Your experience with personal computers is going to open an unlimited career at TI.

TI is into personal computers in a big way, and that means a ground floor opportunity is going to be open for you, the personal computing innovator. You'll be joining the undisputed world leader in creating new products and markets for consumer electronics with the company that invented the calculator on a chip. And it's all going to happen in TI's new Management and Technology Center for Consumer Products in Lubbock, Texas. Located in the high, dry, and cool plains of West Texas, Lubbock is about halfway between Dallas and Albuquerque. It is the home of Texas Tech University. You are just a few hours' drive from skiing in Taos, or touring and shopping in Juarez, Mexico.

Make your career opportunities in the following areas:

Personal Computer Product Marketing Manager
Responsible for establishing distribution channels for personal computer products, developing advertising and sales promotion programs, training, quoting and providing market requirements for new products and software. Requires BS in EE, math, physics or Computer Science. MBA preferred. Minimum of 5 years' experience in consumer sales or marketing related to desk programmable calculators, minicomputer systems, microcomputer systems, or small business systems.

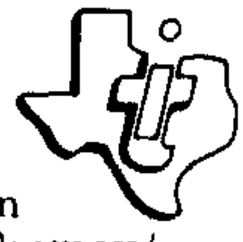
Systems Programmers
Outstanding opportunities – design, code, integrate and debug operating system modules, including device service routines, self-test diagnostics, and system utilities. Requires BSEE or Computer Science plus minimum of 3 years in assembly programming with some high level language experience.

Digital Design Engineers
Opportunity to design and develop digital subsystems for major new products. Projects will require design-to-cost discipline with internal and external component vendors, vendors of peripheral devices and making trade-offs of hardware and software. Requires BSEE with 2 years' experience. Prefer experience in design of bubble and/or flexible disk computer memory subsystems.

Product Design Engineer
Responsibility for mechanical design on major new personal computer products. Interface with electrical design engineers, software development personnel, marketing, purchasing, planning and all areas involved in taking a product from concept through initial production. Requires BSME with a minimum of 3 years' experience in design or closely related field. Knowledge of plastic tooling preferred.

Application Software Specialist
Total responsibility for development of complete application packages for specific business sectors and professionals. Specifications, design, coding, program check-out and documentation for personal computer systems. Requires BA or BS in math or Computer Science or BBA with data processing major with 2-3 years' experience. Program in high level language on mini, micro, or business computer systems.

Marketing Support Engineers
Project responsibility for future product service direction concerning existing as well as future products. Develop and maintain total service program for personal computer systems and field testing/check-out. Requires BSEE or equivalent with at least 3 years' experience with programmable desk calculators, minicomputer systems, microcomputer systems, small business systems, or product service management.



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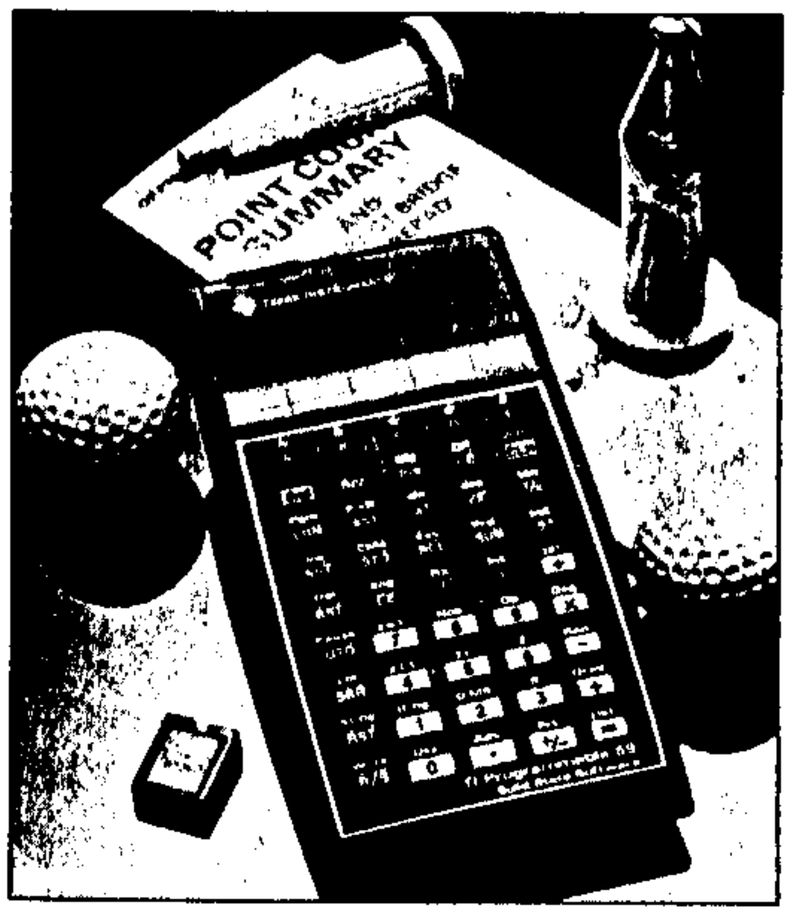
What's New?

SOFTWARE

Leisure Program Library for New TI Calculators



Owners of the Texas Instruments Programmable 58 and 59 calculators (see December 1977 BYTE, page 204) can now enjoy recreational applications of their pocket sized computers with the Solid State Software Leisure Library module. This plug in read only memory unit contains 20 different keystroke programs for golf handicaps, bowling scores, chess ratings, results of deals in duplicate or triplicate bridge, blackjack, acey deucy, craps, NIM, biorhythms, a spacecraft landing and a sea battle game, and other applications. Two programs use the alphabetic and plotting capabilities of the PC-100A printing cradle. The module is $35 from Texas Instruments Inc, Inquiry Answering Service, POB 53 (attn: Leisure Library), Lubbock TX 79408.■

Circle 574 on inquiry card.

FDOS III for ICOM Floppies

FDOS III is a new operating system for 8080 and Z-80 computers using any of ICOM's family of floppy disk drives and interfaces. It is compatible with programs written under FDOS II and has relocatable driver modules for file access. The system includes a string oriented text editor and a relocatable assembler for 8080 or Z-80 programs. Single commands provide for functions such as loading of files, editing and assembly, disk to disk, disk to punch and reader to disk IO. Files may be deleted, renamed or merged to create new files, and may be tagged with attributes to prevent deletion, for example. FDOS III is available from Pertec Computer Corp Microsystems Division, 21111 Erwin St, Woodland Hills CA 91367, (213) 999-2020.■

Circle 575 on inquiry card.

Complete ANSI FORTRAN Compiler for Z-80

This FORTRAN compiler implements full American National Standard FORTRAN IV with a number of extensions, including one and two byte integers, double precision reals, complex, logical and string data types, named COMMON, sequential and direct access IO, and hexadecimal constants. A full library of scientific and string functions is provided, and a linking loader with automatic library search capabilities can link FORTRAN with assembler programs. Generated code can be placed in read only memory, and the package may be used optionally with a planned hardware multiply and divide module for greater speeds of execution. The compiler runs in 24 K bytes of memory in both FDOS IV and CP/M versions. It is available on floppy disk with a user's manual for $349 from Technical Design Labs, Research Park, Bldg H, 1101 State Rd, Princeton NJ 08540, (609) 921-0321.■

Circle 576 on inquiry card.

A FORTRAN Compiler for 8080s

Microsoft, 300 San Mateo NE, Suite 819, Albuquerque NM 87108, has just prepared a brochure on their FORTRAN-80 package, summarizing the features of the compiler for 8080 processors. User's guides for the FORTRAN-80 compiler, MACRO-80 assembler, LINK-80 loader and LIB-80 library packages are available for a price of $20 each. Single user price for the FORTRAN-80 compiler is $500. Versions are said to be available for CP/M, ISIS-II, DTC Microfile and MITS DOS floppy disk operating systems. Write the company for complete details or phone Steve Wood, (505) 262-1486.■

Circle 578 on inquiry card.

Where Do New Product Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the neat new whiz-bang gizmo or save the world software package is of interest to the personal computing experimenters and homebrewers who read BYTE, we print the information in some form. We openly solicit such information from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications.

TDL Version 3.0 "Super BASIC"

Technical Design Labs has introduced Version 3.0 of "Super BASIC," a 12 K BASIC Interpreter. Version 3.0 upgrades and supersedes Version 2.1 with improvements in speed and error handling features. Included with the announcement of this improvement was *The 12 K BASIC User's Manual* of approximately 70 pages in length.

Version 3.0 of Super BASIC provides programmable error handling that allows the user to specify special error handling routines processing any error occurring in the basic program without aborting the program. In addition, the ERR and ERL functions are available to provide further flexibility in error processing.

Version 3.0 of Super BASIC allows for the serial input and output of data from the firm's Zapple Monitor defined reader and punch devices. This data may be in ASCII (using INPUT and PRINT commands), or in binary (READ and WRITE). For noncontrolled reader/punch devices, a high speed binary mode is provided (MLOAD and MSAVE). During data input, end of file detection is provided through the ON EOF GO TO construct.

Version 3.0 provides the VARADR function which allows the address of a particular variable to be passed to an assembly language routine through the CALL statement. This allows routines to return data to the calling program.

Version 3.0 also has a provision to associate arbitrary file name strings with LOAD, LOADGO, and SAVE commands.

Version 3.0 of Super BASIC is being released for use with the CP/M disk operating system and is expected to be available soon in a serial paper tape version.

As with all TDL software it is relocatable and uses the monitor's operating system for its IO handling. It comes with the user's manual and occupies 12 K of core. Although primarily designed to run on TDL's Z-80 microcomputer system, it is adaptable to other systems which use the Zilog Z-80 processor. Super BASIC Version 3.0 is on a diskette and is a part of TDL's Software Package A which consists of Version 3.0, The Macro Assembler 2.2, Z-TEL Text Editing Language and the Text Output Processor. This entire package is available now for $249.

For further information contact Technical Design Labs, Research Park, Bldg H, 1101 State Rd, Princeton NJ 08540, (609) 921-0321.■

Circle 577 on inquiry card.

Correction

The price of the Equinox 100 computer system is $799, *not* $699 as we stated in the new product release on page 172 of the January 1978 issue. Our thanks to Linda Hall of Parasitic Engineering for calling this to our attention.

Introducing the personal computer you've waited for. The Exidy Sorcerer.

I didn't buy my personal computer until I found the one that had all the features I was looking for.

The Exidy Sorcerer does everything I wanted to do and a few things I never dreamed of.

It isn't magic. Exidy started with the best features of other computers, added some tricks of their own, and put it all together with more flexibility than ever before available. Presto! My reasons for waiting just disappeared.

I wanted pre-packaged programs. Software on inexpensive cassette tapes for the Sorcerer is available from Exidy and many other software makers.

I wanted user programmability. The Sorcerer's unique plug-in ROM PAC™ Cartridges contain programming languages such as Standard (Altair 8k*) BASIC, Assembler and Editor (so I can develop system software), operating systems such as DOS (so I can also use FORTRAN and COBOL) and applications packages such as Word Processor.

* Altair is a trademark of Pertec Computer Corp.

I wanted graphics, and the Sorcerer is super. Its 256 character set—more than any other personal computer—includes 128 graphic symbols that I can define.

I wanted high resolution video. With 122,880 points in a 512 x 240 format, I get the most detailed illustrations.

I wanted to display more information. The Sorcerer displays 1920 characters in 30 lines of 64 characters —equal to a double-spaced typed page.

I wanted a full, professional keyboard. The Sorcerer's 79-key data processing keyboard provides designated graphics, the complete ASCII character set in upper and lower case, and a 16-key numeric pad.

I wanted memory. The 12k of ROM holds a Power-On Monitor and Standard BASIC; the 8k of RAM is internally expandable to 32k.

I wanted expandability. Serial and parallel I/Os are built in, and the optional 6-slot S-100 expansion unit lets my system grow.

I wanted a computer that's easy enough for children to use. I just connect my Sorcerer to a video display and a cassette tape recorder, and if I have any questions the easy-to-understand Operation and BASIC Porgramming manuals have the answers.

I wanted to buy from an experienced manufacturer. In five years Exidy has become the third largest producer of microprocessor-based video arcade games.

I wanted to spend less than a thousand bucks. (This is where Exidy does a little magic.) My Sorcerer cost me $895!

Now, what are *you* waiting for?

Call Exidy for the name of your nearest dealer. (408) 736-2110. Or write Exidy, 969 W. Maude Ave., Sunnyvale, CA, 94086.

Exidy inc.

Circle 137 on inquiry card.

BYTE News....

ATARI'S NEW COMPUTERS. The recently announced Atari Model 400 and 800 personal computers are major entries into the market. The 8 K nonexpandable 400 (suggested retail $500) sports a touch audio feedback keyboard and a single read only memory cartridge slot, plus cassette I/O. It also has 16 color graphics with eight luminance levels (!) The 48 K expandable 800 (suggested retail $1000 with 8 K and cassette recorder) has additional color features, full keyboard, 8 K BASIC, high resolution graphics, two read only memory cartridge slots, and much more. Both units use a modified 6502. Availability: August 1979 (limited quantities); full availability: Fall 1979. More details next month.

TI'S NEW PERSONAL COMPUTER. Rumors are flying about Texas Instruments' impending entry into the personal computing market. The unit will reportedly use the TMS 9900 processor with 40 K of read only memory circuits, will generate 20 lines of 40 characters on a standard television, will have provisions for accommodating video disk players and video tape recorders, and will have sophisticated sound production. Sources predict a mid-1979 unveiling.

TI AND GTE DEVELOPING HOME DATA RETRIEVAL SYSTEMS. Since Labor Day, Texas Instruments has been testing a "Teletext" home information system which displays on a standard home television set via a decoder unit. The decoder can be internal or external to the television set. It is expected that the decoder should add about $50 to the television's cost. The data is transmitted during the frame blanking time. The viewer can elect to view the data, the standard picture, or the data superimposed on the picture. Testing should continue throughout 1979. FCC approval is required.

Last October General Telephone & Electronics gave a presentation and demonstration to the FCC of their system, which uses a microprocessor. It would allow a user to retrieve data from a number of different data banks and have it appear on their television screen. The system is still in a very early stage of development.

A television based data retrieval system, called Viewdata, is already in operation in Great Britain. It was developed by the British Post Office.

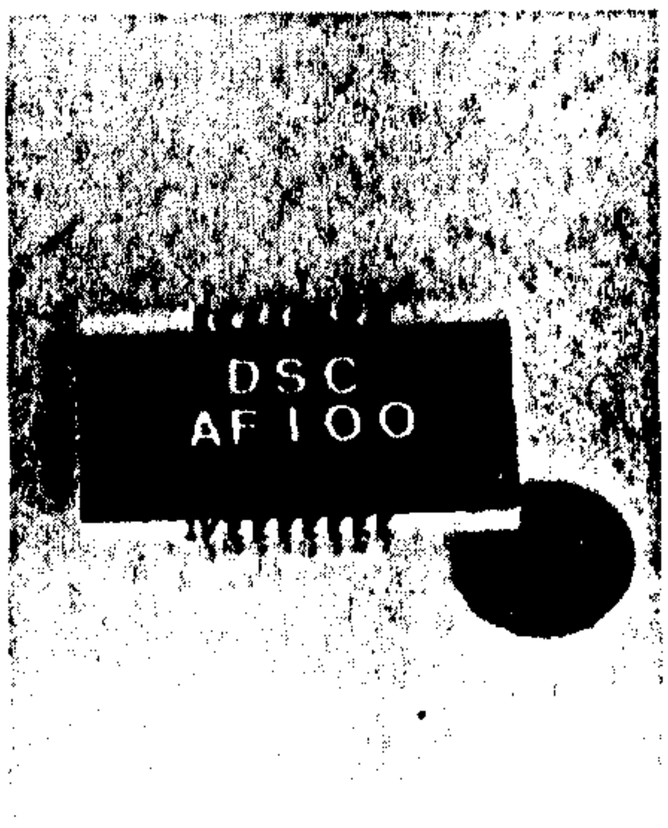
WORD PROCESSING PRINTERS USING DOT MATRIX ARE COMING. All present word processing printers use character impact printing mechanisms and are expensive (typically over $2000). The most popular are the Selectric, Diablo and Qume printers. Dot matrix printers are faster and cheaper but produce crudely formed characters generally considered undesirable for word processing applications. However, several companies are working on dot matrix printers to improve their printing quality. By moving the dots closer together to 1000 dots per inch or closer, characters can be formed which are very close to those of the Selectric. Further, since the dot matrix is under direct processor control, changing a character font requires only a program change rather than a type element change. Imagine being able to change from standard to italic type faces using only software! Although the initial entries (from RC Sanders Technology Systems Inc) in this area will cost more than present impact units, costs should decrease substantially to well below present units.

8080/8085 MICROPROCESSOR PRICES DROP. The 8085, Intel's 1 chip version of the 8080 with added features is now selling for $10 in OEM (original equipment manufacturer) quantities. The 8080 is now down in the $4 to $5 range. Actually the 8085 is in effect cheaper than the 8080 since it does not need extra support devices and works off only 5 VDC. Therefore, most of the new 8080 designs now use the 8085. It is expected that the 8085 will be down in the $4 to $5 range by year's end. The importance of this is that the microprocessor is now insignificant in cost compared to memory and peripheral circuits.

WILL 16 BIT PROCESSORS TAKE OVER? Not yet, at least. There is reason to question whether or not 16 bit processors have achieved the success in the personal computer marketplace achieved by the 8 bit machines. The fact is that there have been at least three 16 bit mainframes available in the personal computer marketplace for over a year now, namely the Technico 9900 computer, the Alpha-Micro computer, and the Heath H-11 computer. Although all three provide better performance than the 8 bit machines, their acceptance does not compare to the smaller machines. It will be interesting to see if any 16 bit mainframes using the Intel 8086 processor will be forthcoming in the near future.

16 BIT PROCESSORS TO BE SECOND-SOURCED. Intel has entered into an agreement with National Semiconductor for the latter to also manufacture the 8086, Intel's 16 bit processor. Zilog has also arranged for second sourcing of their new Z-8000 16 bit processor, but does not expect to be in production until the middle of the year. Intel has been in production on the 8086 since May of last year.

Speech Synthesis Integrated Circuit from TI



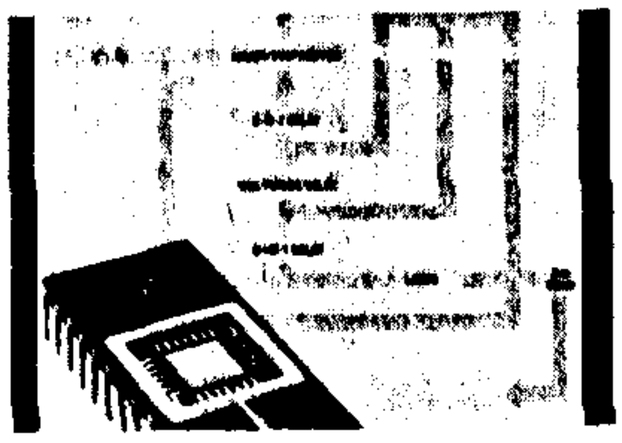
A significant new speech synthesis monolithic integrated circuit has been developed by Texas Instruments Inc, POB 5012, Dallas TX 75222. The circuit, along with two 128 K byte dynamic read only memories, each with the capacity to store over 100 seconds of speech, and a special version of the TMS1000 microcomputer, serve as the main electronics for a new talking learning aid called Speak and Spell, for ages seven and up.

Speech encoding is achieved through pitch-excited linear predictive coding (LPC). LPC is a technique of analyzing and synthesizing human speech by determining from original speech a description of a time varying digital filter modeling the vocal tract. This filter is then excited by other periodic or random inputs. An 8 bit digital to analog converter on the chip transforms digital information processed through the filter into synthetic speech.

Codes for 12 synthesis parameters (ten filter coefficients, pitch, and energy) serve as inputs to the synthesizer chip. These codes are stored in read only memory and, once decoded by on chip circuitry, represent the time varying description of the LPC synthesis model. The LPC speech synthesizer is an advanced design 10 stage lattice filter which has an integrated array multiplier, an adder coupler to the multiplier output and various delay circuits coupled to the adder output.■

Circle 568 on inquiry card.

Dual Tone Separation Filter Integrated Circuit



The Model AF-100 dual tone separation filter integrated circuit provides channel isolation between the low frequency group tone (DTMF) frequencies 697 Hz thru 941 Hz and the high frequency group tone frequencies 1209 Hz thru 1633 Hz. It is intended for applications in which dual tone separation is required, eg: touch tone decoders, transceivers, modem interfaces, etc.

Contained in a 16 pin dual-in-line package, the dual resistance capacitance active filter chip features 30 dB minimum separation between high and low group tones, 1.5 dB maximum in-band deviation, dual and single power supply operation ±12 VDC at 2.5 mA each.

The Model AF-100 is priced at $32. For further information write to Data Signal Corp, 40-44 Hunt St, Watertown MA 02172.■

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TRS-80™ SOFTWARE

Cat No.	Level	Description	Price
1041	2	Star Trek III	$14.95
1036	½	Sci-fi Game Sampler	5.95
1061	½	Hamurabi	6.00
1040	½	Galactic Blockade Runner	9.95
1053	½	Slot Machine	6.00
1042	½	Tarot	5.95
1038	½	Modular Inventory	19.95
1039	½	Renumber	14.95
1042	½	Bingo	5.95
1173	2	Bridge	14.95
1174	2	Sargon Chess	19.95
1048	½	Mach. Lang. Monitor	23.95
1051	½	Biorhythm	5.95
1171	½	Space Trek II	7.95
1172	½	Lunar Lander	7.95

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$265 kit

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BYTE News . . . .

NCC/NYC TO BE THE BIGGEST COMPUTER SHOW EVER. The National Computer Conference (NCC) will happen again June 6 thru 9. Last year 57, 224 attendees turned out for the show, held in Anaheim CA. This year the NCC will be held in the New York City Coliseum. AFIPS, the sponsoring organization, expects attendance to top that of last year. Approximately 400 companies have reserved 1,700 booth spaces on four floors of the Coliseum, with overflow at the New York Hilton and Americana hotels. Last year 396 companies occupied 1,400 booths.

NCC will have a personal computing adjunct at the Americana Hotel, a few blocks away. It will probably be played down, as it was last year. By way of example, the personal computing exhibitors and speakers were not listed in the regular show program book handed out to each attendee; hence, many attendees last year were unaware of the personal computing part of the show.

S-100 BUS STANDARD TO BE ADOPTED SOON. An IEEE committee has been working on a standard for the S-100 bus for over a year, and adoption is expected very soon. Much of the credit for this standard goes to George Morrow of Thinker Toys.

This standard will do two things. One, it will resolve the conflicts between the use of many bus pins by different manufacturers and eliminate the lack of compatibility between many "S-100 compatible" plug-in boards. Two, and possibly more important, it provides use of the S-100 bus for 16 bit processors for extended addressing of up to 8 M bytes of memory and for master-slave multiprocessor systems. This will make the S-100 bus the most powerful bus around and will, no doubt, continue and increase its popularity.

TI AND HP PC SYSTEMS RUMORS. Texas Instruments and Hewlett-Packard continue to maintain tight lips on their rumored personal computer systems. As TI has said, "TI will not discuss products that have not yet been announced." However, information has leaked out on these units which are expected to have a tremendous impact on the personal computing market. Several rumors have been reported in previous BYTE NEWS columns. The latest is that TI will introduce their entry at either the NCC show in June or the Consumer Electronics Show in July. In either event, it is expected to be ready for the 1979 Christmas market.

The HP computer is also expected to be ready by Christmas, and is anticipated to be a stripped down version of their current table-top system. This means that it will use BASIC and be expandable.

Both HP and TI are expected to have $500 list prices for the basic unit. Key retailers have already been approached by both TI and HP to set up a selective distribution. It is rumored that they will favor selected personal computing stores that can do justice to software requirements.

INTEL TO PRODUCE ANALOG MICROPROCESSOR AND SUPER 8 BIT MICROPROCESSORS. Real time processing of analog signals by microprocessors has been severely limited by the slow speed of most microprocessors. For example, an 8080 clocked at 2 M Hz can, at best, synthesize clean sine waves at about 1 to 2 k Hz, which is the low end of the audio spectrum. This fall, Intel will introduce an integrated circuit which combines an analog-to-digital converter, a digital-to-analog converter, microprocessor and read only memory on a single device. It will be capable of processing analog signals up to 13 k Hz. Called the 2920, the integrated circuit will have a 9 bit conversion register. It could be used in conjunction with an 8080 processor, where the 2920 does the signal processing while the 8080 does the data processing.

