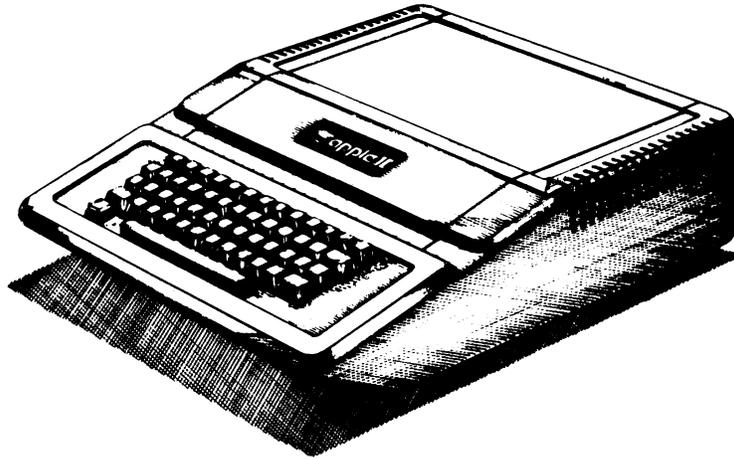




# Apple 2 Computer Family Technical Information



## History of Computer Design The Apple 2 Computer Family

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Apple I  
Apple II  
Apple III  
Apple IIc  
Apple IIgs

# Welcome!

Apple and the History of Personal Computer Design

I'm Ed Tracy, a graduate student at the Institute for the History and Philosophy of Science and Technology at the University of Toronto. This web page is part of a course I took in 1997-8 through the Department of History at U of T, Topics in Material Culture (HIS 1543Y). It was designed for a specific academic setting and its use is intended to remain limited. For such a restricted project, sorting out amorphous net-copyright issues seemed both pedantic and hopelessly unproductive (though I did request permissions, I received no response). Many of the images of computers here were taken from other web sites, acknowledged only in the image sources. So, images as well as text must remain read-only -- use of this site or of any of its content without permission is prohibited.

If you have any suggestions, please write me!

The microcomputer has quickly taken up a large place in daily lives, having gone from a novelty, hobby item to a routinely used tool in less than 20 years. The design of a machine expresses the intended relationship of the user to its functions, a relationship with strong emotional content and corresponding values. Computers are regarded with some ambivalence by most, being sources of frustration and anxiety as well as pride and fascination. Developments in computer technology are common knowledge, though changes are frequent, often little understood, and usually have very little impact on the work of most people. Clearly, computers are regarded as more than tools - these machines encourage a great expenditure of time and money for very little change in productivity. They are objects of desire, subject even to brand allegiance and snobbery. This attraction and attachment to particular computers is most vividly seen for Apple products. A sense of community is often shared by those who own, or even just use, an Apple computer, inciting frequent comparisons to a religious cult.

This web page is dedicated to the study of the personal computer as a cultural artifact rather than simply as a tool or technological accomplishment. Our proximity to and increasing reliance on computers has made it difficult to regard them as material culture. My project is to examine microcomputers, and in particular the products of Apple Computer in the 1980s, as objects developing within a social as well as technological context.

# History of computer design: Apple I



Steve Wozniak's design for the first Apple computer exemplified the elegance in circuitry towards which computer hobbyists aspired. Working in part at the informal Homebrew Computer Club in Palo Alto, California, Wozniak crafted a single circuitboard regarded by fellow hobbyists as "a beautiful work of art" (Levy, 81). His computer comprehensively integrated a version of Motorola's new 6800 processor instead of the far more common 8080 from Intel, a choice originally based on price (Carlton, 38). Wozniak's friend Steve Jobs insisted that they start a company to sell these machines, and Apple Computer was created in April 1976. At \$666.66 each, the Apple I computers sales gradually increased, attracting the attention of investor Armas Clifford (Mike) Markkula. Apple incorporated on January 3, 1977 and moved to a separate building from the makeshift workshop in the garage of Jobs' parents' home (Carlton, 9-10).

