

## ***Chapter 11 Competitive Computers***

As 1980 began, Tandy/Radio Shack had about 40 percent of the personal computer market, Apple Computer was in second place and Commodore in third. The balance of the market was shared by a number of small entrepreneurial companies.

In 1981, the market started to change significantly with the release of the IBM Personal Computer. This computer had instant acceptability, especially in the business segment of the market. In the home consumer segment of the market, a price war evolved between 1982 and 1983 that had a significant impact on companies such as Atari, Commodore, Radio Shack and Texas Instruments. The combination of a requirement for compatibility with the IBM PC and aggressive competition resulted in major financial problems for companies such as Atari, Osborne Computer and Texas Instruments. A dominant company that survived these competitive pressures was Tandy Radio/Shack.

### ***11.1 ... Tandy Radio/Shack***

Reference Section 4.5 for the founding of the Tandy Corporation and computers released in the 1970's.

#### ***TRS-80 Model III***

The TRS-80 Model III computer was introduced in July 1980. The physical configuration was similar to the TRS-80 Model II. The computer, monitor, keyboard and space for two optional 5.25 inch floppy disk drives were enclosed in a one-piece molded housing. The computer used a Z-80 microprocessor with 4K bytes of RAM which was expandable. The non-detachable keyboard had 65 keys and included a numeric keypad. The unit included a high-resolution 12 inch monitor. The computer was sold in three configurations with a price ranging from \$699 to \$2,495. A single floppy disk drive cost \$849.

### ***TRS-80 Color Computer***

The TRS-80 Color Computer, also known as the CoCo was a low cost unit that was announced in the summer of 1980. The computer and a 53 key keyboard were an integrated unit. The computer used the Motorola 6899E microprocessor with 4K bytes of RAM expandable to 16K. A television modulator was built-in for a separate color television display unit. The graphics resolution was 128 by 192 using 4 colors and 256 by 192 using only one color. The basic computer sold for \$399, a 13 inch color video receiver was also \$399 and a cassette recorder was available for \$59.95. The major price war that started in 1982, resulted in the price of the computer dropping to \$199 by June 1983.

### ***TRS -80 Pocket Computer***

The TRS-80 Pocket Computer measured 7 by 2.75 by 0.5 inches and used four mercury batteries. It included a 57 key keyboard and a 24 character liquid crystal display. The computer used two 4-bit CMOS microprocessors with 7K bytes of ROM and 1.9K bytes of RAM. The unit sold for \$249 and was introduced in mid 1980.

### ***TRS-80 Model 16***

The TRS-80 Model 16 was announced in January 1982. It utilized the Motorola 68000 and Z80 microprocessors, with 128K bytes of RAM and one eight inch disk drive. Microsoft provided a XENIX operating system for the computer.

### ***TRS-80 Model 100***

This was the first "notebook" computer and was conceived by Kay Nishi and supported by Bill Gates of Microsoft in 1981/82. Kyoto Ceramics (Kyocera) of Japan manufactured the computer. Radio Shack paid Microsoft a royalty and announced the TRS-80 Model 100 Portable Computer in March 1983.

The basic configuration had a Intel 80C85 operating at 2.4 MHz, 32K bytes of ROM and 8 to 32K bytes of RAM. The unit had a cassette interface and a

display that provided 8 lines of 40 characters with a graphics resolution of 64 by 240 pixels.

This portable unit measured 11.6-inches wide by 2-inches high by 8.25-inches deep and weighed 3 pounds, 14 ounces. It had an integrated liquid crystal display (LCD) and a full-size keyboard with 12 function keys. The unit operated on four AA batteries for about 20 hours or on an optional AC adapter. A 300-baud modem was also built-in..

ROM had a collection of software developed by Microsoft and included: operating system, BASIC interpreter, text editor, communications program, address-book program and appointment-calendar program. The unit varied in price from \$799 for a computer with 8K bytes of RAM to \$1,134 for a unit with 32K bytes of RAM.

#### ***TRS-80 Model 4***

This model was released in 1983. It used the Z80 microprocessor and had 64K bytes of memory. The display could show 24 lines of 80 columns.

#### ***Tandy 1000***

The Tandy 1000 computer was the companies first IBM compatible product and was introduced in December 1984.

### ***11.2 ... Commodore***

Reference Section 4.4 for the founding of Commodore International and computers released in the 1970's.

#### ***CBM 8032***

The CBM 8032 was introduced as a business computer at the National Computer Conference in May 1980. CBM denoted Commodore Business Machine. The basic configuration had a MOS 6502 microprocessor, 18K bytes of ROM and 32K bytes of RAM expandable to 96K. The storage system had dual 5.25-inch floppy-disk drives with 500K bytes of storage per drive. The display had a

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12-inch screen that could display 25 lines of 80 characters.

The unit included a keyboard with a numeric keypad, a cassette interface and a BASIC programming language. Separate single and dual floppy disk drive units were available in various storage capacities. The computer was priced at \$2,829.95.

### ***SuperPET***

The SuperPET 9000 series were an advance PET series based on the CBM 8032 system. The computer used a MOS 6502/6809 microprocessor with 36K bytes of ROM, 96K bytes of RAM and 2K bytes of screen RAM. A green phosphor screen could display 25 lines of 40 characters.

### ***VIC-20***

In 1979/1980 Commodore started to focus its new product development at the low price end of the market. The company wanted to produce a low cost, friendly consumer product for the mass market.

Prototypes of the VIC-20 were demonstrated at the Consumer Electronics Show (CES) in June 1980 and production models at the CES in January 1981. The VIC prefix stands for Video Interface Computer and was derived from the name of the Video Interface Chip developed in 1978.

The basic configuration had a MOS 6502A microprocessor, 16k bytes of ROM and 5K bytes of RAM expandable to 32K. The display had 23 lines of 22 characters.

The unit could be connected to a color television set or a video monitor. The computer included an integrated keyboard with four programmable function keys. External connectors were provided for a cassette recorder, floppy disk drive, program cartridge, games port, TV/monitor and printer. The VIC BASIC was a Commodore modified version of Microsoft BASIC.. The computer was priced at \$299.95 initially and was an immediate success. By January of 1983 Commodore had sold one million VIC-20's. Starting in 1982, a major price war ensued that resulted in the price of the VIC-20 dropping to \$89 by June 1983.

