Chapter 5 Apple Computer in the 1970's

Among the early entrepreneurial microcomputer companies, Apple Computer was an exception. Incorporated two years after the introduction of the MITS Altair computer, it became a dominant commercial success as compared to many other companies formed during that period. The company's initial product, the Apple II, facilitated the change from the hobbyist or technical hacker to the personal "appliance" user in the mass consumer market. The financial initiative of Mike Markkula enabled the aspirations of the two principal founders of company. Steven Jobs provided the entrepreneurial energy that complemented the innovative technical skills of Stephen Wozniak.

5.1 ... Wozniak/Jobs Early Years

Stephen Gary Wozniak was born on the 11th of August 1950 in San Jose, California. He was the first of two sons of three children of Jerry and Margaret Wozniak. The father was an electrical engineer and the mother was active in local politics.

Wozniak had an early interest in electronics and obtained his amateur radio (Ham) license in the sixth grade. He also designed and built electronic projects for his Homestead High School science fairs. One project named "A Parallel Digital Computer" received awards at the Cupertino School District Science Fair and the Bay Area Science Fair. Wozniak was also the president of the Electronics Club and secretary-treasurer of the Mathematics Club at high-school. Through Wozniak's high-school electronics teacher, he became a frequent visitor to the GTE Sylvania computer facility. For one year he and a friend Allen Baum would write FORTRAN programs for the IBM 1130 computer and get familiar with its technology. They also visited the Stanford Linear Accelerator Center's (SLAC) computer facility that had an IBM System/360 computer. Access to the SLAC library became a valued source for information on computer technology.

Wozniak enrolled at the University Of Colorado in Boulder in 1968. He now had access to the university computer and wrote programs in FORTRAN and ALGOL. However the year was a failure academically, so the next year he enrolled at the local De Anza Community College.

Wozniak and Allen Baum had been delving into the intricacies of Data General Nova computers. The analysis progressed to the design of their own versions of the computer. In 1969 Wozniak decided to build his own computer and enlisted the help of his neighbor and friend Bill Fernandez. They scavenged parts from surplus stores, Fairchild, Intel, Signetics and Hewlett-Packard. Wozniak worked on the logic design and Fernandez on the timing circuits and power supply. They called the machine the "Cream Soda Computer" on account of the amount of the drink they consumed during its construction.

Steven Paul Jobs was born on the 24th of February 1955 in San Francisco, California. He was the first of two adopted children of Paul and Clara Jobs. The father had several occupations such as machinist, finance company representative and real estate salesman. His mother had also worked at a number of jobs, including part-time in the payroll department at Varian Associates.

Jobs became interested in electronics during his elementary school years. At the age of twelve, a neighbor who worked at Hewlett-Packard, would take Jobs to visit the company and expose him to its technology. Through his interest in electronics Jobs obtained a summer job at Hewlett-Packard by calling one of the founders Bill Hewlett. He also obtained a part-time job at a surplus electronic parts retailer called Haltek. His familiarity with the parts enabled him to buy and sell parts to Haltek for a profit. Although Jobs had an interest in electronics, his expertise would tend to the commercial rather than the technical aspects. Bill Fernandez introduced Jobs to Wozniak in 1969. This was the beginning of the association and friendship between Jobs and Wozniak.

In 1971, Wozniak moved to Berkeley and enrolled at the University of California, Berkeley campus. About the same time, an article entitled "Secrets of the Little Blue Box" was published in the October 1971 issue of *Esquire* magazine, that initiated an interest by Wozniak and Jobs in telephone hacking. University library texts on phone systems and the infamous phone hacker John Draper, also known as "Captain Crunch" provided additional details. Wozniak developed a digital design to generate the audio tones required to place and route calls in the phone system. They incorporated the design components into a compact box and used it to hack the phone systems of North America and the world in early 1972. Jobs convinced Wozniak to sell the "blue boxes" to other hackers at prices varying from $80 to $300. However Draper's conviction in 1972 of phone fraud charges tempered the commercial activities of Jobs and Wozniak.

Wozniak joined Hewlett-Packard as an associate engineer in 1973. His first assignment was to work on refinements to the HP 35 calculator. It was during this period that Wozniak's interest in flying light aircraft developed.

