal with computers. If you're ready to buy, perhaps you've realized that ads really don't give you all the specs on personal computers, or, as they're also called, microcomputers. Yes, it's true that these machines can do wonders. With one, you can balance a checkbook, keep track of a monthly budget, control appliances in your house, file recipes and keep reminders of birthdays. They are powerful pieces of equipment. But it makes little sense to spend thousands of dollars for a machine to file recipes or balance your checkbook when you can spend only a few hundred and accomplish the same things. If you're interested primarily in games, then it also makes little sense to spend a fortune for a microcomputer.

So, what should you do? First, consider the reasons you'll be buying the machine. Will you be using it to learn, play games, keep track of household records and finances, or for business purposes? When you've considered the reasons, the next step is to wade through all the conflicting claims. You're going to need patience and persistence to find the machine that's right for you.

For the first-time buyer who's interested in learning about what makes a computer and programming tick, a good buy is the Timex 1000 or Commodore VIC-20. With both, there are programmed instruction courses which will lead you through the ins and outs of programming and computers.

If your primary interest is in simple game playing, with a minor amount of personal computing on the side, then any of the low-cost home computers,

such as the Texas Instruments TI-99/4A, Radio Shack TRS-80 Color Computer or, again, the VIC-20 would be the ticket. These systems feature enough expandability to satisfy most demands and they can become flexible learning machines. You should be able to live with cassette program input, using your TV as the video output device.

However, if you're more serious about applying a computer to a variety of home, game, learning or business tasks, then consider machines such as the Apple IIe, Commodore 64 or IBM Personal Computer, all with at least one disk drive for storage. Microcomputer disks speed up program loading and are far more convenient to use and store than cassette tapes. There's a wide variety of software and hardware, including remote appliance control, telephone communications and electronic diagnostic work.

Top-of-the-line computer systems like those here provide plenty of power. Text and charts detail why you might choose the Radio Shack Model 100 (for its portability), IBM-PC (for expandable memory), or Apple IIe (for high-resolution color), to cite a few examples.

PM photos:
Bill Ashe

For the serious computerist, a second drive is a must. It eliminates the need to switch disks constantly in and out of one drive. Memory expansion, to the maximum your budget will allow, is also a good idea.

If you want color graphics, then consider a color monitor and color driver card (if needed). This is especially important in statistical analysis work. However, these extra options will boost the cost of the basic machine well over $3,000 in many instances.

In all cases, if you want to learn more about the computer, be sure it is programmable in BASIC. This way, you'll be able to write your own programs.

Here's a more detailed look at some of the systems on the market.

$100 to $500

You'll find two types of microcomputer in the $100 to $500 range—the calculator-style machine (for less sophisticated business uses) and the learning/home/games machine.

In general, the calculator-type microcomputer is more limited in its functions than the learning/home/games machine. Typically, it will interface with some type of mass storage system, such as a cassette recorder, for storing program data, and it will use a one-line liquid crystal display to show the results of a programming effort. These machines have only limited amounts of memory and are best used for engineering tasks and as learning tools. Although their attributes vary somewhat, their keyboards are arranged in typewriter style and some of them also

SYSTEMS FROM $100 TO $500

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
ATARI	Atari 400	$299	Home	Membrane	TV	16K (expandable)	BASIC ASSEMBLER PILOT	Games/Home
COMMODORE	VIC-20	$200	Home	Typewriter	TV	5K (expandable)	BASIC	Games/Home
MATTEL	Aquarius	$200	Home	52 calculator-type keys	TV	12K (expandable)	BASIC	Games/Home Learning
MULTITECH ELECTRONICS	MPF II	$399	Home	48 calculator-type keys	TV	90K	BASIC	Games/Home
PANASONIC	JR-200	$350	Home	65 calculator-type keys	TV	48K	BASIC	Games/Business Home/Learning
RADIO SHACK	TRS-80 Pocket Computer 1	$128	Home/ Bus.	65 mini-keys	24-char. LCD	1,424-step	BASIC	Games/Business
	TRS-80 Pocket Computer 2	$200	Home/ Bus.	65 mini-keys	24-char. LCD	4K-12K (expandable)	BASIC	Games/Business
	TRS-80 Pocket Computer 4	$70	Home/ Bus.	63 mini-keys	10-char. LCD	5K (expandable)	BASIC	Games/Business
	TRS-80 color	$400	Home	52 calculator-type keys	TV	24K (expandable)	BASIC LOGO ASSEMBLER PILOT	Home Learning Business
SHARP	PC-1211	$160	Home/ Bus.	65 mini-keys	24-char. LCD	1,424	BASIC	Games/Business
SHARP	PC-1500	$220	Home/ Bus.	65 mini-keys	24-char. LCD	3.5K (expandable)	BASIC	Games/Business
SPECTRA VIDEO	SV-318	$230	Home	65 calculator-type keys	TV	64K	BASIC FORTRAN COBOL	Games/Business Home/Learning
TEXAS INSTRUMENT	TI-99/2	$100	Home	Plastic type	TV	31K	BASIC	Home/Games Learning
	TI-99/4A	$375	Home	Typewriter	TV	16K (expandable)	BASIC ASSEMBLER LOGO	Home/Learning
TIMEX COMPUTER	1000	$70	Home	Membrane	TV	9K (expandable)	BASIC	Games/Learning
	2000	$150	Home	40 calculator-type keys	TV	32K (expandable)	BASIC	Home/Games
VIDEO TECH	VZ-200	$100	Home	46 calculator-type keys	TV	16K (expandable)	BASIC	Home
	Creativision	$159	Home	Membrane	TV	16K (expandable)	BASIC	Games/Home Learning

SYSTEMS FROM $500 TO $1,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
ATARI	Atari 800	$649	Home	61 keys	TV	16K	BASIC	Home/Games Learning
COMMODORE	Commodore 64	$595	Home/ Bus.	65 keys	TV	64K	BASIC FORTH PILOT LOGO	Home/Games Learning/Bus.
	Commodore 64	$994	Home/ Bus.	64 keys	TV	64K (disk drive included)	BASIC	Home/Business Games/Learning
EPSON-AMERICA	HX-20	$795	Home/ Bus.	64 keys	TV	64K	BASIC	Business
NEC	PC-8001	$995	Home/ Bus.	84 keys	TV/ CRT	32K	BASIC FORTRAN PASCAL	Home/Business Games/Learning
PANASONIC	RL-H1000	$500	Home/ Bus.	65 mini-keys	24-char. LCD	2K	BASIC	Home/Business
	RL-H1400	$600	Home/ Bus.	65 mini-keys	24-char. LCD	4K	BASIC	Home/Business
RADIO SHACK	TRS-80 Model III	$999	Home/ Bus.	65 keys	Built-in CRT	16K	BASIC	Home/Business Games/Learning
	TRS-80 Model 100	$799	Home/ Bus.	Standard	LCD	8K	BASIC	Home/Business

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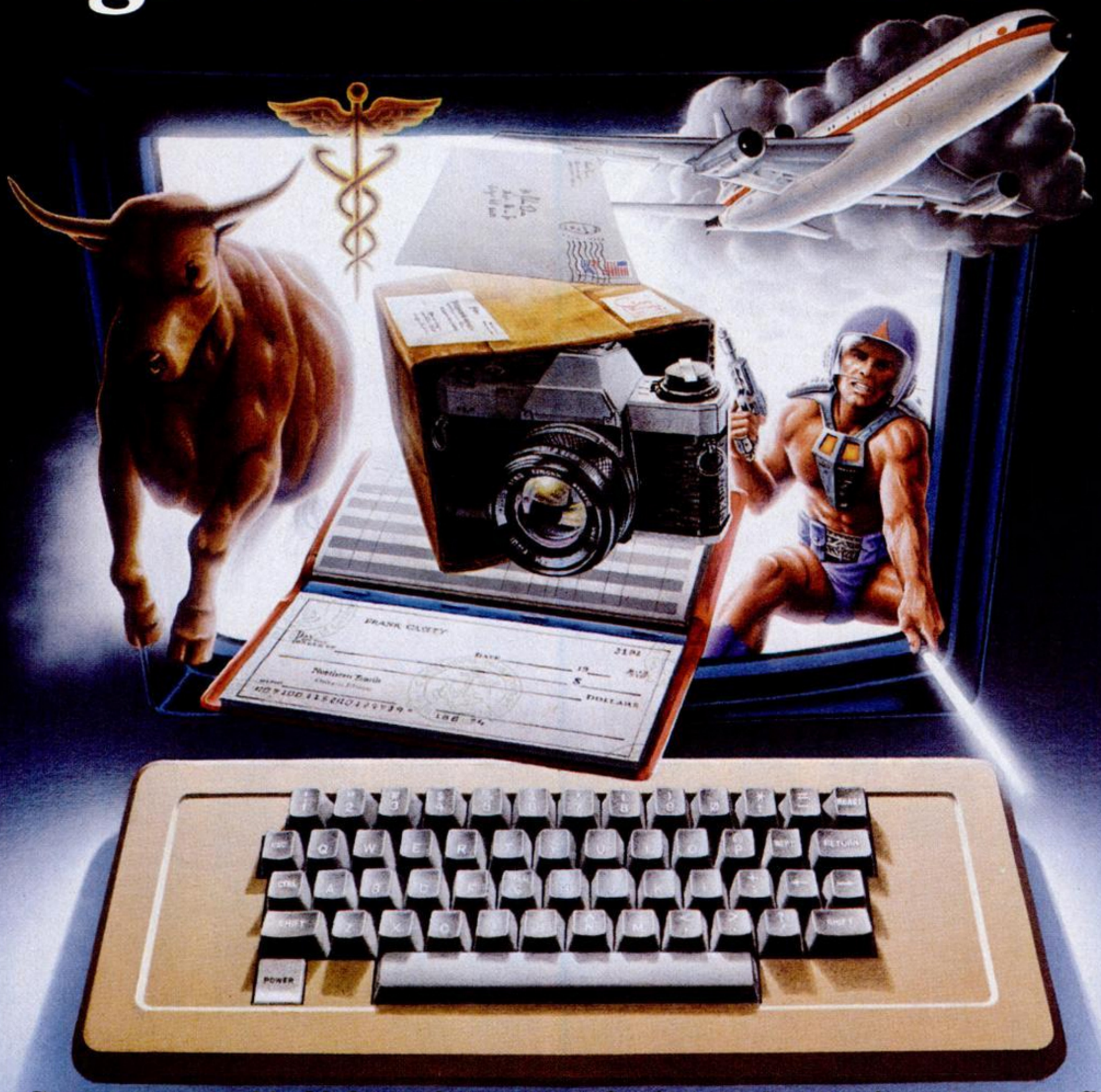

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feature built-in calculator keyboards.