The Apple I did not require the assembly of computer kits, but also did not come in a case. Building an enclosure was an opportunity for the self-expression of the user who appreciated but could not equal the elegance of Wozniak's electronics design. This expression varied considerably, "from

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simple pine boxes and polished cherrywood containers with integrated keyboards to rugged brushed aluminum and black metal boxes with rivets on the sides, which evinced a high-tech look. One owner even installed his Apple I inside a leather briefcase, with the circuitboard in the top, a keyboard bolted to the bottom and a lamp cord trailing out the back, creating the first laptop computer." No standard appearance had developed for a microcomputer, and large business computers, generally impersonal cabinets enclosed in dark sheet metal, did not provide an obvious model (Kunkel, 12-3). A personal computer was more than an oxymoron; it was inconceivable to many even in the mainframe computer industry - a variously identified executive at Hewlett-Packard reportedly rejected Wozniak's offer of the Apple I design, saying that people would not want computers on their desks at home (Butcher, 63). The appearance of the early personal computer could be shaped by an individual owner with few preconceptions.

# History of computer design: Apple II



Steve Jobs believed that appearance guided a user's approach to a computer, and as Steve Wozniak improved the design of the Apple for its next version, Jobs concentrated on the case. The Apple II was advertised as a "complete, ready to use computer, " and had an integrated keyboard with ports for a separate colour display and a cassette recorder for data storage. Marketed towards consumers rather than computing hobbyists, the Apple II was introduced with an advertisement illustrating a scene in a kitchen, a man resting his hand familiarly on his computer as it displays a chart of the stock exchange, and a woman in the background smiling towards him from her own work at the sink. Technical details are isolated to a single column that tersely reveals that the Apple II is also available "in board-only form for the do-it-yourself hobbyist" (Apple ad in Byte, Jan. 1978). This was an entirely novel repositioning of the computer towards the general public, with a promise that computing could be easy, fun and productive. Jobs insisted that the design of the case reflect this new audience.

Wanting the Apple II to be what would later be described as an "appliance" computer (Helmets, 18), Jobs looked for inspiration among household appliances at Macy's department store before hiring Jerry Manock, an industrial designer. Manock describes the shape of the Apple II case as having been "dictated by the size of the circuitboard and the keyboard that fits into a wedge on the front. It had to be tall enough for expansion cards to be slotted vertically onto the motherboard and have enough interior space to dissipate heat thrown off by the power supply" (Kunkel, 13-4). Jobs and Wozniak conflicted over using expansion slots for additional customized circuitboards, Jobs believing that they were inappropriate for a consumer market which would not be comfortable altering circuitry. Wozniak's desire for expandability prevailed and the height of the Apple II case reflects its eight expansion slots. However, the necessary removable lid does not interfere with the simple integrity of the design. The wedge of the keyboard at the front of the machine is angled downwards so to facilitate typing, and angled more sharply inwards towards its bottom at the base of the keyboard. Above the keyboard, a narrow trench in the wedge visually isolates the interactive front of the machine, and at the left of the portion of the wedge above it there are two chocolate-brown badges with Apple's logo and the model name of the computer to help reinforce its unique physical identity. The rectangular back portion of the case has short vertical vents that wrap around the sides, over chamfered corners, to extend slightly onto the top of the case. This wedge of the keyboard, the vents wrapping around the corners of the sides, and the 45-

degree chamfers on each corner all result in a case that appears smaller and less boxy.

Though constructed with enough space to satisfy the expansionist desires of most hobbyists, the Apple II case presents a closed face to the user, an appearance of integrity that is strengthened when a monitor is placed on the top of the long rectangular back to leave only the front wedge exposed. It suggests a self-contained appliance and not simply a protective enclosure for electronics intended for manipulation. However, at the time of its introduction, its identity as an appliance was generated most strongly by the material of the case. The Apple II was the first computer to be enclosed in plastic. Sheet metal enclosures were cheaper to manufacture and provided better shielding for the electromagnetic radiation generated by circuitry, but Steve Jobs insisted that molded plastic was essential to the computer as a consumer item. The desired effect was evidently achieved. A review in the popular "small systems journal" *Byte*, then marketed towards computing hobbyists, called it "elegantly styled" and compared it to an "overgrown pocket calculator" (Helmert, 20).