On completion of high-school in 1972, Jobs enrolled at Reed College in Portland, Oregon. It is at Reed College that Jobs began Bohemian associations, an interest in Eastern mysticism and meditative religions such as Zen Buddhism. These associations and interests adversely affected his academic studies. Jobs left Reed College and started working for Atari engineering on their video games in early 1974. Jobs combined an Atari business trip to Europe with a personal mystic excursion to India. On his return from India he combined a Bohemian lifestyle, a renewed interest in Zen Buddhism and his association with Atari.

Wozniak attended the first meeting of what became the Homebrew Computer Club in March 1975 with Allen Baum. The meetings were an important forum for Wozniak to exchange information on the latest microcomputer technology. Jobs also attended a few of the club meetings with Wozniak. It was at the Homebrew Computer

Club that Wozniak met Chris Espinosa and Randy Wigginton who would later become employees of Apple Computer.

In mid 1975, Alex Kamradt enlisted the help of Wozniak to develop a convenient video terminal with a keyboard to replace the cumbersome Teletype terminals. Kamradt was the founder of Call Computer, a time-sharing company in Mountain View, California. Kamradt and Wozniak formed a subsidiary of Call Computer named Computer Converser. Kamradt provided the financing and Wozniak was to develop the design. Kamradt arranged for Jobs to run the business and develop the terminal for manufacture. The intent was for the initial terminal to evolve at a later stage into a computer. Wozniak designed and built a terminal, but he lost interest and withdrew from the project.

5.2 ... Apple I Board

During 1975 a number of factors occurred which motivated Wozniak to design a microcomputer. Hewlett-Packard was offering employees a large discount on the Motorola MC6800 microprocessor and related chips. Wozniak also had the experience of designing the Cream Soda Computer and the Computer Conserver terminal. Then the technology exposure and enthusiasm generated by the Homebrew Computer Club provided the synergy that resulted in a new microcomputer design by Wozniak. It would be an enhancement of the Computer Conserver terminal incorporating the MC6800 microprocessor.

Wozniak and Baum changed the design concept after attending the WESCON trade show in September 1975. Wozniak purchased a MOS Technology 6502 microprocessor that was a derivative of the Motorola MC6800 and only cost $25. The significantly lower cost compared to either the Motorola or Intel 8-bit microprocessors, resulted in Wozniak changing the microprocessor for his new design. He also decided to use dynamic rather than static memory chips. Prior to building the hardware Wozniak decided to write a version of BASIC for his new microcomputer. The number of changes required to convert the microcomputer design to the MOS 6502 microprocessor

were minimal. Wozniak completed the computer board and interfaced it with his video terminal and keyboard in March 1976

Wozniak had discussions with Hewlett-Packard to determine their interest in producing a microcomputer. The company declined and provided Wozniak with a legal release. They advised him that "HP doesn't want to be in that kind of market."

Wozniak demonstrated the computer board at the Homebrew Computer Club in April. However the members did not have much enthusiasm for the board. Applications using the Intel 8080 microprocessor had greater popularity. Wozniak also handed out schematics of the microcomputer design at the club meetings.

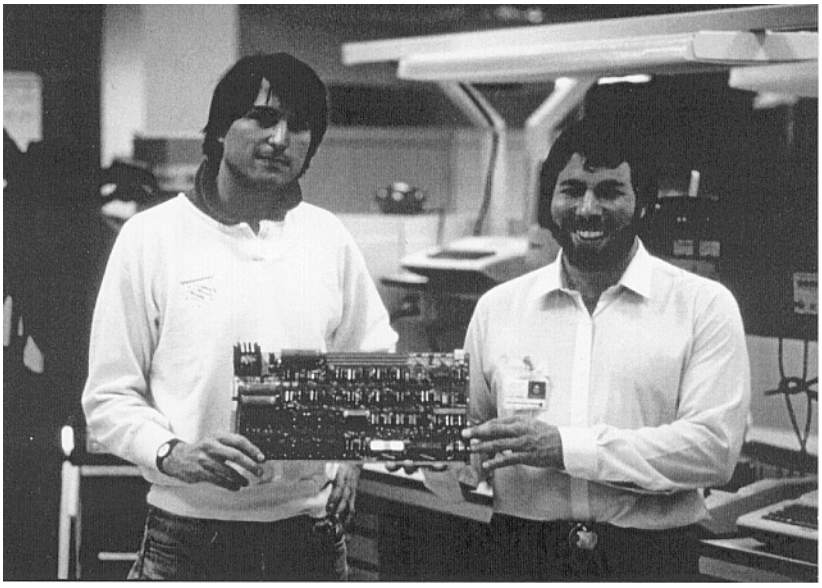

Figure 5.1: Steven P. Jobs and Stephen G. Wozniak holding an Apple I board – a 10 year anniversary photograph.