Learning/home/games machines include the Atari 400, Commodore VIC-20, Timex 1000, Video Technology VZ-200, Mattel Aquarius, Video Technology Creativision, Multitech Electronics Micro Professor MPF II, TI-99/4A, Panasonic JR-200, Timex 2000 and Radio Shack TRS-80 Color Computer. These machines are programmable in BASIC and have keyboards ranging from plastic membrane-style to full typewriter-style. They can all be expanded into much more powerful systems and they use your television set for display.

$500 to $1,000

Stepping up in bucks allows you to choose from a wide variety of microcomputers. They range from the calculator-style Panasonic RL-H1000 and RL-H1400 to the briefcase-style Radio Shack TRS-80 Model 100 and Epson HX-20 to such home/business machines as the Radio Shack TRS-80 Model III or the Commodore 64.

The new breed of briefcase-style computers deserves special comment. Actually self-contained, these units have full typewriter keyboards and use liquid crystal displays. Interestingly, the Radio Shack unit uses a multiline LCD, which makes it into a full, portable business system.

Learning machines also have their place in this price range. The Atari 800 is more powerful and flexible than the 400 and has more versatility because of its typewriter-style keyboard. It can be used both as a learning tool and as the basis of a powerful home system.

Some powerful home/business systems have their origins in this price category. They include the Commodore 64, Panasonic RL-H1000 and Radio Shack TRS-80 Model III. These machines are capable of handling not only household chores, but also such business tasks as word processing. They have expandable memories, which means they can handle more complex routines and feature the ability to use disk drives for mass storage. The TRS-80 Model III includes its own display tube in a single enclosure.

$1,000 to $2,000

Here the home machines get down to business. Serious business. Key-

SYSTEMS FROM $1,000 TO $2,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
APPLE	Apple IIe	$1,395	Home/ Bus.	Typewriter	TV	64K	BASIC	Home/Learning Business/Games
	Apple IIe	$1,990	Home/ Bus.	Typewriter	TV/ CRT	64K (disk drive included)	BASIC LOGO	Home/Learning Business/Games
ATARI	1200XL	$1,395	Home/ Bus.	60 keys	TV	64K	BASIC PILOT	Home/Business
COMMODORE	Commodore 64	$1,785	Home/ Bus.	64 keys	TV/ CRT	64K (2 disk drives included)	BASIC	Home/Games Business
HEATH	H-89	$1,399	Home/ Bus.	84 keys	Built-in b&w CRT	48K (disk drive included)	BASIC FORTRAN PASCAL	Home/Business
IBM	IBM-PC	$1,335	Home/ Bus.	83 keys	TV	64K	BASIC COBOL FORTRAN P-SYSTEM ASSEMBLER	Home/Business Learning/Games
NON-LINEAR SYSTEMS	Kaypro II	$1,795	Business (portable)	62 keys	Built-in 9" CRT	64K (2 disk drives included)	BASIC	Business
OSBORNE	Osborne I	$1,795	Business (portable)	81 keys	Built-in 5" CRT	64K (2 disk drives included)	BASIC	Business
RADIO SHACK	TRS-80 Model III	$1,849	Home/ Bus.	65 keys	Built-in b&w CRT	48K (disk drive included)	BASIC CP/M COMPATIBLE	Home/Learning Games/Business

SYSTEMS FROM $2,000 TO $3,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
APPLE	Apple IIe	$2,385	Home/Bus.	Typewriter	TV/CRT	64K (2 disk drives included)	BASIC	Home/Learning Business/Games
BASIS	Basis 108	$2,150	Home/Bus.	Typewriter	CRT	64K (disk drive included)	BASIC	Home/Business
COMMODORE	Commodore 64	$2,084	Home/Bus.	64 keys	TV/CRT (Color CRT added)	64K	BASIC	Home/Business Games
COMPAQ	Compaq	$2,995	Home/Bus. (portable)	IBM-PC style	CRT	64K (disk drive included)	BASIC FORTRAN COBOL PASCAL	Home/Business
EPSON-AMERICA	QX-10	$2,995	Home/Bus.	Typewriter	CRT	64K (disk drive included)	BASIC	Home/Business
HEATH	H-89	$2,294	Home/Bus. (kit)	84 keys	Built-in b&w CRT	48K (2 disk drives included)	BASIC FORTRAN	Home/Business
IBM	IBM-PC	$2,104	Home/Bus.	83 keys	TV	64K (disk drive included)	BASIC COBOL FORTRAN PASCAL	Home/Business Learning/Games
	IBM-PC	$2,784	Home/Bus.	83 keys	CRT added	64K (disk drive included)	BASIC	Home/Business Learning/Games
RADIO SHACK	TRS-80 Model III	$2,295	Home/Bus.	65 keys	Built-in b&w CRT	48K (2 disk drives included)	BASIC	Home/Business Learning/Games
TEXAS INSTRUMENTS	Professional Computer	$2,595	Home/Bus.	Typewriter	CRT	64K (disk drive included)	ASSEMBLER FORTRAN COBOL PASCAL	Home/Business
ZENITH DATA	Z-100	$2,899	Home/Bus.	108 keys	CRT	28K (disk drive included)	BASIC	Home/Business

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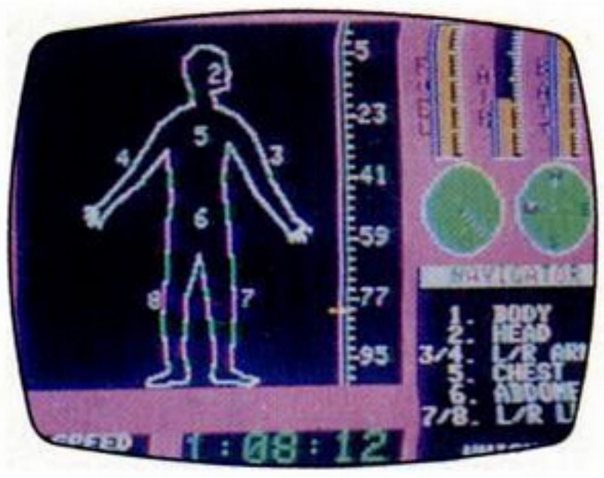

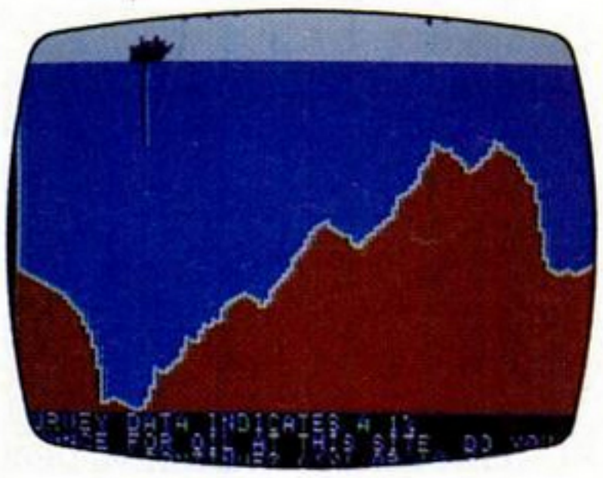

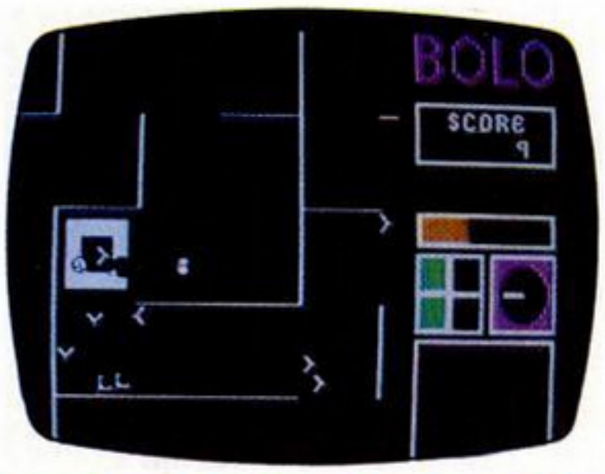

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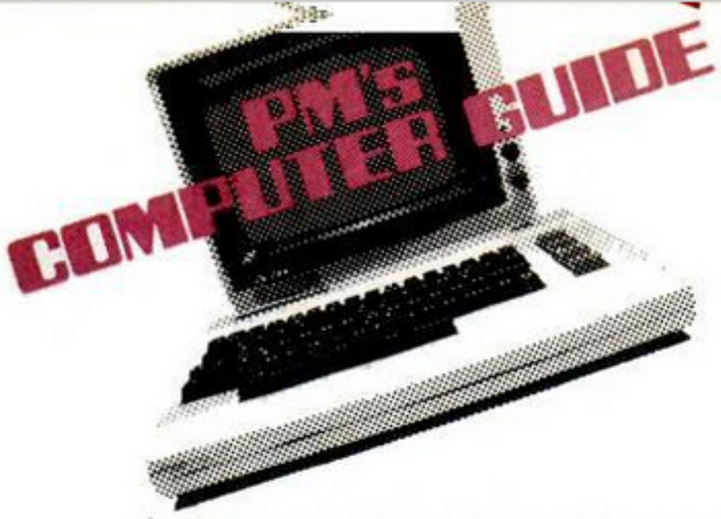


boards, for instance, now feature standard typewriter keys rather than calculator-type keys, plastic mini-keys or membranes.