### ***Commodore 64***

The Commodore 64 computer was announced in January 1982. The basic configuration had a MOS 6510 microprocessor, 20K bytes of ROM and 64K bytes of RAM. The unit had a 40 column display with 16 colors.

The unit had Sprite graphics and a music synthesizer chip. It was released in September 1982 at a price of \$595. In 1983 it was released to mass merchandisers and the price dropped below \$400.

### ***MAX Machine***

Initially developed with the name of Ultimax as a low cost computer with a target price of \$149. It had only 2K bytes of memory, a 25 line by 40 column display and contained a music synthesizer chip. The MAX Machine was announced at the Consumer Electronics Show in June 1982. It was not successful and was withdrawn shortly after introduction.

### ***Commodore SX-64***

The Commodore SX-64 is a portable version of the Commodore 64 computer which was announced at the Consumers Electronics Show in January 1983.

### ***Commodore PLUS/4***

The Commodore PLUS/4 was initially called the 264 series. The computer was introduced at the Consumer Electronics Show in January 1984. The computer featured a built-in integrated software program called 3-Plus-1. The program included a word processor, spreadsheet, business graphics and a database.

In January 1984 Jack Tramiel resigned from Commodore and was replaced by Marshall Smith as president. Following this a significant number of Commodore executives departed from the company. Shortly after leaving Commodore Tramiel founded a new company called Tramel Technology Limited (TTL). In July, TTL acquired Atari from Warner Communications Inc., in a shared ownership agreement. Then in August, Commodore acquired the Amiga Computer Corporation. Commodore

released the Amiga 1000 computer in 1985 that sold for \$1,295. It featured outstanding graphics, a multitasking windowing operating system and sound capabilities.

### ***11.3 ... Osborne***

Adam Osborne graduated with a doctorate degree in chemical engineering from the University of Delaware in 1968. Osborne then worked for Intel and wrote technical manuals for the early microprocessors. In 1975 he wrote a book entitled *An Introduction to Microcomputers* [44]. This was one of the first popular books to describe the microprocessor in an introductory manner. It was the start of Osborne as an author and publisher. He also wrote a computer opinion column for the trade press called "From the Fountainhead." In 1979, Osborne sold his publishing company to McGraw-Hill. Osborne decided to enter the personal computer market and founded Osborne Computer Corporation in 1980.

#### ***Osborne 1***

Osborne hired Lee Felsenstein to design a low cost portable computer. The Osborne 1 computer was introduced in March 1981 at the West Coast Computer Faire.

The basic configuration consisted of a Z-80A microprocessor operating at 4 MHz with 4K bytes of ROM and 60K bytes of RAM. The storage system had two 5.25-inch floppy-disk drives with a capacity of 100K bytes on each disk. The unit had a built-in 5-inch video monitor. The display was organized as 32 lines of 128 characters with 24 lines of 52 characters visible and scrolling to view the remainder of screen.

This portable unit measured approximately 20.5 inches wide by 9 inches high by 13 inches deep and weighed about 24 pounds. The integrated unit included the video monitor, two 5.25-inch floppy disk drives and detachable keyboard. The keyboard had 69 keys with a numeric keypad. The numeric keys could be programmed to operate as function keys.

Osborne arranged to obtain CP/M from Digital Research, Word-Star from MicroPro and SuperCalc from Sorcim at very reasonable prices. This allowed him to

incorporate them as a bundled software package with the machine. C-BASIC and Microsoft MBASIC languages were also included for programming. The entire system, computer and software was priced at \$1,795 and was extremely successful.

### ***Osborne Executive***

An improved portable model called the Osborne Executive with a larger display was announced in early 1983. The basic configuration had a Z-80A microprocessor operating at 4 MHz and 10K bytes of ROM and 128K bytes of RAM. The storage system had two half-height 5.25-inch floppy-disk drives with a capacity of 204K bytes on each disk. The display was a 7-inch amber monitor capable of displaying 24 lines of 80 characters.

The Osborne Executive computer had the same case as the Osborne 1 computer but had a slightly heavier weight of 28 pounds. The entire keyboard was software programmable.

A complete package of software was provided with the system and included: CP/M Plus and UCSD p-System operating systems, MBASIC, C-BASIC, Word-Star, SuperCalc and a database management program called Personal Pearl. The complete system including software cost \$2,495.

An upgrade model called the Executive II was also announced. This unit included an additional board with an Intel 8088 microprocessor, 128K bytes of memory, 640 by 200-dot high-resolution monochrome graphics and MS-DOS operating system. This additional board and software provided a degree of IBM compatibility. The complete system cost \$3,195.

Rapid expansion of the company during 1982 accompanied by new management personnel resulted in financial difficulties. Then the early announcement of the new Osborne Executive computer in early 1983 ahead of availability, significantly reduced sales and cash flow. The result was Osborne Computer Corporation went bankrupt in September 1983. This era is chronicled by Osborne in his book *Hyper-Growth: The Rise and Fall of Osborne Computer Corporation* [161]. In the spring of 1984 Osborne founded a new company Paperback Software

International. The company markets low cost software for small companies.

### ***11.4 ... Kaypro***

The company was initially founded as Non-Linear Systems in 1953 by Andrew Kay to produce digital voltmeters. Due to market conditions Kay decided in 1980 to enter the personal computer market. The company name was subsequently changed to Kaypro Corporation.

#### ***Kaycomp II and Kaypro II***

The computer developed was a portable unit with disk drives, keyboard, nine-inch monitor, bundled software and sold for \$1,795. The computer was named Kaycomp II and was introduced in April 1982. The computer name was later changed to Kaypro II.

The basic configuration had a Zilog Z80 operating at 2.5 MHz with 64K bytes of RAM. The storage system had two double-density, dual-sided 193K byte 5.25-inch floppy-disk drives built-in. The unit had a 9-inch green-phosphor monitor that displayed 24 lines of 80 columns.