Photograph is courtesy of Apple Computer, Inc.

In early 1976 Jobs convinced Wozniak that they should try and sell the microcomputer boards. The initial concept was that they would sell only a bare printed circuit board to friends, a few stores and to members of the Homebrew Computer Club. The customer would then purchase the components and insert them into the board to complete the microcomputer. To pay for the boards Wozniak sold his Hewlett-Packard calculator and Jobs his Volkswagen van.

Jobs and Wozniak decided to form a partnership and formalized it by placing an advertisement in a local newspaper. The advertisement required a name for the company and at Jobs suggestion they selected Apple Computer Company. Jobs obtained the services of Ron Wayne who was a field service engineer at Atari to draw the schematics of the board and design a motif for the company. Jobs also used Wayne to convince Wozniak of the commercial potential of the company. Jobs, Wozniak and Wayne signed a partnership agreement in April 1976. Jobs and Wozniak split ninety percent of the company and Wayne received the remaining ten percent. Wozniak would be responsible for engineering, Jobs for marketing and engineering and Wayne for documentation and mechanical engineering.

Apple Computer now called the microcomputer the Apple I. It included the MOS 6502 microprocessor, 256 bytes of ROM, 8K bytes of RAM and a partial power supply. Interface connectors provided for video output, a keyboard and an external card to connect a cassette recorder. The Apple I had no graphics or color, and no speaker. The video was 24 rows of 40 characters stored in shift registers and displayed at 60 characters per second. The program in ROM was a small monitor routine that enabled the input or output display of memory and a capability to start a program at a particular address. The BASIC interpreter required 4K bytes of memory, leaving 4K bytes for user programs.

Following the club demonstrations Jobs contacted Paul Terrell, the founder of Byte Shop's regarding the possible sale of the Apple I boards in his stores. Terrell agreed to purchase fifty boards with the component parts assembled on the board. He agreed to pay

about $500 per board with cash on delivery. This was a significant breakthrough for Apple Computer. However it required extensive efforts by Jobs to arrange the procurement of parts with a "net 30 days credit." He also arranged to borrow $5,000 from Allen Baum and his father. Assembly of the boards was at Jobs parents home using his sister to insert the components on the boards. They then delivered the assembled boards to Terrell around July and received the cash as promised.

Jobs arranged for a mail-drop box and an answering service to give a proper company image. Jobs now hired his friend Bill Fernandez who became Apple's first employee. Jobs moved the assembly of a second batch of fifty boards from the home bedroom to the garage. With pressure from Terrell at Byte Shop's, Wozniak developed a small board for a cassette interface to facilitate the input of the BASIC interpreter software. The interface board with Wozniak's BASIC interpreter sold for $75. After input from the Homebrew Computer Club, Jobs and Wozniak established a price of $666.66 for the microcomputer board. Ron Wayne became concerned about his potential financial obligations to the company and terminated his share of the partnership in the summer of 1976. Jobs now arranged financing for a second batch of computer boards.

Wozniak started adding a number of improvements to the Apple microcomputer during 1976. A key improvement would be the addition of color capabilities. Cromemco had demonstrated color displays with their "Dazzler" machine at the Homebrew Computer Club. Innovative changes to the Apple I memory and video circuits provided for color with fewer chips and lower cost. Wozniak also wanted his computer to be capable of playing a game called Breakout that he and Jobs had developed for Atari. This resulted in circuits being added for game paddles and sound.

In August 1976 Jobs and Wozniak attended the Personal Computing 76 show in Atlantic City, New Jersey to demonstrate the Apple I board and the prototype of their improved design. Stan Veit of the New York Computer Mart retail store had agreed to provide them with space at his booth. Processor Technology

demonstrated their new SOL microcomputer with its integrated keyboard and attractive enclosure at the Personal Computing Fair. The company also started advertising the Apple I board in *Dr. Dobb's Journal* and the September 1976 issue of *Interface Age*.