Intel has done another clever thing. They have taken an 8086 and limited its data I/O (input/output) to 8 bits and memory addressing to 16 bits. It is called the 8088 and will deliver five times the performance of the 8080 (2 M Hz). Actually, the 8088 is an 8086 split into two 8 bit microprocessors on one integrated circuit, one handling I/O and the other data processing. It offers most of the features of the 8086 (eg: hardware multiply/divide).

NATIONAL SEMICONDUCTOR TO INTRODUCE NEW MICROS. It is nearly three years since National introduced their last microprocessor. (Actually, we must give National credit for pioneering the 16 bit microprocessor with the PACE and IMP-16 microprocessors introduced in 1975.) Now National is bringing out a new CMOS 8 bit microprocessor that will be software compatible with the 8080, have added features and consume less power. Further, they will introduce a 16 bit microprocessor that is a "cut above" the Z-8000 and 68000. Production is expected by the end of the year.

MICROPROCESSORS FOR $1 APIECE? Maybe not this year. . .but it is approaching fast. Synertek recently reduced the 100 lot price for the 6502 (used in the PET, Apple, OSI, etc) from $10 to $7. In high volume they have reduced the price from $4 to $2.50. I can still remember paying $350 for an 8080, just four years ago!

BYTE News . . . .

FCC TRYING TO CRACK DOWN ON TV INTERFERENCE. The Federal Communications Commission (FCC) has asked Atari, Apple, Commodore, Heath, Southwest Technical Products, and Radio Shack to submit their personal computer systems for TV interference testing. The systems made by these companies are presently exempted from FCC regulations since they are not directly connected to a TV set. However, there have been complaints regarding radio frequency (RF) interference from personal computer systems, and the FCC has decided to develop regulations regarding permissible RF radiation levels.

The computer manufacturers involved have indicated a willingness to cooperate with the FCC's effort. The regulations could fine noncomplying manufacturers and permit the issuance of cease and desist orders. Some industry experts feel that a few manufacturers' computer systems would not pass the FCC regulations.

INTEL ENHANCES 8086 FAMILY WITH I/O PROCESSOR. Intel continues to lead the way in microprocessor and microcomputer systems. Recently they announced the 8089, an I/O (input/output) processor to work with the 8086 16 bit microprocessor. This processor can more than double the performance of the 8086 by relieving it of I/O operations, much like the communications channel on an IBM 370.

$200 DISK SYSTEM EXPECTED BY YEAR END. Shugart and Matsushita Electric of Japan have signed an agreement whereby Matsushita will manufacture a low cost version of Shugart's popular minifloppy disk drive. The drive is expected to sell for $50 in large OEM quantities and retail at about $125. Add to this the interface/controller circuitry, and the total retail cost should work out to a little over $200. This is less than a third of the price of current minifloppy systems. Matsushita expects to be making 100 drives per hour by year end.

The drive will store 70 K bytes, use a new head design, and be housed in sheet metal rather than cast aluminum. It will be only 2 inches high, half the height of the current drive. An industrial version with heavy duty components will be sold at $65 OEM.

Nippon Electric (NEC) is also rumored to be developing a low cost 5 inch disk drive.

14 MILLION MICROPROCESSORS SOLD LAST YEAR. That's right, 14 million microprocessors were manufactured in 1978. One million 8 bit microprocessors and 13 million 4 bit microprocessors were made. If you didn't realize it already, most were used in games. The most manufactured microprocessors were the 8 bit 6502 and the 4 bit TMS-1000. However, sales of electronic games using microprocessors have recently taken a sharp drop. Hence, the probability exists that there may be a slight decrease in microprocessor production in 1979.

16 BIT MICROPROCESSOR PICTURE STILL FUZZY. It is beginning to look as if Intel may have taken the right approach with the 8086 by designing a part which could be placed in production far ahead of the Zilog Z-8000 or Motorola 68000. They have over a year's head start compared to the Z-8000 and possibly another half year's lead over the 68000.

The 8086 part is far simpler than the Z-8000 or 68000 parts, and as a result it is closer to the earlier generations of microprocessors. Support parts for the 8086 such as the new 8087 floating point coprocessor also give the 8086 a commanding availability lead over the other two contenders at this time. All three machines are aimed at the high end of microcomputer application, providing significant computational power equivalent to traditional mini and main frame computers.

BYTE News . . . .

BUBBLE MEMORY ARRIVES FOR PERSONAL COMPUTERS. Rockwell International has introduced a bubble memory board for a personal computer system. The board contains 128 K bytes of storage and plugs directly into the expansion bus for the AIM-6502 processor (which is the same as the KIM-1 bus). Rockwell also supplies a controller card which allows the bubble memory to function as a floppy disk replacement. The controller will control up to 16 memory boards for a total of 2 M bytes of bubble memory. However, before you rush out to buy it, be aware that each bubble memory board costs $2500 and the controller board costs $1000.

Intel and National will also soon become manufacturers of bubble memory. Texas Instruments and Rockwell are currently supplying bubble memories. Texas Instruments and Rockwell devices contain 256 K bits. The Intel device, which will be in volume production in early 1980, will contain 1 M bits, while the National device will contain 256 K bits. Texas Instruments and Rockwell have been producing limited quantities of the bubble memory devices and they do not expect to begin volume production until 1980. Furthermore, one Japanese manufacturer, Fujitsu, appears to be near bubble memory introduction.

MORE LARGE COMPANIES RUMORED ABOUT TO ENTER PERSONAL COMPUTER MARKET. Rumors continue that RCA, Hewlett-Packard and Zenith are seriously considering entering the personal computer market. Each is known to have a personal computer system development project in progress. Other companies seriously investigating the market include IBM and Bell Labs, each of which is known to have personal computer projects at the research facilities.

Several Japanese companies also introduced personal computer systems at the June NCC show in New York, Matsushita introduced its JD-700 to sell for $5,000 to $6,000. It has a 2 K byte read only memory, two minifloppies, and a printer, and it uses Extended BASIC. Sord introduced the M200 ($6,000 to $7,000), which uses a Z-80 with 64 K memory, up to four minifloppy drives, and BASIC, FORTRAN, or COBOL. Ai Electronics showed its APC-20 ($7,500) which is Z-80 based, has two 5 inch drives and hardware arithmetic, and has software options which include FORTRAN, BASIC, COBOL, PL/3 and CP/M.

DIGITIZED HI-FI ON THE HORIZON. An industry group called the "Digital Audio Disk Council" was formed in late 1978 to establish guidelines and standards for pulse code modulation (PCM) recordings. The council includes 35 companies and is an international group. The standard is expected to be adopted in one to two years.

It is expected that pulse code modulation recordings will be the next generation of super hi-fi disks. The technique provides wider frequency response and greater dynamic range, and virtually eliminates distortion and noise. The record will also include an address code for random access of selections. Applications to published software products may well impact the small computer field.

INTEL RETIRES THE 1103. Intel has finally retired the 1103 dynamic memory which houses 1 K bits. This was Intel's first successful MOS memory product and it was a pioneer in the field of IC-MOS memories. Intel has made 35 million of these units since its introduction in 1971.

TI INTRODUCES SPEAKING TRANSLATOR. At the June Consumer Electronics show, Texas Instruments introduced a hand-held language translator which displays and speaks the translated words through the use of a speech synthesizer circuit. This is a significant advance over the Craig and Lexicon units introduced six months earlier, which only display translated words. The unit will cost $250, plus $50 for plug-in language modules. English, Spanish, French and German modules will be available, with Russian, Japanese and Chinese to follow later. The unit displays 1000 words, 500 of which can be spoken. Craig has also increased their module vocabularies to 2,400 words.

UPI NEWS WIRE NOW AVAILABLE TO PERSONAL COMPUTER USERS. United Press International (UPI), one of the prime sources of news used by newspapers throughout the country, has made their service accessible to personal computer users. The UPI wire can be dialed as a local number in most US cities. UPI will charge $15 per hour during business hours, and $2.75 during other times.

IBM DEVELOPS ULTRA-HIGH SPEED LOGIC. The IBM Research Center at Yorktown Heights NY has disclosed their development of logic circuits with switching speeds of 13 picoseconds. Based on

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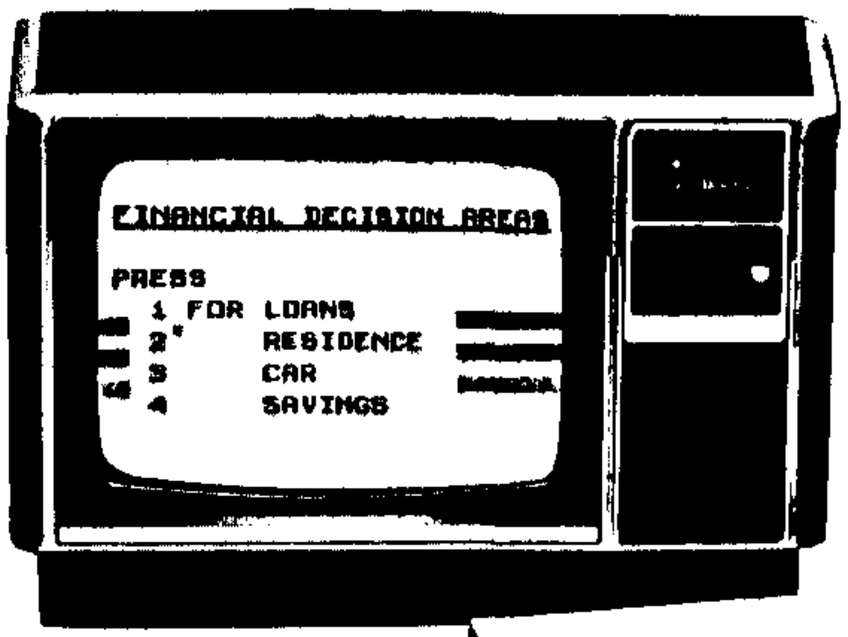

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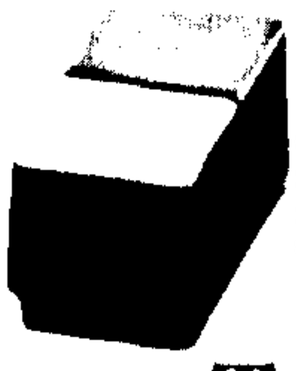

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The TI 99/4 was designed to be the first true home computer – skilled computer users and beginners alike will be able to put it to effective use right away.

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- **Built-in equation calculator** – Unique convenience feature helps you find quick solutions to everyday math problems, as well as complex scientific calculations. Directly accessible from the keyboard.

If you're new to computers, the TI-99/4 is for you.

You can begin using the TI Home Computer literally minutes after you unpack it. Without any previous computer experience or programming knowledge. You simply snap in one of TI's Solid State Software™ Command Modules and touch a few keys. Step by step instructions are displayed right on the screen. So you or just about anyone in your family can use the TI 99/4.

Two pioneering technological developments in particular set the TI-99/4 apart from the rest.

Solid State Speech™ – This optional speech synthesizer enables the TI 99/4 to literally speak – to provide verbal prompts and special messages to the user. Actually reproduces the human voice electronically. Hundreds of words are available, and plug in word modules will add hundreds more. TI's exclusive technology lets you call up the words you want by simply typing them in. Outstanding voice clarity and fidelity. Solid State Speech is a proven technology already on the market in TI's unique Speak & Spell™ electronic learning aid for children.

Solid State Software™ Command Modules – Available in a wide range of application areas, these optional ROM modules actually add application program memory to your TI 99/4. They let you use the TI Home Computer immediately with no programming. Serious programmers will appreciate the time and effort saved by these pre-programmed modules. Plus, they'll let you introduce your family to the computer in the easiest possible way. Solid State Software was pioneered by TI for use with its powerful programmable calculators.

A world of genuine, practical applications exist for the TI Home Computer right now.

In addition to the many personal finance, home management, educational and entertainment uses for the TI 99/4, there are also a variety of home business and professional applications. The TI 99/4 is a powerful problem-solving tool – an ideal solution where larger, more expensive computers would be impractical.

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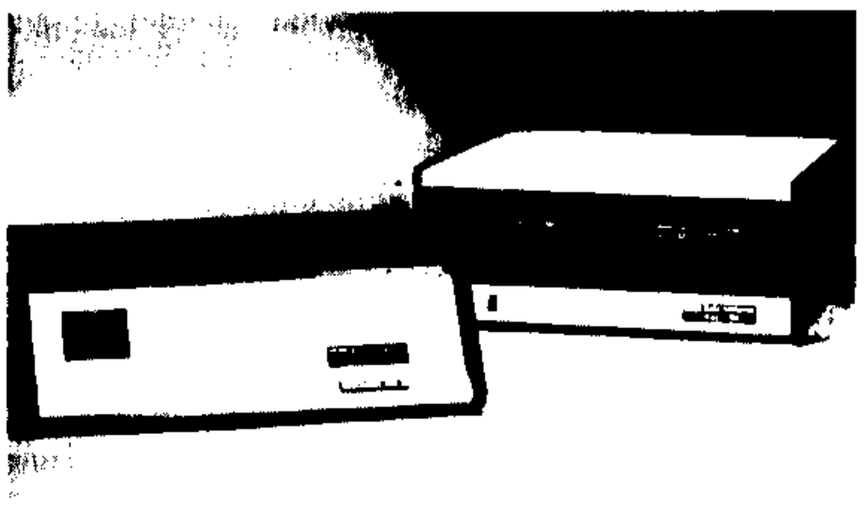

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The TI-99/4 offers an unmatched combination of features and capabilities including an optional speech synthesizer that enables it to literally speak — to provide verbal prompts and special messages to the user. At ComputerLand the TI-99/4 is one incredible, affordable computer system.

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BYTE News . . . .

HOME BUS STANDARD BEING DEVELOPED: Stanford Research Institute, Menlo Park California, and the Home Bus Standard Association, Washington DC, are conducting a feasibility study to develop a home bus standard. It will allow home electronic appliances to interact with one another over regular home wiring.

TI MICROCOMPUTER PICTURE IN TRANSITION: Although Texas Instruments finally introduced its 99/4 personal computer system in June, it is expected to be an interim product. TI failed to get FCC approval for the original version and also ran into processor production difficulties which forced the introduction of a high-priced personal computer system ($1150). TI is still pursuing a rule change request with the FCC and the development of its 9985 stripped down version of its 9940 16-bit processor. TI hopes to then introduce a personal computer system for under $500 which connects to a standard color-television receiver.

TI has also expanded its small business computer (99/7) marketing efforts. The 99/7, which starts at $5000, will be marketed by Moore Business Forms, through over 750 sales offices as well as through computer stores and TI's own retail outlets.

AT&T TESTING HOME INFORMATION SYTSTEMS: American Telephone and Telegraph Co has undertaken customer acceptance tests of several home information systems similar to the Viewdata system. Among the systems AT&T will test are the Knight-Ridder system (reported in the August BYTE News), a system developed by McDonnell Douglas, and a Bell Labs developed system.

The Knight-Ridder system test will take two years and involve 150 to 200 families in Miami, Florida. The system will transmit news, sports results, weather,and public information. The McDonnell Douglas system will be tested in Kansas City, Michigan, and New York. It will allow users to call a special number, key a special code on a push button phone, and receive the requested information in audible form. No details are as yet available on the Bell system.

HEATH ACQUIRED BY ZENITH: Heath Co, a leader in the consumer electronic kit business, was sold by Schlumberger Ltd to Zenith Radio Corp for $64.5 million. In 1977 Heath introduced two personal computer kit systems, the H-8 which is based on the 8080 processor, and the H-11 which is based on the Digital Equipment Corp (DEC) LSI-11. Heath entered into a three-year contract with DEC. Heath also entered the adult-education market. Heath sales for the last several years have declined at a 3 to 5% rate.

Zenith, a manufacturer of radio and television receivers, has been diversifying. They have been making video monitors for terminals and cable-television converters. Immediately after the acquisition was completed, Heath announced an aggressive marketing program to sell assembled computer systems through a network of distributors and original equipment manufacturers.

8-INCH WINCHESTER DISK MARKET STILL TRYING TO GET OFF THE GROUND: Despite the publicity and advertising, only one manufacturer is presently shipping production quantities of 8-inch hard-disk drives. The company is International Memories Inc (IMI), which is currently shipping limited quantities of their 11 M byte drive at $1775. IMI will introduce a 20 M byte unit early next year, and expects to reduce the price on the 11 M byte unit 10 to 20% by midyear as production is increased.

Micropolis expects to start shipping limited quantities of its 27 and 45 M byte drives soon. The introductory price for the 45 M byte drive is $2688 and should drop to under $2000 by midyear.

Shugart has not yet revealed its marketing plans for its 8-inch rigid drive.

COMPUTERIZED PORTABLE HOME ENTERTAINMENT CENTER SHOWN: Sharp Electronics recently showed a portable unit, about the size of a typical portable stereo system, which included the following: a television receiver with a 4.5 inch screen, an AM/FM radio, a stereo cassette, a digital clock, a calculator, and a personal computer. The computer's 48-key keyboard slides into the unit for storage, when it becomes necessary to transport the unit. The video screen is used for display, and the audio cassette recorder is for data and program storage. It uses BASIC, has graphics capabilities, and is expandable. No immediate marketing plans have as yet been announced.

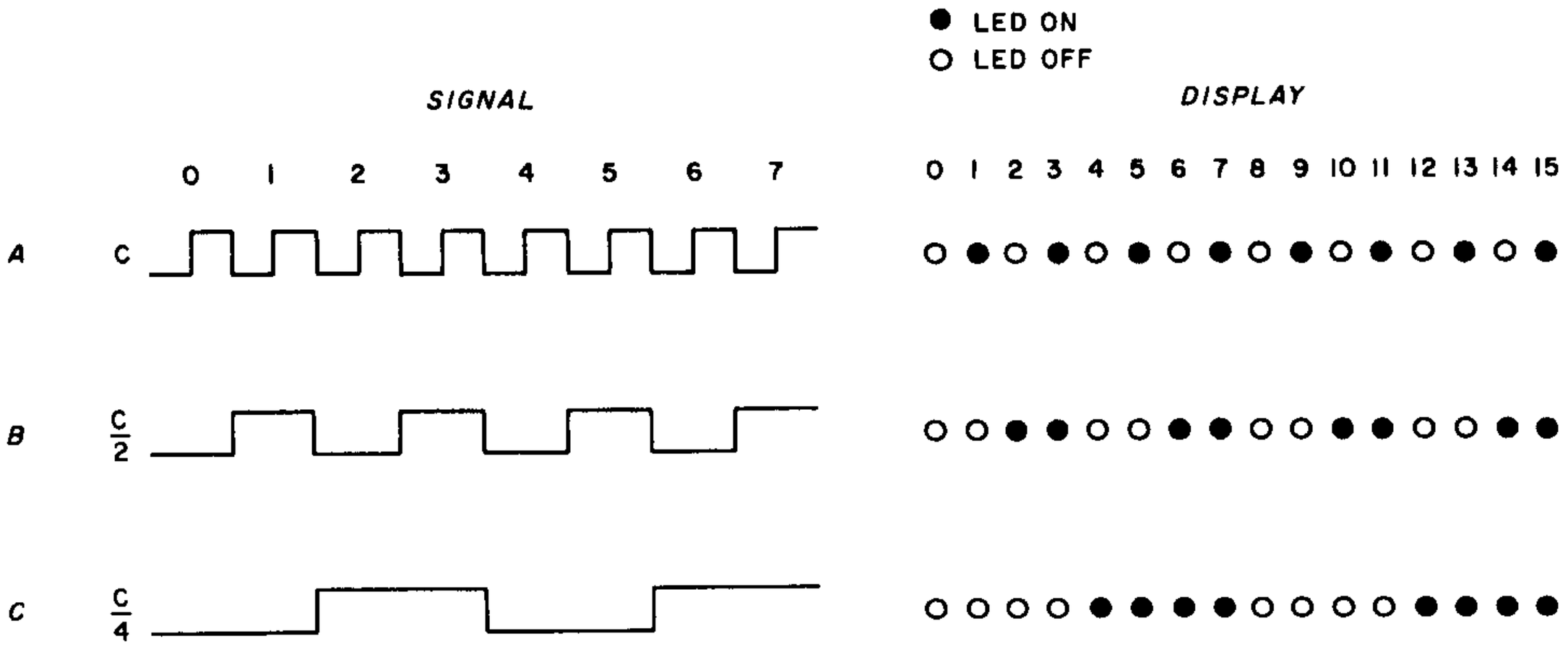

Figure 2: Comparison of waveforms as they might be displayed on an analog oscilloscope, and as they are displayed on the digital oscilloscope. The dark circles indicate lighted light emitting diodes (LEDs). The open circles show unlighted LEDs.

Text continued:

of the enable and data strobes are sequentially scanned.

The data and enable strobe signals are sent to latches. The data strobe provides the information to be stored when the enable strobe of the same latch goes low. The latches are updated every 8 clock cycles. The output of each latch is used to drive an LED. The LED will glow if the output of the latch is low (a 0 state). In this manner, the serial digital signal is mapped onto the array of 16 LEDs.

The digital oscilloscope is also useful as a logic design and analysis aid. It can generate a truth table for a combinational logic network of up to 4 inputs. To accomplish this, simply connect the clock signal, the clock divided by 2, the clock divided by 4, and the clock divided by 8 to the inputs of the logic network (pins 23, 22, 21, and 20 of IC1.) Connect the output of the logic network to the signal input of the digital oscilloscope. Figure 5 illustrates how to make these connections to a logic network. ■

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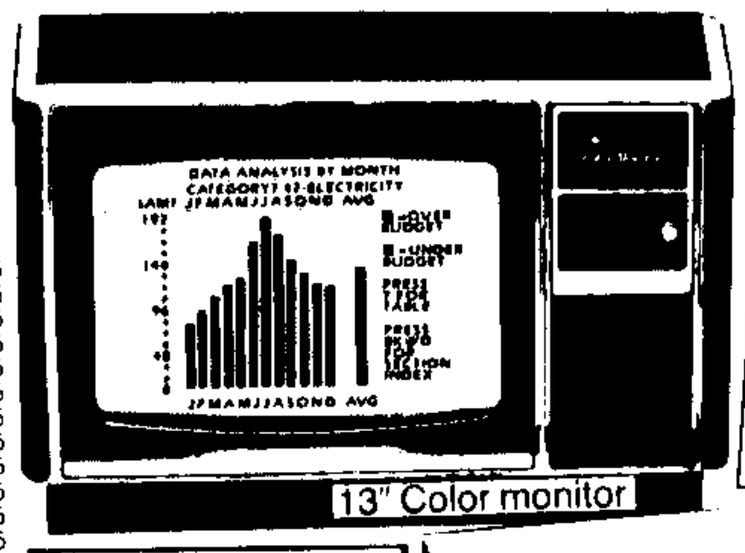

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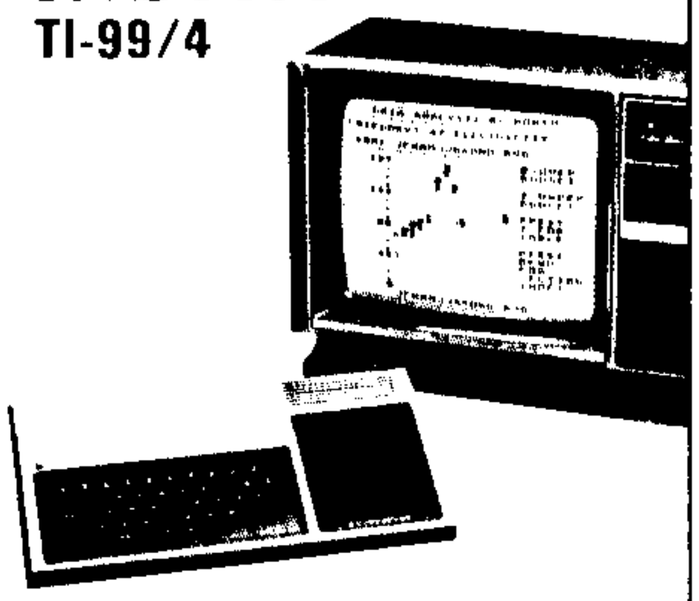