Powerful systems such as the Apple IIe and the IBM Personal Computer are in this category along with the full-feature portables. Atari also has a more powerful home computer in this price range, the 1200XL, which includes a disk drive. This machine can be used for business, home, games and learning.

All-in-one computers abound in this price classification. They're split between the traditional-looking computer workstation-type units such as those from Radio Shack and portables. These machines feature large amounts of memory, full keyboards, possibly a disk drive or two and a built-in video display device. They can handle such tasks as business bookkeeping and planning, as well as word processing.

Portable microcomputers are relatively new. They are sold as full-feature systems consisting of two disk drives for storage, complete business software, video display tube and cabinet.

$2,000 to $3,000

It's in this category that microcomputers become truly professional systems, as memory and functions combine to produce machines which are capable of handling complex tasks. Here, machines generally include about 64,000 bytes of memory (64K). These machines nearly always include one or two disk drives for mass storage.

Four machines are worth closer examination.

The first one is from Texas Instruments—the Professional Computer. At $2,595, this machine includes one disk drive, has a full-travel, typewriter-style keyboard and is programmable in high-level languages. Another powerful system is Epson-America's QX-10, aimed primarily at the home/business user. It includes a special word processing and financial program called Valdocs, and one drive. The QX-10 is a total package, capable of handling a budget, personal letter or business books. A powerful portable is the Compaq, an IBM-PC compatible unit, which uses the same type of software and hardware as the PC. It is aimed primarily at the business user. A PC workalike, the new Zenith Z-100 is in this price category, too. With one drive, it's equipped to be programmable in BASIC and can handle both business and home tasks.

$3,000 and up

The personal computers over $3,000 usually include two drives in the total package.

The machines are fully decked out and can handle tasks requiring large amounts of data storage. The Apple IIe and the IBM-PC with two drives each would be examples of computers in this price range. The machines here use video display monitors, and they can perform graphics functions. Generally, these machines are aimed at the business market rather than at the home user.

When you go over the $4,000 mark, you'll find the all-business machines such as the IBM-XT (Extended), Zenith Z-100 and Radio Shack's TRS-80 Model 16. This group includes far more memory and advanced capabilities than the average home or small business would normally need.

Now, use our charts to find your own dream machine. **PM**

SYSTEMS FROM $3,000 TO $5,000

Manufacturer	Model	Price	Market	Keyboard	Display	Memory	Language	Applications
BASIS	Basis 108	$3,085	Business	Typewriter	CRT	64K (2 disk drives included)	BASIC	Home/Business
COMPAQ	Compaq	$3,599	Home/Bus. (portable)	IBM-style	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL PASCAL	Home/Business
DIGITAL EQUIPMENT	Rainbow 100	$3,495	Home/Bus.	84 keys	CRT	64K (2 disk drives included)	BASIC C	Home/Business
	Professional 325	$3,995	Business	103 keys	CRT	256K (2 disk drives included)	COBOL CROMIX RATFOR FORTRAN	Business
	DECMate II	$3,740	Business	103 keys	CRT	256K (2 disk drives included)	PASCAL CP/M	Business
IBM	IBM-PC	$3,363	Home/Bus.	83 keys	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL PASCAL	Home/Business Games/Learning
	IBM-PC-XT	$4,995	Home/Bus.	83 keys	CRT	131K (2 disk drives included)	BASIC COBOL FORTRAN PASCAL	Home/Business Learning/Games
KAYPRO	Model 10	$3,000 (est.)	Home/Bus. (portable)	71 keys	CRT	10-Mb hard disk (included)	BASIC	Business/Home
NORTH STAR	Advantage	$3,999	Business	87 keys	Built-in CRT	64K (2 disk drives included)	BASIC	Business
RADIO SHACK	TRS-80 Model 12	$3,199	Business	82 keys	Built-in b&w CRT	80K (disk drive included)	BASIC	Business
	TRS-80 Model 12	$3,999	Business	82 keys	Built-in b&w CRT	80K (2 disk drives included)	BASIC	Business
	TRS-80 Model 16	$4,999	Business	76 keys	Built-in CRT	128K (2 disk drives included)	BASIC	Business
TEXAS INSTRUMENTS	Professional Computer	$3,100	Home/Bus.	Typewriter	CRT	64K (2 disk drives included)	BASIC FORTRAN COBOL	Home/Business
ZENITH DATA	Z-100	$4,099	Home/Bus. (all-in-one)	108 keys	CRT	128K (2 disk drives included)	BASIC	Home/Business

are hidden behind the recessed kick panel.

Our workstation is easy to build. The sides of each unit are higher than the tops, so that you have only a simple butt joint to make. There are no curves to cut, and all of the major surfaces—the tops, sides and backs—are formed from a single piece. All hardware is available at any hardware store.

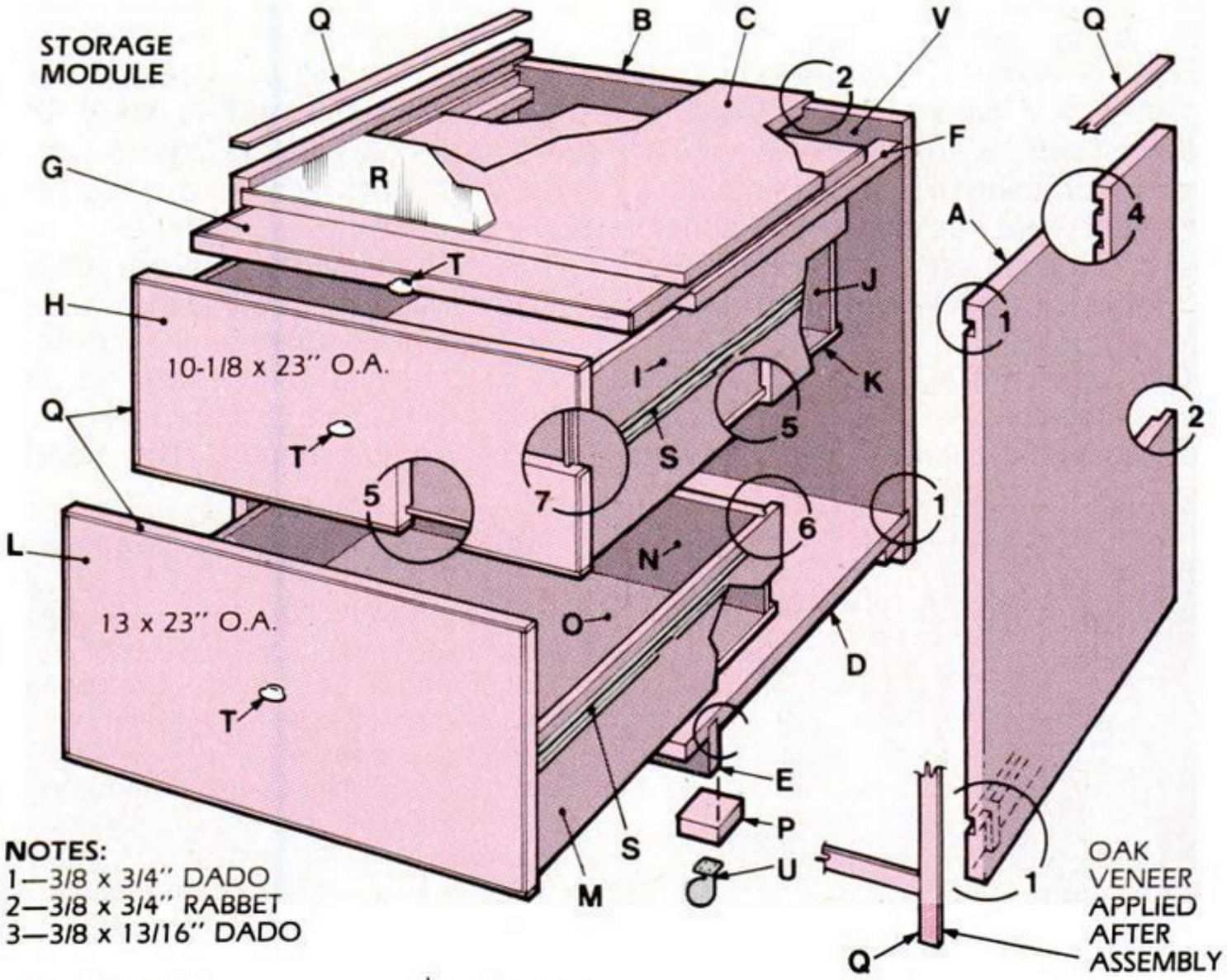
We built our workstation of oak cabinet grade plywood with Formica brand plastic laminate tops. You could use solid hardwood or solid pine throughout, but costs will mount. Painted plywood would make a functional substitute. Don't use an oil finish for surfaces which may come in contact with floppy disks. Laminate is best, though polyurethane varnish or paint are okay.