It was obvious to Jobs that the current prototype would require additional improvements to compete commercially. Consequently they decided to design a unit with an attractive case, built-in power supply and integrated keyboard. Wozniak also wanted to add expansion slots to facilitate expansion of the computer's capability. An expanded ROM had the Apple BASIC programming language and additional routines for items such as an improved video display, cassette recorder and a disassembler.

Wozniak had concentrated on the digital aspects of the computer and did not have a power supply to complete an integrated design. Jobs contacted Al Acorn, the chief engineer at Atari who recommended Rod Holt. Jobs wanted a power supply design that did not require a cooling fan. The computer would then be silent in operation compared to the competitors with their somewhat noisy fans. Apple hired Holt on a consulting basis to design the power supply.

In October 1976, Commodore International expressed an interest in the purchase of the Apple Computer Company. Commodore had just purchased MOS Technology and was planning to enter the microcomputer market. However the price of $100,000 and other conditions set by Jobs were not acceptable to Commodore. Apple Computer showed the new Apple computer to Stan Veit of the New York Computer Mart during a trip to the West Coast. Jobs offered Veit 10 percent of Apple Computer for an investment of $10,000. However Veit required all his available capital for his own store and rejected the offer.

5.3 ... Founding of Apple Computer

In June 1976, Jobs had contacted the advertising and public relations company founded by Regis McKenna. The company had Intel as a client and Jobs liked the unique advertising that the McKenna agency provided. The agency also handled the marketing activities for Paul Terrell's Byte Shop's and Atari. After discussions with Jobs, McKenna agreed to handle the Apple Computer Company.

Apple did not have the funds required for marketing and future development. In August, Nolan K. Bushnell of Atari advised Jobs to contact a venture capitalist Donald T. Valentine of Sequoia Capital, who in turn recommended A. C. "Mike" Markkula. Markkula was in his early thirties, a retired multi-millionaire from Intel. Markkula decided to finance Apple Computer by investing $91,000 of his own money and arranging and guaranteeing a $250,00 line of credit with the Bank of America. Markkula, Jobs and Wozniak had equal one-third shares of the business and Rod Holt received a small percentage. Markkula however insisted that Wozniak leave Hewlett-Packard and join Apple full time. The participants in the founding were the two initial Apple partners, Jobs and Wozniak, Holt the power supply designer and Markkula the financier. They founded the Apple Computer, Inc., in January 1977 and purchased the previous Apple Computer Company partnership in March.

To run the company Markkula selected Michael M. Scott who was an associate from his days at Fairchild Semiconductor. Markkula hired Scott as president of the company. He was an engineer who had worked at Beckman Instrument Systems, Fairchild Semiconductor and was director of National Semiconductor's manufacturing line. With the founding of the new company, Markkula had operations moved from the Jobs family garage to a building in Cupertino, California.

5.4 ... Apple II

The company decided to use the Apple II model designation for the improved prototype. They also decided to introduce the Apple II computer at the First West Coast Computer Faire. Jim Warren had scheduled the Faire for April 1977 at the Civic Auditorium in San Francisco, California. Apple also decided to develop a new logo to replace the original partnership motif. The Regis McKenna agency worked on a new design and developed the striped apple with six colors and a bite removed on the side.

Jobs was determined to have an attractive housing for the Apple II. A Hewlett-Packard designer Jerrold C. Manock had agreed to design the plastic case. The housing incorporated a 53-key Teletype-style keyboard. Holt had developed a digital design for the power supply. The unit was smaller, lighter and generated less heat than conventional power supplies. Once again Jobs obtained the services of Howard Cantin, an associate from Atari who had done the Apple I board, to do the artwork for the new motherboard. Wozniak had decided on eight 50 pin expansion slots. He also adjusted the BASIC interpreter to fit within the limitations of the ROM memory.

The computer used a MOS 6502 microprocessor and 4K bytes of dynamic RAM, expandable to 48K. The video system could display 24 rows of 40 characters in upper case only. The unit included an audio cassette interface and four analog game paddle inputs. Customers used their own TV sets as monitors by using a radio frequency modulator and stored programs on audio cassettes.

The ROM incorporated the system monitor program, utility routines and an Apple BASIC interpreter that also became known as Integer BASIC. Allen Baum, Chris Espinosa and Randy Wigginton assisted Wozniak in the software development.