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02	2400	RCL 0	TAKES CARE OF
03	41	—	TAIL AND HEAD
04	2407	RCL 7	WINDS
05	41	—	
06	2304	STO 4	
07	2407	RCL 7	
08	51	+	
09	1551	8 ≥ 0	
10	1313	GTO 13	
11	1312	GTO 12	
12	2304	STO 4	
13	2404	RCL 4	
14	1541	8 × < 0	
15	1320	GTO 20	
16	09	9	
17	00	0	
18	51	+	
19	2304	STO 4	
20	1404	f SIN	
21	2403	RCL 3	
22	61	×	
23	2402	RCL 2	
24	71	÷	
25	1504	8 SIN $^{-1}$	
26	2305	STO 5	
27	2404	RCL 4	
28	2406	RCL 6	
29	51	+	
30	1551	8 ≥ 0	
31	32	CHS	
32	2405	RCL 5	
33	1551	8 ≥ 0	
34	32	CHS	
35	51	+	
36	2406	RCL 6	
37	51	+	
38	1404	f SIN	
39	2403	RCL 3	
40	61	×	
41	2405	RCL 5	
42	1404	f SIN	
43	71	÷	
44	1541	8 × < 0	
45	32	CHS	
46	74	RS	GROUND SPEED
47	2400	RCL 0	
48	2405	RCL 5	
49	51	+	TRUE HEADING ■

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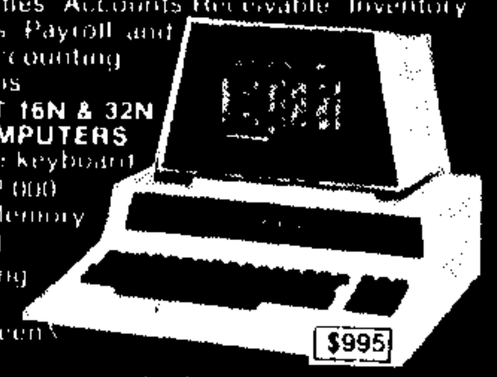

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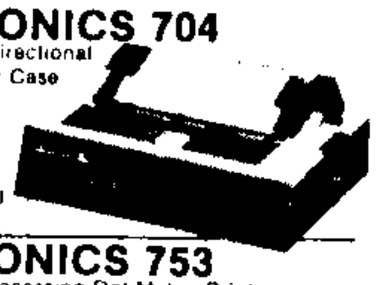

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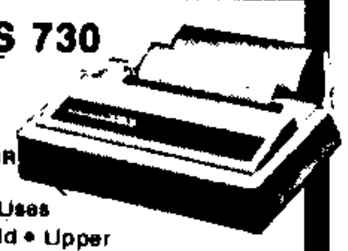

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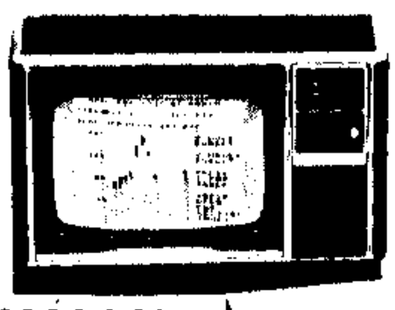

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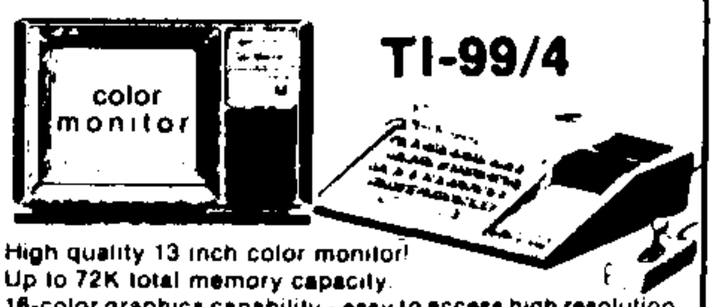

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Based on the powerful Z-80 CPU, this kit is an ideal introduction to microprocessors. It has an on-board keyboard and display, plus cassette tape interface and expansion provisions for two S-100 connectors. This "Do-it-all-Board" will also program the 2716 2K

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VDB-8024

An **80 by 24** I/O mapped video board for S-100 systems. An on-board Z-80 processor is used to control all functions. A total of 256 user-programmable characters are available, including 128 characters that are supplied with the board. **This is virtually a stand-alone terminal!**

KIT **$319.95**
ASSEMBLED AND TESTED **$469.95**

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This 64 by 16 memory-mapped video board is ideal for use with word processing software such as the Electric Pencil.

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The ultimate memory-mapped 80 character by 24 line video board, the Vector Graphics FWII has many advanced features: Onboard parallel keyboard port, Power-on jump circuit, 8 X 10 dot character matrix, and the optional ability to program your own characters and/or graphics symbols. this is THE perfect board for text editing systems.

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Features include 300 Baud Answer/Originate Bell 103
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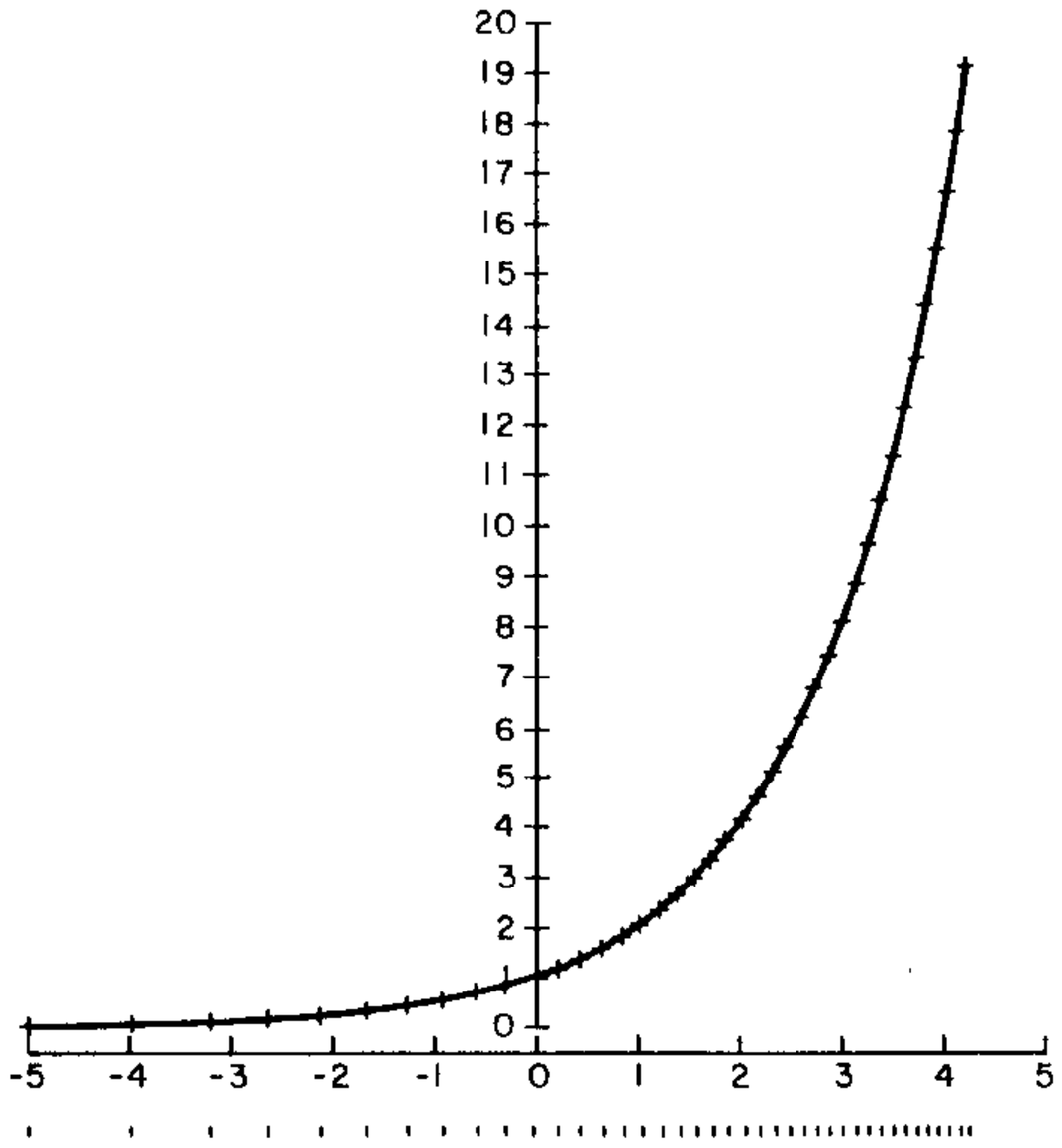


Figure 4: *Identical to figure 2 except that crosses are used to indicate plotted points. Note similar line segment lengths at both ends of the curve, but vastly different $\triangle X$ s (distances between marks below X axis). Note also the shorter line segments in area of greater curvature.*

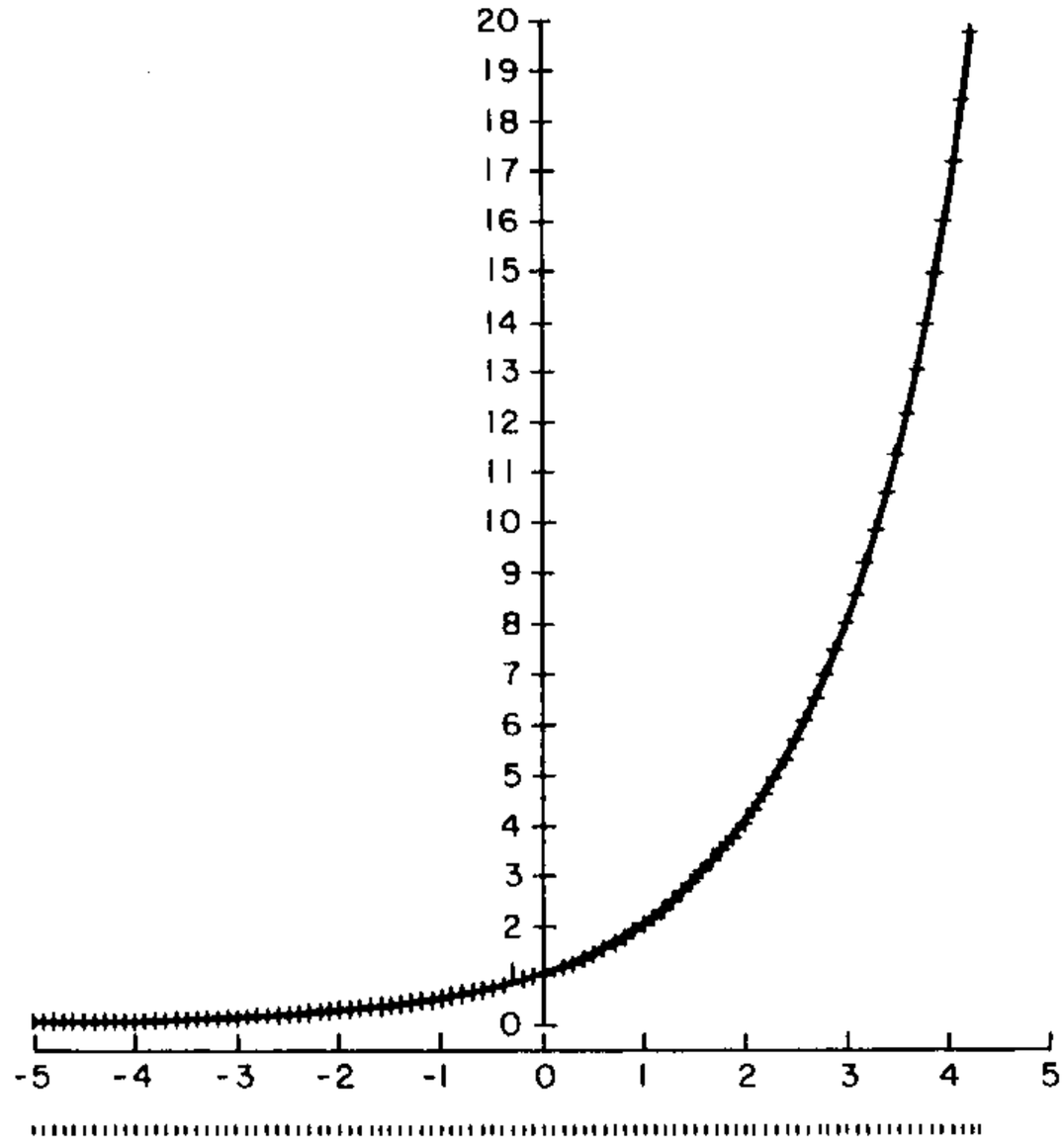
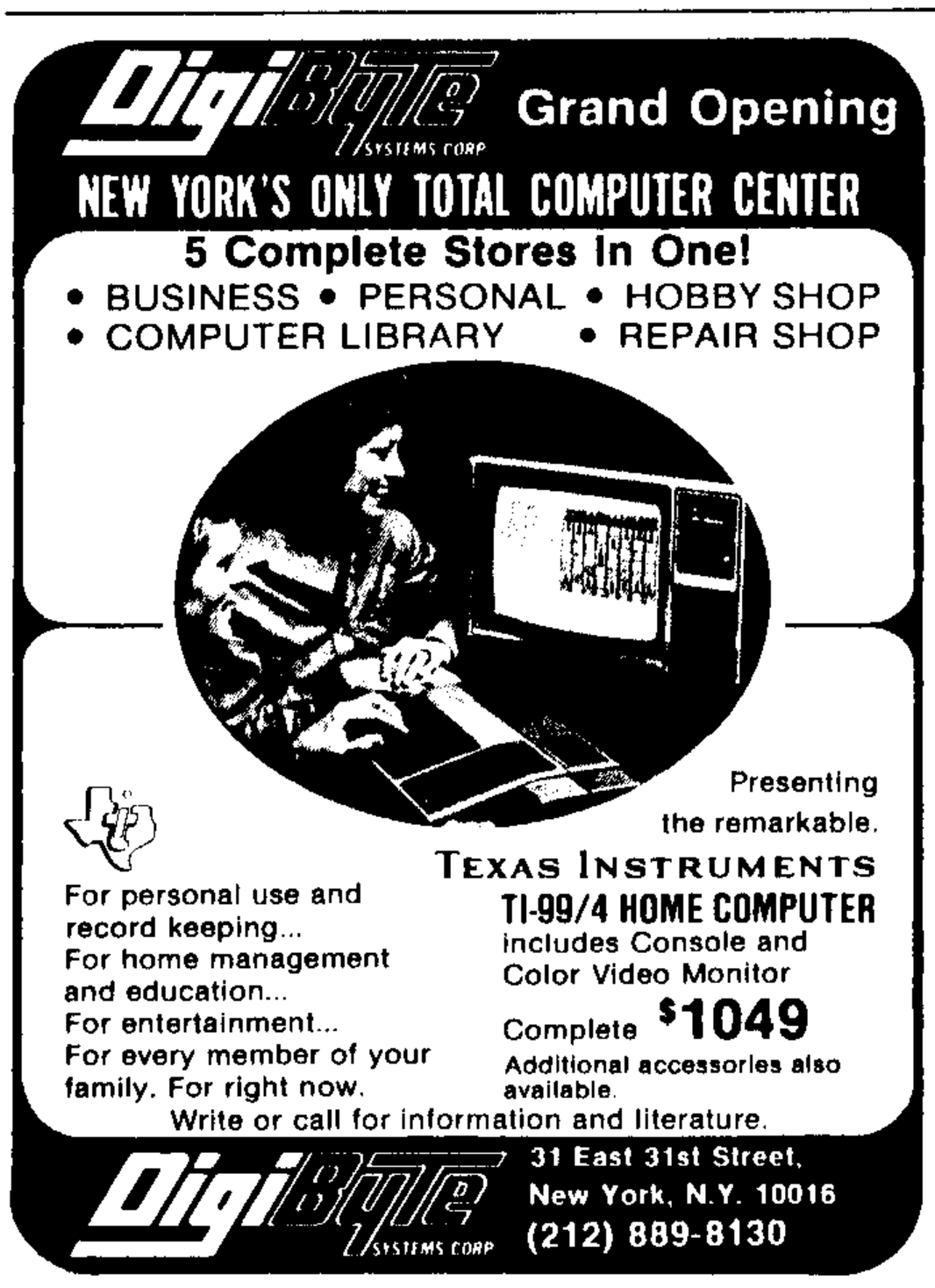


Figure 5: *Same as figure 3 with the crosses at all plotted points. Note the reasonable line segment lengths in the upper-right portion of curve, but unnecessarily short line segments in the lower left portion of curve due to the use of constant $\triangle X$.*



The arctangent of the last plot slope is computed to yield the last plot angle. Taking the cosine of the last plot angle and multiplying by the value of the desired line-segment length (using X axis units) yields the required $\triangle X$ estimate for the next point as illustrated in figure 6. That is, when the last two line segments' curvature is zero:

$$\triangle X_i = X_{i+1} - X_i = L \cos \left\{ \arctan \left[\frac{N(Y_i - Y_{i-1})}{M(X_i - X_{i-1})} \right] \right\} \quad (1)$$

where:

L = desired maximum line-segment length,
N/M = scale difference adjustment factor.

This determines the contribution to $\triangle X$ from the plot slope (or first derivative) effects.

Notes on Figure 6

Assume (X_4, Y_4) and (X_5, Y_5) have been plotted, and $\triangle X_4$ and Q_4 (the corresponding slope angle) have been calculated, but that $\triangle X_5$, X_6, Y_6, and Q_5 are not yet known. It is assumed that Q_5 will be approximately equal to Q_4, which is generally true for small line-segment

Circle 87 on inquiry card.

What's New?

PUBLICATIONS

New Trackball Products Catalog

Measurement Systems Inc has announced publication of their 12-page catalog of Trackball products. Trackballs are widely used for the human operator to perform positioning or contouring tasks on interactive displays either in computer peripherals or radar systems. Almost one half of the catalog contains technical and application data so that the reader gains a full understanding of this product. The balance of the catalog provides extensive data on specific standard items with options available. Fourteen trackballs are described, ranging in size from 2 to 3½ inches in diameter (5.08 to 8.89 cm). For further information, contact Measurement Systems Inc, 121 Water St, Norwalk CT 06854.

Circle 539 on inquiry card.

Free Apple Software Catalog from Rainbow

This 45-page catalog includes over 100 games of all types, fifteen business applications, twelve demonstration programs from voice recognition and speech synthesis to high-resolution and color graphics, and software development programs. Rainbow's "Pot O' Gold" of 49 games and demonstrations is also featured.

Prices for programs on cassette and diskette average around $10 to $20. Write Rainbow Computing Inc at 9719 Reseda Blvd, Northridge CA 91324 or call (213) 349-5560 for your free catalog.

Circle 541 on inquiry card.

PIPS for VIPS

PIPS written by Tom Swan contains 160 pages of programs and documentation for use on the RCA COSMAC VIP, and an appendix describing modifications which can be made to allow the *PIPS* programs to be run on the ELF computers.

The first program, "Character Designer," facilitates building and editing a complete American Standard Code for Information Interchange (ASCII) and graphics character set, the remaining three programs use the display capabilities generated by the "Character Designer" to build text files. "Messager" allows easy text and graphics display from within CHIP-8; "Text Editor-21" is a general-purpose text editor, and "Disassembler-7" is an 1802 machine language disassembler. All these programs utilize a high-resolution display method described in *PIPS*. The remaining programs in the book are a "CHIP-8 Program Editor" and two games written in CHIP-8: Space Wars and Surround.

The book is available from Aresco, POB 1142, Columbia MD 21044, for $19.95. The price includes a companion cassette containing all the *PIPS* programs.

Circle 542 on inquiry card.

New Book Series on Computers

Academic Press Inc, 111 5th Ave, New York NY 10003, is publishing a series of books that cover a wide range of topics in the computer field.

Physics of Computer Memory Devices, Artificial Intelligence, Computer Vision Systems, Pattern Recognition and Artificial Intelligence, and *Associative Networks* are some of the books now on the market.

The prices range from $29 to $39.50

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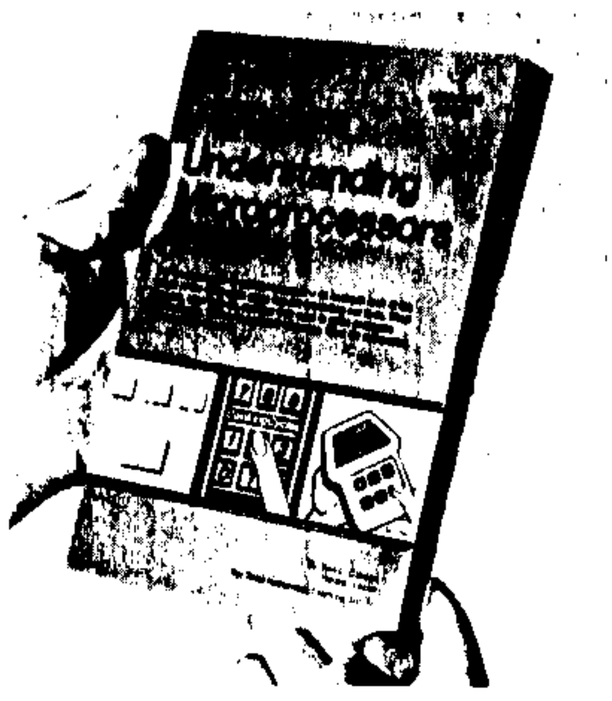
Book on Microprocessors from Texas Instruments



Written in nontechnical language, *Understanding Microprocessors* covers the aspects of microcomputer systems which use a microprocessor chip as the central unit for processing and control. This book provides the layman with the basics of what comprises a microprocessor, how it fits into the microcomputer system, what other system parts are necessary and how the microcomputer system functions. It introduces the reader to digital electronics, integrated circuit functions and includes 8- and 16-bit microprocessor applications with exercises and solutions. It is priced at $4.95 and is available from Texas Instruments Inc, POB 3640, MS 84, Dallas TX 75285.

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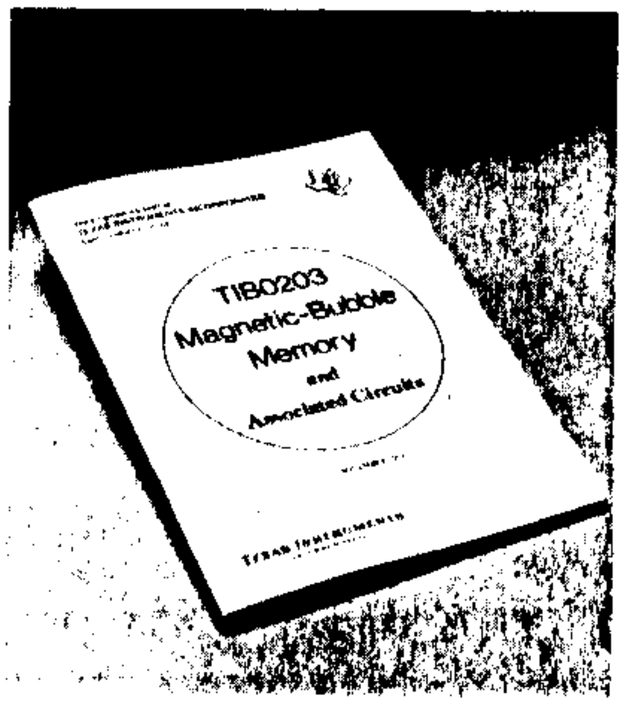
Free TIB0203 Data Book from Texas Instruments



A data book on the TIB0203 magnetic bubble memory has been announced by Texas Intruments Inc, POB 225012, Dallas TX 75265. The 48 page book, publication number LCC4430, contains complete specifications on the TIB0203 and, in addition, an 8 page discussion on the basic fundamentals and advantages of magnetic bubble memories. Also included in the manual are specification sheets for the interfacing integrated circuits which have been designed for use with the TIB0203. The additional data sheets include those for SN74LS361 function timing generator, SN75281 sense amplifier, SN75380 function driver, and SN75382 coil driver. Data sheets for standard devices which are needed for bubble memory system design, such as TSP102 thermistor and VSB53 Schottky-diode bridge, are also included.

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Communications Card	210.00	16K Upgrade Kit	74.95
Business Software Pkg	625.00	Apple Radio Car	159.00
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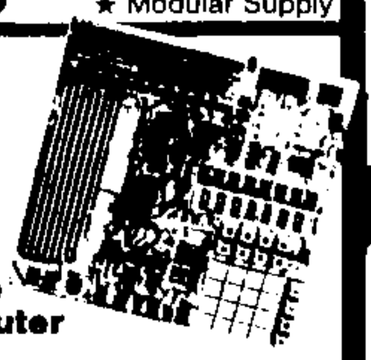

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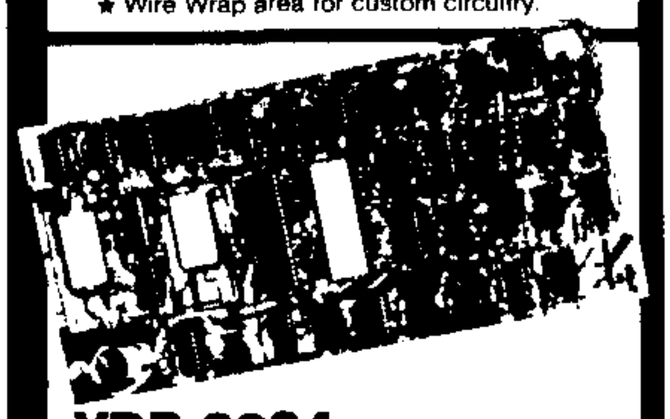

VDB-8024 Video Display Board $319 KIT

With On-Board Z80 Microprocessor

★ Full 80 Characters by 24 lines display.
★ Characters displayed by High Resolution 7 x 10 Matrix.
★ Keyboard Power and Interface.
★ Composite Video Output.
★ Separate TTL Level Synchronization and Video Outputs.
★ 2K Bytes Independent On-Board Memory.
★ On-Board Z80 Microprocessor.
★ Glich Free Display.