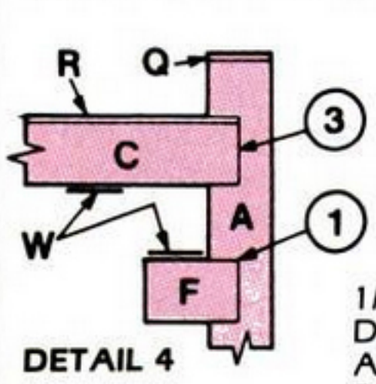
With our ergonomic guidelines, you'll end up with furniture that's as advanced as the computer it holds. **PM**

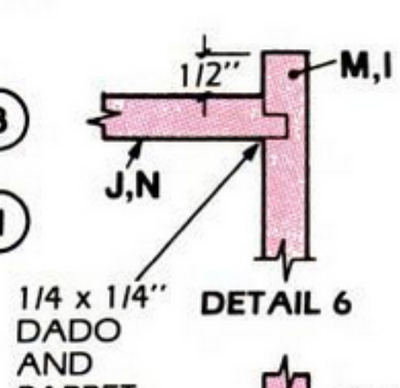
MATERIALS LIST—STORAGE MODULE

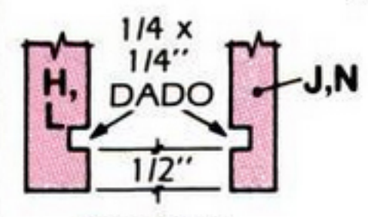
Key	No.	Size and description (use)
A	2	3/4 × 29 × 30" oak veneer plywood (side)
B	1	3/4 × 24 × 27 7/8" particleboard (back)
C	1	3/4 × 24 × 30" particleboard (top)
D	1	3/4 × 24 × 29 5/8" particleboard (bottom)
E	1	3/4 × 2 5/8 × 24" oak veneer plywood (kick)
F	2	3/4 × 1 1/8 × 28 1/8" pine (shelf support)
G	1	3/4 × 23 × 29" oak veneer plywood (pull-out shelf)
		UPPER DRAWER
H	1	3/4 × 10 × 23" oak veneer plywood (front)
I	2	1/2 × 9 1/4 × 19" lauan mahogany plywood (side)
J	1	1/2 × 8 1/2 × 21 3/4" lauan mahogany plywood (back)
K	1	1/4 × 18 1/2 × 21 3/4" lauan mahogany plywood (bottom)
		LOWER DRAWER
L	1	3/4 × 12 7/8 × 23" lauan mahogany plywood (front)
M	2	1/2 × 6 3/4 × 19" lauan mahogany plywood (side)
N	1	1/2 × 6 × 21 3/4" lauan mahogany plywood (back)
O	1	1/4 × 18 1/2 × 21 3/4" lauan mahogany plywood (bottom)
P	4	3/4 × 3 1/2 × 3 1/2" plywood (mounting block)
Q		1/16" oak veneer
R		1/16 × 24 × 30" plastic laminate*
S	2 pr.	18" full extension drawer slide
T	3	Brass drawer pull
U	4	Caster
V	2	3/4" No. 8 rh screw (adjusting screw)

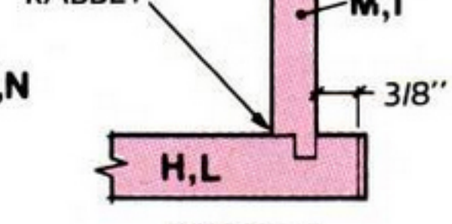
Misc: Carpenter's glue, linseed oil, paste wax, contact cement.
*Formica brand plastic laminate, tidal sand No. 917.

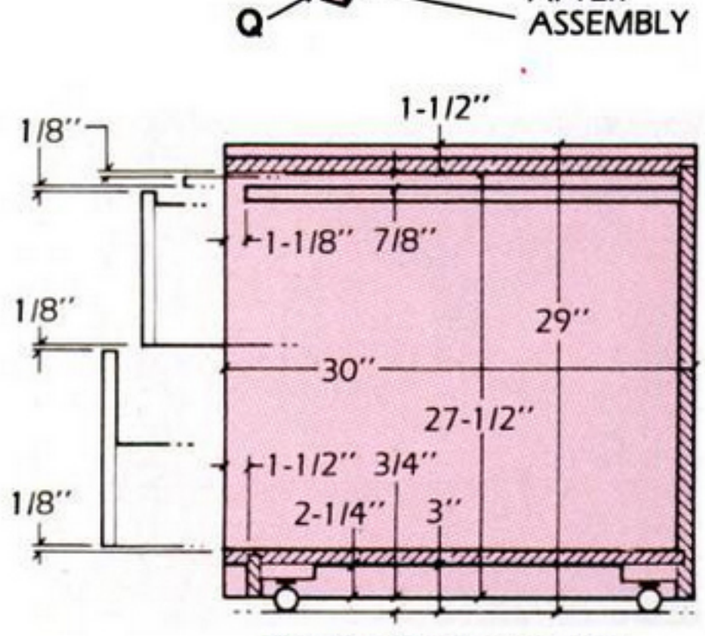












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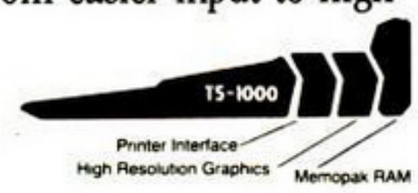
If you own a TS-1000 or ZX-81 computer and want to bring out the power within it, you'll want Memotech. From easier input to high quality output and greater memory, Memotech makes the add-ons you demand. Every Memotech peripheral comes in a black anodized aluminum case and is designed to fit together in "piggy back" fashion enabling you to continue to add on and still keep an integrated system look.



MEMOPAK RAM All Memopak RAMs are directly addressable, user transparent, are neither switched nor paged and no additional power supply is required. You can also choose the Memopak RAM which is just right for your needs. From economy to power. **16K RAM** The Memopak 16K RAM is the most economical way to add memory to your TS-1000. It is fully compatible with the Timex or Memotech 16K RAMs to provide you with up to 32K of RAM. The 16K RAM also offers additional add-on capabilities through its "piggy back" connection. **32K RAM** The 322K Memopak enables you to execute sophisticated programs and store large data bases and like the 16K RAM is fully compatible with Timex's or Memotech's 16K RAMs to give you a full 48K of RAM. **64K RAM** The 64K Memopak is powerful enough to turn your TS-1000 into a computer with capabilities suitable for business and educational use. It accepts such BASIC commands as 10 DIM A (9000). **MEMOCALC** Memocalc, our spreadsheet analysis software, enables TS-1000 users to perform complex number crunching routines with ease. With the 64K RAM a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Quick revisions can be achieved by entering new data to your formula.

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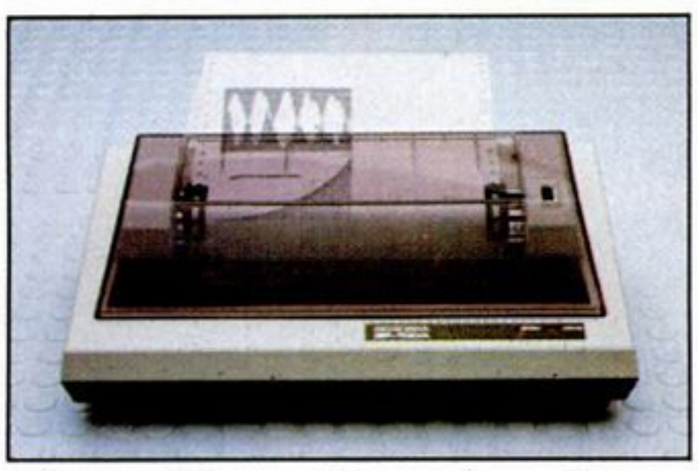
CENTRONICS PARALLEL AND RS232 INTERFACES Memotech's Interfaces enable your TS-1000 to use a wide range of compatible printers. The resident software in the units gives the complete ASCII set of characters. Both Memopak Interfaces provide lower case character capabilities and up to 80 column printing. The RS232 Interface is also compatible with modems and terminals.

SEIKOSHA GP 100A PRINTER The Seikosha GP 100A uses a 5x7 dot matrix printing format with ASCII standard upper and lower case character set. Printing speed is 30 characters/second with a maximum width of 80 characters. The printer uses standard fanfold paper up to 9-1/2 inches wide. The GP 100A is offered as a package including cable and interface. Other printer packages are also available through Memotech.



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RS232 Interface	99.95		
Printer Cable	19.95		
GP 100A Printer Package**	399.00		
Shipping and Handling	4.95		$ 4.95
Tax (Colorado residents only)			
TOTAL			$

*All prices quoted in U.S. dollars. Prices and specifications subject to change without notice.
**Please add an additional $5.00 for printer shipping charges.
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COMPUTER SOFTWARE

Programs Solve 'What Ifs'

Ever since *Visicalc,* computers have offered users the power to juggle their finances. Latest programs in this category are better than ever.