Though thought impressive on its introduction, the plastic of the initial Apple II case was quite crudely constructed. To fit a tiny budget and tight deadline - Jerry Manock was hired only nine weeks before the West Coast Computer Faire in April 1977 where the Apple II was introduced - reaction-injection molding was used. This process is fast and inexpensive to set up, but leaves surface irregularities. Many case parts had to be sanded to fit together properly. Moreover, the light brown paint chosen did not adhere well to the polyurethane, so that surviving cases from early production inevitably have flakes revealing the lighter colour of the plastic below. By December 1977, tooling was completed for cases made out of the more durable and smooth ABS (acrylonitrile-butadiene-styrene) plastic which did not require painting or finishing and could be produced in larger volume (Kunkel, 15).

Large-scale production was quickly needed. Apple's ads attracted a far larger audience than previous mass-produced computers, and the development of software increased demand for the machine. In particular, *VisiCalc*, the first commercially successful spreadsheet program, was a "killer application," helping to increase sales of the Apple II from \$770 000 in 1977 to \$7.9 million in 1978 (Kunkel, 15). In early 1978, Apple offered an external disk drive at a lower price than any previous, solidifying the position of the Apple II as a computer for those interested in the functionality of software rather than tinkering with electronics. By August of 1978, the Apple II could be advertised quite honestly as "the world's best selling personal computer" (Apple ad in *Byte*, August 1978, p. 14-15).

# History of computer design: Apple III



Apple had reached outside of the small number of hobbyists on which other companies focused to attract the growing home and school markets. At the same time, the Apple II remained the most popular hobby computer because of its open architecture - "an entire subindustry" emerged to add functionality to the Apple II via its many expansion ports (Moore, 68). To add to its great success, Apple began designing a computer specifically for businesses in 1978. Unlike Wozniak's Apple II, the Apple III was designed by committee, features continually being added by the many engineers and marketers involved. Apparently no one doubted the machines' success. One engineer, Richard Jordan, recalled the atmosphere around the Apple III design, saying, "As Apple's stock price took off, we all felt like geniuses, even though most of us had nothing to do with the Apple II . . . Pretty soon, we figured that it was impossible for us to fail, no matter what we did" (Kunkel, 16). When the Apple III belatedly appeared in September 1980, it failed, not just commercially, but literally. With too many components causing electrical shorts, it reportedly had a nearly 100% failure rate (Smarte, 381).

The failure of the Apple III began with the design of its case. Jerry Manock and a contracted industrial designer, Dean Hovey, completed the basic design for the case before its circuitry was complete. Late changes made by another Apple designer, Bill Dresselhaus, would be superficial, so that the design of the electronics was shaped by an existing form. This illustrates the then unique importance placed by Apple on the physical appearance of its machines; Apple valued case design enough to contradict the practice of the hobby market from which it had emerged by subordinating the elegance of electronics to that of its enclosure. FCC guidelines for electromagnetic shielding not yet available, Manock and Hovey designed an aluminum chassis for the interior of the case, using space requirements initially given by engineers. As features grew, this chassis, already cast, became increasingly crowded. Steve Jobs insisted, as he had done with the Apple II, that the Apple III be an appliance. To Jobs, this meant that there would be no fan to dissipate the heat generated from its densely packed components; he considered the noise of

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a fan to be industrial and "inelegant" (Kunkel, 16). Though the Apple III design was improved in 1981 and again in 1983, when it was renamed the Apple III+, it sold very poorly and was finally discontinued in 1985.

Though it ironically led to its own failure through its perceived importance, the Apple III case successfully expresses the adaptation of the Apple II style to a business environment. The keyboard appears as a separate unit in front of the computer itself. This separation would quickly emerge as a standard characteristic for computers designed for business. Without the integrated keyboard, the Apple III seems more boxy than the Apple II, but it is also not as long. Its front bezel is angled up towards the user, elevated about the keyboard in a gesture that facilitates and encourages interaction with its integrated floppy drive. The corners on both the computer and the keyboard share the 45-degree chamfers that Manock had used for the Apple II, and the same placement of the name badge and identical beige plastic help reinforce the impression that the Apple III is a less frivolous but close relative to its predecessor.

# History of computer design: Apple IIc



The Apple IIc was introduced along with the Macintosh in January 1984. To assure customers that the older technology would not be discarded in the Macintosh revolution, banners at its introduction proclaimed "Apple II forever" (Levy, 223-4), and advertisements promised "our newest brainchild is certainly not an orphan." Apple used the established position of the Apple II in this ad, calling the IIe "the granddaddy of the whole personal computer industry," but its new Apple IIc was clearly rapidly aging technology (Apple ad in Byte, Aug. 1984, p. 0-1). Enthusiasm was revitalized through industrial design, a revolution in appearance alongside the Mac's revolution in function that would not fully extend to the Macintosh itself for nearly three years.