TRS-80/APPLE

MEMORY EXPANSION KITS
4116's
16K (200/250 ns.)
8 pcs. for **$74.95**
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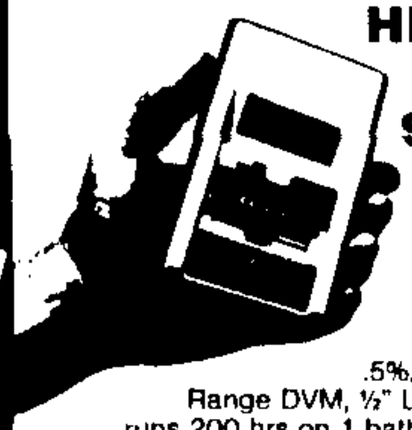

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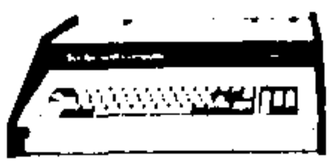

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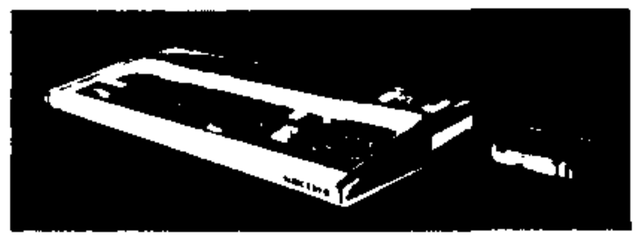

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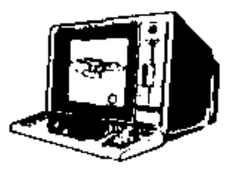

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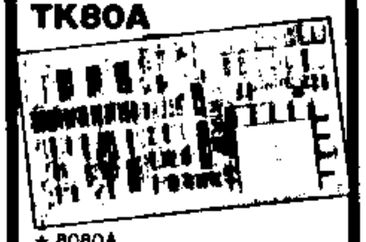

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BYTE News . . . .

INTEL 32-BIT MICROPROCESSOR RUMORED: As reported in this column last April, Intel was rumored to be working on a 32-bit microprocessor. The project is moving closer to reality as Intel has assigned a part number to the device. It will be called the 8800 (not to be confused with the Altair 8800 computer). The instruction set will not be compatible with Intel's 8-bit or 16-bit microprocessors. The device will be housed in the new 64-pin QUIP (quad-in-line package, see "BYTE News," June 1979) which is cheaper, smaller, and easier to test than dual-in-line packages. The 8800 is reportedly being developed at Intel's facility in Aloha OR. The first test prototypes are reported to have been produced.

TI RF MODULATOR FCC WAIVER GRANTED: The Federal Communications Commission (FCC) has granted Texas Instruments a waiver which permits TI to connect its personal computers to home color television receivers using a radio frequency (RF) modulator. TI originally petitioned the FCC for approval of the RF modulator system in February 1979. The petition was rejected since the regulations required that the complete system be submitted for approval: TI submitted only the RF modulator for approval. Subsequently, Texas Instruments applied for a waiver, provided that the modulator unit met the standards.

The FCC asked other personal computer system manufacturers to comment on the TI request. Radio Shack, Apple Computer, Commodore, Mattel, and Atari responded negatively to the request. Apple, Atari, and Mattel went to great expense to comply with the FCC regulations. The Radio Shack and Commodore systems, which contain integral displays and do not use RF modulators, do not come under the FCC regulations.

The FCC decision further waives testing by the FCC and merely requires that the manufacturer provide the FCC with test results showing compliance. In a related action, the FCC relaxed the standards on RF interference generated by commercial and personal computer systems.

Several personal computer manufacturers that compete with TI have already stated that this waiver will give TI a competitive advantage. Furthermore, several firms publicly questioned the FCC's rule-making methods in making its decision. The likelihood now is that the other personal computer makers will offer systems with RF modulators. It will probably take these manufacturers at least a year to bring out such competing systems.

ULTRA MINI-FLOPPY DRIVE INTRODUCED: Sanyko Seiki Manufacturing Co, Tokyo, Japan, has begun producing samples of an ultra-small floppy disk drive and controller. Called the FMC-100, it uses a 2-inch floppy disk that stores 8 K bytes on one track. It is intended for use in word-processing typewriters and personal computer systems.

THWARTING COMPUTER SOFTWARE PIRATING: A patent (number 4,168,396) has been issued to Robert M Best, Seattle WA, for a "microprocessor which prevents the piracy of computer programs." The device reportedly uses cryptography to protect the software. It is called a *crypto-microprocessor* and stores software in cipher to prevent it from being copied, disassembled, or altered by unauthorized processes. Authorized users can decipher the software with special encryption keys. The patent states that the device is intended primarily for use in personal computer systems.

AC LINE TO TTL INTERFACE IC INTRODUCED: General Instrument Optoelectronics of Palo Alto CA has introduced a low-cost, 8-pin integrated circuit that can be used to directly monitor AC power line circuits and provide transistor-transistor logic (TTL) outputs. The device, therefore, can be used to interface your microprocessor inputs easily and directly to monitor AC power-line-operated devices such as motors, solenoids, relay contacts, and the like. It can also be used to detect power failure and other such applications.

FLAT PANEL TERMINAL DISPLAYS BECOMING AVAILABLE: Computer terminals using flat-screen video displays are getting close to the marketplace. The technology is based on the plasma panel developed by Owens-Illinois, Toledo OH, in the late 1960s. Currently, Interstate Electronics of Anahiem CA, IBM, and Fujitsu have these panels in production. Control Data and NCR are planning large-scale production. IBM now makes approximately 100,000 plasma panels annually, which

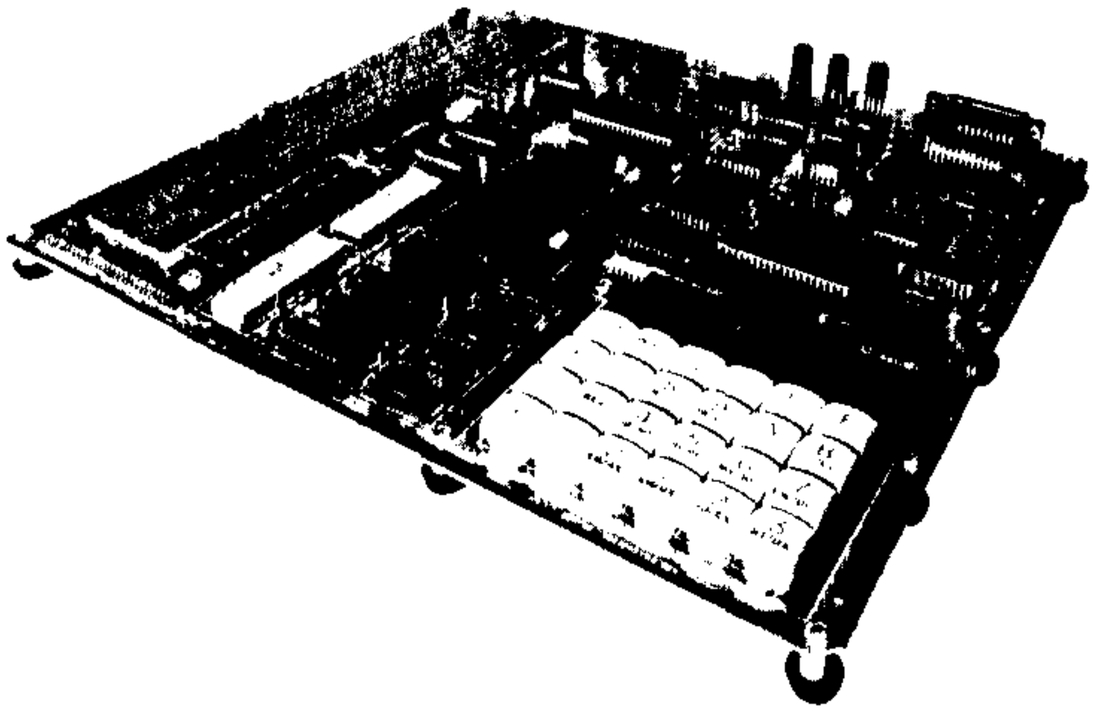
What's New?

SYSTEMS

Microcomputer Kit with 8086 Processor

The Intel SDK-86 is a complete 8086 microcomputer system on a board with memory and I/O (input/output) systems in kit form. This stand-alone 16-bit microcomputer allows designers to obtain hands-on experience with Intel's 8086 16-bit HMOS microprocessor, which offers ten times the processing power of the 8080 processor.

Included in the kit is an 8086 processor; 8 K bytes of 2316 or 2716-type read-only memory; 2 K bytes (expandable to 4 K bytes) of 2142-type programmable memory; 48 parallel I/O lines (implemented through two 8255A programmable peripheral interface devices); an RS-232 or current loop serial I/O structure (implemented via an 8251A universal synchronous/asynchronous receiver-transmitter); selectable data rate from 110 to 4800 bits per second (bps); TTL-compatible bus signals and parallel I/O signals; 24-key hexadecimal data and control keyboard; 8-digit hexadecimal display and control (using an 8279 programmable keyboard and display controller); and 256 vectored interrupts.



The 2 K bytes of 2142-type programmable memory can be doubled by implementing additional devices in the positions provided. There is room for 8 K bytes of program instructions using either or both of the keyboard and terminal software monitors included in the kit. There is a fully buffered system bus. Programs and data may be entered three ways: from the built-in keyboard; through a built-in serial communications interface; or via cable (SDK-C86) from any Intellec Microcomputer Development System.

A complete design library is provided with the kit. This library includes both the assembly and user manual, plus an MCS-86 user manual and 8086 assembly language reference manual. The SDK-86 microcomputer kit is priced at $780. For further information, contact Intel Corp, 3065 Bowers Ave, Santa Clara CA 95051.

Circle 594 on inquiry card.

Personal Computer Introduced by Texas Instruments

Texas Instruments has introduced a personal computer featuring easy-to-use computing power for personal finance, home management, family entertainment and education. Designated the Model TI-99/4, the system consists of a console with 16 K bytes of programmable memory, a wide range of sound effects, sixteen colors for graphic display, a powerful extended BASIC programming language, and a 13-inch color video monitor.

At the heart of the TI-99/4 is a library of Texas Instruments Solid State Software command modules. These command modules allow users instant program accessibility. Solid State Software command module titles include: Demonstration, Diagnostic, Early Learning Fun, Beginning Grammar, Number Magic, Video Graphs, Home Financial Decisions, Household Budget Management, Video Chess, Football, Physical Fitness, Speech Construction, Investment Analysis, Personal Record Keeping, Statistics, Early Reading, and Tax and Investment Record Keeping.

Among peripheral accessories offered is a Solid State Speech synthesizer with a price of $150. By building a basic vocabulary into the language system, home programmers can place audible messages in their programs. The speech synthesizer module has a 200-word vocabulary and plugs into the console. Speech can be written into programs using BASIC programming language. Future command modules will call up spoken words automatically.

TI BASIC is a full floating point, 13-digit expanded version of BASIC that is fully compatible with ASCII and the BASIC specification of the American National Standards Institute. TI BASIC includes a full complement of 24 BASIC statements, 14 commands, color graphics, and sound and music over four full octaves. A *Beginner's BASIC Guide* for self-teaching comes with the TI-99/4. For users knowledgeable about programming, McGraw-Hill has published *Programming BASIC With the TI Home Computer*, a book by Herbert Peckham.

Remote controls are offered as accessories to the TI-99/4. Two of these controls may be connected to the computer at the same time. Each includes a multiposition (360°) rotary lever with a side-mounted pushbutton. Other accessories offered by Texas Instruments include: a printer, disk storage, and an RS-232 interface device for connecting the computer to other electronic devices.

The price for the TI-99/4 system is $1150. Solid State Software command modules carry prices ranging from $19.95 to $69.95 each. For further information, contact Texas Instruments Inc, Consumer Relations, Attn TI-99/4, POB 53, Lubbock TX 79408.

Circle 595 on inquiry card.

(1a) Input Registers

Register Code	Function
R4	Data Input
R5	Interface Status
R6	High Byte Data Input
R7	(Not Used)

(1b) Output Registers

Register Code	Function
R4	Data Output
R5	Interface Control
R6	High Byte Data Output
R7	Data Transfer Trigger

Table 1: *Interface definitions for the 98032A parallel interface. Table 1a defines the input registers, and table 1b defines the output registers.*

Register Architecture

I stated earlier that each interface would have a unique address on the I/O bus and would be selected by the peripheral address line on that bus. Each interface is divided into registers that are individually addressable by means of a register code. The register model divides the interface into eight different registers. Four of these are output registers that take data from the computer (the computer *outputs* to them). The other four are input registers, supplying data to the computer (the computer gets *input* from them).

Let's now assign a function to each of these interface registers. The 98032A interface uses the definitions shown in tables 1a and 1b.

R4 registers are the primary means of data transfer between the computer and the interface, and in turn, the peripheral. The R4 output data register is directly connected to the output signal lines of the 98032A. The R4 data input register is connected to the interface input lines. The R6 input and R6 output registers allow the 98032A to be used as two 8-bit interfaces instead of one 16-bit interface. The R6 registers read or control the upper eight data lines when the interface is in the byte mode, that is, when the interface is handling data in 8-bit

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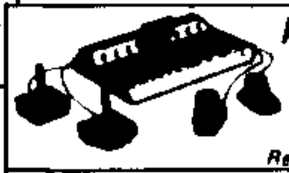
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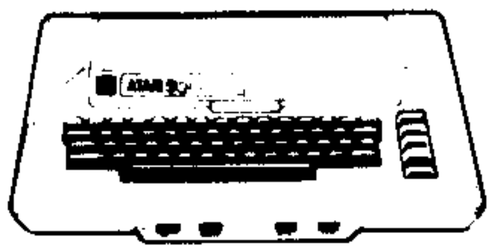

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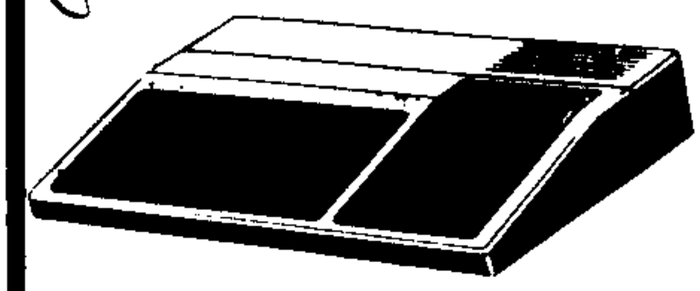

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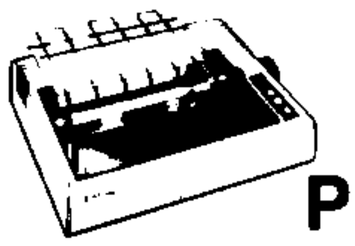

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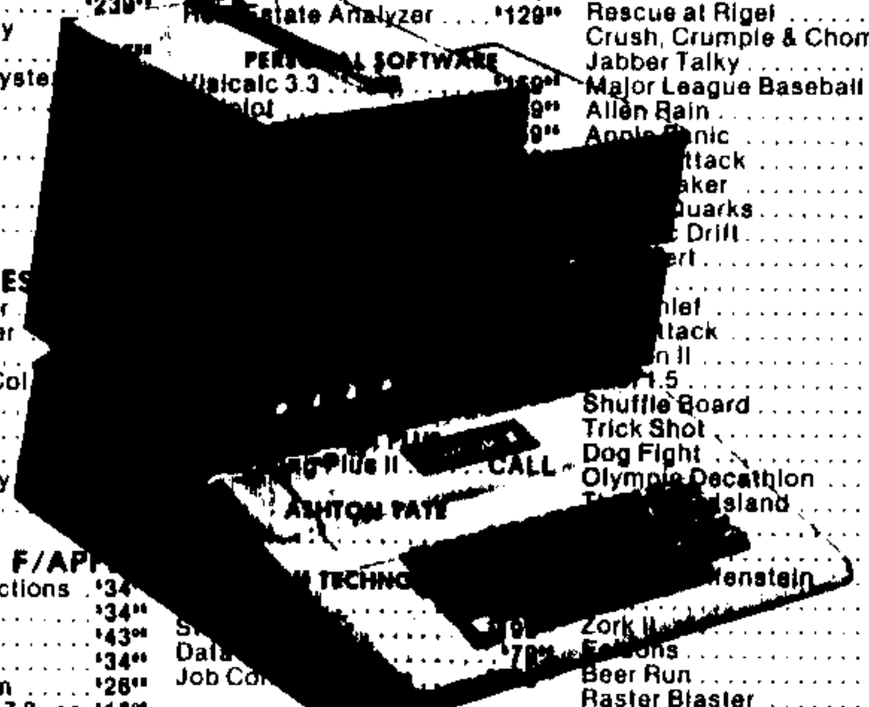

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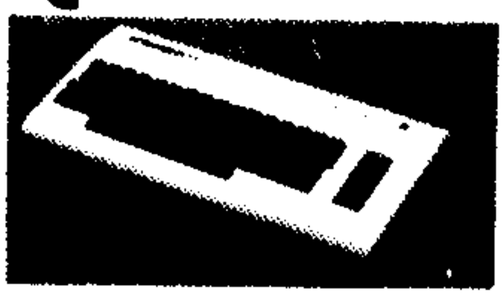

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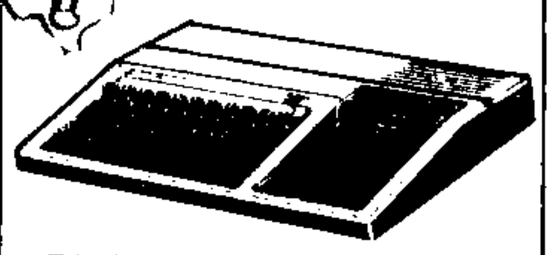

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Listing 1 continued:

```
  15:GOTO 210;
END; {OF UPPER-CASE STATEMENT}
GOTO 190;

210: IF B<>W THEN B:=B+Q ELSE
   BEGIN WRITE ('!');
      FOR J:=1 TO W DO IF (M[A,J]=2) OR (M[A,J]=4) THEN WRITE ('  !')
                                                   ELSE WRITE ('   ');

      WRITELN;
      IF A=H THEN GOTO 500 ELSE
         BEGIN WRITE ('+');
            FOR J:=1 TO W DO IF M[A,J]>2 THEN WRITE ('--+')
                                         ELSE WRITE ('  +');
      WRITELN; B:=1; A:=A+1; END
      END;
I:=A; J:=B; Q:=1; GOTO 190;

500: X:=FNA(W-2)+1; M[H,X]:=M[H,X]-2; ONCEWITHSTYLE;
     FOR I:=X-1 DOWNTO 1 DO WRITE ('   '); WRITELN ('STOP');
END.
```

gram will intentionally enter a nonfrontier cell.

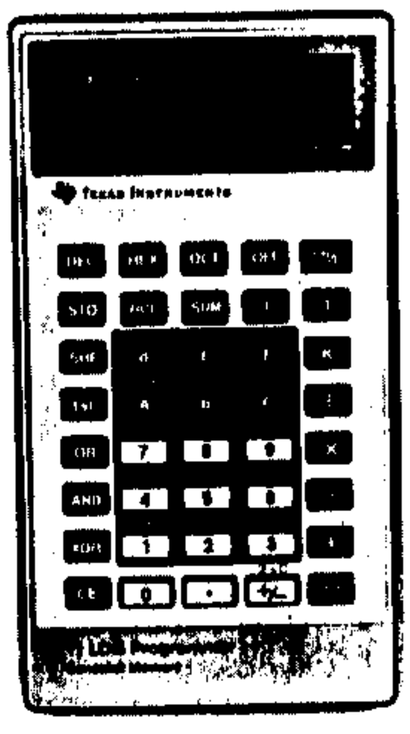
Now the program has finished the first line of the maze. It is no longer possible for any more work to be done to this line because there are no longer any frontier cells surrounding any cell on the line. So the system prints the top line.

Now the system moves to the leftmost cell of the second line of the maze and does exactly the same thing over again for this new line. And so the program continues, left to right, top to bottom, creating and printing the maze.

When the program has completed the maze—but before it has printed the last line—it is time to make the exit. The program randomly picks a spot on the last line of the maze and blows a hole through the bottom of the maze pattern, thus creating the stop point. The last line is printed, then the STOP message, and you have a maze with only one solution. See listings 2a and 2b on page 282 for a sample maze and its matrix.

Additional Comments

The program makes a boundary by setting the outer rows and columns of the matrix to 1, making them nonfrontier. This method wastes the outer limits of the matrix and decreases the size of the maze but is much faster than any kind of numeric subscript out-of-bounds checking since the program logic treats these outermost nonfrontier cells as off-limits territory. Therefore it won't go beyond them and cause a subscript error. Note that this requires a maze of 10 by 10 to actually be stored in a 12 by 12 matrix. Naturally, the percentage of memory required as overhead to store these outermost values goes down rapidly as the size of the maze increases, so this method becomes highly efficient with very large mazes.



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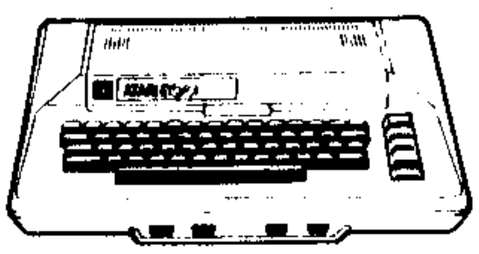

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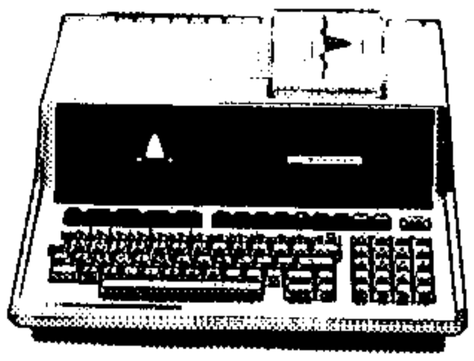

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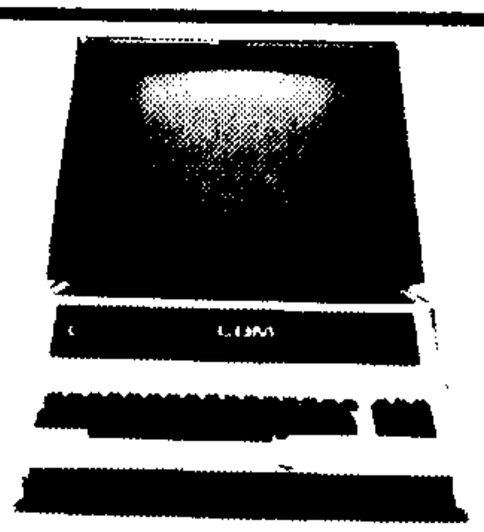

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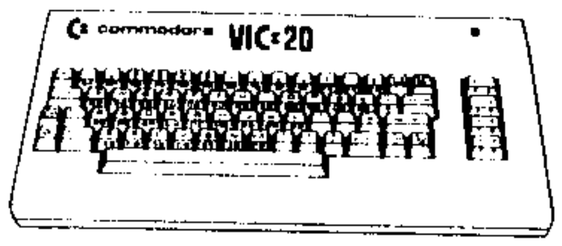

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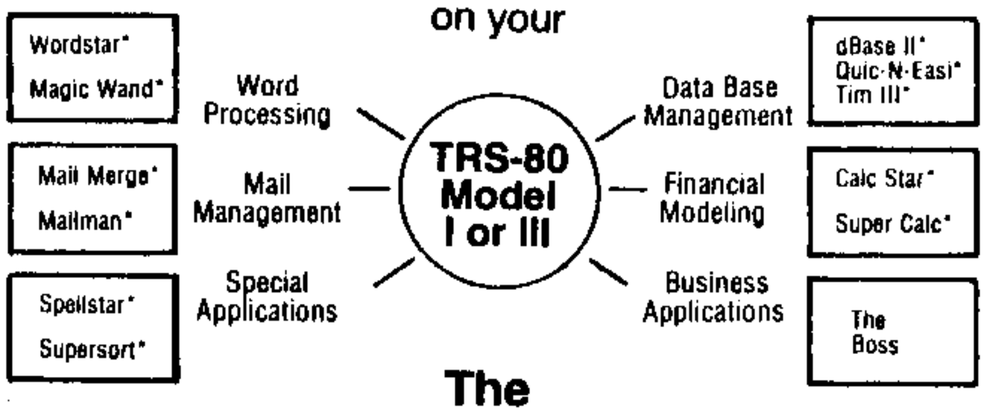

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AgDisk Financial Management Series One, an agricultural financial-management package in Pascal for the Apple II. Floppy disk, $140. Harris Technical Systems, 624 Peach St., POB 80837, Lincoln, NE 68501.