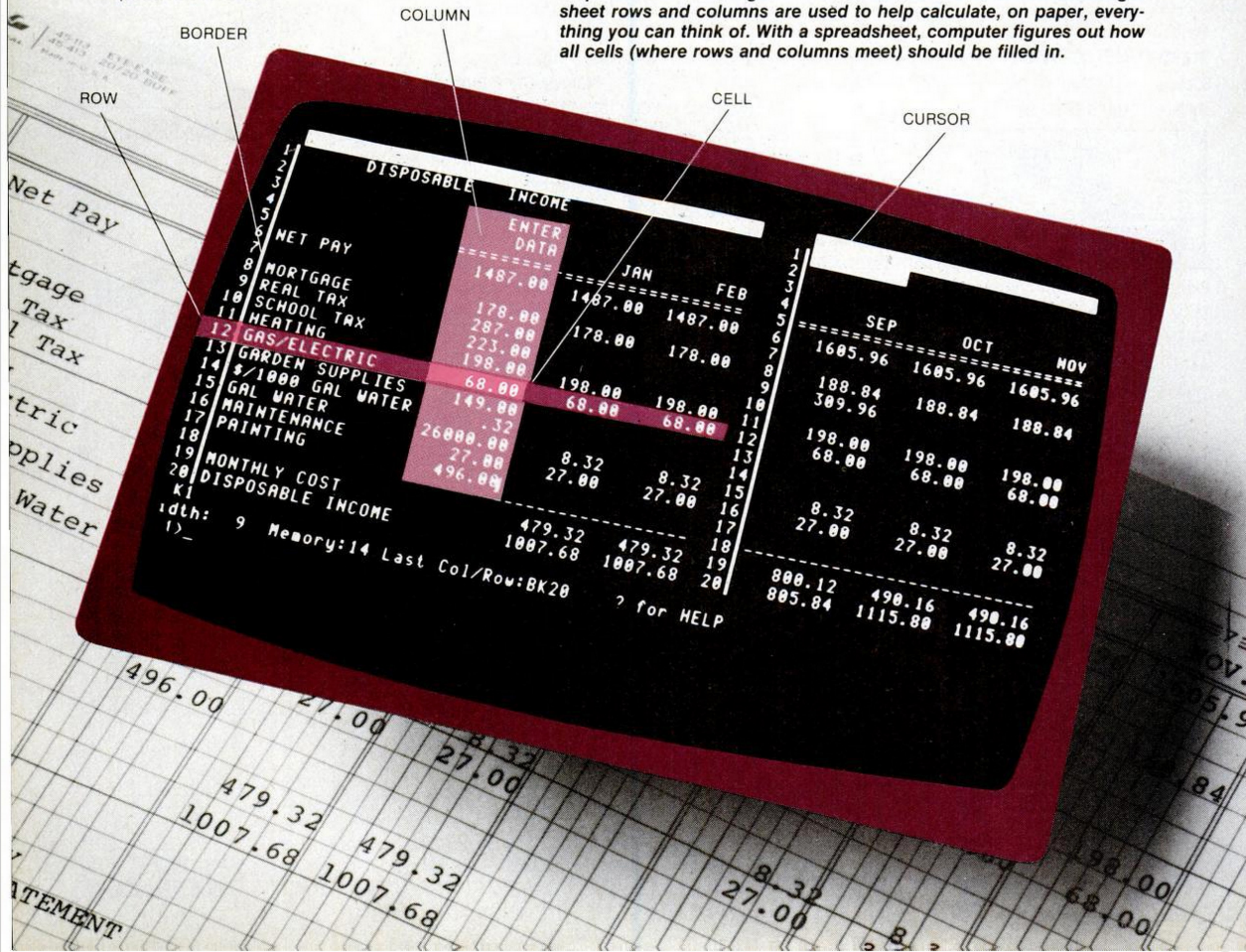
Will a new heating system for your home really pay for itself in two years? Is it practical to make major repairs to your car or should you trade it in for a new model? Will new machinery for your business increase profits? How much will your savings be worth when you retire?

Solving "What if . . . ?" problems is precisely the kind of thing computers do best. Plug in the right numbers to the right kind of program and the computer will run forever, if necessary, printing out every conceivable answer to your questions. It will give you 10, 20, 30 or more hypothetical answers to "What if . . . ?" in even less time than it would take you to write the problem down on paper.

The computer software that answers your "What if . . . ?" questions is called an *electronic spreadsheet,* and is best known under such names as *Visicalc, MultiPlan, Supercalc, Target, VU-Calc,* and innumerable other variations of *". . . Calc."*

Visicalc, Supercalc, and the other *Calc* programs are electronic representations of the accountant's spreadsheet, a large paper on which a pattern of rows and columns form a grid of boxes called cells. On a spreadsheet, the accountant calculates the cash flow of a family, business, or whatever he is working on. The data in a cell, whether a value or a mathematical formula, can be made dependent on the data in other cells. A variation in the data of just one cell can ripple through many others. So,

PM photos: Herb Friedman



A spreadsheet is a ledger sheet transferred to a video screen. Ledger sheet rows and columns are used to help calculate, on paper, everything you can think of. With a spreadsheet, computer figures out how all cells (where rows and columns meet) should be filled in.

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as you might imagine, it takes a lot of erasing and recalculation of values each time the information in a single cell is changed.

The format of the electronic spreadsheet closely resembles the paper version. There are labeled rows and labeled columns, and the intersections of the rows and columns create cells. Formulas, values and even titles are entered into the cells through the keyboard. But unlike the paper spreadsheet that requires much erasing to plot the effect of changing the data in a cell, the electronic spreadsheet can recalculate all the affected cells almost instantly. The user can actually see the changes ripple through the cells row by row *and* column by column.

Video worksheets

The "sheet" of cells filled with titles, values and formulas is called a *worksheet.* As a general rule, the size of the worksheet is much greater than what can be shown on a video screen, so the screen functions as a window that can be positioned on any part of the worksheet. Depending on the specific type of Calc program, it's possible to combine widely different areas of a worksheet on the video screen, create a video display that combines sections from other worksheets, and even get a printout of combined worksheets.

If you don't care to prepare your own worksheets, you can obtain prewritten worksheets on a floppy disk. These worksheets are called templates and are available from several sources for both home and business applications. The templates contain all the needed formulas to manipulate your own set of figures. They can save you many hours of work.

There is some form of Calc software which will run on just about every computer. The precise features, such as the size of the worksheet, the mathematical operators and the on-screen prompts, depend on the particular computer, the available computer memory and, of course, the software. Surprisingly, features or convenience of operation have nothing to do with price or anything else.

For example, the program *VU-Calc* for the Timex computer sells for less than $20. It provides a worksheet of 26 rows by 36 columns (936 cells). It's not a large sheet by any means, but it will run in only 16K of RAM (Random Access Memory). It has a superb screen display that's particularly effective for beginners and, while it has only the simple mathematical operators of addition, subtraction, multiplication and division, it has many of the cell functions of the more expensive, better known Calc programs.

Unfortunately, because *VU-Calc* is loaded into the computer from cassette tape, it's slow. It takes almost three minutes just to load the program, close to five minutes to load a saved version of a worksheet.

The most common forms of Calc software, such as *Visicalc* and *Supercalc,* provide a worksheet of nominally 63 columns by 255 rows, or more than 16,000 cells. They are intended to run in computers having from 32K/48K to 64K of RAM. In addition to larger worksheets, these spreadsheet programs provide advanced mathematic operators and routines such as auto-summation of selected columns and rows, automatic calculation of NPV (Net Present Value), exponentiation, and the transcendental functions such as sine, cosine and tangent. They also provide the relational operators of *equal* or *not equal to, less than* and *greater than* (" " and " "), and If . . . Then . . . Else.

There are, of course, many differences between spreadsheet programs, even when, on the surface, they appear to provide similar features. For example, while the cell-by-cell construction—

	A	B	C	D	E
1			SAMPLE	SPREADSHEET	
2					
3		100%	120%	150%	200%
4		-------	-------	-------	-------
5	ENTER VALUE=>	1			
6					
7	ADD 2	3	3.6	4.5	6
8	ADD 2	5	6	7.5	10
9	ADD 2	7	8.4	10.5	14
10	ADD 2	9	10.8	13.5	18
11	----------	---------	--------	-------	--------
12					
13	TOTAL	24	28.8	36	48

	A	B	C	D	E
1			SAMPLE	SPREADSHEET	
2					
3		100%	120%	150%	200%
4		-------	-------	-------	-------
5	ENTER VALUE=>				
6					
7	ADD 2	(B5+2)	(B7*1.2)	(B7*1.5)	(B7*2)
8	ADD 2	(B7+2)	(B8*1.2)	(B8*1.5)	(B8*2)
9	ADD 2	(B8+2)	(B9*1.2)	(B9*1.5)	(B9*2)
10	ADD 2	(B9+2)	(B10*1.2)	(B10*1.5)	(B10*2)
11	----------	---------	--------	-------	--------
12					
13	TOTAL	SUM(B7:B10)	SUM(C7:C10)	SUM(D7:D10)	SUM(E7:E10)

Above are actual printouts of a spreadsheet program (*Supercalc*). Top shows figures as they would normally appear. Bottom shows formulas resulting in figures.

How A Spreadsheet Works

The two figures above are printouts of what you would see on the video screen while running a simple spreadsheet. This particular worksheet will take any number you enter and add 2 to it four times in a row. It will then multiply the four new numbers by varying percentages and display the results.

Take a look at Figure 1. The number 1 has been entered to the right of the line which says ENTER VALUE=. The spreadsheet program then automatically calculates all the other numbers.

For instance, the program first added 2 to 1 and got 3, which it displayed in the 100% column. Then it showed that 120% of 3 is 3.6, and so on for the next two percentages.

Automatically adding to existing numbers and taking percentages of the result is just one example of the thousands of operations you can write a spreadsheet template or worksheet to do. While such things as amortizing loans and doing complex ledgers call for sophisticated programming, it's all mainly a matter of practice.

Figure 2 shows some of the formulas that were devised to accomplish our sample task.