Apple had a prime location at the front of the Faire hall due to an early commitment by Jobs. Markkula organized an attractive booth with a backdrop displaying the new company logo. Apple displayed all three of the

only assembled computers with a large screen monitor for program demonstration. The Faire was a tremendous success with about thirteen thousand people attending. Apple received orders for about three hundred Apple II computers within a few weeks.

Markkula with the assistance of a consultant had developed a business plan. Michael Scott started hiring personnel for accounting, engineering, production and sales. He subcontracted anything that Apple could not produce at lower cost. Quality problems with the case resulted in the purchase of new mold tooling.

Some Apple II boards shipped around May 1977 and the Apple II computer was available to the general public by June at a price of $1,298. The company offered Apple I board owners the option of upgrading to the new Apple II computer. Apple sold about seven thousand Apple II's by the end of 1977.

Figure 5.2: Apple II computer, monitor and two disk drives.

Photograph is courtesy of Apple Computer, Inc.

An extended BASIC interpreter called Applesoft also became available. Apple had purchased a license in August 1977 for Microsoft BASIC that included functions for doing floating-point mathematics. Randy Wigginton then made changes to adapt the interpreter for the Apple II. This resulted in the hybrid product with the name of Applesoft I that was released in November. Loaded from a tape recorder, it required 16K bytes of memory. Then in the spring of 1978, Wigginton made improvements to the interpreter that was released as Applesoft II.

5.5 ... Apple Disk II Drive

Apple was under pressure from dealers and customers to develop an alternative to the slow and at times unreliable cassette tape storage system. Wozniak started evaluating the floppy disk drive controller technology of IBM, North Star Computers and Shugart Associates in late 1977. Jobs was also contacting Shugart who were one of the first manufacturers of minifloppy disk drives for the microcomputer market.

The electronic circuit design developed by Wozniak for the floppy disk-controller card was an innovative design using a minimum number of components. Shugart manufactured the 5.25-inch disk drive. The disk had 35 tracks with thirteen 256 byte sectors on each track. It had a storage capacity of 116K bytes per disk. Apple also released an operating system developed by Randy Wigginton and Wozniak called DOS 3.1.

The company introduced an early version of the disk drive at the Las Vegas, Consumer Electronics Show in January 1978. The final design of the Apple Disk II drive was released in June. The drive, controller card and DOS 3.1 operating system cost $495 at introduction. Apple had released the lowest priced floppy disk drive system offered by a microcomputer manufacturer. The Apple Disk II drive was a success and had a direct impact on further improvements to computer sales.

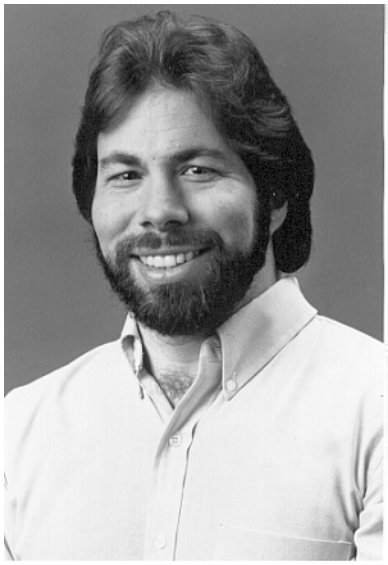

Fig. 5.3: Steven P. Jobs. Fig. 5.4: Stephen G. Wozniak.

Figure 5.5: A.C. (Mike) Markkula, Jr.

Photographs are courtesy of Apple Computer, Inc.

5.6 ... 1978/79 Activities

In January 1978 Apple obtained additional financial investment from venture capitalists Arthur Rock, Donald Valentine's Sequoia Capital and Venrock Associates. During 1978 the Apple II computer sales were overwhelming and an order backlog developed. Apple increased staff and by the summer of 1978 the company had about 60 employees. Chuck Peddle, formerly of MOS Technology and Commodore joined Apple during the summer of 1978. However differences between Apple and Peddle led to him returning to Commodore at the end of 1978. During 1978, Henry E. Singleton the chairman of Teledyne Inc., and a friend of Arthur Rock made a significant investment in Apple stock and became a company director. Apple sales for 1978 were 7.8 million dollars.

