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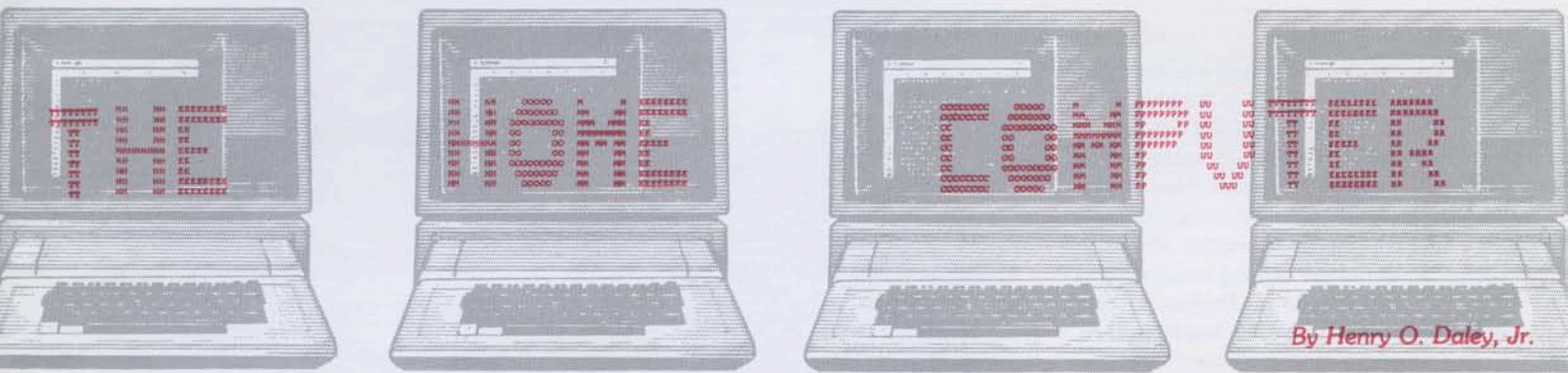
# The Home Computer

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By Henry O. Daley, Jr.

In mid-1969, **B**usicom, a now-defunct Japanese desk calculator manufacturer contracted with Intel, an American company, to develop a series of products using the new integrated circuit (IC) technology. In this process, the electrical circuits are built into small silicon crystals called "chips." Busicom had planned to use these products in a new line of programmable calculators. The first design by Intel was built around four chips: one that handled the calculations and logic; a second that stored a series of pre-programmed instructions; the third, a memory chip that held the data involved in a specific application; and the last that was used to help transfer information from one place to another. The chip that handled the calculations and logic decisions was called the central processing chip. It was designated as a 4004 by Intel since it was capable of handling four binary digits (bits) of information at a time. This chip later became known as the first microprocessor. Intel received the right to market this chip independent of Busicom and introduced the chip to the market in 1971.

In 1972 Intel made a slightly more advanced version of the microprocessor which could handle eight bits of information. They called this an 8008. This product was developed as a controller for another company, now known as Datapoint, but by the time the product was ready for market, the price of the components normally used as controllers had come down. This circumstance, combined with the fact that the new chip technology was much slower than the old, led Datapoint to give up on the product; consequently, Intel was left with a new product no one wanted.

With the the hope that it would sell more of its other chips, specifically memory chips, Intel introduced the 8008 into the market. Much to the apparent surprise of everyone, this new product began to sell. Intel quickly realized what was happening and a year later introduced a revised version called the 8080 which was ten times faster than the 8008 and needed fewer supporting chips. By 1974, nineteen different versions of microprocessors were available on the market

and the number has continued to grow each year. From a product that seemed destined for failure, a million-dollar industry has developed.

**T**he development of the microprocessor led to the creation of the microcomputer. Microprocessors, the brains within all microcomputers, do all the arithmetical calculations and make all decisions that take place within the machine. The first microcomputer was built around the 8080A (a version of the 8080). Presently, over two-hundred different microcomputers are on the market, each one using a specific microprocessor.

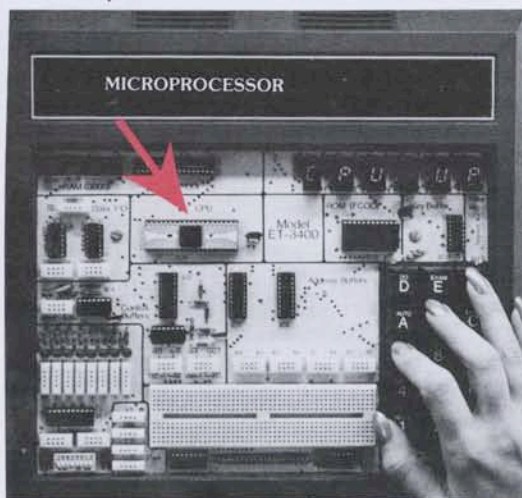
As the cost of the various chips decreases, more and more inexpensive microcomputers are being built. It appears that the 80s will be the age of the microcom-

puter. Drexel University is requiring all students and faculty to have the identical computers. Clarkson is requiring all freshmen starting this fall to buy the same brand of computer. The particular computer chosen varies from one college to another, from inexpensive, \$600.00 models, to full systems costing \$3,000.