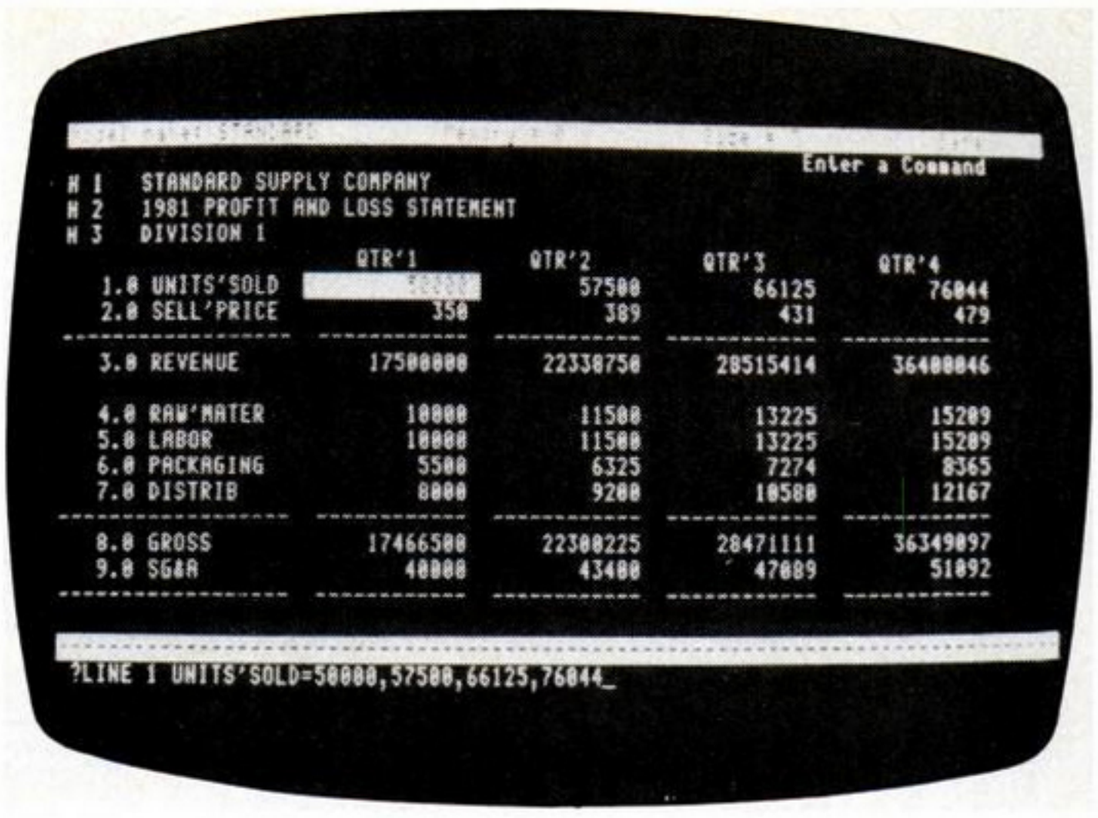
The entered value is typed in (as in Fig. 1) at the location where column B intersects Row 5. This is called *cell B5.* The first time the spreadsheet adds 2 to that value happens in column B, Row 7 or in *cell B7.*

The formula in cell B7 (again in Fig. 2) says B5+2. So, whatever value is in B5 will have 2 added to it and that new value will be displayed in B7.

So, if 1 (as shown) is typed into B5, the number 3 (as shown) appears in B7. But—and here is the real power of spreadsheets—if you typed 5 in B5, then 7 would appear in B7. Results change automatically as you enter new numbers.

So if you're doing a very complex budget, you can examine such things as what-if-the-rent-goes-up and see all the results right away. Spreadsheets make this kind of numbers management easy.

SuperCalc *from Sorcim (right) was one of the best Calc-style programs we looked at. Like* **MultiPlan** *and some other best bets, it enables the user to switch back and forth from the filled-in cells to programmed formulas.*



which was pioneered by *Visicalc* and later *Supercalc*—is the standard basic means of preparing a worksheet, *Target PlannerCalc* can be *programmed* rather than written cell by cell. Just typing the statement LINE 4 GROSS INCOME= 1000, 2000, 3000, 4000 will enter the title GROSS INCOME and all the pertinent information in the correct cells on row 4.

Window on the world

But rapid programming of data in cells isn't the only reason for the electronic spreadsheet's popularity. For many, the most important feature is the split window. The window is the small part of the spreadsheet seen by the video display. Splitting the window allows the user to compare results from different parts of the spreadsheet, or even parts or data from different spreadsheets. For example, a spreadsheet of a family's yearly net income month by month, used to determine when extra cash will be available—perhaps to purchase a washing machine or take a short vacation—can't fit on a screen because there are too many months for a screen display. It's simply too wide. But, it is possible to split the screen either vertically or horizontally so specific months can be compared side by side.

Until recently, Calc programs permitted one screen split—either horizontal or vertical. The latest versions of Calc software, such as *MultiPlan,* permit several splits, even bordered windows within the main window. *MultiPlan* permits up to *eight* such splits.

Choosing your Calc software

Calc software varies widely in price and features. Regardless of what you're willing to pay, it must run within your system and provide the operating features you need. The system limitation is RAM. There must be the minimum amount required by the software. But keep in mind that everything else is 100 percent expansion. That is, if the spreadsheet program and the DOS (Disk Operating System) are running in 32K RAM, leaving only 4K available for your spreadsheet, increasing the system RAM to 64K provides a full additional 32K for data, not just another 4K.

Then, consider how often you will use the software. If you use it frequently, say daily, you can easily remember the operating codes and you will have no real need for on-screen prompts. But assume you use the program infrequently. Remembering 20 to 30 or more codes isn't all that easy and on-screen prompts are a decided convenience. Although the on-screen prompts on the *prompt line* of *Supercalc* by Sorcim use only a single letter to represent a function or control code, they are easy to keep in mind because they are exactly the same prompts used by Sorcim's other software.

If prompts are hard for you to remember, or you use the software very infrequently, then the full-word menu-to-sub-menu on-screen prompts of something like *MultiPlan* might be what you need. All function prompts are always on-screen and in plain English. The user can either press a single letter key which represents the prompt, or move the cursor to the word describing the desired function.

Finally, consider if you plan to write a worksheet at all. It's a programming job that can take days, weeks or months to debug. There are many prewritten templates available. While some are for home and family use, most are for business. They include real estate management, engineering, even general payroll, including the printing of standard accounting forms.

Not every type of template is available for every Calc-type program. If you find a template that's suited to your particular use, you might want to buy the Calc program for which it was written. Remember, your own application is the most important consideration in purchasing Calc software. **PM**

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You get plenty of practical experience. Under NRI's carefully planned training, you even install a *disk drive* verifying at each step its operation. Using the NRI Discovery Lab® that also comes as part of your course, you build and study circuits ranging from the simplest to the most advanced. You analyze and troubleshoot using the professional 4-function LCD digital multimeter you keep to use later in your work. Then you use the lab and meter to actually access the interior of your computer...build special circuits and write programs to control them. You "see" your computer at work and demonstrate its power.

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NRI offers you the opportunity to train with the TRS-80 Color Computer as an alternative to the Model 4. The same technique for getting inside is enhanced by using the new NRI-developed Computer Access Card. Only NRI offers you a choice to fit your specific training needs.

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

Become the Complete Computer Person

In addition to training in BASIC and advanced machine language, you gain hands-on experience in the operation and application of the latest computers for both business and personal jobs. You're trained to become the fully rounded, new breed of technician who can interface with the operational, programming, and service facets of all of today's computers. You're ready to take your place in the new electronic age.

Other Opportunities

NRI has been giving ambitious people new electronic skills since 1914. Today's offerings also include TV/Audio/Video Systems servicing with training on our exclusive Heath/Zenith computer-programmable 25" diagonal color TV...Industrial Electronics, Design Technology...and other state-of-the-art courses.

The Catalog Is Free. The Training is Priceless.

Send the postage-paid card for our 104-page catalog showing all courses with equipment and complete lesson plans. There's no obligation other than to yourself. See how NRI can help you take advantage of the exciting job and earnings opportunities in the exploding field of microcomputers. If card has been removed, please write to us.

NRI Schools
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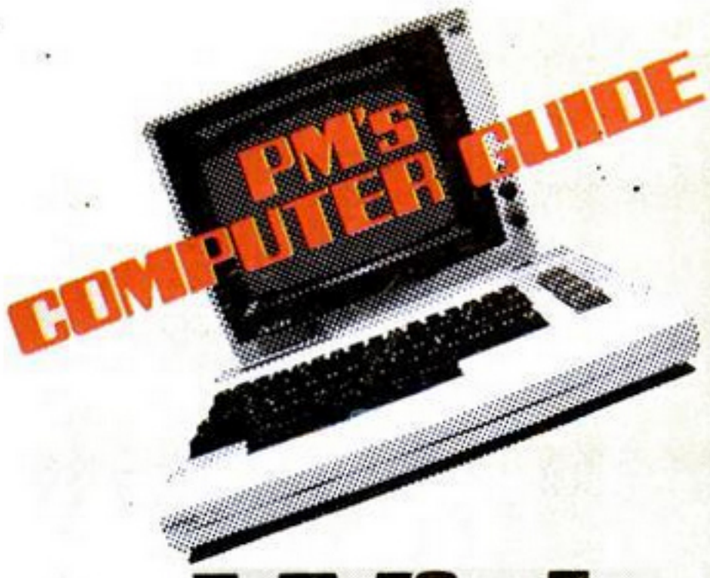
We'll give you tomorrow.



COMPUTER TELECOMMUNICATIONS

Communicating With Other Computers

Swap information, connect to vast networks or just chat. You can even fall in love. All you need is a computer and a modem.

Telecommunications is using a computer to communicate with other computers over normal telephone lines. You accomplish this with a device you add onto your personal computer—a modem. It may be a box which goes outside your computer or a circuit board which plugs inside.

When you type on your computer's keyboard, the modem converts the letters and numbers into digital tones. While the Morse Code uses dots and dashes, the computer ASCII (pronounced *askey*) code uses two different, almost musical, tones to encode your information.

After the modem is connected to your computer and phone line, check the services offered by large computer networks such as The Source and Compuserve. When you call one of these networks, via computer, you are calling a giant mainframe computer that may store thousands of databases full of information.

You just call a local number and computers along the way take care of routing your modem's tones through complex telephone byways to that central mainframe computer. The same network sends the larger computer's tones to you. In this way, your computer can have two-way contact with the large computer and, at the same time, hundreds of users can all be connected to that same large computer.

Once you are connected to the mainframe computer, informational databases will be at your disposal. You will be able to do everything from reading news reports from The Associated Press to looking up airline schedules.

But still, you can buy a newspaper for 30 cents, so why use a computer? Well, besides the fact that you would have to buy hundreds of newspapers and magazines to equal the information stored in the computer, don't forget the *interactive* uses of telecommunications.