The portable unit measured 18 by 15.5 by 8 inches and weighed 26 pounds. The detachable keyboard had 86 keys which included a 14 key numeric keypad.

The operating system was CP/M and both a MBASIC interpreter and SBASIC compiler languages were provided. Other programs included with the system were: PerfectCalc, PerfectFiler, PerfectSpeller, PerfectWriter, Profit Plan and Word Plus.

The Kaypro 4 and 10, computers were subsequently released. The Kaypro 4 had diskette capacity of 392K bytes and the Kaypro 10 had both increased diskette capacity and a 10 megabyte hard disk.



### ***11.5 ... Compaq***

Rod Canion, James Harris and William Murto founded the Compaq Computer Corporation in February 1982. The name Compaq was selected to provide a unique identity associated with the initial focus of producing a "compact" computer. This focus resulted in a proposal to produce a portable computer that would avoid direct competition with IBM. Each of the founders had been senior managers at Texas Instruments (TI). Canion had been manager of three TI Product Customer Centers, Harris a vice-president of TI engineering and Murto a former vice-president of TI marketing and sales. The company received initial financing from the Sevin-Rosen Partners, a high-tech venture capital firm. Benjamin M. Rosen, a partner in the venture capital firm subsequently became chairman of the board for Compaq. H.L. Sparks and other marketing executives were recruited from IBM in 1982, to manage the marketing and sales organization. The company went public in December 1983.



Figure 11.1: Founders of Compaq Computer.  
Photograph is courtesy of Compaq Computer Corporation.

Compaq was the first company to introduce a successful IBM compatible computer. The Canadian Hyperion computer preceded it, but it was not successful. Compaq achieved the compatibility by reverse engineering the IBM ROM BIOS chip. They also obtained the cooperation of Microsoft, to adapt a BASIC interpreter and MS-DOS for the new portable computer that provided identical functions and compatibility with the IBM PC.

### ***Compaq Portable***

The Compaq Portable was announced in November 1982. The basic configuration had an Intel 8088 microprocessor with 128K bytes of RAM expandable to 256K. The storage system had a 320K byte double-sided 5.25-inch floppy-disk built-in. The unit had a 9-inch green monochrome monitor capable of displaying 25 lines of 80 characters.



Figure 11.2: Compaq Portable computer.  
Photograph is courtesy of Compaq Computer Corporation.

The portable unit measured 20-inches wide by 8.5-inches high by 15.3-inches deep and weighed 28 pounds. At this weight, a more correct term would have been "luggable." The integrated unit included the video display, a 5.25-inch floppy-disk drive with provision for a second drive and a detachable keyboard. The IBM style of keyboard had 83 keys, 10-key numeric keypad and 10-key function pad. A socket was provided for the addition of the Intel 8087 coprocessor. MS-DOS was the operating system

The Compaq Portable was priced lower than the IBM PC. A basic unit with 128K bytes of RAM and one 320K byte disk drive cost \$2,995. A two-disk-drive system cost \$3,590.

### ***Other Models***

The Compaq Plus with a 10MB hard disk drive was introduced in October 1983.

The Deskpro 286 was Compaq's first desktop computer and was introduced in June 1984. The Deskpro 386 computer was released in September 1986. It was the first IBM compatible computer to use the Intel 32-bit 80386 microprocessor. A special memory management software system was developed by Microsoft. It was released eight months ahead of a similar IBM product.

The Compaq Portable 286 was released in June 1984 and the Compaq Portable 386 in September 1987.

The Compaq LTE was the companies first notebook PC and was introduced in October 1989.

The SystemPro was Compaq's first server computer, it used EISA (Extended Industry Standard Architecture) and was introduced in November 1989.

### ***11.6 ... NeXT***

Steven P. Jobs founded NeXT Computer Inc., in September 1985 following his departure from Apple Computer, Inc. Five key Apple personnel joined Jobs in the formation of NeXT. They were Susan Barnes the Macintosh controller, George Crow an engineering manager, Dean Lewin the higher education marketing manager, Rich Page who was an Apple Fellow and Bud

Tribble the Macintosh software manager. The NeXT computer was developed with an initial market target of the higher-educational users. Input from various schools and universities influenced the design. In early 1987 Ross H. Perot invested twenty million dollars in the company. The NeXT computer was released in October 1988.

The basic configuration had a Motorola 68030 microprocessor operating at 25 MHz with a 68882 math coprocessor and 8 megabytes of RAM expandable to 16 megabytes. The storage system used the first commercially available erasable optical drive with a removable 256 megabyte capacity cartridge. A fast NuBus architecture with four 32-bit expansion slots was incorporated. The unit had a 17-inch monochrome monitor with a resolution of 1,120 by 832 pixels.

The computer had advanced VLSI (Very Large Scale Integration) technology and a built-in Motorola digital signal processor. NeXT had developed its own UNIX based operating system named NeXTSTEP. The operating system was included free with the computer that had an impressive graphical interface. On introduction it was termed the machine for the 90's. However the price of \$6,500 for the computer and \$1,995 for the NeXT laser printer, would be a limiting factor on initial sales.

### ***11.7 ... Miscellaneous***

#### ***Access Portable Computer***

The basic configuration had a Zilog Z-80A microprocessor operating at 4 MHz with 8K bytes of EPROM and 64K bytes of RAM. the storage system had two double-density 5.25 inch 184K byte floppy-disk drives. The unit had a 7-inch amber monitor that could display 25 line of 80 characters.

The portable unit measured 16.1 by 10 by 10.8 inches and weighed 33 pounds. The computer had a detachable keyboard, a built-in Epson MX-80 dot-matrix printer, two 5.25-inch floppy-disk drives, an acoustic and direct connect modems. Included with the computer was a set of software: CP/M operating system, Microsoft's MBASIC, C-BASIC, PerfectWriter,

PerfectSpeller, PerfectCalc, PerfectFiler and TELCOMU communications program. The complete system was priced at \$2,495.