The initial design for the IIc began before the development of Snow White by the Apple designer Rob Gemmell. Work on the machine began in December 1983 when Jobs saw Toshiba's first portable PC and agreed that Gemmell should follow a portable Apple II concept that he had long suggested. Though portable, with a handle on its back that also folds down to tilt the keyboard into a comfortable typing position, the Apple IIc does not have an integrated display and can be considered a direct descendent of the previous Apple II design. With the handle elevating the back, it tilts to the same angle as the original Apple II keyboard, and it has a similar inwards slope towards its base from the bottom of the keyboard. However, the Apple IIc is otherwise remarkably different. The playful pet-like appearance and unnecessary detailing are absent, and the familiar wedge extending out from the otherwise boxy enclosure is replaced by a simple nearly square form. This does not give a bulky appearance, though, but only emphasizes its small size: 12" long, 11.25" wide and only 2.25" high. This tablet-like shape precludes any internal expansion slots, but the IIc is as powerful as the Apple IIe, and even additionally has an integrated disk drive on its right side.

Esslinger's designers did not alter Gemmell's IIc until after tooling had already begun, so it does not have a zero-draft enclosure. In every other way, though, it is the fullest embodiment of the language, reverently still called by frogdesign "Snow White pure." Apple even agreed to engineer a new keyboard for the machine, at a cost of \$200 000, to include a 2 mm radial curve around it. The front of the unit containing the keyboard is slightly recessed, isolating the interactive front of the machine, but there is also a thin line

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around the disk lever to make it visually apparent. Vents are hidden within Snow White lines on the back portion. The Apple logo on the left is balanced with the model name on the right at the back from these lines, while the front setback in behind the keyboard similarly balances three buttons on the left with two LCD lights on the right. These buttons and lights are tilted at the same angle as the 48-point Univers Italic graphics that frogdesign chose for the keycaps, giving a hint of playfulness that is subliminally connected to the functionality of the machine. The keyboard itself and the disk drive lever are khaki, a serious offset to the machine's otherwise cheerful creamy off-white, a colour known at Apple as Fog (Kunkel, 37-40).

The Apple IIc was immediately popular, receiving the highest first-day orders in Apple's history. By the end of 1984, over 400 000 had been sold, most with the zero-draft display which Apple and frogdesign designed to be cantilevered by a stand over the back of the computer. This popularity was driven in large part by its appearance; the IIc was the first Apple product to receive formal recognition for its industrial design, for which it won several prestigious awards (Kunkel, 40).

# History of computer design: Apple IIgs



A year after the Apple IIc was introduced, frogdesign began work on the next - and last - major update to the Apple II family. When it appeared in October 1986, the Apple IIgs exemplified Gassée's plan to gain profits via technological advance - it used a unique and powerful mouse-driven operating system that was a hybrid between that of the Apple II and the Macintosh. It was also a hybrid in industrial design, signaling a shift in the appearance of Apple's products towards the standard that had been set by IBM.

The Apple IIgs has both an external keyboard and an external display, but it does not entirely take the form of the PC. Instead, its case is visually separated into two components, with a triangular piece topped with a rectangular lid. The bottom triangle laps over by a couple of inches towards the user, making a visual reference to the keyboard wedge of the earlier Apple II. This wedge has a function; it protects the front of the machine's long circuit board which fills the bottom section. The components in the top box do not require the full length of the motherboard, so it is cut off, leaving the wedge. While the footprint on the desk is no smaller, this design greatly decreases the apparent size of the computer and retains its identity as an Apple II. Its platinum colour and the Snow White lines running on its sides and top give the product an elegance which further identifies it as a new Apple product.

# History of computer design: Bibliography and related links

Much of the available historical work on computers concentrates on business models and economics. They rarely discuss computers as artifacts, but they do provide some of the historical background necessary for a study of material culture.

Apple Computer, Inc., 1990 Annual Report.