Schools throughout the country are buying microcomputers for student use from kindergarten on up. Families with young children in school have probably heard them talk about the use of computers in school. In fact, anyone who plans to buy a home video game machine should consider a home computer instead, especially if there are school age children in the home. The prices are similar and one can do much more with a home computer.

Microcomputer Trainer

Robert Ward



puter as the 70s was the age of the hand calculator. Some microcomputers that are available now cost less than these original calculators. Because of the ready availability of microcomputers and their relatively low cost, many colleges are requiring that all students own microcomputers and faculty in those colleges must integrate the microcomputers into their courses. For the past two years Rensselaer Polytechnic Institute has given twenty of their freshman students IBM personal computers (PC) with printer and disk worth around \$3,000. Carnegie Tech. will soon require all freshmen to have

Some of the areas in which home computers can be used are:

**Household finances:** Programs are available for keeping household records of possessions, collections, (e.g. stamp, coin, etc.) income tax records, monthly financial planning, shopping lists and similar types of items.

**Education:** Software programs are available for the various microcomputers that allow you to learn at home. Programs vary from elementary mathematics to history, physics, foreign languages, spelling, reading and many others. Other types of programs teach new hobbies such as music, playing chess or bridge.

**Games:** Many of the inexpensive microcomputers take software cartridge packs similar to the video game machines, e.g. Radio Shack's color computer, Texas Instruments 99/4A, Commodore's Vic 20 and Atari's 400 or 800. With the extra memory available to the computers, the graphics can be more sophisticated than in home video game machines. In fact, the new home video game machine by Atari is essentially a modified Atari 400 computer without the keyboard. This enables the machine to produce better graphics.

**Word Processing:** Software is available for all the microcomputers to enable one to use them as word processing machines. Many well-known writers are using microcomputers to write and store their books. This process leads to faster corrections and better looking copies of articles. At many colleges students are writing master's and Ph.D. theses on micros. Professors can check their progress by reading from their computers and inserting changes directly.

All microcomputers can be used to access large amounts of information called data bases which are available over telephone lines. In order for one to take advantage of these added data bases, it is necessary to buy a device called a MODEM which enables the computer to communicate to other computers over the telephone.

**A**dditional areas of information made available by data bases are:

**Banking:** The Shawmut Bank of Boston, and many other banks throughout the country, allow customers to pay bills over the phone via computer, transfer money from one account to another and transfer just about any other type of business they would otherwise do in person. With no cost in postage, this could save money over a period of time.

**National Information Networks:** Many types of information services are available. People who invest can dial the Dow Jones service and obtain a listing of stocks, their recent price earnings and a historical report on the stocks.

**C**ompuServe is a national information service that owns many different services. It includes up-to-date news, weather and sports, a reference library, games, education and many other features. An encyclopedia called the *On-Line World Book Encyclopedia* is available for no extra charge other than hook-up time. This is a twenty-two volume set which is updated regularly to keep up with the latest facts. Historical searches can be readily done using this program. Home shopping can also be done through a service called Compu-Store. The service features information for many special interest groups, photography buffs and musicians for example. In addition a national bulletin board can be accessed. If a subscriber has a problem, he can leave it on the bulletin board and if someone can help, they will. An electronic newspaper is also available as well as an electronic mail service.

For those who know nothing about computers a few definitions of terms are appropriate. The electrical components and