### ***Acer***

Stan Shih was a principal in the June 1976 founding of Multitech International Corporation in Taiwan. Initially the company produced consumer electronic products. The company name was changed to Acer Incorporated in 1987. North American operations are controlled by Acer America Corporation. Acer is a highly decentralized company that manufactures most of its own components and peripherals. The company is now a major worldwide supplier of personal computers.

### ***Acorn***

The Acorn computer was an important British microcomputer that was developed by Acorn Computers Ltd., in conjunction with the BBC (British Broadcasting Corporation) in the early 1980's. Two models were produced, the BBC Models A and B.

The Model B had a basic configuration that used a MOS 6502 microprocessor operating at 2 MHz, 16K bytes of ROM and 32K bytes of RAM. A disk drive was available. The unit could display 24 lines of 40 columns or 25 lines of 80 columns. High-resolution graphics was 256 by 640 pixels in 2 colors.

The unit had a full-size typewriter style keyboard with function keys. The ROM memory included a BBC BASIC interpreter and a 6502 assembler. The Model B computer was priced at 399 pounds sterling and the Model A with fewer features at 299 pounds sterling.

### ***Apple II Clones***

The first Apple II clone was announced by Franklin Computer Corporation in the spring of 1982. It was named the Ace 100. Apple Computer successfully sued Franklin for copying Apple's system software at a Federal Court in January 1983. This resulted in the bankruptcy of Franklin Computer by the end of 1984.

The Laser 128 was a clone of the Apple II and was available by the end of 1986. It was a low cost computer

produced by Video Technology. An improved version named the 128EX/2 was subsequently released.

Other manufacturers in the Far East and Europe produced clones with names such as the Apollo II, Orange Computer and Pineapple.

### ***AST Research***

Safi Qureshey, Albert Wong and Thomas C. Yuen started a high-tech consulting firm that incorporated as AST Research, Inc. in 1980. The company name prefix is derived from the initial of their first names. AST Research started by producing peripheral cards. The company went public in 1984 and introduced its first personal computer, the Premium/286 in 1986. Albert Wong left the company in 1988.

### ***Atari***

For the founding of the Atari Corporation and its first computers see Section 4.6. By 1982 Atari was one of the largest manufacturers of computer-based video games. However, in late 1982 sales of video games started to drop. During this period Atari decided to shift a significant portion of its production to overseas manufacturing. This resulted in massive layoffs of its personnel beginning in February 1983 and continued into the summer. Deteriorating conditions resulted in the resignation of Atari director Raymond Kassar in July 1983 and the recruitment of James J. Morgan to replace him. By the end of 1983, Atari had lost more than \$500 million. Atari had announced the 1200XL computer in January 1983.

Then in July 1984 Atari was acquired by Jack Tramiel of Tramiel Technology Limited. Tramiel had left Commodore International in January and negotiated a shared ownership agreement with Warner Communications Inc. Within a month Tramiel significantly reduced Atari's personnel again and its physical facilities.

Staff were immediately assigned to developing a new computer for introduction at the January 1985 Consumer Electronics Show. The new computer would use a 16-bit microprocessor.

**Corvus Concept**

Advertised as "a complete system for automating the modern office" in early 1982. It featured a rotatable monitor that could be turned 90 degrees for display in portrait or landscape modes.

The basic configuration had a Motorola 68000 microprocessor operating at 8 MHz and 256K bytes of RAM, expandable to 512K. The storage system had a separate 8-inch floppy-disk drive and a separate hard-disk drive with 6, 10 or 20 megabyte capacities. The unit had a 14-inch monochrome monitor with a 8.5-inch by 11.5-inch viewing surface. It could display 63 lines of 90 columns in the portrait position or 47 lines of 117 columns in the landscape position.

The unit had a standard 91-key keyboard, numeric keypad and 10 software-definable function keys. A package of software was available from Corvus: operating system, logical spreadsheet, EdWord word processor, Pascal, FORTRAN and a CP/M emulator. The basic unit cost \$4,995, floppy-disk \$1,500 and \$2,495 for a 6 megabyte hard-drive.

**DEC**

Digital Equipment Corporation (DEC) entered the microcomputer marketplace in April 1982. The computers were of a higher quality, and higher price. Cofounder Kenneth Olsen stated "DEC is not in the consumer business." Three products were introduced: the DECmate II -- a word processing system with limited computing capabilities, the Professional 300 series and the Rainbow 100 series. Barry James Folsom was a principal in the engineering design.

The Rainbow series were general purpose computers that consisted of the 100 and 100+ models. The Rainbow 100 had a basic configuration that used a Z80A microprocessor and a 16-bit Intel 8088 microprocessor. The memory had 64K bytes of RAM expandable to 256K. The storage system had two 5.25-inch 400K byte floppy-disk drives built-in. The display was a separate 12-inch unit that could display 24 lines of either 80 or 132 columns. The unit had a separate keyboard with 103 keys, a numeric pad and 20 function keys. A significant feature

of the computer was the two microprocessors that allowed application software to run on either MS-DOS or CP/M operating systems. The price was \$4,190. The main differences in the Rainbow 100+ was that main memory was increased to 128K bytes, expandable to 896K and a 10 MB hard disk drive was included.

The Professional series consisted of the Models 325 and 350. These were personal minicomputers based on the 16-bit PDP-11 architecture. Both models used the DEC three-chip F-11 CPU. Both models had 512K bytes of RAM, expandable to 768K on the Model 325 and to 1,280K on the Model 350. Both models had two 5.25-inch 400K byte floppy-disk drives and the Model 350 included a 10 MB hard disk drive. Two operating systems -- P/OS and RT-11 based on PDP-11 systems were available.

Sales were significantly below expectations. DEC had a bureaucratic organization and poor marketing capabilities that were not suited to the fast changing personal computer market. Another factor was problems with the initial Rainbow computer running IBM software. This resulted in DEC terminating production of the computers in February 1985

### ***Dell***

Michael S. Dell, purchased his first computer, an Apple II, at the age fifteen in 1980. He then took it apart to improve his understanding of how it was designed and made. Shortly after the introduction of IBM Personal Computer he started buying, upgrading and selling IBM compatible computers. This modest beginning was the start of Dell's method of direct sell to the end user.