Apple has surprisingly little organization of its archival materials for research such as mine. However, they very happily sent me annual stockholder reports for several of the years within my period, and, though not particularly useful, they are quite interesting in revealing Apple's self-conscious corporate culture. [Since this was written in spring 1998, the organization of Apple's web site has been substantially improved, especially for access to technical archival material - but its meagre history pages have been removed.]

Butcher, Lee, *Accidental Millionaire: The rise and fall of Steve Jobs at Apple Computer*, New York: Paragon, 1988.

Carlton, Jim, *Apple: The inside story of intrigue, egomania, and business blunders*, New York: Random House, 1997.

This book is the result of many interviews with people in the computer industry and it contains many interesting facts and a few insights. However, its thesis, that Apple persistently ignored great business opportunities to its own eventual decline, is necessarily focussed on managerial conflicts. He seems to have very little knowledge of technical issues, though he offers broad explanations that would satisfy a general reader.

Carroll, Paul, *Big Blues: The Unmaking of IBM*, Crown: New York, 1993.  
Chposky, James and Ted Leonsis, *Blue Magic: The People, Power and Politics Behind the IBM Personal Computer*, Facts on File: Oxford, 1988.

Ferguson, Charles H. and Charles R. Morris, *Computer Wars*, New York: Random House, 1993. Rose, Frank, *West of Eden: The end of innocence at Apple Computer*, New York: Viking, 1989.

Sculley, John, *Odyssey: Pepsi to Apple... Journey of adventure, ideas, and the future*, New York: Harper & Row, 1987.

Smith, Douglas K. and Robert C. Alexander, *Fumbling the Future: How Xerox invented, then ignored, the first personal computer*, New York: William Morrow, 1988.

Young, Jeffrey S., *Steve Jobs: The journey is the reward*, London: Scott, Foresman and Co., 1988.

Garsten, Christina, *Apple World: Core and periphery in a transnational organizational culture*, Stockhold: Stockholm Studies in Social Anthropology, 1994. Garsten's *Apple World* is an anthropological study of a business. It was not of great help to me, but was interesting for having a very different perspective.

Levy, Steven, *Insanely Great: The life and times of Macintosh, the computer that changed everything*. New York: Viking, 1994.

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Levy is a journalist and self-declared computer novice who was allowed access to the Macintosh in its development, became hugely enamored of it, and has been writing for the magazine MacWorld ever since. He gives an anecdotal and celebratory history of the Macintosh and the people influencing Apple.

The most helpful of technology journalism was found in Compute! (particularly 1988-91), Byte (1978-91), and MacWorld (1984-91). These computer magazines provided advertisements, reviews, speculations, opinions, and technical information for the period examined, as well as occasional nostalgia. Cited articles are listed here:

Comly, Dan, "User's Report: The PET 2001," Byte, March 1978, p. 114-127.  
Fluegelman, Andrew, "The Making of the Macintosh," MacWorld, Vol. 1 No. 1, 1984, p. 126-36.  
Helmer, Carl, "An Apple to Byte," Byte, March 1978, p. 18-46.  
Levy, Steven, "A Shut and Open Case," MacWorld, Jan. 1987, p. 55-7.  
Moore, Robin, Apple's Enhanced Computer, the Apple IIe," Byte, February 1983, p. 68-74.  
Morgan, Chris, "Of IBM, Operating Systems, and Rosetta Stones," Byte, Jan. 1982, p. 6.  
Smarte, Gene and Andrew Reinhardt, "15 Years of Bits, Bytes, and Other Great Moments," Byte, Sept. 1990, p. 369-400.  
Williams, Gregg, "A Closer Look at the IBM Personal Computer," Byte, Jan. 1982, p. 36-70.

These books are extremely unusual in showing a concern for the physical design of computers:

Gelernter, David, Machine Beauty, BasicBooks: New York, 1998.  
Machine Beauty concentrates on the design of computer interfaces, but it does also briefly criticize the standard physical design, suggesting some very rudimentary alternatives. Gelernter is not a designer, historian or technologist, and his treatment is superficial and vague enough to be accessible yet frustrating to anyone.

Kunkel, Paul, AppleDesign: The work of the Apple Industrial Design Group, with photographs by Rick English, New York: Graphis, 1997.