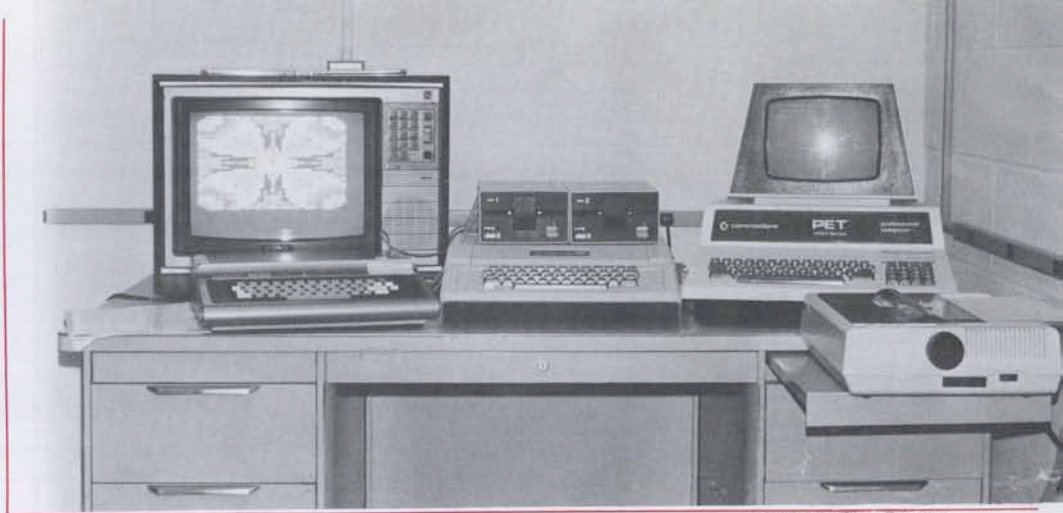


Photo by Ron Rezzani

material used to make a computer are called the "hardware." The instructions that cause the computer to function are known as the "software." The hardware computer is composed of a microprocessor, memory to store the software, a device to communicate to the microprocessor, such as a typewriter-like keyboard, and a device such as a television screen used by the computer to communicate with the user. These last two are referred to as input/output devices. The larger the amount of memory, the more that can be stored in a computer at a given time.

There are two different types of memory, ROM and RAM. ROM memory is **Read Only Memory**. The cartridge used in the video game machines is an example of this. This type of memory permanently stores instructions for a specific usage. RAM memory is **Random Access Memory**. This is memory that is used temporarily as the computer does calculations or receives information from the user. Memory is measured in units of K where K actually means 1024. A 16K memory has 16 x 1024 or 16384 bytes of memory. A byte is eight bits and represents the way a computer stores information. To store any single letter, number, or even a space in a computer takes one byte of memory. A minimum system for satisfactory work at home is a 16K system. Less memory leads to restrictions on what can be done. Keep this in mind in comparing computers and their prices. Some of the least expensive computers have the smallest amount of memory.

Microcomputers come in two basic styles. You can buy a complete package containing the input/output devices, memory and microprocessor in one unit. Examples of this are the TRS-80 Model III and Commodore PET computers. The other approach is to have separate units for the different components. The memory and microprocessor are one unit, while a wire connects this to a television screen through an RF adapter. The Apple II computer and TRS-80 color computer are examples of this approach. Though the one package system is neater and looks better, it is more expensive as a starting system. In the above photograph, the color computer is on the left while the Apple II is in the middle and a Commodore Pet is on the right.

**I**n the table below, some options are separated by a /. This means the basic computer can be bought in two ways, the larger the memory, the more expensive the system. The graphics display row tells how many characters per row can be put across the screen and how many rows. The price list is the suggested retail price and is for comparison only. Almost all of these systems can be bought at a lower cost than listed. The Vic-20 for example, is selling as low as \$169. Some systems, such as the Apple II and Atari 800 can no longer be bought with less than 48K of memory. All of these computers use the language BASIC as the beginning language for programming. Let us look at each company separately.

	Timex/ Sinclair	Apple II II (+)	Vic 20	Commo- dore 64	TRS 80 color	TRS 80 III	TI 99/4A	Atari 400/800
<b>basic ROM</b>	8K	12K	16K	20K	8K/16K	4K/14K	26K	10K
<b>system RAM</b>	2K	48K	5K	64K	16K	4K/16K	16K	16K/48K
<b>color</b>	NO	YES	YES	YES	YES	NO	YES	YES
<b>Graphics display</b>	32 x 24	40 x 24	22 x 23	40 x 24	32 x 16	32 x 16 or 64 x 16	32 x 24	40 x 24
<b>colors</b>	...	15	16	16	8	...	16	16
<b>Cartridge slot</b>	NO	NO	YES	YES	YES	NO	YES	YES
<b>Price</b>	\$99.95	\$1330	\$299	\$595	\$399/499	\$699/999	\$299	\$299/899
<b>Sound effect</b>	NO	YES	YES	YES	YES	NO	YES	YES
<b>Languages available</b>	BASIC	BASIC PASCAL PILOT LOGO LISP other	BASIC	BASIC PILOT LOGO PASCAL	BASIC LOGO FORTH PILOT	BASIC COBOL PASCAL PILOT FORTRAN others	BASIC LOGO PASCAL PILOT	BASIC PILOT FORTH PASCAL

**Timex/Sinclair:** Its basic advantage is cost. Though memory is small and peripheral equipment is not available yet, it is a good starter system to learn about programming. The form of BASIC used here is missing some important commands such as READ, DATA. It has a pressure sensitive keyboard which is a nuisance to use. All keys are multifunctional, that is each key does three or more operations depending upon when it is pressed. This can be awkward for beginners. A new color version called SPECTRUM should be available in the U.S. in a few months. It is now being sold in England.