While attending the University of Texas, Dell created a company called PC's Limited to market his computers in January 1984. PC's Limited soon attained sales of between \$50,000 and \$80,000 per month. Dell left university and incorporated the company as Dell Computer Corporation in May. Products were still sold under the PC's Limited brand name. The strategic orientation of the company was to market more sophisticated, build-to-order, PC compatible computer systems directly to end customers. This eliminated the



markup to dealers and resellers and provided a significant cost advantage in product pricing.

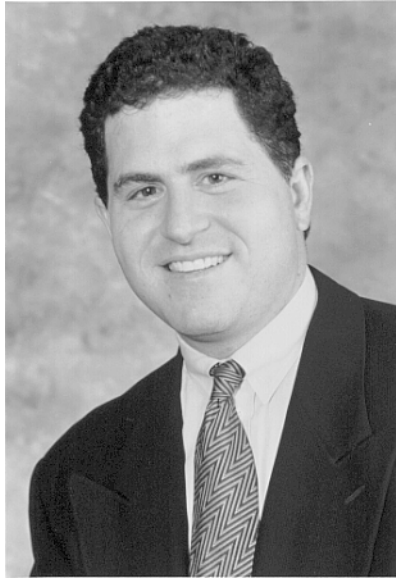


Figure 11.3: Michael S. Dell.

Photograph is courtesy of Dell Computer Corporation.

To improve profitability Dell decided to produce his own computer. This was simplified by using a chip set for the Intel 286 microprocessor supplied by Chips and Technology, Inc. The design was contracted to an engineer name Jay Bell for \$2,000. In 1986, Dell introduced at the spring COMDEX show the fastest performing 286-based computer system. The 12 megahertz machine was priced at \$1,995 compared to IBM's 6 megahertz machine priced at \$3,995.

By the end of 1986, Dell Computer had sales of about \$60 million. The company was growing, and opened Dell UK in June 1987. To finance an aggressive growth of the company, Dell arranged with Goldman Sacks & Company for a private capital offering in October. The company made its first public offering of shares in June 1988.

In mid 1987, the company began to change its advertising from the use of PC's Limited to the use of the Dell Computer trademark. The change to the use of the new trademark on all product lines was completed in April 1988.

### ***Epson***

For Epson corporate history and printer development see Section 17.5.

The HX-20 was the first "notebook" computer and was announced in November 1981. The basic configuration had two Motorola 6301 microprocessors (a CMOS version of the 6801) operating at 614 kHz, 40K bytes of ROM and 16K bytes of RAM expandable to 32K. A microcassette was used for storage. The unit could display 4 lines of 20 characters (32 by 120 dots). The unit measured 11.3-inches wide by 8.5-inches deep by 1.7-inches high and weighed 3 pounds, 13 ounces. It had an integrated liquid-crystal-display (LCD), standard-size keyboard, 24-character-per-line printer and a built-in cassette interface. A Microsoft BASIC interpreter and a word processor called Skiwriter were also included with the unit which was priced at \$795.

The HX-40 computer was a 3.5 pound notebook computer with a CP/M operating system, 32K bytes of ROM and 64K bytes of RAM. It had a liquid crystal display with 8 lines of 40 characters.

The Geneva computer was a 4 pound notebook computer with a CP/M operating system, 32K bytes of ROM and 64 K bytes of RAM. It had a 8 line by 80 character liquid crystal display (LCD).

The QX Series was Epson's first line of personal computers and were introduced in 1983. The QX-10 had a 8-bit CP/M-80 compatible operating system. an optional 16-bit MS-DOS board was available. The QX-11 used an Intel 8088 microprocessor with 256K bytes of RAM expandable to 512K. It also had two 3.5 inch floppy disk drives and a 12 inch green monochrome monitor with a resolution of 640 by 400 pixels. The QX-16 had a 16-bit microprocessor with an MS-DOS operating system and a 8-bit microprocessor with a CP/M-80 operating system. The

unit had 512K bytes of RAM and dual 5.25 inch floppy disk drives.

Epson's first IBM PC compatible computers were the Equity Series which were introduced in 1985. The Equity I was compatible with the IBM PC computer. It used a Intel 8088 microprocessor with 256K bytes of RAM. It had a single 5.25 inch floppy disk drive. The Equity II was compatible with the IBM PC/XT computer. It used a NEC V-30 microprocessor which was compatible with the Intel 8086 microprocessor. It had 640K bytes of RAM and was available with a single 5.25 inch and a 20 megabyte hard disk drive. The Equity III was compatible with the IBM PC AT computer. It used a Intel 80286 microprocessor with 640K bytes of RAM. It was available with a 5.25 inch floppy disk drive, 20 megabyte and 40 megabyte hard disk drives.

### ***Gateway 2000***

Theodore W. Waitt started assembling computer systems in 1987 and founded Gateway 2000, Inc., with his brother Norm Waitt and Mike Hammond in 1988. Waitt selected the company name to suggest that their computers were the gateway to the 21st century. Gateway is a major direct marketer of personal computers.

### ***GRiD***

John Ellenby founded GRiD Systems Corporation in 1979. Prior to the founding of GRiD Systems, Ellenby worked for Xerox at PARC (Palo Alto Research Center) and was responsible for the development of the Alto II computer. The company has focused on the high quality segment of the portable computer market, rather than the low cost segment. The company was acquired by the Tandy Corporation in 1988.

A portable IBM compatible laptop computer named the Compass I was introduced in April 1982. The computer weighed less than ten pounds, had a flat electroluminescent screen and a built-in modem. To achieve greater durability and reliability the models utilized bubble memory for secondary storage instead of floppy-disk drives. The Compass II model was introduced in June 1984.

GRiDCase was a portable IBM compatible laptop computer that weighed 12 pounds and included a built-in 3.5 inch floppy-disk drive. The GRiDCase was introduced in April 1985 and the GRiDCase Plus in September 1986.