During 1978 the necessity of developing models to follow the Apple II became evident. This started the development of an interim model that became the Apple II Plus. Apple also started a project for a new computer with the code name of "Sara" in late 1978, that would become the Apple III. The success of the Apple Disk II led to delivery problems with the disk drive supplier. Apple established a second supplier called Alps Electric Company of Japan. It also resulted in a project with the code name of Twiggy for Apple to develop and produce a new floppy-disk drive. Apple named the drive Twiggy because of its thin design (a name associated with a female model of that era).

Apple introduced the Apple II Plus in June 1979 with a unit cost of $1,195. It had 48K bytes of memory, a new ROM with Applesoft Extended BASIC, an auto-start for easier startup and screen editing. Apple also introduced its first printer, the Silentype in June. Then they introduced a word processing program called Apple Writer 1.0 followed by the release of the Apple II Pascal programming language in August.

Personal Software, Inc., released the VisiCalc spreadsheet software developed by Dan Bricklin and Bob Frankston in October 1979. This program was only

available for the Apple II initially and had a very significant impact on increasing computer sales.

Lisa Project

During 1979 Apple was looking at the development of a new product that would utilize the latest technology and target the office market. The Apple II product line would focus on the home and school user and the Apple III computer on the small business user.

The project had the code name of "Lisa." Writers have attributed the code name to a manager's daughter or to the name of Jobs alleged daughter. Apple based the new computer design on a 16-bit architecture using a new Motorola MC68000 microprocessor. The project plan targeted the computer as a $2,000 system to be shipped in 1981. Jobs wanted a movable keyboard to provide a more comfortable means of input. Ken Rothmueller was in charge of engineering and John D. Couch headed software development. Bill Atkinson who was a senior programmer was working on a bit-mapped graphics system for the new computer.

In the summer of 1979 a coincidence of interests developed between Xerox Corporation and Apple Computer. Xerox wanted the marketing/production expertise of Apple in the personal computer consumer market. Xerox was considering the possible introduction of a new computer product to implement the technology they had created at the Palo Alto Research Center (PARC) in California. Apple Computer was arranging additional financing and had an interest in the possible implementation of the new Xerox technology. This resulted in Xerox Corporation investing one million dollars in the shares of Apple Computer. Another factor was that Jef Raskin wanted Jobs to visit PARC and improve his understanding of graphic user interface concepts that Raskin had implemented on the Macintosh project. Lawrence "Larry" G. Tesler provided demonstrations of the Xerox systems to Atkinson, Couch, Jobs, Rothmueller and other Apple personnel in November and December of 1979.

The Xerox concept of a computer "desktop," graphical interface and the use of a mouse was the new vision of computer technology that Jobs had been

searching for. Apple immediately changed the Lisa project to incorporate various Xerox technological concepts. Apple also decided to create a set of application programs for Lisa and to develop the software within the company.

Macintosh

In early 1979 Jef Raskin proposed a concept for an inexpensive computer for the masses. A "desktop appliance" with the screen, keyboard, storage, printer and all the software built-in. There would be no peripheral expansion slots. Raskin wanted to develop both the hardware design and the software together with the objective of creating a simple user friendly interface. He wanted to incorporate some aspects of the PARC graphics technology in a portable configuration that would sell for a price targeted at about $995. Raskin named the computer Macintosh. Although the name is similar to the McIntosh apple, he intentionally changed it to avoid a potential conflict with a high-fidelity audio equipment manufacturer called McIntosh Laboratories. Jobs opposed the new computer proposal. However Raskin received board approval to continue the research project in September 1979.

The design configuration changed as the interplay between Raskin's initial objectives and pricing constraints occurred. Principals in the initial computer design were Brian Howard and Burrell C. Smith. By late 1979 the design configuration had evolved to include the Motorola M6809E microprocessor, 32K bytes of ROM and 64K bytes of user memory. The video system had changed from using a television to a 7-inch built-in bit-mapped screen with a 256 by 256 pixel resolution that could display 25 lines with an average of over 80 characters per line.

Conclusion

Other companies such as Atari, Commodore, Radio Shack and Texas Instruments provided competing computers in a rapidly expanding market. However Apple computer sales had increased from about seven thousand units in the 1977 founding year, to an annual rate of 35,000 in December 1979. For the 1979 fiscal year, the company had net sales of 47.9 million dollars and employed 900 people. The combination of an easy to use color system, the Apple Disk II drive and the VisiCalc spreadsheet software gave Apple a significant advantage. Apple Computer, Inc. was now the dominant supplier of personal computers.

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