Alkemstone, an adventure-type game for the Apple II. Floppy disk, $39.95. Level-10, Suite 507, 7475 Dakin St., Denver, CO 80221.

Apple-Aids, a disk-utility package for the Apple II. Floppy disk, $49.95. Advanced Operating Systems, 450 St. John Rd., Michigan City, IN 46360.

Beer Run, an arcade-type game for the Apple II. Floppy disk, $29.95. Sirius Software Inc., 10364 Rockingham Dr., Sacramento, CA 95827.

Enhanced Graphics Software for the IDS 460G/560G, a graphics utility for the Apple II. Floppy disk, $44.95. Computer Station Inc., 11610 Page Service Dr., St. Louis, MO 63141.

Graphic Writer, utility to combine graphics with Applewriter text for the Apple II. Floppy disk, $34.95. Computer Station Inc. (see address above).

Hadron, an arcade-type game for the Apple II. Floppy disk, $34.95. Sirius Software Inc. (see address above).

Hi-Res Computer Golf, a computerized golf game for the Apple II. Floppy disk, $29.95. Avant-Garde Creations, POB 30160, Eugene, OR 97403.

The Liberator, a programming utility and library of subroutines for the Apple II. Floppy disk, $29.95. Pear Software, 407 Terrace, Ashland, OR 97520.

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Ultra Hi-Res Graphics, utility for use with the IDS 460G/560G printers with the Apple II. Floppy disk, $49.95. Computer Station Inc. (see address above).

Atari

Atari Word Processor, a word-processing system for the Atari 800. Floppy disk, $149.95. Atari Inc., Computer Division, POB 427, Sunnyvale, CA 94086.

The Duplicating Machine, a program-duplication utility for the Atari 400 and 800. Floppy disk, $19.95. Midwest Software, 2707A Ridge Court, Lawrence, KS 66044.

CP/M

CP/M Adventures 1-12, a series of Scott Adams's adventures for CP/M (Z80). 8-inch floppy disk, $129.95. Adventure International, 507 East St., POB 3435, Longwood, FL 32750.

Ficomp CP/M 2.2. Utilities, a set of utility programs for CP/M (Z80). 8-inch floppy disk, $24.95. Ficomp Inc., 3017 Talking Rock Dr., Fairfax, VA 22031.

Copy86, a utility program for copying Z80 CP/M files to and from 86-DOS. 8-inch floppy disk, $120. GIOS Enterprises, 9784 Woodhollow Way, Sacramento, CA 95827.

PET

Concentration, Memory, Cosmic Collision, Hangman, and Torpedo Command, games for the PET 2001. Cassette, $5.99 each. Royal Software, 149-45 83rd St., Howard Beach, NY 11414.

PET/CBM Cross-Reference Program, a cross-reference utility program for the PET/CBM. Floppy disk, $29.95. Oppenheimer Software, 79th Street Boat Basin #39, New York, NY 10024.

Texas Instruments

Adventureland, an adventure-type game for the *TI-99/4*. *Floppy disk*, $29.95. Texas Instruments Inc., 13500 North Central Expressway, POB 225012, Dallas, TX 75265.

Car Wars, an arcade-type game for the TI-99/4. Command Module (i.e., ROM cartridge), $39.95. Texas Instruments Inc. (see address above).

The Count, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc. (see address above).

Ghost Town, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc. (see address above).

Pirate Adventure, an adventure-type game for the TI-99/4. Floppy disk and Command Module (i.e., ROM cartridge), $29.95. Texas Instruments Inc. (see address above).

Pyramid of Doom, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc. (see address above).

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Bisplan, a business-modeling program for the TRS-80 Models I and III. Cassette, $20. Mariah Com-

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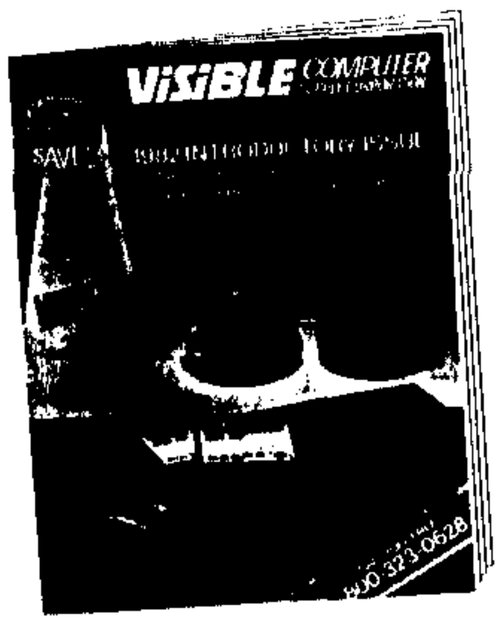

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The iAPX 88 Book costs $7.50. Contact Intel Corp., Literature Dept., 3065 Bowers Ave., Santa Clara, CA 95051, (408) 734-8102.
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Microprocessor Operating Systems

Microprocessor Operating Systems provides in-depth descriptions of National Semiconductor's BLMX-80, Intel's iRMX 80/88 and iRMX 86, Data General's MP/OS, Texas Instruments' Rx, Bell Lab's Unix, Motorola's VERSAdos, and Zilog's RIO/CP and ZRTS operating systems. The book is available for $11.95 from Microcomputer Applications, POB E, Suisun City, CA 94585, (707) 422-1465.
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ICP Software Business Review analyzes software solutions to business problems for the corporate and data-processing executive. Existing and potential information-management problems are identified, and software solutions are proposed. Contact International Computer Programs, 9000 Keystone Crossing, Indianapolis, IN 46240, (800) 428-6179; in Indiana, (317) 844-7461.
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TI Logo Source

Microcomputers Corporation has a new catalog and a newsletter for Texas Instruments' TI-99/4A computer users. The bimonthly TI Logo Source newsletter is filled with reviews and news of the latest developments in Logo software. The catalog is packed with lists of available Logo programs. Both are free from Microcomputers Corp., POB 191, Rye, NY 10580, (914) 967-8370.
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Data Manual

The design and operation of the OB68K1 single-board computer are described in a data manual available from Omnibyte. The OB68K1 computer system features the Motorola 16-bit MC68000 microprocessor on a Multibus/IEEE P796 bus and software compatibility with Motorola's MEX678KDM. The manual is available for $10 from Omnibyte Corp., 245 West Roosevelt Rd., West Chicago, IL 60185, (312) 231-6880.
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Microcomputer Buyer's Guide

Webster's Microcomputer Buyer's Guide reviews more than 150 microcomputer systems from more than 50 suppliers. Individual chapters elaborate on the general topics of theory, applications, independent software vendors, and a wide range of display and printing terminals. The guide costs $25, plus $2.50 postage and handling. Contact Computer Reference Guide, 135 South Harper Ave., Los Angeles, CA 90048, (213) 852-4886.
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CP/M Users Software Directory

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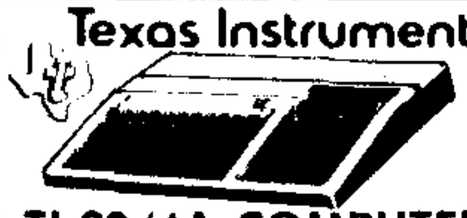

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Software Received

Apple

Apple Spice, a set of assembly-language routines to supplement Applesoft for the Apple II Plus. Floppy disk, $29.95. Adventure International, 507 East St., POB 3435, Longwood, FL 32750.

Borg, an arcade-type game for the Apple II Plus. Floppy disk, $29.95. Sirius Software Inc., 10364 Rockingham Dr., Sacramento, CA 95827.

Eliminator, an arcade-type game for the Apple II. Floppy disk, $29.95. Adventure International (see address above).

Executive Briefing System, a system to develop and present visual information for the Apple II. Floppy disk, $199. Professional Software Technology, 180 Franklin St., Cambridge, MA 02139.

Foosball, an arcade-type game for the Apple II. Floppy disk, $29.95. Sirius Software Inc. (see address above).

Key Perfect, a program to verify keyboard program entry from a printed listing for the Apple II. Floppy disk, $29.95. Micro-Sparc Inc., POB 325, Lincoln, MA 01773.

P-LISP, a LISP interpreter for the Apple II. Floppy disk, $199.95. Gnosis, 4005 Chestnut St., Philadelphia, PA 19104.

Rubik's Cube Unlocked, solves Rubik's Cube puzzle for the Apple II. Floppy disk, $24.95. Double-Gold Software, 13126 Anza Dr., Saratoga, CA 95070.

Saga #1 Adventureland, an adventure-type game with graphics for the Apple II Plus. Floppy disk, $19.95. Adventure International (see address above).

Track Attack, an arcade-type game for the Apple II. Floppy disk, $29.95. Broderbund Software, 1938 Fourth St., San Rafael, CA 94901.

Twerps, an arcade-type game for the Apple II Plus. Floppy disk, $29.95. Sirius Software Inc. (see address above).

VC-Manager, a Visicalc-file manipulator for the Apple II Plus. Floppy disk, $65. Micro Decision Systems, POB 1392, Pittsburgh, PA 15219.

CP/M

C/80 Version 2.0, a compiler for the C programming language for CP/M (Z80). 8-inch floppy disk, $49.95. The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423.

Microshell 1.1, an operating system with Unix-like features for CP/M (Z80). Floppy disk, $150. New Generation Systems Inc., 2153 Golf Course Dr., Reston, VA 22091.

Catalog, a disk-cataloging system for CP/M (Z80). 8-inch floppy disk, $75. SRX Systems, 2812 Westberry Dr., San Jose, CA 95132.

FloBASIC 1.1, a preprocessor that helps produce structured programs in BASIC for CP/M (Z80). 8-inch floppy disk, $90. Terrasoft, 25 Bryan Rd., Rowayton, CT 06853.

Texas Instruments

Mission Impossible, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc., 13500 North Central Expressway, POB 225012, Dallas, TX 75265.

Strange Odyssey, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc. (see address above).

TI Invaders, an arcade-type game for the TI-99/4. Command module (ROM cartridge), $39.95. Texas Instruments Inc. (see address above).

Voodoo Castle, an adventure-type game for the TI-99/4. Floppy disk, $29.95. Texas Instruments Inc. (see address above).

TRS-80

AW Rats!, an arcade-type game for the TRS-80 Models I and III. Cassette, $14.95. Creative Thaumaturgy, POB 107, Forest Park Branch, Dayton, OH 45405.

Crunch, an arcade-type game for the TRS-80 Models I and III. Cassette, $14.95. Creative Thaumaturgy (see address above).

Earthquake San Francisco 1906, an adventure-type game for the TRS-80 Models I and III. Floppy disk, $20.95. Adventure International, 507 East St., POB 3435, Longwood, FL 32750.

Electric Pencil 2.0, newest version of the word processor for the TRS-80 Models I and III. Floppy disk, $89.95. IJG Inc., 1260 West Foothill Blvd., Upland, CA 91786.

Lion's Head Adventure, an adventure-type game for the TRS-80 Models I and III. Cassette, $14.95. Creative Thaumaturgy (see address above).

Sfinks 3.0, a chess-playing program for the TRS-80 Models I and III. Cassette and floppy disk, $39.95. William A. Fink, POB 5912, Lighthouse Point, FL 33074.

Space Invader, an arcade-type game for the TRS-80 Models I and III. Cassette, $14.95. Creative Thaumaturgy (see address above).

Super Color Writer 1.0, a word processor for the TRS-80 Color Computer. Cassette, $49.95. Nelson Software Systems, POB 19096, Minneapolis, MN 55419.

Trashman, an arcade-type game for the TRS-80 Models I and III. Cassette, $14.95. Creative Thaumaturgy (see address above).

ZX80

ZX80 1K Disassembler, a disassembler and memory test for the 4K-ROM ZX80 and the Microace. Cassette, $9.95. Lamo-Lem Laboratories, POB 2382, La Jolla, CA 92038.

ZX81 1K Disassembler, a disassembler and memory test for the 8K-ROM ZX81 and the Microace. Cassette, $9.95. Lamo-Lem Laboratories (see address above).

Other Computers

AC Circuit Analysis, analyzes complex electronic circuits for transfer function or impedance for the Atari 800. Floppy disk, $39.95. L. W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524.

Ezlabel, a mailing-list and label-printing program for the IBM Personal Computer. Floppy disk, $39.95. Systemics, 3050 Spring St., West Bloomfield, MI 48033. ■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

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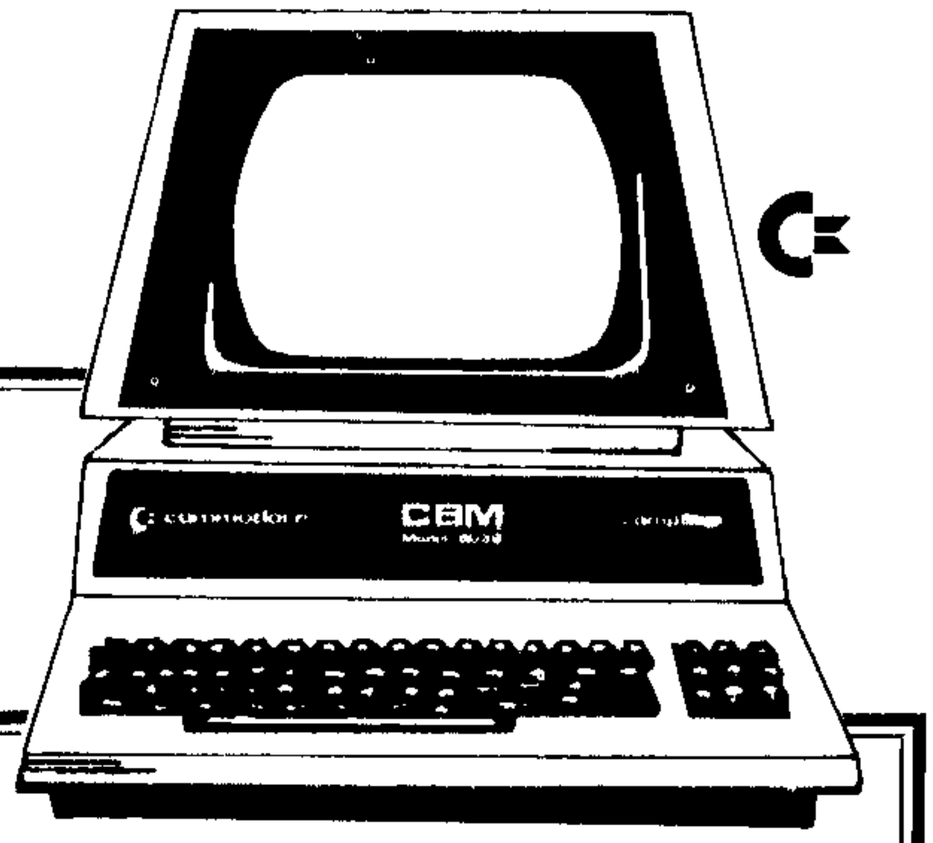

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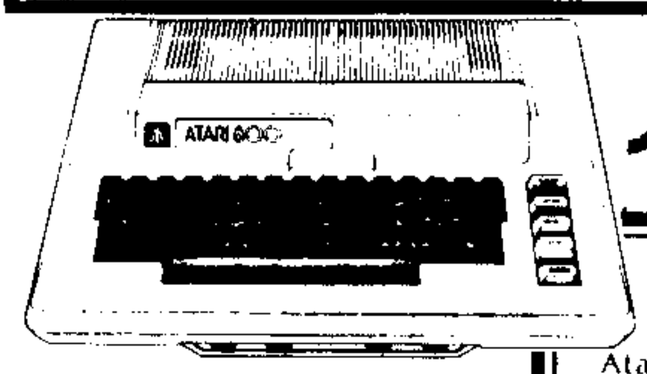

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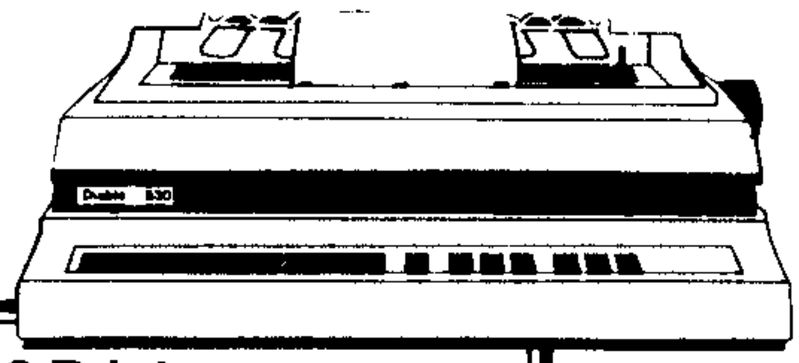
8220 TRS-80 Cable	$ 35.00



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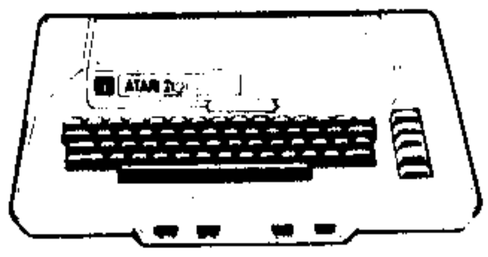

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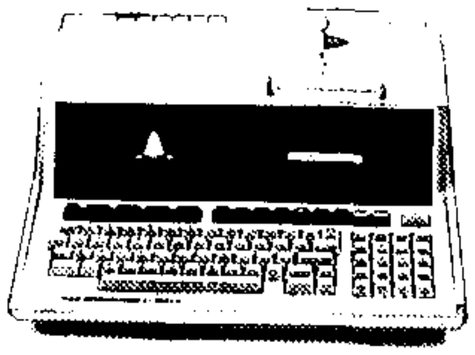

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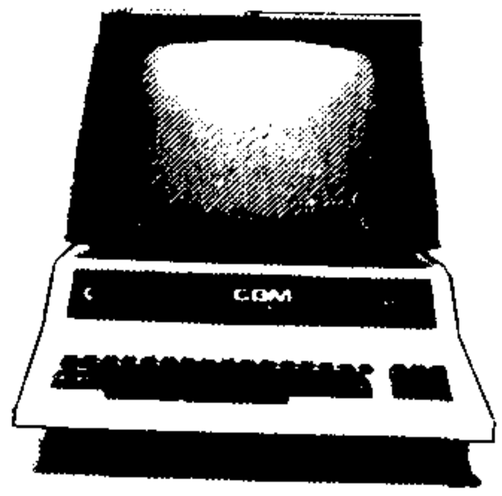

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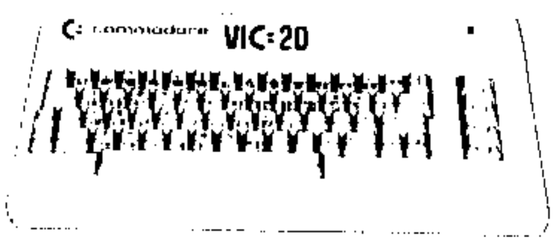

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Lil' Men from Mars, an arcade-type game for the Atari 800. Floppy disk, $23.95. Dynacomp Inc. (see address above).

Mailmaster, a mailing-list utility program for the Atari 800. Floppy disk, $39.95. Dynacomp Inc. (see address above).

Protector, an arcade-type game for the Atari 400/800. Floppy disk, $29.95. Synapse Software (see address above).

Stockaid, a stock performance-analysis program for the Atari 800. Floppy disk, $29.95. Dynacomp Inc. (see address above).

Teacher's Aide, a tutorial package covering elementary mathematics for the Atari 800. Floppy disk, $17.95. Dynacomp Inc. (see address above).

Tricky Tutorials, a six-lesson package covering advanced programming for the Atari 400/800. Floppy disk, $99.95. Santa Cruz Educational Software (see address above).

Turnkey and Menu, an auto-execute utility for BASIC programs for the Atari 800. Floppy disk, $17.95. Dynacomp Inc. (see address above).

CP/M

68000 Disassembler, a disassembler for 68000 systems based on the Motorola Exormac. 8-inch floppy disk, $200. Norsoft Consultants, Veungsdalveien 1, 3600 Kongsberg, Oslo, Norway.

The Programmer's Apprentice, a program-development system for creating MBASIC source programs for CP/M. 8-inch floppy disk, $800. The Software Group, 10471 South Brookhurst St., Anaheim, CA 92804.

PET

Genesis, a program to develop computer-assisted instructions for the PET/CBM. Cassette, $30. Greenwood Software, 1214 Washington, The Dalles, OR 97058.

Phantom Figher, an arcade-type game for the PET/CBM. Cassette, $14.95. Magic Carpet, POB 35115, Phoenix, AZ 85069.

Pharmacology Update, a tutorial package for health-care professionals for the PET/CBM. Floppy disk, $149.95. Dynacomp Inc., 1427 Monroe Ave., Rochester, NY 14618.

Star Voyager, an arcade-type game for the PET/CBM. Cassette, $9.95; floppy disk, $12.95. Paul Yates, 1955 Shady Brook Lane, Morgan Hill, CA 95037.

Vortex, an arcade-type game for the PET/CBM. Cassette, $14.95. Magic Carpet (see address above).

TI-99/4

Space Spiders, an arcade-type game for the TI-99/4. Cassette, $9. Glo-Data, POB 374, Stony Point, NY 10980.

Video Titles I, a program to produce customized titles for video recordings for the TI-99/4A. Floppy disk, $24.95 J & KH Software, 2820 South Abingdon St., Arlington, VA 22206.

TRS-80

BASIC Faster and Better Demonstration, a software library of demonstration programs for use with the book *Faster and Better & Other Mysteries* for the TRS-80 Models I and III. Floppy disk, $19.95. IJG Inc., 1260 West Foothill Blvd., Upland, CA 91786.

BASIC Faster and Better Library, a software library of routines for use with the book *Faster and Better & Other Mysteries* for the TRS-80 Models I and III. Floppy disk, $19.95. IJG Inc. (see address above).

Battle Trek, a Star Trek-type game for the TRS-80 Models I and III. Cassette, $29.95. Voyager Software, POB 15-518, San Francisco, CA 94115.

Ghost Gobbler, an arcade-type game for the TRS-80 Color Computer. Cassette, $21.95. Spectral Associates, 141 Harvard Ave., Tacoma, WA 98466.

Gradebook 2.0, a disk-based gradebook program for the TRS-80 Models I and III. Cassette, $34.95. MM Computer Club, 333 75th St., Downers Grove, IL 60516.■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

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the more than 83,000 public elementary and secondary schools in the country. This would amount to a donation of at least $200 million, based on the list price of the system. In order to do this Apple wants Congress to change the current law to allow the company a tax break for the donation. The current law says such deductions can be made only for scientific equipment given to higher-level educational institutions for research purposes.

Such a give-away would, of course, pay handsome dividends for Apple. After all, how long would a school be able to live with only one Apple computer? And certainly students would try to convince their parents that they simply must have an Apple II to do their homework because there is only one at school and they can't get time on it.

In last month's column I mentioned that, despite *Apple's cancelling of discount* mail-orders, dealer advertisements continue to appear offering discounts on Apple II computers. However, note that these outlets are not franchised Apple dealers. These are discount outlets that buy machines from overstocked Apple dealers. In fact, many franchised Apple dealers count on these resales to keep volume high so that they may qualify for higher discounts from Apple. Apple is attempting to stop this "brokering" of computers but as yet has not been successful.

Concurrent CP/M: CP/M is without doubt the most popular disk operating system for 8-bit microcomputers. Digital Research keeps improving CP/M by adding new features while maintaining compatibility between newer and older versions, thereby insuring continued life for languages and applications software. The firm's latest version is Concurrent CP/M-86, which allows multiple tasks to execute simultaneously. For example, a system can be sending or receiving a file or batch of files in the background while the operator is doing another task in the foreground on the console. Different tasks can access the same data file without destroying data integrity. Passwords and time stamps on files are supported. The first implementation has been done for the IBM Displaywriter.