The GRiDPad is a tablet styled portable introduced in 1989. The "Pad" in GRiDPad stands for "pen and display." The unit did not have a keyboard, but used a stylus for input. Physically it measured 12.5 by 9.25 by 1.5 inches and weighed 4.5 pounds. It used an Intel 80C86 processor, had 1 MB of RAM with MS-DOS in ROM. The LCD screen was 8 by 5 inches and the CGA resolution was 640 by 400 pixels. The GRiDPad sold for \$2,370.

### ***Hewlett-Packard Company***

See Section 2.4 for the founding of Hewlett-Packard and Chapter 4 for some of the company's early products. In the early 1980's a number of computer product lines were developed: Series 70, portable computers., Series 80, desktop computers for technical users., Series 100, desktop computers for business users and Series 200, high performance computers for engineering applications. The following are examples of products from each of these series.

The HP-75 Portable computer had 48K bytes of ROM and 16K bytes of RAM expandable to 24K. The storage system had a built-in magnetic card reader with a storage capacity of 1,300 bytes. The unit had a 1-line, 32 character liquid-crystal-display (LCD). The portable unit measured 11.1 by 6 by 1.1 inches and weighed 1 pound, 10 ounces. The integrated keyboard had 65 keys. A BASIC interpreter, text editor, file manager, clock/calendar and appointment scheduler programs were included. The portable unit was priced at \$995.

The physical configuration of the HP-85 computer included a 5-inch video display, thermal printer, data cartridge drive and a keyboard. The microprocessor was a 8-bit custom HP design with 32K bytes of ROM and 16K bytes of RAM expandable to 32K. The 5-inch monitor screen could display 265 by 192 dots in graphics mode or 16 lines of text. An Enhanced BASIC interpreter was included in ROM memory. The computer was priced at \$3,250 and was available in January 1980.

The HP-150 computer with a touch screen was introduced in September 1983. The innovative "touch screen" allowed a user to point to commands on the screen as an alternative to either keyboard entry or mouse activated selection. The basic configuration had an Intel 16-bit 8088 Microprocessor and 256K bytes of RAM expandable to 640K. The storage system had two 3.5-inch diskette drives with 246K bytes storage capacity. The unit had a 9-inch green monochrome screen that could display 27 lines of 80 characters. A 5 or 14.7 megabyte hard disk drive could be substituted for one of the 3.5-inch diskette drives. The separate keyboard had 107 keys, including a numeric keypad and cursor control pad. The computer used the MS-DOS operating system.

The Series 200 models used the Motorola 68000 microprocessor. The first product released was the Model 226, the Model 216 was the lowest cost product and the Model 236 the most expensive.

The HP Vectra PC was introduced in 1985.

In April 1989, HP purchased the Apollo Computer company for \$476 million and merged it into its own workstation product line.

### ***Hyperion***

The Hyperion was a portable computer developed by the Dynalogic Corporation that was founded by Murray Bell in Ottawa, Canada. In 1981, Dynalogic encountered financial difficulties. This resulted in 80 percent of the company being acquired by the Bytec Management Corporation, a venture capital company that was co-founded by Michael Cowpland. Dynalogic introduced the portable computer at the 1982 spring COMDEX show in Atlantic City, New Jersey. The unit was compatible with the IBM Personal Computer. To obtain compatibility, The IBM BIOS was reverse engineered and MS-DOS was used. The unit used an Intel 8088 microprocessor, had two 5.25-inch floppy disk drives, a 7-inch amber monitor, a detachable keyboard, weighed 28 pounds and was priced at \$4,950 (Canadian).

The Hyperion portable computer was acclaimed at the COMDEX show. It had preceded the Compaq portable computer by about six months. However, starting with the

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production release in January 1983, things did not proceed smoothly. A company reorganization resulted in Bell leaving in March. In October, Cowpland merged several of his companies into Bytec-Comterm to produce the computer. Then starting in late 1983, a large number of customer complaints were received about disk drive failures due to overheating. This resulted in a significant drop in sales and by the fall of 1984 production was terminated.

### ***Lobo Max-80***

The Lobo Max-80 computer was produced by Lobo International in Goleta, California around 1982-83. The basic configuration consisted of a Z-80B microprocessor operating at 5 MHz, 128K bytes of RAM, storage capacity of four 3.5 or 5.25-inch drives and a hard drive.

### ***NEC***

The Japanese Nippon Electric Company (NEC) introduced the PC-100 personal computer in October 1983. The computer used the Intel 8086 microprocessor with 128K bytes of RAM, expandable to 768K. The display used a full-bit mapped screen with a resolution of 512 by 720 pixels.

NEC was an early developer of portable computers. It introduced the MultiSpeed portable around 1986 that featured a multiple speed processor. In 1989, NEC introduced the UltraLite notebook type of computer. The UltraLite measured 11.75 by 8.33 by 1.4 inches, weighed 4.4 pounds and with a 1 MB silicon hard disk drive it was priced at \$2,999. The unit used the NEC V-30 microprocessor, had 640 KB of memory and a 4.25 by 8.25 inch backlit LCD could display 25 rows by 80 columns.

### ***Packard Bell***

Packard Bell Electronics, Inc. was founded in 1926 as a producer of radios. It expanded its consumer electronic products to include television during the 1970's. In the 1960's, Packard Bell produced hybrid mainframe computer systems and was purchased by Teledyne in 1968. However, it was not successful. In late 1985, Beny Alagem purchased the Packard Bell name from

Teledyne. Then in 1986, Beny Alagem, Jason Barzilay and Alex Sandel founded a personal computer company using the Packard Bell Electronics name. Packard Bell became one of the dominant companies supplying personal computers through innovative marketing and aggressive pricing. In 1988 it had attained a position of number 6 in the USA market share.

### ***Silicon Graphics***

James H. Clark, an associate professor of electrical engineering at Stanford University and six other graduate students founded Silicon Graphics, Inc. (SGI) in 1982. Clark had designed an integrated circuit chip in 1981, called the Geometry Engine, that enabled the rapid display of three-dimensional graphics. This formed the basis for SGI's introduction of the IRIS 1000 3-D terminal and the IRIS Graphics Library in November 1983 and the IRIS 1400 3-D workstation in late 1984. The workstations would range in price from \$40,000 to \$50,000. One notable use of SGI workstations was in the creation of the dinosaur graphics for the movie *Jurassic Park*.