**Apple II (+):** This has excellent color graphics and a tremendous number of available software programs. It is the best seller of the small computers in the U.S.; over 700,000 have been sold. It is more expensive than the other computers suggested here. A basic system with a disk drive for storage runs around \$2,000.

A new version of the Apple II has recently become available, called the Apple IIE. This comes standard with 64K of memory and is expandable to 128K. It has a few more keys with both upper and lower cases and the ability to display 80 columns on a screen. This should drive the cost of Apple II's down a little. Almost 20,000 Apple II computers are being sold every month.

**Commodore:** This company makes both the VIC-20 and Commodore 64. In terms of world sales of microcomputers, Commodore is the leader. Both machines are new and there are only a limited number of programs available for each. Programs are not necessarily usable on both machines. There have been some problems with the cassette on the VIC-20. The C64 has the potential of being the best computer in this price group. Its graphics and sound are outstanding.

**Radio Shack/Tandy:** This company is well known for its TRS-80 products. The Model III is a complete unit with space for two disks on the unit. It is a good, inexpensive business machine as well as home computer. The color computer uses Motorola's 6809E microprocessor. This microprocessor is one of the best, if not the best eight-bit microprocessor in the field. The system is excellent and its BASIC language is one of the best available. The language has outstanding commands such as PAINT, CIRCLE, DRAW AND SOUND and structured commands such as IF THEN ELSE. Its basic weakness is an inexpensive keyboard with  $\frac{3}{4}$  size keys.

For the first time, Radio Shack will soon be selling its computer through stores other than Radio Shack dealers. The color computer has been repackaged in cream or white and is being sold as a TDP-100. It is better looking than the current Radio Shack brand because of its color, but it is still the same machine. A lot of software is available from sources outside of Radio Shack. Until recently, Radio Shack has not acknowledged the existence of these companies. This policy has now been changed and a book will soon be available from Radio Shack listing the various outside programs, their cost and the seller.



### **A minimum system for satisfactory work at home is a 16K system.**

**Texas Instruments:** The 99/4A is a revised version of an earlier model. It has an inexpensive case and keyboard that contains only 48 keys, fewer than what is offered by most other computers. Each key has to be used for more than one purpose.

TI BASIC is a good program but is relatively slow. The multiple use of the keys can be a problem for beginners. Its color and sound generation capabilities are excellent, however. Many programs are available from Texas Instruments.

**Atari:** The 400 and 800 are the two basic systems produced by Atari. The 400 contains a pressure sensitive keyboard which is not recommended. It is an excellent machine, with color graphics that are the best of the small machines. It is an excellent computer on which to write games. The 800 is similar but with a full-size typewriter keyboard and memory expansion beyond that of the 400. No language comes with the system. A package of up to \$100 must be bought before programming in BASIC can be accomplished.

In the next few months more computers in this range will become available. IBM is supposed to be coming out with a system costing less than \$1,000. The company is presently making a large inroad in the field of home computers. In terms of sales IBM stands third, behind the Apple and Radio Shack in this country and will probably pass both in the next year or two. Their personal computer was not discussed here as its cost is quite a bit higher than those listed.

A couple of last warnings may be appropriate. As anyone who owns a video, game can verify, the machine's cost is only the beginning. Each cartridge adds to the price of the system. This is also true for these computers. The original cost of the system is small compared to other costs. This is part of the reason for the discounts and rebates now going on. As you learn to use the computer you will want additional attachments such as disk drivers and printer. In the photograph on Page 10 two disk drives can be seen on top of the Apple, while the printer is to the far right. Once you use a disk drive you will never want to go back to tapes. The cost of various software programs also adds up. Since TI's 99/4A is a 16-bit machine, the cost of additional peripherals is generally greater for the 99/4A than for eight-bit machines as is the cost for software.

A second point to consider is the service on the machine if something goes wrong. If you are not capable or knowledgeable enough to repair the machine yourself be certain you do business with a firm that does repair.

A last point to consider is that there are many companies making computers now. Some may be out of business in the next few years. Be sure to buy a system from a company that will most likely be around in the future. The products listed here are made by companies that should be in business in years to come.



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*Dr. Daley teaches a course on the use and interfacing of computers to instruments used in the laboratory. He is the author of a college textbook on microprocessors and microcomputers published by Holt, Rinehart, and Winston entitled Fundamentals of Microprocessors.*