Digital Research is also reportedly at the "beta test" stage on version 3 of CP/M-80.

Smalltalk News: Ed Cherlin, Director of Personal Computer Research at Strategic Inc., a marketing research firm, predicts that "Smalltalk will become the dominant operating system and programming language for 16-bit personal computer systems" and that it "will shut the Unix window of opportunity before it is fully open." He further predicts that "numerous leading-edge personal computer and office automation manufacturers will be flooding the market with Smalltalk systems, which are vastly more powerful and easy to use than Unix systems. Versions of CP/M for 16-bit systems will also be squeezed out." He expects Smalltalk versions from Apple, DEC, Hewlett-Packard, Tektronix, and several Japanese companies during the coming year, and he believes that IBM has a similar product in development.

The Marketplace: TI (Texas Instruments) has again slashed the price on its personal computer in an attempt to compete with the likes of

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the TRS-80 Color Computer, the Atari 400 (both priced at $399), and the Commodore VIC ($299). TI's price to dealers is now under $300, with a suggested $350 retail price. (The computer was originally introduced with a $1000 price tag.) This under-$500 market is expected to become even more competitive as the Japanese enter the market. And NEC will shortly be introducing the PC-6000, which will probably carry a $400 price tag.

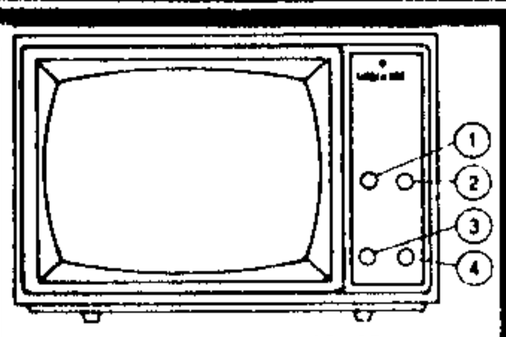
International Resource Development Inc. (IRD), Norwalk, Connecticut, another marketing research firm, predicts that the share of the microcomputer marketplace will soon undergo marked change. The current market share is Tandy/Radio Shack: 28%; Apple: 25%; Hewlett-Packard: 11%; Commodore: 10%; Xerox, DEC, and IBM combined: 10%; and all others: 16%. IRD claims that this will change substantially so that by 1985 the lineup will be IBM: 23%; Xerox: 17%; Tandy/Radio Shack: 15%; Hewlett-Packard: 14%; Apple: 12%; DEC: 11%; Commodore: 3%; and all others: 5%.

Still another marketing research firm, Creative Strategies International, San Jose, California, forecasts that more than 12 million personal computers will be made over the next five years with an annual growth rate of 59%. They expect prices to drop 20% per year through 1986. They claim further that last year six personal computer firms each did over $50 million in business. They expect this number to rise to eleven firms this year.

Microsoft Sues: More and more software suppliers are going to court to protect their copyrighted software. Previously I reported that Digital Research and Micropro have filed suit against a dealer who allegedly illegally copied and sold their software. Last month, I reported on Atari's suit against Magnavox, in which Atari sought to protect the screen images used in its Pac-Man computer game.

The latest suit has been brought by Microsoft, which has gone to court charging software piracy. Microsoft charges that Advanced Logic Systems (ALS), Sunnyvale, California, has copied the BIOS and BOOT programs for Microsoft's Z80-based Apple Softcard and is selling them as part of a product called "The Synergizer." Microsoft charges that the code is a byte-for-byte copy with the exception that ALS changed the copyright notices and altered two message strings. Otherwise, according to Microsoft the two programs are identical, right down to the initials of the Microsoft programmer who created the software.

Print System Merges Text and Graphics: Xerox has announced a new printing system that allows text and graphics to be merged and printed electronically, thus doing away with typesetting, plate-making, collators, and printing presses. Software allows artwork functions such as cropping, scaling, and reduction. Text and graphics can be merged and printed at



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BY-S

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Robotics News: In Japan, Mitsubishi has introduced a robotics arm that can be connected to a microcomputer by way of a Centronics-type parallel port (not all the lines are used). Move Master software is provided that runs under CP/M. The cost in Japan is the equivalent of $5000. The product is intended as a teaching aid and for sales promotion. There is no word on when it might be introduced in the United States. For information write: Mitsubishi, 2-3 Marunouchi 2-Chrome Chiyoda-Ku, Tokyo 100 Japan; or call: (218)2173.

Find A Date With Your Computer: The newest thing in computerized bulletin-board systems is the "Dial-A-Match" system. Several such systems are already in operation on personal computers connected to telephone lines and are operated as free public services (contributions are welcome). Although the software varies from system to system, the procedure is pretty much the same. Call the system via modem with your computer or a terminal. If it is your first time on the system you will be asked to complete a questionnaire. The system will then match you up with other callers and furnish you with information on the person or persons you are matched with. You can then exchange messages with anyone else on the system.

Foreign Exchange: My list of foreign computer bulletin-board systems is growing; here's an update: systems in England include Forum-80 Hull (04-828-59169), Forum-80 London (01-747-3191), and Forum-80 Milton (09-085-66660). You might also try CBBS London (01-399-2136), Mailbox Liverpool (05-122-09733), or ACC (09-084-4262). In Holland there's Forum-80 (01-313-512-533), and based in Sweden are ABC-80 Stockholm (010-468-190522), University Research (010-468-23660; guest password: "66,66"), Elfa (010-468-7300706), and Tree Tradet (010-468-190522).

Random News Bits: Look for an R2D2-like robot kit to be introduced in the January Heathkit catalog. The 2-foot 2-inch 6808-based Hero 1 will have simulated eyes, ears, and a voice (using the Votrax SC-01 chip) and will be highly mobile. The kit will cost approximately $1000; an optional $100 manipulator (arm) will be available, as will a $150 robotics course. . . .**M.H.**

Dataquest, a marketing research firm, reports that the Intel 8086 is still the leading 16-bit microprocessor, with an estimated 78% of the market, compared with 15% for the Motorola 68000 and 6.6% for the Zilog Z8000. Dataquest reports that last year 718,000 Intel 8086 processors were shipped, compared to 139,000 Motorola 68000s and 61,000 Zilog Z8000s. . . . Prices for single-board computers are dropping. Intel has dropped the price for its iSBC 88/25 (based on the Intel 8088) from $1295 to $790 (single unit) and $520 (large quantity) to meet competition from DEC's Falcon 16-bit unit. . . . Texas Instruments will distribute 430 programs of Control Data Corporation's Plato software for its TI-99/4A home computer in 108 courses for kindergarten through high school levels. . . . Telegenix Corp., Cherry Hill, New Jersey, has introduced a giant (measuring more than 10 feet diagonally) 80-character by 24-line neon planar-gas display panel and controller. Price is only $52,500. . . . Perex Inc., San Jose, California, has introduced the first S-100 Ethernet interface (a two-board set). . . . Zilog has introduced an 8-user Unix-like system, called the System 8000, with a base price of $13,000. . . . Vector Graphic Inc., Thousand Oaks, California, following in the footsteps of Apple, has terminated its supply contract with Computerland. Apparently sales slumped dramatically when Computerland took on the IBM Personal Computer, DEC, et al. Computerland, before these defections, carried 20 different computer lines. Vector Graphic stated that last year only 9% of its sales came through Computerland. . . . Evotek Corp., Fremont, California, has announced a 5¼-inch Winchester-technology hard-disk drive with up to 50 megabytes of storage. . . . HP (Hewlett-Packard) has signed a $30-million contract for Sony's new 3½-inch "microfloppy," which has an unformatted storage capacity of 440K bytes. HP is the first company besides Sony to adopt the drive. . . . Hitachi Ltd., Tokyo, has unveiled an 8088-based system that it claims is compatible with the IBM Personal Computer.

MAIL: I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a self-addressed, stamped envelope.

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Software Teledelivery Efforts Falter

At last year's Winter Consumer Electronics Show, several companies announced or discussed plans for electronic delivery of software. Some, including Xante, Romox, and Cumma *Technology, planned to download to erasable programmable read-only memory (EPROM)* cartridges at dealer terminals. Others, including Control Video's GameLine and the Nabu Network's cable service, downloaded programs directly to computers or video games.

Xante, Romox, and Cumma have all ceased operations, mainly because of poor dealer response and the general collapse of the cartridge video-game market. Nabu's cable-TV-based software-downloading service continues to operate in Ottawa, Ontario, despite financial troubles. Control Video Corp., Vienna, VA, said poor distribution and the general video-game slump led it to cancel its GameLine service for the Atari 2600 VCS.

Control Video is now testing a new service which allows subscribers to play 20 games available each month as often as they wish for a $14.95 monthly fee, which includes rental of a 2000-bps modem from BellSouth. MasterLine is now available for Apple II and Commodore 64 owners in Atlanta, Los Angeles, Houston, and Washington, DC.

Separately, NBC announced that it would cancel the NBC Teletext service in late January.

NANOBYTES

Intel introduced the 82588 single-chip local-area-network controller. The 82588 can be used in low-cost baseband or broadband networks—including such IEEE 802.3 protocols as IBM's PC Network and the developing STARLAN—at speeds up to 2 megabits per second. Initial pricing will be $45 each in large quantities. . . . **Laserstore**, Princeton, NJ, plans to sell a 2.5-gigabyte write-once optical streaming-tape drive. The drives should be available in large quantities in mid-1986 for about $2500. . . . **Multi Solutions** announced a licensing agreement with **Computer Engineering & Consulting** of Tokyo, under which CEC will translate Multi Solutions' SI operating system for Japanese computers. Currently, SI runs on several 68000-based computers and is being translated by MSI for the IBM PC AT. The agreement guarantees a minimum of $40 million in royalties, according to Multi Solutions. . . . **WATCOM Products Inc.** has released two products developed at the University of Waterloo in Canada. WATFILE is a $295 data-management system for the IBM PC; JANET/2 is networking software for IBM's PC Cluster system. . . . **Alphacom** announced a *133-character-per-*second printer at $249 that it says is compatible with Epson's RX-80. . . . **Corvus** and **NEC** have agreed to jointly develop a single-chip controller for Corvus's Omninet local-area network. Currently, an Omninet controller requires three chips developed by Corvus. . . . **Advanced Micro Devices** now offers a 10-MHz version of the 80186 processor. . . . **Phoenix Software**, Norwood, MA, has developed an IBM PC XT-compatible ROM BIOS and is developing software compatible with IBM's PC AT. Phoenix's earlier IBM PC-compatible ROM BIOS code has already been licensed by **AT&T**, **Kaypro**, **Tandy/Radio Shack**, **Wyse Technology**, and **Zaisan**. . . . Rumors that **Tandy** would begin selling **ACT** computers in its Radio Shack stores are apparently false. Instead, the two companies announced a joint venture to operate a chain of computer stores in Europe, called **TA ComputerWorld**. The stores will sell both Tandy and ACT computer products. . . . **AST Research** announced RamStak, a memory-expansion board for the Apple Lisa computer. The board can add up to 2 megabytes of memory to the Lisa; with 512K bytes, it's priced at $1395. . . . **Mosaic Electronics**, Oregon City, OR, announced Access-M, an expansion card for the Commodore 64 adding up to 1 megabyte of memory. The standard $195 card includes 64K bytes of RAM and RAM-disk software; additional memory is plugged into the card. . . . PortaAPL, a $275 APL interpreter for the Macintosh, was introduced by **Portable Software**, Cambridge, MA. PortaAPL adds a full-screen editor and access to many Macintosh ROM toolbox routines to the standard APL language but requires a 512K-byte Macintosh. . . . **C Line Inc.**, Chicago, IL, announced a dBASE II-to-cEnglish converter. The $795 program converts standard dBASE II source code into cEnglish, which is then translated by the $900 cEnglish program into C, which is in turn compiled into machine language by a C compiler.

NO CELEBRATION of BYTE's 10th anniversary would be complete without the acknowledgment of some of the events and contributions that helped to shape the magazine. In the too-few pages that follow, we tried to capture some of the flavor of the past 10 years.

Special thanks to all contributors and to the BYTE staff, especially Gregg Williams, who chaired the project, Richard Shuford, Rich Malloy, Mark Welch, and Stan Wszola.

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A MICROCOMPUTING TIMELINE

PHOTOGRAPHED BY PAUL AVIS

What follows is a modest and, we hope, correct timeline of personal computing. If the number of entries per year is any indication, then the most active years of personal computing were 1975, 1976, *and* 1977 *and* 1982, 1983, *and* 1984.

Although the roots of personal computing go back further, the excitement really *started in January* 1975, *with the publication of* Popular Electronics' *cover story on the* Altair 8800. *A slogan printed on the cover of the first three issues of* BYTE *said it all:* "Computers—The World's Greatest Toy." *The slogan expressed the ideal that lured many, but few of us had the stamina and consuming fanaticism needed to make it happen; you had to design and build* everything *yourself, hardware and software. Most of you also had to learn electronics, mathematics, and the art of deciphering arcane, poorly written spec sheets—the phrase "by your bootstraps" took on new meaning.*

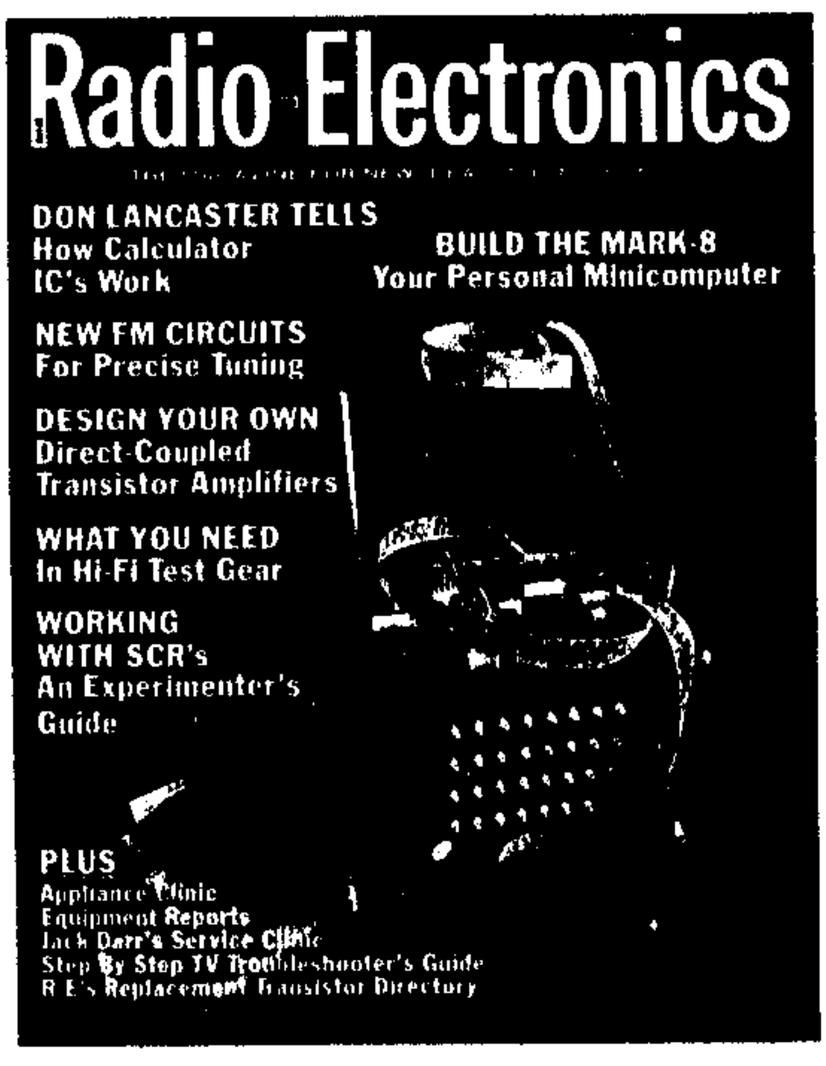
By 1978, *things were different; you could buy microcomputers and they would usually work, but it wasn't the same. Prior to* 1978, *the excitement was in saying "Look, my design works!" But when you took it for granted that it worked, the question became "What can you do with it?"; however, the answer was "Not all that much." Most systems lacked a disk drive and had* 32K *bytes of memory or less. The years between* 1978 *and* 1982 *were slow, evolutionary years—not too exciting, but necessary.*

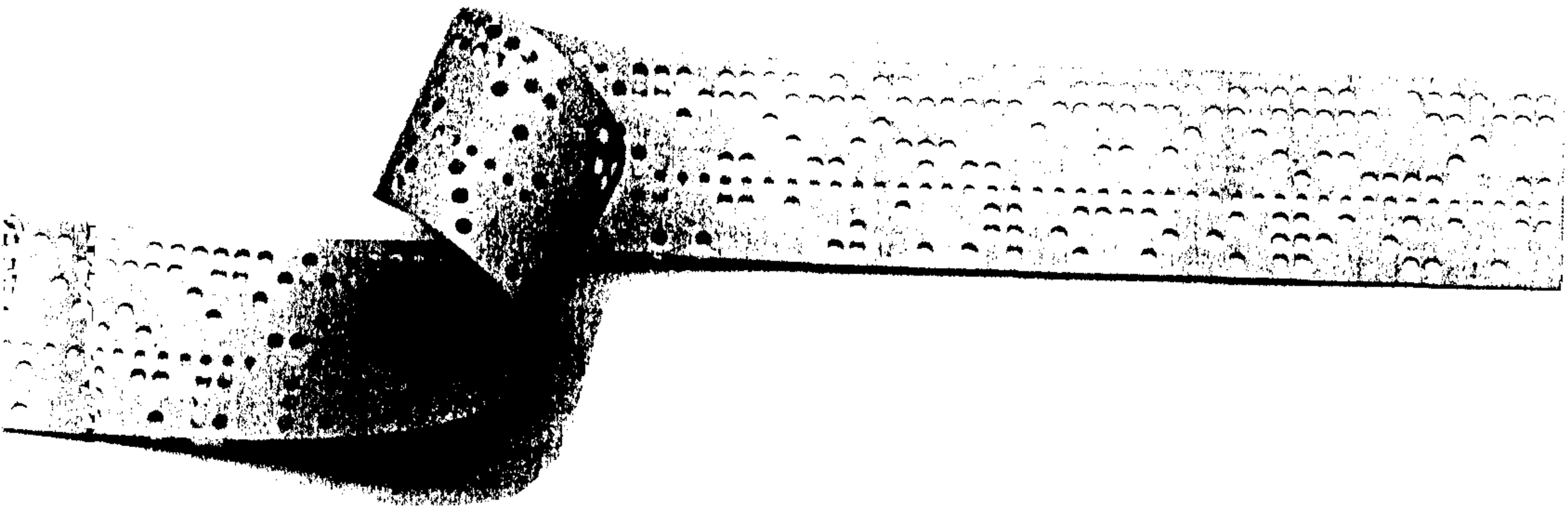
By late 1981, *the industry was poised for growth, and* IBM's *introduction into the marketplace catalyzed that growth into a bumpy, breathtaking ride that shows no signs of slowing (though it did take about a year to get started, that is, to produce a significant number of* IBM-*related products). Personal computers finally could perform and were affordable enough to be used by people who weren't just hobbyists; that progress continues to build as computers become simultaneously cheaper and more capable.*

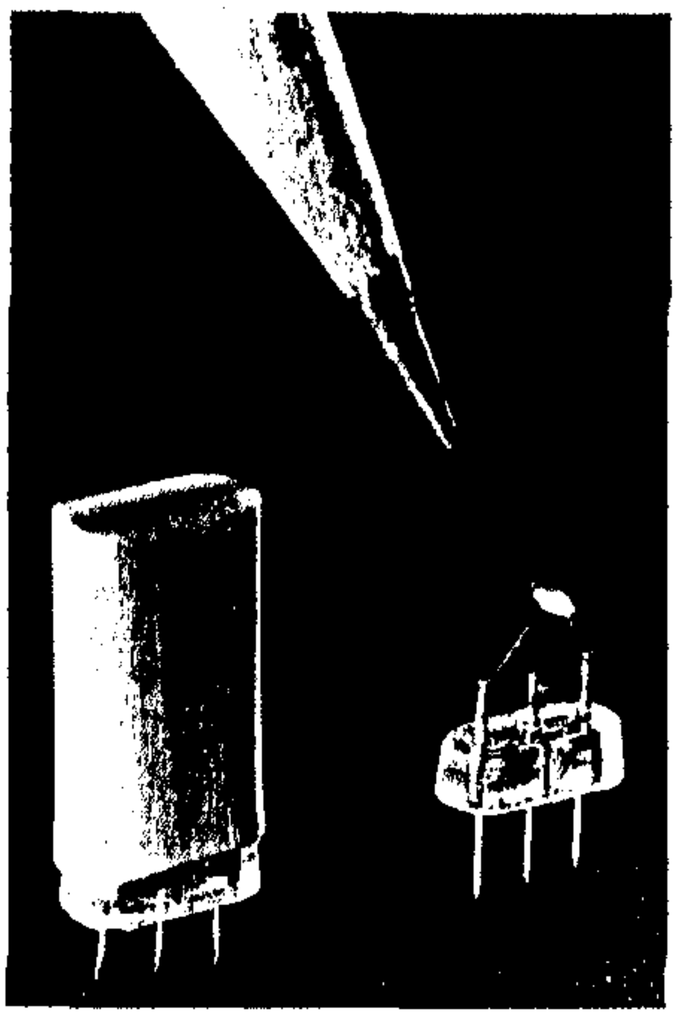
BYTE *has kept a close watch on the computer industry's growth and we felt the need to annotate this timeline. When dates have been difficult to pinpoint, we've approximated them. In general, it has been an active and interesting first ten years.*

—Gregg Williams and Mark Welch

JULY 1974 RADIO-ELECTRONICS' COVER STORY IS ON THE MARK-8.





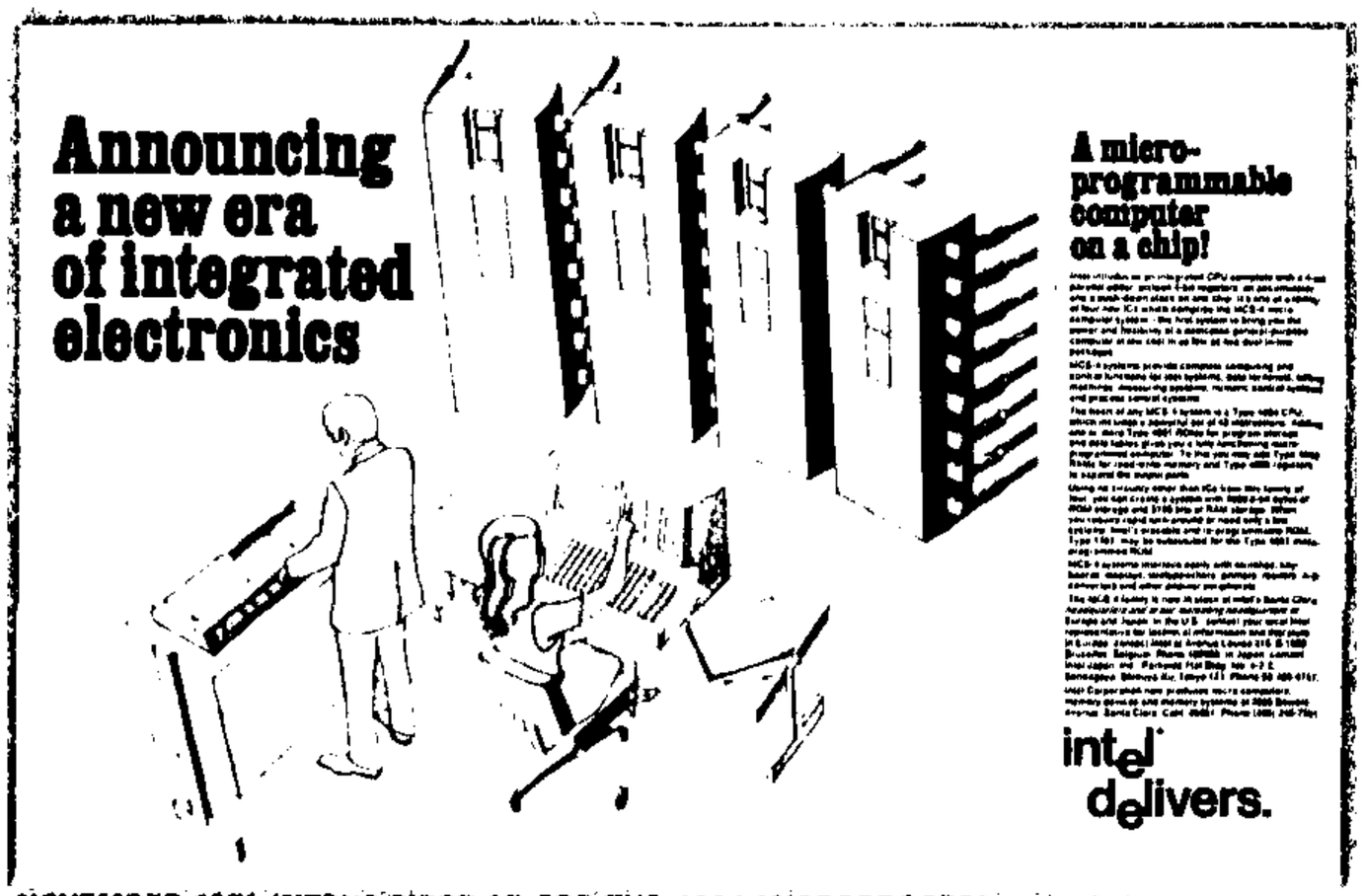


UPI/BETTMANN NEWSPHOTOS

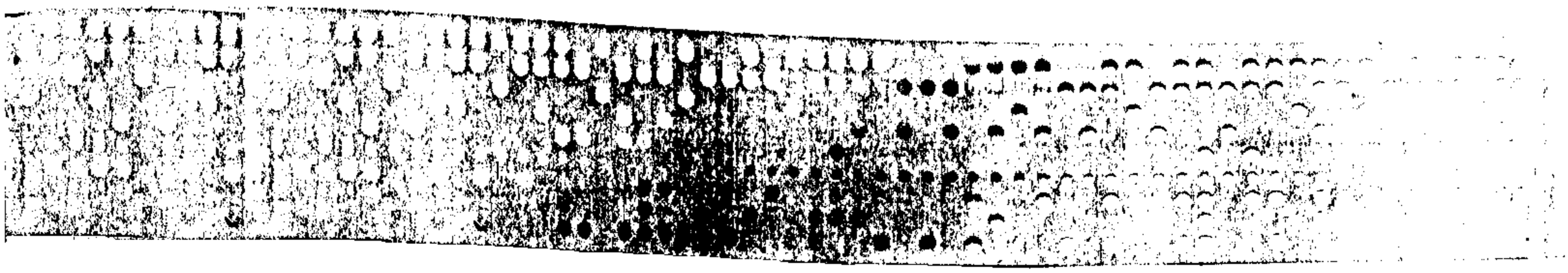
1948 THE TRANSISTOR IS INVENTED AT BELL LABORATORIES.