Former Hewlett-Packard executive Edward R. McCracken joined Silicon Graphics as chief executive officer in 1984 and the company went public in 1986. A dissatisfaction with corporate management and the strategic direction of the company, resulted in Clark leaving SGI in January 1994.

### ***Sinclair***

Clive M. Sinclair began his career as a writer of periodical articles, technical manuals and books in England. He started Sinclair Radionics to produce electronic kits for amplifiers, radios and other products in July 1961. In the 1970's the company developed and released consumer products such as electronic calculators, miniature televisions and digital watches. However by the late 1970's the company encountered financial difficulties due to various product problems and an extremely competitive calculator market. Sinclair obtained government financial

assistance starting in 1976 that led to him losing control of the company.

Sinclair Research Ltd., designed and produced the ZX80, ZX81 and QL "Quantum Leap" computers.

The ZX80 computer was widely advertised as a low cost computer at a price of \$199.95 and was announced in North America in February 1980. The computer used a Zilog 8-bit Z-80A microprocessor operating at 3.25 MHz. Memory consisted of 4K bytes of ROM that contained a BASIC interpreter and 1K bytes of RAM expandable to 16K bytes. The unit had a built-in RF modulator for connection to a monochrome television set which could display 24 lines of 32 characters. An integrated plastic membrane keyboard had 40 pressure sensitive keys. A connector for connection of a cassette recorder was provided.

The ZX81 computer was built by the Timex Corporation and announced in March 1981. This computer subsequently became the Timex/Sinclair 1000 computer.

### ***Southwest Technical Products***

Southwest Technical Products released the SwTPC 6809 in 1980. It used the Motorola MC 6809 microprocessor with 8K bytes of RAM. The unit motherboard had eight 50-pin slots and eight 30-pin slots. Three boards were provided: a processor board, a programmable memory board and a serial-interface card. The unit sold for \$495 as a kit, or \$595 assembled and tested.

### ***Sun Microsystems***

Sun Microsystems, Inc. has not been known as a supplier of personal computers, it is however a dominant manufacturer of engineering and scientific workstations. Andreas Bechtolsheim, William N. Joy, Vinod Khosla and Scott G. McNealy founded the company in January 1982.

Khosla had previously helped to found a company called Daisy Systems in 1980 that provided computer-aided engineering systems (CAE). However, after a year-and-a-half with the company, Khosla left to fulfill a desire of producing a low-cost general purpose computer



for engineers and scientists that could be connected to a network. His investigation for this new computer led him to Bechtolsheim, who had developed hardware for a network at Stanford University. Khosla and Bechtolsheim then contacted financier Robert Sackman of U.S. Venture Partners who provided part of the initial financing for the founding of the new company. Khosla offered a friend Scott McNealy, who was a manufacturing manager at Onyx Computer the position of director of manufacturing operations and the status as a founder. The founders now required a specialist in the UNIX operating system used by the engineering and scientific community. This resulted in a meeting with William Joy who had been a principal in the design of Berkeley UNIX, a version of UNIX developed at the Berkeley campus of the University of California. Joy accepted an offer to join Sun and was also given founder status. Khosla became the chief executive officer.

A prototype of the first graphics workstation based on Bechtolsheim's previous design was prepared by May 1982. It was a low cost open system with networking capabilities suitable for the CAD/CAM market place. The workstation was named Sun-1, used a Motorola MC68000 microprocessor, had one megabyte of memory and incorporated the UNIX operating system. A production version called the Sun-2 was released in late 1982 that used a refinement of the Berkeley UNIX operating system called SunOS.

Khosla's management style resulted in a conflict with the Sun board and his resignation in the fall of 1984. He was succeeded by Scott McNealy as interim CEO and as permanent CEO in 1985. The Sun-3 series of workstations that used the Motorola MC68020 microprocessor, were introduced in September. This new workstation became highly successful.

During 1985, Sun introduced the slogan "The Network is the Computer." This was an extension of the concept whereby the power of a personal computer is significantly increased by a connection to a network. It also led to the concept of the low cost network computer.

In the mid 1980's, Sun started finding new sales for its workstations in the automobile manufacturing and financial trading markets. The company was doing very well, and went public in March 1986.

Sun had decided that it required a more powerful microprocessor than Motorola could provide for future networking capabilities. It therefore decided to develop its own RISC microprocessor and recruited Anant Agrawal in April 1984 to lead the design team. The new design was given the name Scalable Processor Architecture (SPARC), and was introduced in July 1987.

The success of the Sun-3 workstation resulted in Sun displacing the Apollo Computer company as the leading producer of technical workstations by 1987. In October, Sun recruited Ed Zander from Apollo Computer as a vice president of marketing. Zander became the chief operating officer and is now the second in command at Sun.

In January 1988, AT&T formed an alliance with Sun by purchasing 7.5 percent of the company, estimated to be worth \$320 million. The intent of the alliance was to merge the AT&T UNIX and Sun UNIX into one unified operating system. It was also hoped that the other major companies with UNIX systems would participate in the unification. However, they decided not to and formed the Open Software Foundation (OSF) in May 1988 to create their own unified UNIX system. The alliance was not successful and resulted in AT&T selling its investment in Sun in 1991. However, it did lead to the development of Sun's UNIX based Solaris operating system.

In 1988, Sun introduced the 386i personal computer. The *i* stood for "integrated" operating system, that contained a blend of UNIX and DOS features. However, sales were extremely poor and it was discontinued shortly after.

Sun introduced the SPARCstation 1, its first RISC technology workstation using the new SPARC microprocessor in April 1989. However, the company also reported its first quarterly loss in June. This resulted in organizational changes and layoffs.

***Texas Instruments (TI)***

For earlier microcomputer releases by Texas Instruments in the late 1970's see Section 4.7. In January 1983, Texas Instruments introduced the TI Professional computer (TIPC) for professionals and small business users. The TIPC used an Intel 8088 microprocessor with 8K bytes of ROM, 64K bytes of dynamic RAM, a single 320K byte, 5.25 inch floppy disk drive and an optional internal floppy disk drive or 10 MB hard disk drive. The TIPC architecture supported an optional speech recognition system.