While connected to a database, you are seated in front of a full-fledged computer with a keyboard. It is a two-way connection. You can read what is coming across the screen, and then—in many instances—you can type back.

Computers communicate over phone lines by sending letters and numbers in ASCII code. Each character is sent as a nine-note combination of two tones. Any phone line may be used.

This is called *interactive video* and is the future of the computer networks.

Both The Source and Compuserve (the two largest computer networks) are beginning to tap the wellspring of interactive video. Both began their services by offering electronic mail (called EMAIL on Compuserve and SMAIL on The Source), which meant you were no longer at the mercy of the Postal Service if your addressee was also hooked into the computer revolution.

Quick and easy-to-learn areas allow you to type in a message to anyone else on the network. And, your message is delivered in a few moments, or a couple of hours at most.

SIGs, or Special Interest Groups, is an area that has been pioneered by Compuserve, although The Source is now offering a "Participate" program that is similar. In a SIG, a person leaves a message about that group's interest, or he replies to a string of messages. An original message, replies received and responses to replies can be read in either sequential or logical order.

On Compuserve, the SIGs have proven to be popular and now cover almost every interest. There are popular SIGs for owners of the Heath, Apple, TRS-80 and Commodore computers; other SIGs about medicine or fire safety; some discuss how to write; and others show people how to sell their software ideas. Whether you want to exchange recipes or learn about going to the moon, there is a SIG for you.

And, both networks have extensive bulletin-board areas where you can buy or sell everything from software to a new home. In The Source's POST area or Compuserve's BULLET database, you'll find an electronic classified ad may solve your problems.

But the real power of the computer networks and of some of the bulletin-board programs discussed in *Join The Love Networks* (page 108) lies not so much in what they offer, but in the ability to reduce distances to nothing. Once

PM photos: Frank Lusk
Photos taken at Computer Center, New York, N.Y.

How To Use Menu Screens

Compuserve Page CIS-1

Compuserve Information Service
1 Home Services
2 Business & Financial
3 Personal Computing
4 Services for Professionals

5 User Information
6 Index

1.

1 ***After you sign on to Compuserve, the main menu appears.***

Compuserve Page FIN-1

BUSINESS AND FINANCIAL SERVICES

1 News Reports
2 Reference Databases
3 Communications

2.

2 ***We took the "Business and Financial Services" route, and the first menu in this section appears. Three choices are offered. This is called branching out.***

Compuserve Page FIN-10

---------NEWS REPORTS--------

1 Business Information Wire
2 MMS Financial Analysis
3 Commodity Report
4 Archer Commodity Report

5 Stevens Business Reports
6 Investor Protection Report
7 Investment News and Views
8 RayLux Investors Reports

3.

Compuserve Page FIN-10

-------COMMUNICATIONS-------

1 Electronic Mail
(user to user messages)
2 User Directory
3 Talk to Us

4.

3 ***"News Reports" menu will now send you directly to different reports and analysis programs.***

4 ***If you had chosen the "Communications" entry, a new menu would have taken you to electronic mail or other facilities.***

Compuserve Page FIN-20

-------REFERENCE DATABASES-------

$ 1 MicroQuote
$ 2 Quick Quote
$ 3 Standard and Poors
$ 4 Value Line Data Base II
$ 5 Descriptions and Premium Program Rates

$ Indicates Premium Programs

5.

5 ***In the "Reference Databases" choice, dollar signs show that such things as Microquote cost extra if you want to continue.***

you learn to use their data storage and transfer areas, you're close to a concept known as the *decentralized office*.

Let's say that you have a long report to send to your company's offices throughout the country. The first thing to do would be to word process your report or other document. The document that you write is stored on a computer disk as a *file*. This file contains the document in the form of the ASCII code.

You must then take advantage of a process called uploading. Uploading a file means that you use your own computer to send the document now stored as a file on a disk to another computer. In this case, you telephone a local number and send the file to the private storage area you have available on the network's main-frame computer. This uploading process is usually controlled by a *terminal program* which you've bought for your computer. (Such programs include *ASCII EXPRESS—THE PROFESSIONAL* for both Apple and IBM, *DATA CAPTURE 4.0* for the Apple and *PCTALK* for the IBM, among others.

Once you have uploaded your file all the offices you want to share that information with must go through the reverse process, called downloading. A printer turns the files back into documents. After reading the material, the office managers frame their replies and upload their final responses.

Vanquishing distance may prove to be the computer's greatest asset. **PM**

Modems come in various shapes and sizes. Tymshare's Scanset terminal (top) includes both a modem and display with a full keyboard. Hayes Smartmodem 1200 (middle) connects any computer to a phone line. Universal Data System's 212A/D puts a full menu of commands on the connecting computer's screen.

JOIN THE LOVE NETWORKS

A computer network may be made up of hundreds of small computers all calling a giant, mainframe computer system. Or, it can be something, well, more intimate.

Many computers will operate as electronic bulletin boards when equipped with the right software. A bulletin-board computer accepts phone calls from other computers (any computer with a modem will do) and allows the person with the calling computer to leave, or post, a message. The caller may also read any of the messages previously posted and may respond to them.

There are now thousands of these bulletin-board computers throughout the country. They're run from living rooms, computer stores, colleges and even hospitals. The people running them all have one thing in common: They are shaping, today, the methods that other people will use to communicate tomorrow.

The bulletin boards cover all interests, from computer adventure games to high-level discourses on surgical procedures. If you become involved in these bulletin-board systems, you may find your monthly phone bill taking off like a rocket.

Because they are not large networks, you must pay for a long-distance call to any computer system beyond your free calling area. Although there are bulletin boards in every state, you are bound to find a couple you love that are 2,000 miles away.

The latest trend in these electronic services is what we term "the love network." Here, believe it or not, you may find the mate of your dreams only a short ASCII code away.

Callers to a dial-your-match system are first given a secret password. Then they are asked to fill out a short questionnaire. The questions ask such things as height and weight, and may also get into astrological signs and sexual preferences. Nothing too forward—most of the questions might be asked at a typical office party. Then the fun begins. The caller's questionnaire is computer matched with all the others and a list of likely matches is printed on the screen. The caller can then read the answers given by those the computer has picked as compatible. If all looks good, a correspondence can begin.

According to Gregg Collins of Matchmaker Enterprises, the idea has really taken root. Everything from casual dating to marriage has resulted between people who have met via computer. So, if you're ready for it, on the other side of your modem, people like Lynn 432, Jill 490, Janet 418, Clark 201, Tony 765 and many more are just dying to meet you. And, who knows, if you really hit it off, maybe someday you'll even see each other!

So whether you want to play *Star Trek* or cupid—a modem is your ticket to the future.

Below is a list of some other computer systems to call (in order of area code).

Edison, N.J.	(201) 627-5151
Piscataway, N.J.	(201) 932-3887
Cranford, N.J.	(201) 272-1874
Haledon, N.J.	(201) 790-6795
Danbury, Conn.	(203) 744-4644
Seattle, Wash. (Apple Crate I)	(206) 935-9119
Seattle, Wash. (Apple Crate II)	(206) 244-5438
Staten Island, N.Y.	(212) 442-3874
New York, N.Y.	(212) 991-1664
New York, N.Y. (McGraw-Hill)	(212) 997-2488
Santa Monica, Calif.	(213) 829-1140
Los Angeles, Calif. (Dial-Your-Match) #1	(213) 842-3322
Los Angeles, Calif. (Games)	(213) 336-5535
Los Angeles, Calif. (Computer World)	(213) 859-0894
Los Angeles, Calif.	(213) 831-3574
Dallas, Tex. (Hacker-net)	(214) 824-7160
Baltimore, Md.	(301) 764-1995
Greenbelt, Md. (NASA)	(301) 344-9156
Miami, Fla. (Big Apple)	(305) 948-8000
Chicago, Ill. (Gamemaster)	(312) 475-4884
Chicago, Ill.	(312) 545-8086
Arlington Heights, Ill.	(312) 870-7176
Niles, Ill. (IBM-PC)	(312) 647-7636
Greenfield, Ind.	(317) 326-4152
Indianapolis, Ind.	(317) 787-5486
Iowa City, Iowa (Apple-Med)	(319) 353-6528
Cedar Rapids, Iowa	(319) 364-0811
Atlanta, Ga.	(404) 926-4318
Hayward, Calif.	(415) 538-3580
Baton Rouge, La.	(504) 454-6688
San Antonio, Tex.	(512) 340-6720
Montreal, Canada	(514) 937-2188
Long Island, N.Y.	(516) 334-3134
Phoenix, Ariz.	(602) 996-9709
Boston, Mass.	(617) 646-3610
Boston, Mass. (Pirates' Harbor)	(617) 738-5051
Herndon, Va.	(703) 471-0610
Annandale, Va. (IBM PCUG)	(703) 560-0979
Washington, D.C. (AMRAD)	(703) 734-1387
Houston, Tex. (Madam Bokeathea Society)	(713) 455-9502
Freeport, Tex. (Gulfcoast)	(713) 233-7943
Anaheim, Calif.	(714) 772-8868
Burlington, Vt.	(802) 862-7023
Newhall, Calif. (Computer Arts Message System)	(805) 255-6445
Kansas City, Mo.	(816) 861-7040
Memphis, Tenn. (Medical)	(901) 276-8196
Missions, Kan. (Movie Guide)	(913) 432-5544
El Paso, Tex.	(915) 755-1000

Hundreds of other phone numbers to call, as well as step-by-step examples on using a modem, are contained in *The Small Computer Connection*, by Neil L. Shapiro, published by Micro Text/McGraw-Hill, New York, N.Y.