Pre-1975

1948 John Bardeen, Walter Brattain, and William Shockley of Bell Laboratories invent the transistor.
1959 Texas Instruments unveils the first integrated circuit.
1964 John G. Kemeny and Thomas E. Kurtz develop the BASIC programming language at Dartmouth College.
Digital Equipment Corp. advertises the PDP-8 minicomputer, which, at $16,200, is "a full, general-purpose computer that scientists can afford—but it gets personal."
1970 OCTOBER *Scientific American* publishes Martin Gardner's first "Mathematical Recreations" column on John Conway's game of Life.
1971 Intel Corp. puts the 4-bit 4004 microprocessor on a single chip. Its initial price is $200.
1972 NOVEMBER Intel Corp. introduces the 8008, their first 8-bit microprocessor.
Nolan Bushnell founds Atari and ships the Pong video game.
1973 Scelbi Computer Consulting offers the 8008-based Scelbi-8H computer kit ($565 with 1K byte of memory).
FALL Intel Corp. announces the improved 8080 8-bit microprocessor.
SEPTEMBER *Radio-Electronics* magazine publishes Don Lancaster's TVT-1 computer terminal project.
1974 Brian W. Kernighan and Dennis M. Ritchie develop the C programming language.
SUMMER Gary Kildall develops the CP/M operating system.
JULY *Radio-Electronics'* cover story is "Build the Mark-8: Your Personal Minicomputer."
SEPTEMBER *Creative Computing* magazine founded.



NOVEMBER 1971 INTEL'S FIRST AD FOR THE 4004 MICROPROCESSOR IN ELECTRONIC NEWS.



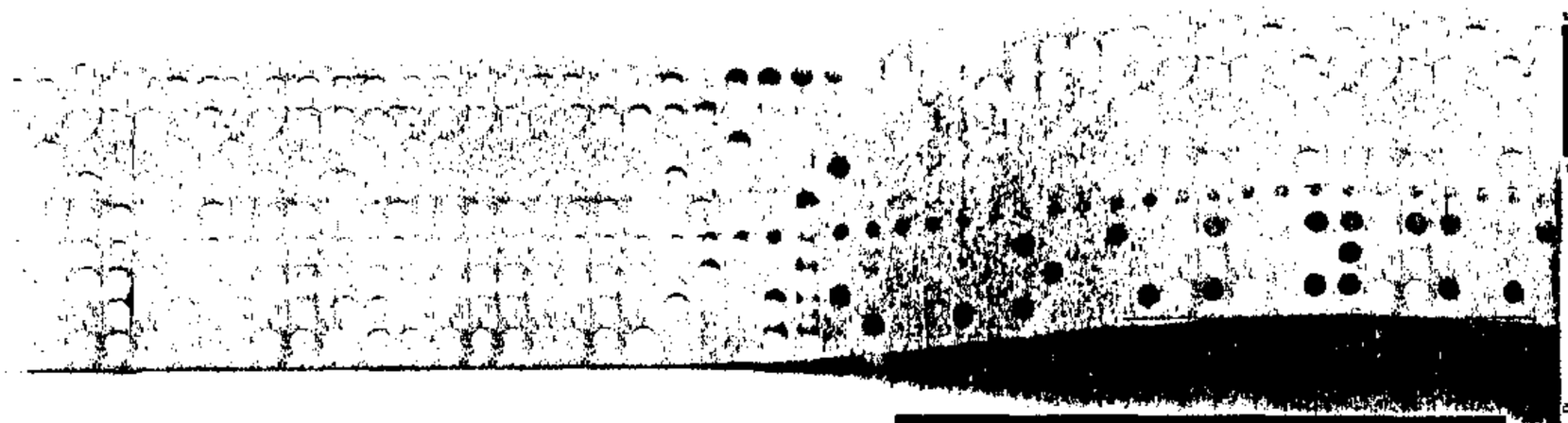
1975

WINTER Zilog Inc. develops the Z80 microprocessor, whose instruction set is a superset of the 8080's.
JANUARY Carl Helmers founds *Experimenters' Computer System* (ECS), which lasts for five issues before he moves to BYTE.
JANUARY *Popular Electronics'* cover story is "World's First Minicomputer Kit to Rival Commercial Models...Altair 8800." The Altair 8800 kit, with an Intel 8080 microprocessor, 256 bytes of memory, and a toggle-switch-and-LED front panel, sells for $395.
MARCH Homebrew Computer Club founded.
MAY Amateur Computer Group of New Jersey founded.
SUMMER IMS International announces the IMSAI computer, which is essentially an improved clone of the Altair 8800.
SUMMER MOS Technology announces the MC6501 at $20 and the MC6502 at $25; at this point, the 8080 costs about $150.
FALL MITS (the company that sells the Altair 8800) announces 4K-byte and 8K-byte BASIC (from Microsoft's founders Bill Gates and Paul Allen) for $350 and $500, respectively ($60 and $75 for purchasers of complete Altair systems).
FALL Dennis Allison publishes Tiny BASIC—later enhanced by many, including Tom Pittman and Li-Chen Wang.
FALL Sphere Corp. offers the Sphere I computer kit (6800, 4K bytes of RAM, ROM monitor, keyboard, video interface, for $650).
FALL MOS Technology announces the KIM-1 microcomputer, an assembled single-board computer (6502, 1K byte of RAM, 2K-byte monitor in ROM, keypad, LED readout, cassette and serial interfaces, for $245).
SEPTEMBER IBM announces the IBM 5100, the first briefcase-size computer (with BASIC, 16K bytes, and a tape cartridge storage system, for about $9000.
SEPTEMBER BYTE publishes its first issue.
SEPTEMBER Godbout advertises the Pace kit in BYTE with "7 segment readouts for easy octal debugging."
NOVEMBER Southwest Technical Products Co. advertises the M6800 computer kit (6800, serial interface to terminal, monitor in ROM, for $450). Unlike the Altair, it has *no* front-panel switches!
DECEMBER MITS unveils the Altair 680 kit (6800, 1K byte of RAM, serial interface, for $293).
DECEMBER Microcomputer Associates Inc. offers the JOLT kit (6502, 512 bytes of RAM, serial interface to terminal, monitor in ROM, for $249).
DECEMBER Robert Tinney's first BYTE cover.

1976

JANUARY *Dr. Dobb's Journal of Computer Calisthenics and Orthodontia (Running Light Without Overbyte)*, a homebrew hardware and software magazine, publishes its first issue.
MARCH David Bunnell of MITS organizes the First World Altair Computer Convention in Albuquerque, New Mexico.
SPRING Texas Instruments announces its TMS9000, the first 16-bit microprocessor.
APRIL Apple Computer Inc. formed.
APRIL Cromemco Inc. advertises the Dazzler TV interface board—the first color display for a microcomputer.
SUMMER Keuffel and Esser (K&E) ceases its production of slide rules and donates its last one to the Smithsonian.
JUNE SwTPC M6800 ad promises "SOFTWARE—The flood is near. Editor and assembler now available. BASIC and more games right away. Yours for the cost of copying. WE DON'T SELL SOFTWARE—WE GIVE IT TO YOU. ENJOY IT, COPY IT, WE WON'T COMPLAIN..."
JUNE Scelbi releases SCELBAL, a BASIC-like language for $49 (includes source); it runs in 8K bytes of memory or more.
AUGUST First floppy-disk-drive ad in BYTE (ICOM Frugal Floppy, 8-inch, for $1195 [single quantity]).
AUGUST John Dilkes organizes the Personal Computing Festival in Atlantic City; it is the first microcomputer show of national scope.
AUGUST First portable computer: STM Systems' "BABY!" (6502, 2K bytes of RAM, bootstrap program in ROM, system software on tape, for $850 assembled).
FALL Steve Wozniak proposes that Hewlett-Packard Co. create a personal computer; Steve Jobs proposes the same to Atari—both are rejected.
SEPTEMBER Ohio Scientific Instruments advertises OSI 400 (6502, 6572, or 6800, parallel and serial ports, 1K byte of RAM, 512 bytes of PROM, kit prices—$140 and up).
OCTOBER Cromemco Inc. offers 4-MHz Z80 board for Altairs and other S-100 systems ($395 kit, with a monitor program on paper tape).
OCTOBER PolyMorphic Systems advertises the S-100–based POLY 88 (8080A, 512 bytes of RAM, video/keyboard interface board, 1K byte of ROM, cassette interface, for $685 in kit form).
NOVEMBER Steve Ciarcia's first article (not Circuit Cellar).
DECEMBER Processor Technology advertises the Sol computer (8080, S-100 bus, 1K byte of RAM, 1K byte of PROM, 1K byte of video RAM, keyboard, cassette, serial, and parallel interfaces, BASIC-5 on cassette—kit, $995; with dual 8-inch drives and operating system, $1695; an assembly-language TREK-80 game, PT 8K BASIC, and 8080 FOCAL are also available). The machine was invented by Lee Felsenstein.
DECEMBER Michael Shrayer writes Electric Pencil, the first popular word-processing program for microcomputers.
DECEMBER Shugart announces its 5¼-inch "minifloppy" disk drive for $390.

FALL 1975 THE SPHERE 1 COMPUTER KIT



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APRIL 1976 APPLE I BOARD

BYTE

the small systems journal

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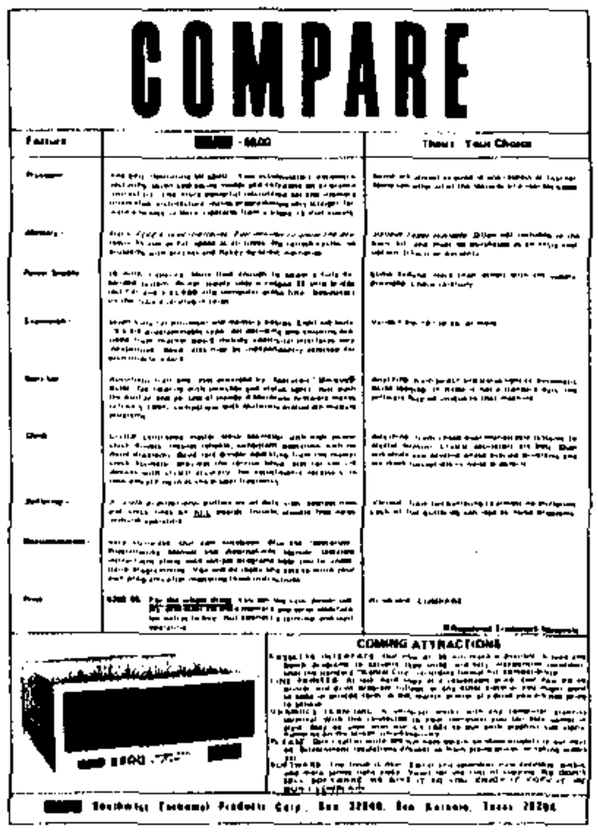
Cassette Interface – Your ey to inexpensive bulk memory

Assembling Your Assembler

an YOU use these SURPLUS KEYBOARDS? (You bet you can!)

COMPUTERS - *the World's Greatest Toy!*

SEPTEMBER 1975 BYTE'S DEBUT



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JUNE 1976 SWTPC SOFTWARE AD

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- Commodore to drive cable

If you need a power supply and cabinets, we've got that too!

iCOM's famous FDOS-II software

iCOM's FDOS-II software package is now available for the OEM or the hobbyist. Its super features such as named variable length files, subutility presets open and close, multiple merge and delete, help make your project a winner right away. Versions to run on any 8080 or 8800 based system are ready to ship. Use FDOS II either in your development system or integrate it into your application's package. In either case it's easy to do and low cost too.

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Powerful controller

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Call us today. When it comes to microperipherals™, iCOM has the answers.

MICROPERIPHERALS icom

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- Intersec MITS 80U
- Intersec 8
- Motorola M6800
- PDS Microtec™ 80

AUGUST 1976 ICOM'S FRUGAL FLOPPY AD

"PACE" 16 BIT MICROPROCESSOR

GODBOUT

KIT 16 BIT MICROCOMPUTER

AVAILABLE SEPT. 1 - $125

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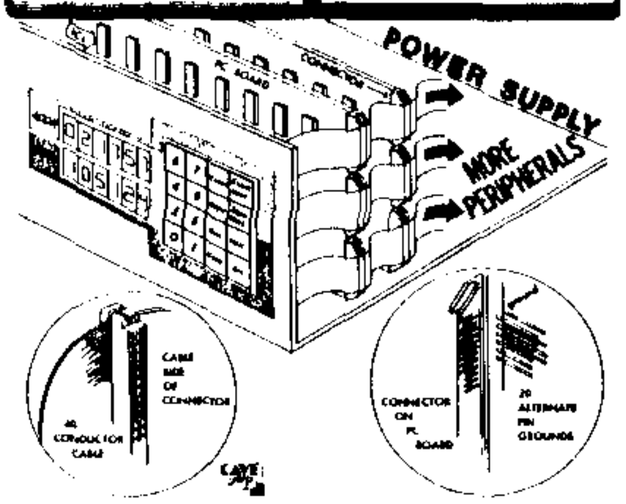
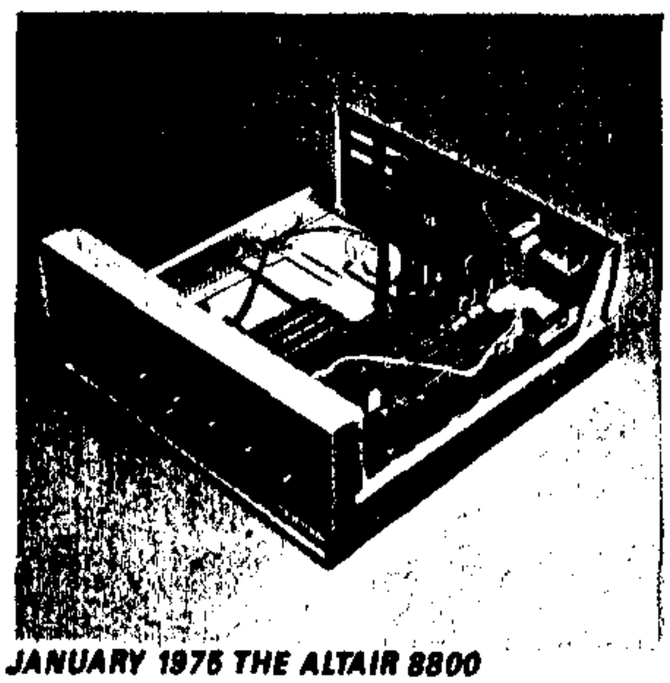


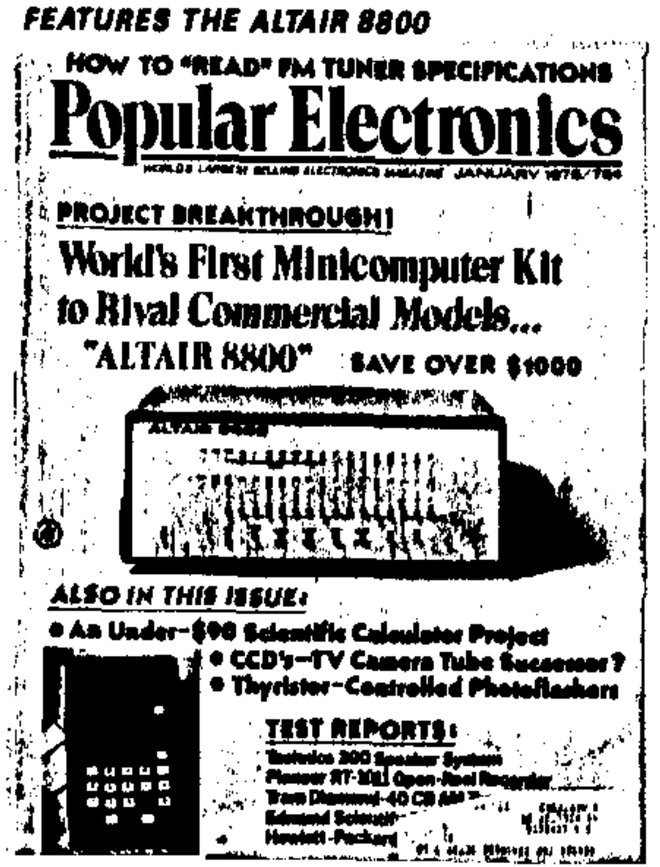
SEPTEMBER 1975 GODBOUT PACE KIT AD

FALL 1975 THE KIM-1



JANUARY 1975 THE ALTAIR 8800

JANUARY 1975 POPULAR ELECTRONICS' FEATURES THE ALTAIR 8800



HOW TO "READ" FM TUNER SPECIFICATIONS

Popular Electronics

PROJECT BREAKTHROUGH!

World's First Minicomputer Kit to Rival Commercial Models...

"ALTAIR 8800" SAVE OVER $1000

ALSO IN THIS ISSUE:
- An Under-$90 Scientific Calculator Project
- CCD's—TV Camera Tube Successor?
- Thyristor-Controlled Photoflashers

TEST REPORTS:

1977

WINTER Ohio Scientific Instruments offers the first microcomputer with Microsoft (floating-point) BASIC in ROM; it is also the fastest.
JANUARY *Kilobaud* (which later changed its name to *Microcomputing*) publishes its first issue.
FEBRUARY Computer Shack (which later changes its name to ComputerLand) opens its first store.
APRIL Jim Warren organizes the 1st West Coast Computer Faire in San Francisco. The Apple II and Commodore PET (see below) are introduced there.
APRIL Commodore Business Machines Inc. unveils its PET computer (6502, 4K bytes of RAM, 14K bytes of ROM, keyboard, display, tape drive, for $595 assembled). Its all-in-one packaging and 8K bytes of Microsoft BASIC were innovative. Its calculator-pad keyboard was (unfortunately) the precedent for later microcomputers.
JUNE Camp Retupmoc, the first week-long computer camp, is held in Terre Haute, Indiana.
JUNE Apple Computer Inc. runs its first ad in BYTE (6502, 4K bytes of RAM, Integer ROM and monitor in 16K bytes of ROM, keyboard, cassette interface, 8-slot motherboard, game paddles, graphics/text interface to color display, for $1298; with maximum 48K bytes of RAM, $2638).
AUGUST SwTPC offers a two-drive 6800 system with terminal, monitor, and computer for $1999.
AUGUST Microcomputers become more widely available (service does, too) through Radio Shack: their TRS-80 Model I (Z80, 4K bytes of RAM, 4K bytes of ROM [Level I BASIC], keyboard, display, cassette interface, and recorder) costs $599.95.
OCTOBER North Star Computers announces its Horizon computer (Z80A, 16K bytes of RAM, one 5¼-inch floppy drive, 12-slot S-100 motherboard, serial interface to terminal, $1599 kit, $1999 assembled).
NOVEMBER Ciarcia's Circuit Cellar begins.

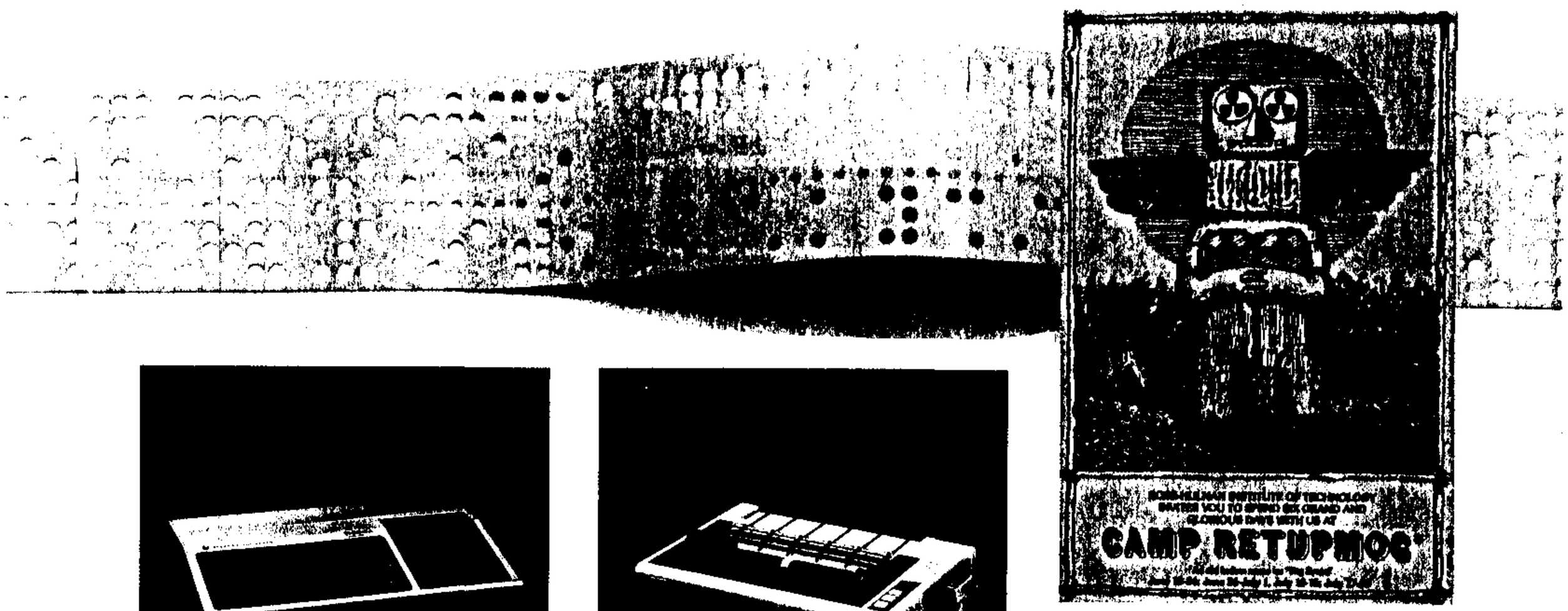
1978

FEBRUARY Ward Christensen and Randy Seuss create the Computerized Hobbyist Bulletin Board System, the first major CBBS running on a microcomputer.
MARCH Kathe and Dan Spracklen's Sargon wins the 2nd West Coast Computer Faire chess tournament. (The 3rd takes place in Los Angeles in November.)
APRIL The Digital Group advertises the Byte-master, a sewing-machine-size computer housing a display, keyboard, and disk drive. Never very popular, it predates the Osborne 1.
MAY Ken Bowles first describes the machine-independent UCSD Pascal language/operating system in BYTE.
JUNE Exidy unveils the Sorcerer (Z80, 8K bytes of RAM, 12K bytes of ROM, keyboard, parallel, serial, and cassette interfaces, $895). The machine's innovations are its user-definable characters and its optional software on plug-in ROM cartridges.
AUGUST MicroPro International unveils WordMaster, the precursor of the ubiquitous WordStar word processor (which appears in mid-1979).
DECEMBER Epson America Inc. announces the MX-80 dot-matrix printer; its high performance and low price stun competitors and force competition and lower prices in the printer market.
DECEMBER Atari announces the Atari 400 and 800. The 800 has a full keyboard, 8K bytes of RAM (expandable to 48K via memory slots), two ROM cartridge slots, and custom graphics and sound chips designed by Jay Miner (who later designs the Amiga custom chips); it originally costs $1000. The machines do not become available until late 1979. A derivative machine (now costing under $100) is still on the market, and its graphics are unsurpassed in the 8-bit market.