Texas Instruments encountered problems with the TI-99/4 computer released in 1979 and released the TI-99/4A in the summer of 1983. This was an improved computer with more memory and a lower price.

The TI CC40 (Compact Computer 40) was a small inexpensive portable computer introduced in the early 1980's. It measured 9.2 by 5.7 by 1 inches and had a 1-line, 31 character liquid crystal display (LCD). The memory was 6.2K bytes of RAM and a TI BASIC interpreter was included with the unit which was priced at \$250.

The TI products were not successful and the company suffered significant financial losses in the highly competitive market between 1982 and 1983. This resulted in the company announcing its withdrawal from the home computer market in October 1983.

***Timex/Sinclair 1000***

The Timex/Sinclair 1000 is essentially the same as the Sinclair ZX81 computer. It was manufactured by Timex Corporation and was available in 1982 at a price of \$99.95.

***Toshiba***

The Tokyo Shibaura Electric Company, or Toshiba Corporation was formed by the merger of two large Japanese electrical equipment manufacturers in 1939. The company made significant investments in information, communication and semiconductor technology in the early 1980's. Toshiba introduced the first 1-megabit DRAM chip in 1985 and the T3100 laptop computer in 1986. Toshiba is now a leading producer of laptop computers.

### ***Victor 9000 and Sirius 1***

In 1980 Chuck Peddle left Commodore to form his own company Sirius Systems Technology to produce a 16 bit microcomputer for the business market. Prior to this he had been a principal in the design of the 6800 microprocessor at Motorola Inc., designer of the 6502 microprocessor at MOS Technology and the PET microcomputer at Commodore International Inc.

To improve the marketing capabilities for the new computer he became associated with Victor Business Products, an established producer of calculators and cash registers to form a new company Victor Technologies Inc. Victor would concentrate on the United States market and Sirius on the international market.

The design was started in December 1980 and the first prototype was shown in April 1981. Two computer products evolved from the same design, the Victor 9000 and the Sirius 1. They were essentially identical except for the industrial design.

The basic configuration used an Intel 8088 microprocessor, 16K bytes of ROM and 128K bytes of RAM expandable to 896K. The storage system had two 612K byte 5.25-inch single-sided floppy-disk drives built-in. The unit had a high-resolution (800 by 400) green-phosphor monitor.

The unit came with a choice of three keyboards which were detached and had up to 103 keys. The operating systems were MS-DOS and CP/M-86. The basic configuration was priced at \$4,495. Initially the computer was a success in both North America and Europe. However by summer of 1983 Victor Technologies was having financial difficulties and filed for bankruptcy in February 1984. Later in the year a Swedish company Datronic purchased the company.

### ***Xerox***

Xerox had acquired Shugart Associates, a disk drive manufacturer in 1977, and appointed one of its cofounders Donald J. Massaro as president of the Dallas, Texas Office Products Division in 1979. Massaro supported the Systems Development Division (SDD) and the

"Star" office automation system project. In February 1980, Massaro appointed David Liddle to head a group responsible for production of the Star computer. The computer was introduced as the 8010 "Star" Information System at the National Computer Conference (NCC) in April 1981.

The basic configuration had a Xerox developed MSI (Medium Scale Integration) processing unit that was about three times as fast as an Alto computer. The computer had 512K bytes of RAM and a 10 or 29 megabyte hard disk storage system. The display terminal had a bit-mapped 10.5 by 13.5 inch screen with a resolution of 72 pixels per inch, horizontally and vertically. Extensive research extended the graphical desktop user interface developed at PARC. New developments included overlapping windows, a menu bar and enhanced icons. A two-button mouse was used to position the cursor and for other desktop control activities. Other features incorporated were items such as a What-You-See-Is-What-You-Get (WYSIWYG) document editor that used a 16-bit character set to accommodate foreign languages and capability for distributed personal computing via an Ethernet connection. However, the cost of \$16,595, a closed system with the software only available from Xerox and a lack of a financial spreadsheet resulted in its low market acceptance.

To expand the product line, a crash project for the Xerox 820 personal computer was initiated. However the computer costs were excessive and the technology dated which resulted in its failure.

To combat the low acceptance of the Star system, Xerox initiated an improved design of the Star computer. The new design was released as the 6085 "ViewPoint" workstation in 1985. The ViewPoint workstation incorporated an improved performance MESA processor, optional IBM Personal Computer compatible processor, one megabyte of memory (expandable to 4 megabytes), 5.25 inch floppy disk drive, a 10 to 80 megabytes hard disk and an Ethernet connection. The base system initially cost \$6,340.

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PARC also developed a powerful processor called Dorado, that was at least ten times as powerful as an Alto computer.

### ***Zenith***

Zenith Data Systems (ZDS) was another manufacturer that cloned the IBM Personal Computer in the early 1980's, ZDS did this by reverse engineering the BIOS software chip similar to that done by Compaq.

ZDS was also an early manufacturer of portable computers for the U.S.A. government. The Zenith MiniSport was an early lightweight that measured 12.5 by 9.8 by 1.33 inches and weighed 5.9 pounds. It used an Intel 80C88 processor, had 640 KB of RAM, a 2.5-inch 720 KB floppy disk drive and an 8.5 by 3.25 inch backlit transfective display.

The Bull company purchased ZDS in 1989.

### ***Other Companies***

Excaliber Technologies was founded in 1980 to produce a computer called Powerstation that was designed for executives. Dennis Barnhart founded Eagle Computer in November 1981 to produce personal computers. The Aquarius computer was announced by Mattel in January 1983. Coleco Industries, a toy and video-game manufacturer introduced the Adam home computer that included a letter-quality printer with a low price of \$599 in June 1983. Convergent Technologies announced a three pound portable computer called Workslate with a built-in spreadsheet in late 1983. Many other companies entered the personal computer market during the 1980's such as Morrow's Micro Decisions.