TECHNOLOGY UPDATE

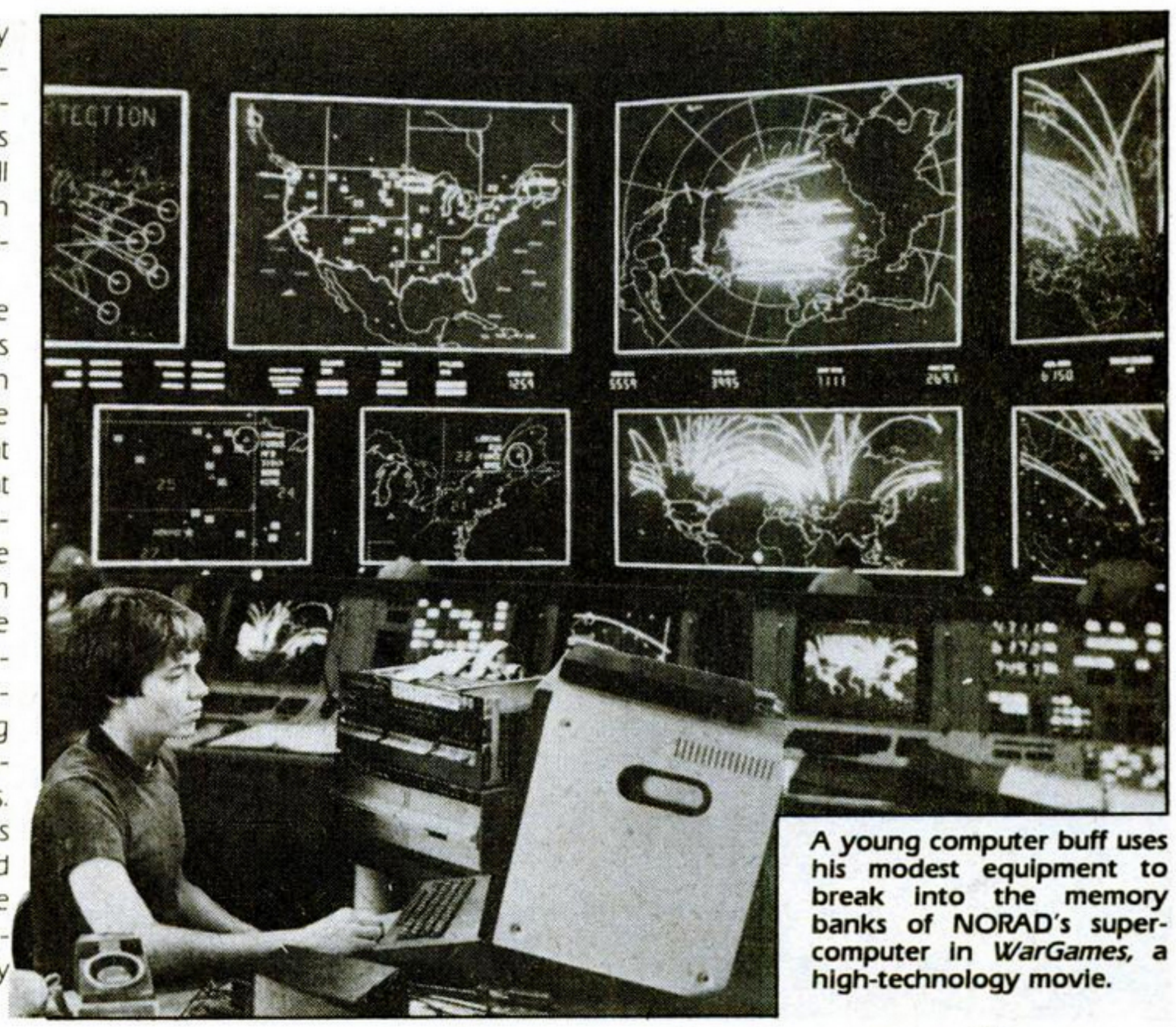
MILITARY

License needed to play *WarGames*

A teen-age computer buff accidentally gains access to the Defense Department's supercomputer on his personal console. Within moments, he's matching wits with the single computer responsible for all the nuclear missiles under the North American Air Defense (NORAD) command. And it quickly escalates to the brink of war with Russia.

This improbable plot is overcome by the quick pace and dazzling high-technology sets of *WarGames*, the MGM/United Artists film. In particular, Angelo Graham's design of the NORAD computer room stands out as a bright haven of accuracy. Defense Department spokesman William Hutchins says the celluloid NORAD computer center looks a lot like the real thing. The film makers had help from retired Air Force TV liaison Duncan Wilmore and a half dozen Defense Department contractors who supplied the equipment to generate graphics. The graphics show everything from the location of an advancing Soviet submarine force to the readiness of U.S. missiles.

But among the film's unbelievable points was the control that a single computer had over all U.S. missiles. After all, a single Space Shuttle uses one main and three backup computers. The Defense Department won't say how many computers run the real NORAD.



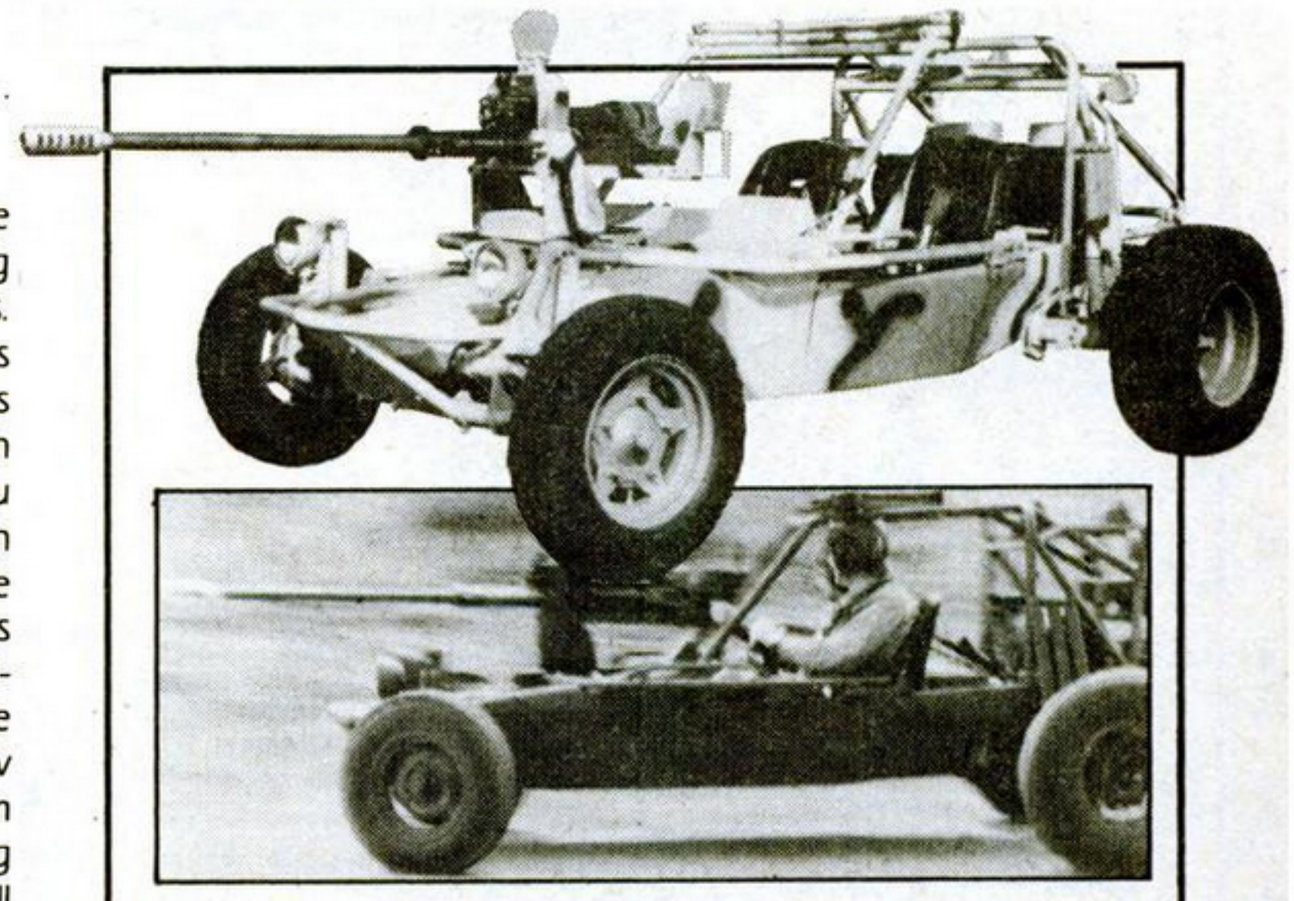
A young computer buff uses his modest equipment to break into the memory banks of NORAD's supercomputer in *WarGames*, a high-technology movie.

But can you cook?

The heralded steel pot worn by GIs since World War II is going the way of the jeep—out. Next year, the Army will begin replacing the steel helmets and their plastic liner inserts with all-plastic helmets. The new Kevlar headgear, which strongly resembles the helmets worn by German troops in the '30s and '40s, weighs about 6 ounces less than the original steel pot. But the 53-ounce replacement is much more bullet-resistant, according to Army testers at Natick, Mass. Du Pont, which makes Kevlar, says more than half the police officers in America wear Kevlar bulletproof clothing. In fact, the Army says the new plastic pot provides at least 25 percent more ballistic protection than the steel helmet. But the new model melts or cracks from extreme heat, so cooking dinner in your headgear will soon be part of military history.

Army's Kevlar plastic helmet (left) will replace the steel pot (right).

Of course, soldiers firing their weapons will appreciate a helmet that doesn't cover their eyes with every kick of the rifle.



DUNE BUGGIES RIDE TO WAR

Dune buggies do a great job of scrambling over rugged terrain just for fun. Realizing that they might do equally well on the battlefield, the U.S. Army is now arming similar vehicles for hit-and-run combat missions. Made by Emerson Electric, the little fat-tired FAVs (for Fast Attack Vehicles) can fire a 30-mm cannon or missile launcher while moving at 80 mph.