1979

SPRING CompuServe, a telecommunications utility, founded.
MAY Dan Bricklin and Bob Frankston of Software Arts Inc. show the VisiCalc spreadsheet program at the 4th West Coast Computer Faire. This program caused many to take microcomputers seriously for the first time. VisiCalc was originally marketed by Personal Software (which later changed its name to VisiCorp), but Software Arts regained the rights to VisiCalc in September 1984. (VisiCorp merged with Paladin in late 1984, and Software Arts merged with Lotus in April 1985.)
MAY The FORTH Interest Group distributes the first public-domain version of fig-FORTH, which begins the eventual widespread availability of the language on microcomputers.
JUNE The Source telecommunications utility founded.
JUNE Texas Instruments unveils the TI-99/4, which originally sold for $1150 (which included a color monitor). The machine is slow (even though it uses TI's TMS9900 16-bit processor), the button-style keyboard is oddly laid out, and TI discouraged third-party software. The revised TI-99/4A solved some problems, but TI finally discontinued the computer in late 1983; its closeout price went as low as $50.
SUMMER Magic Wand becomes the first serious competitor to WordStar; it was just as powerful and easier to use.
SUMMER Wayne Ratliff develops the Vulcan database program (Ashton-Tate later markets it as dBASE II).

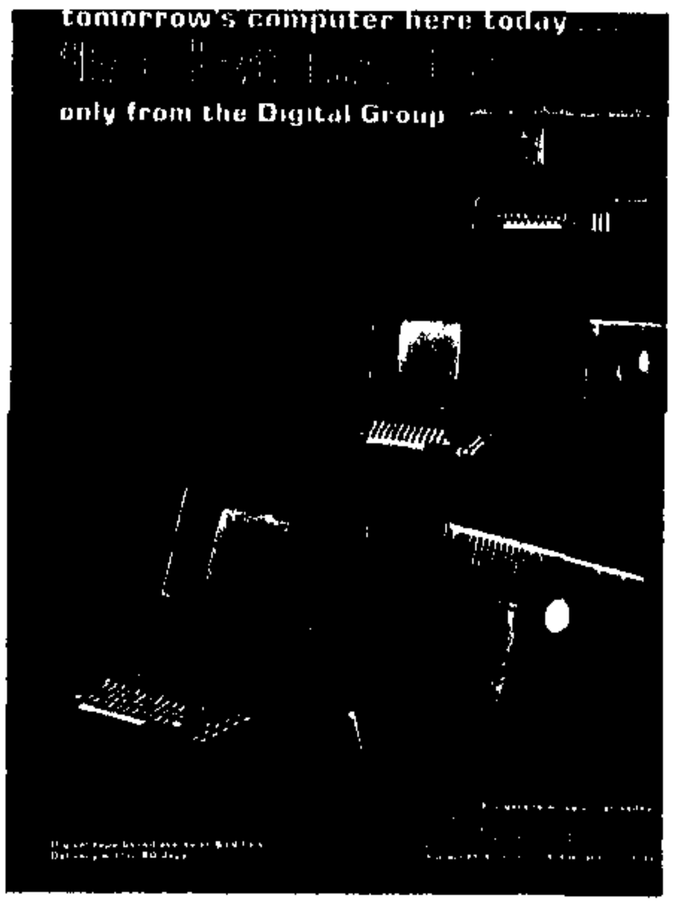
JUNE 1977 APPLE'S FIRST AD IN BYTE



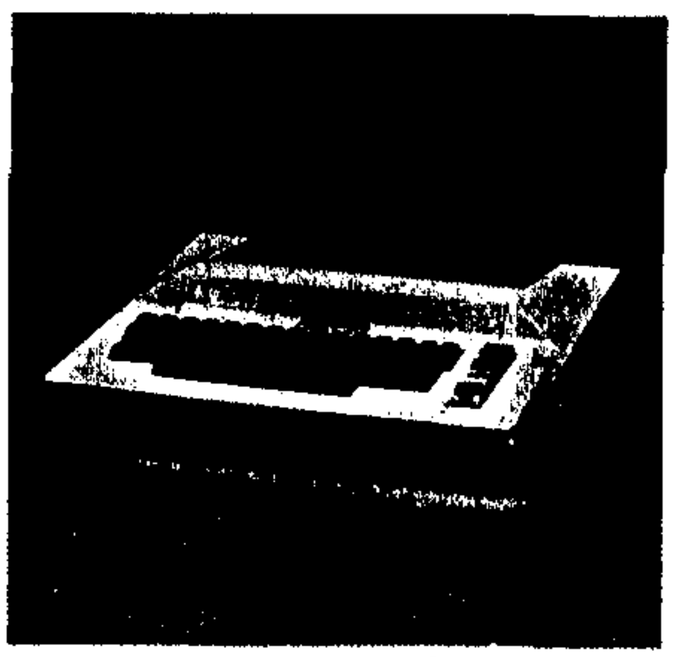
JUNE 1977 THE FIRST COMPUTER CAMP

JUNE 1979 THE TI-99/4A

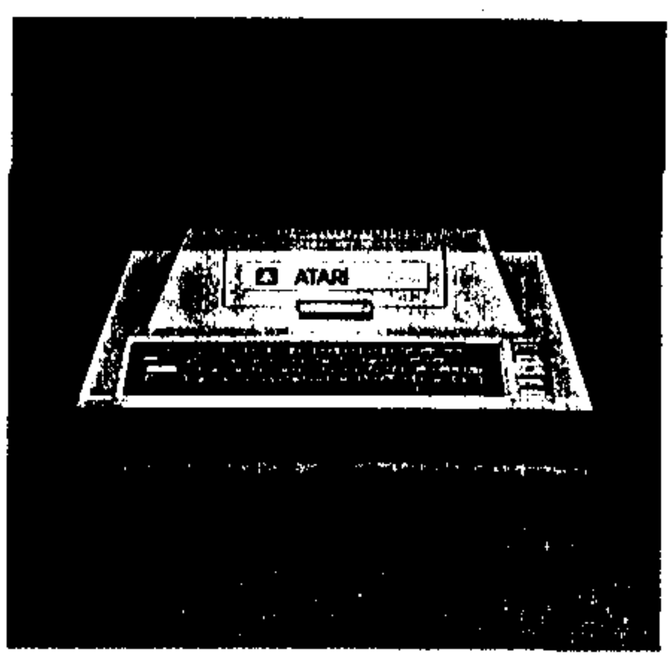
DECEMBER 1978 THE EPSON MX-80



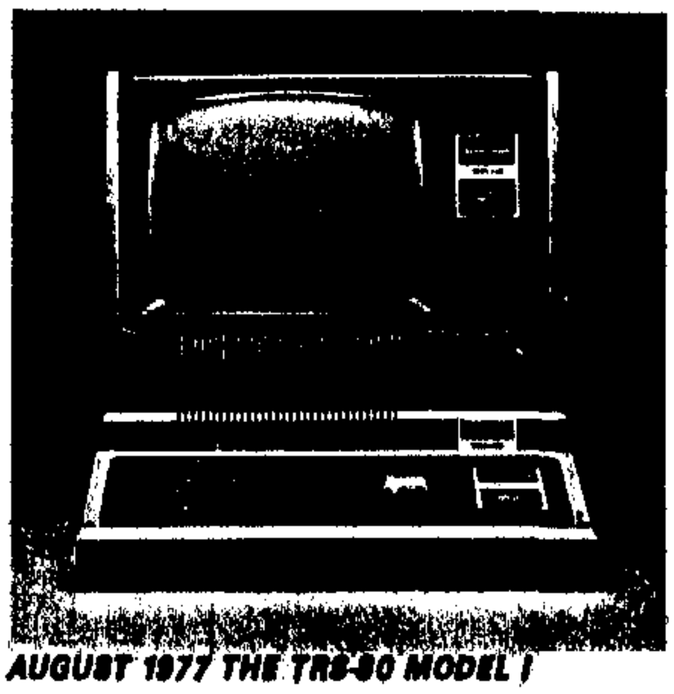
APRIL 1978 THE BYTEMASTER



DECEMBER 1978 THE ATARI 800

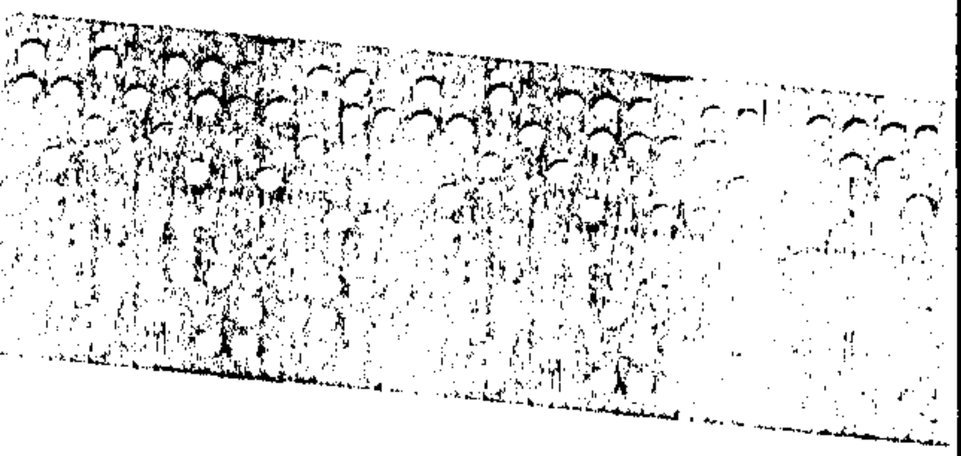


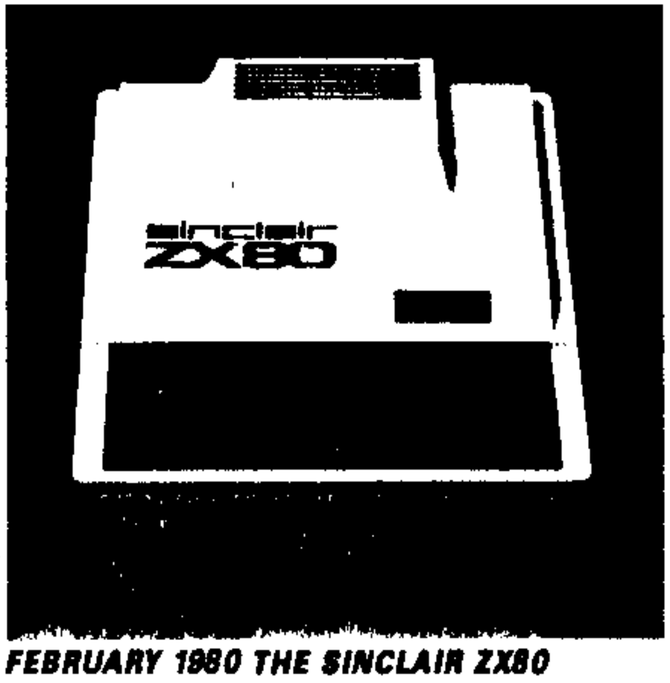
DECEMBER 1978 THE ATARI 400



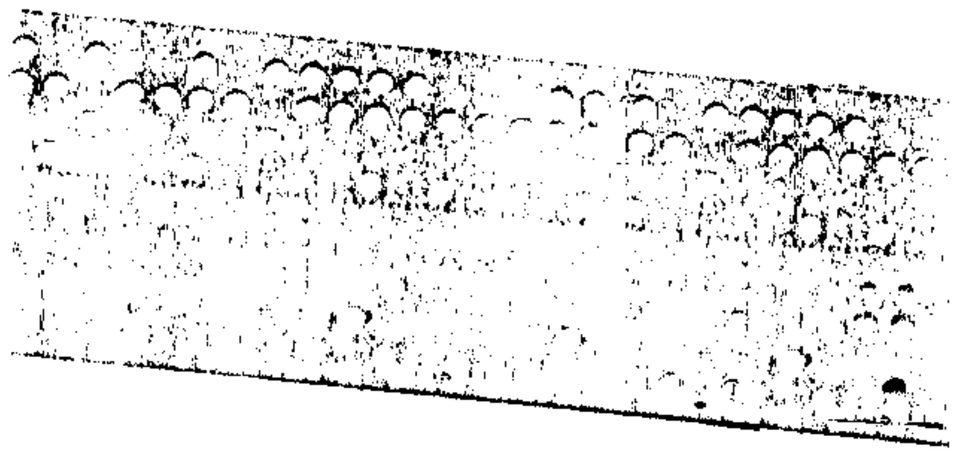
AUGUST 1977 THE TRS-80 MODEL I

APRIL 1977 THE COMMODORE PET



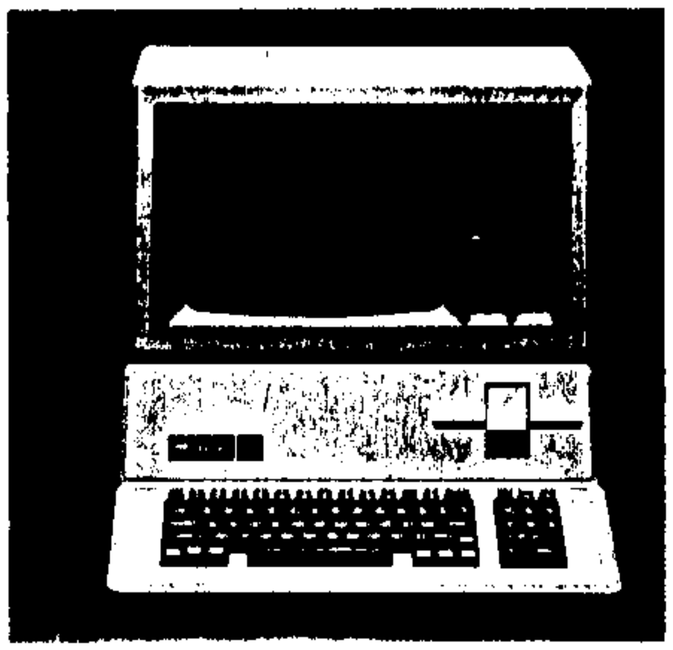


FEBRUARY 1980 THE SINCLAIR ZX80

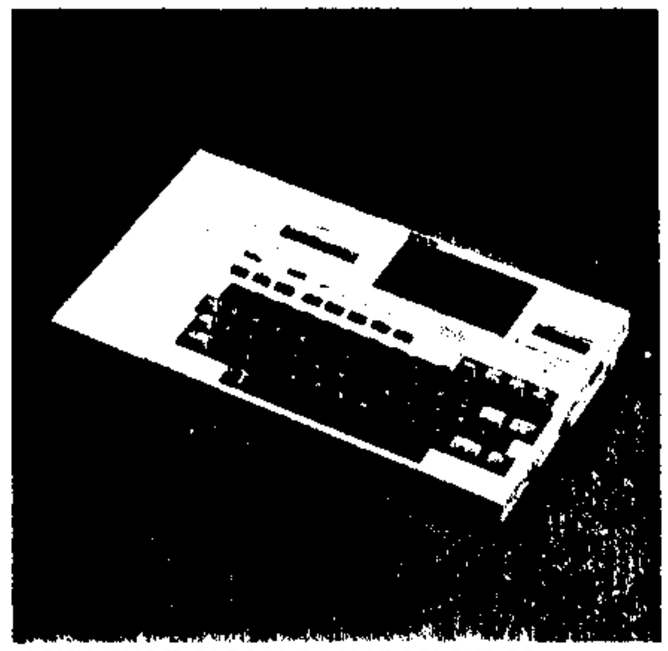


1980

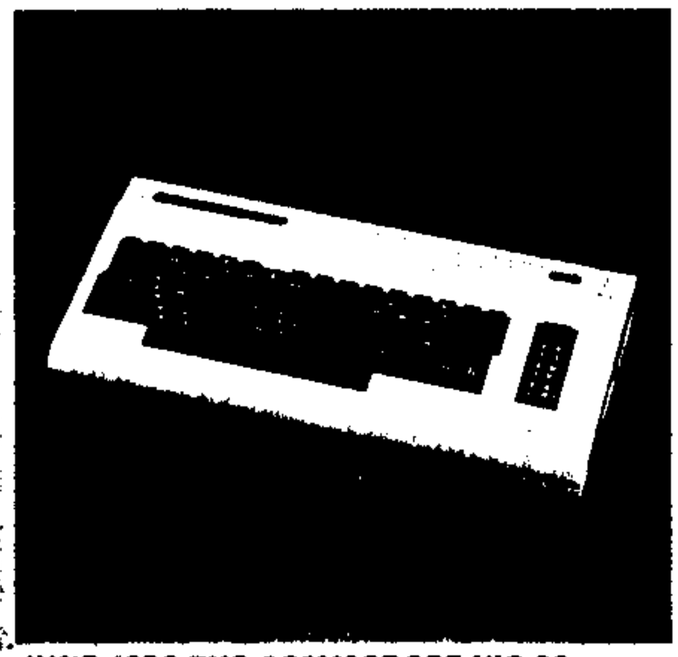
FEBRUARY *InfoWorld* **publishes its first issue.**
FEBRUARY Sinclair Research announces its ZX80 computer (Z80A, 1K byte of RAM, 4K integer BASIC in ROM, plastic membrane keyboard, $199). Its successor, the ZX81, was later marketed by Timex for under $100 before Timex left the microcomputer market.
MARCH Microsoft Corp. shows its first hardware product, the Z80 SoftCard for the Apple II at the 5th West Coast Computer Faire. The sudden availability of CP/M business software for the Apple contributes greatly to Apple Computer Inc.'s success.
MAY Apple Computer Inc. announces the Apple III, which is delivered a year late and has, at first, a high failure rate. The machine never becomes the replacement for the Apple II that Apple Computer wanted it to be.
JUNE Shugart begins selling 5¼-inch Winchester hard-disk drives.
JUNE Commodore Business Machines unveils the VIC-20 (6502A, 5K bytes of RAM, BASIC in ROM, serial, cassette, and modem interfaces, ROM cartridge slot, color display, for $299).
SUMMER Radio Shack announces its TRS-80 Color Computer (6809E, "chicklet"-style keyboard, 4K bytes of RAM, BASIC in ROM, color display, serial and cassette interfaces, for $399). They also announce the TRS-80 Model III, which replaced and improved their original Model I.
SUMMER "Zork, the Great Underground Empire" is first distributed by Personal Software Co. and later by Infocom, its creators. Infocom changed the nature of adventure games by allowing full-sentence input.
JULY Jerry Pournelle's "The User's Column" begins in BYTE.



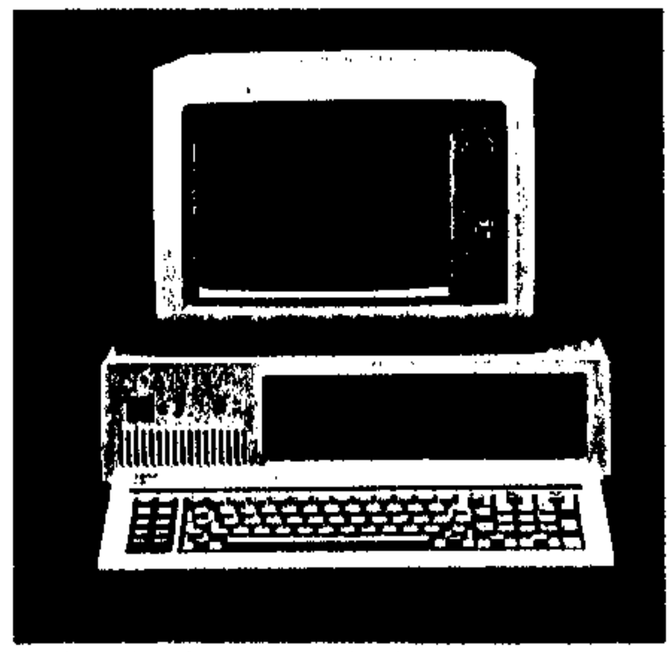
MAY 1980 THE APPLE III



NOVEMBER 1981 THE EPSON HX-20

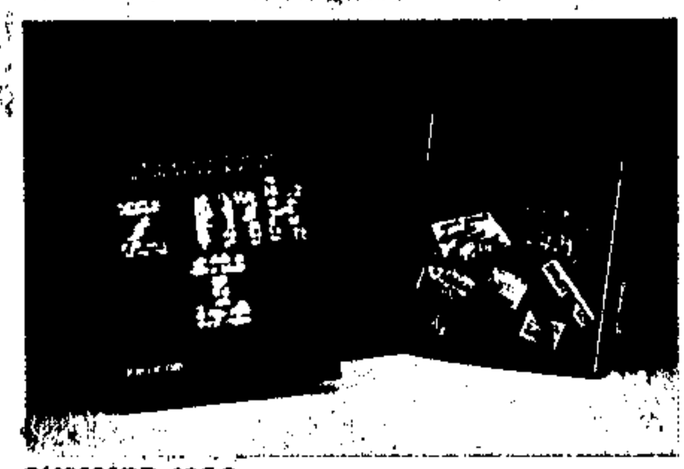


JUNE 1980 THE COMMODORE VIC-20

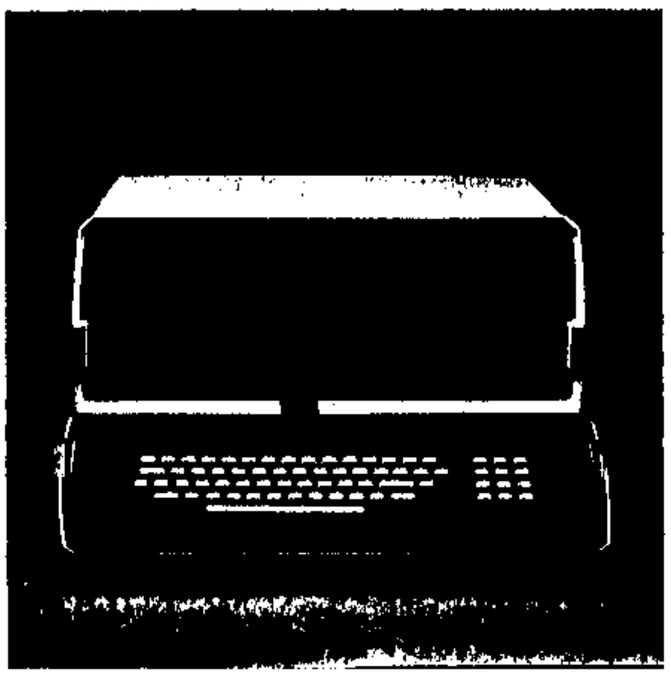


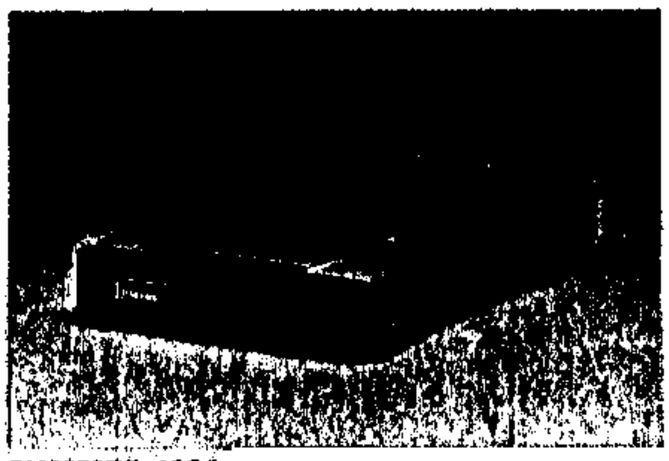
AUGUST 1981 THE IBM PC

APRIL 1981 THE OSBORNE I



SUMMER 1980
ZORK—AN EARLY ADVENTURE GAME





SUMMER 1981
THE HAYES SMARTMODEM 300