AppleDesign is a beautiful if often inarticulate book with over 400 photographs of Apple products and concepts for products that were not released. It is often inaccurate in technical details and is remarkably full of typos, but it is the best source of information on the people involved in Apple's industrial design. The variety and creativity of the design work done by Apple and by frogdesign is particularly vivid in the products that were not released, though these are outside the scope of my study.

Laurel, Brenda (ed.), The Art of Human-Computer Interface Design, New York: Addison-Wesley, 1990. This book, containing essays by many Apple employees, provides useful information of the design of computer operating system interfaces. There is a strong link between hardware and software, especially with Macintosh computers, but, more importantly, the interface of a computer is now commonly regarded as analagous to physical space. I'm interested in regarding this kind of "cyber-space" as material culture, and will continue to research this area.

These works describe models for analyzing material culture. As I've said, none are specifically geared towards the study of computers, but they each have

contributed to my perspective. The articles by Cooke and Gilborn are particularly useful.

Cooke, Edward S., Jr., "The Study of American Furniture from the Perspective of its Maker,"

Perspectives on American Furniture, ed. Gerald W.R. Ward. New York: Norton, 1988, p. 113-126.

Flemming, E. McClung, "Artifact Study: A Proposed Model," Winterthur Portfolio 9 (1974), 153-73.

Gilborn, Craig, "Pop Pedagogy: Looking at the Coke Bottle" in Material Culture Studies in America, ed. Thomas J. Schlereth. Nashville: AASLH, 1982, p. 183-191.

Kenneth Hudson, "Current Trends in Industrial Archeology," Victorian Studies, Sept. 1972, p. 91-98.

Marquet, Jacques, "Objects as Instruments, Objects as Signs" in History from Things: Essays on Material Culture Studies, ed. Steven Lubar and W. David Kingery. Washington: Smithsonian Institution P., 1996, p. 181-203.

Prown, Jules, "Mind in Matter: An Introduction to Material Culture Theory and Method," Winterthur Portfolio 17, no. 1 (spring, 1982), 1-19.

Material culture studies are gradually becoming more common among historians of technology. Lubar and Gordon are among the growing few in the intersection between these broad fields:

Gordon, Robert B., "The Interpretation of artifacts in the history of technology" in History from Things: Essays on Material Culture Studies, ed. Steven Lubar and W. David Kingery. Washington: Smithsonian Institution P., 1996, p. 74-93.

Lubar, Steven, "Machine Politics: The political construction of technological artifacts" History from Things: Essays on Material Culture Studies, ed. Steven Lubar and W. David Kingery. Washington: Smithsonian Institution P., 1996, p. 197-214.

The emergence of material culture study is one theme in the history of the history of technology. Staudenmaier's is the most accessible study of his own emerging discipline:

Staudenmaier, John M., Technology's Storytellers, Cambridge: MIT Press, 1989.

Studies of computer technology are often done by those embracing or advocating the technology itself. As such, many of my primary references are available through the Internet.

Apple's own page for its history was always surprisingly meagre, but it has now vanished entirely, assumedly a victim of Jobs' refashioning of the company image. However, general Apple information can be found from the detailed sets of web pages from Apple Computer Inc. and Apple Canada. Also, Apple's Chief Evangelist, Guy Kawasaki, has personally created the Evangelist web page containing links to many resources primarily intended for advocacy.

<http://www.evangelist.macaddict.com/>

frogdesign, the design house that heavily influenced the look of Apple's products, gives a timeline of their work in the industrial design of several large corporations, including several in the computer industry:

<http://www.frogdesign.com/nosw/timeline.html>

IBM has an extensive web page relating their long history in computing industries:

<http://www.ibm.com/ibm/history/>

The Computer Museum in Boston has a page that gives only very general information about the history of computers and computing:

<http://www.tcm.org/>

A recent PBS television series, "Triumph of the Nerds," is supported by a website:

<http://www.pbs.org/>

Commercial web pages are generally not very helpful for historical information. The study of computers is at a stage similar to that of industrial archeology, as described by Kenneth Hudson in 1972 when a change was beginning to occur; much of the direct work is being done by amateurs. Most of the web pages I have used are done by individuals or clubs, out of interest rather than financial gain. A few of these follow:

General computer history resources:

The History of Home Computers During My Lifetime has excellent and succinct historical information on particular machines and innovations. Some of it is fairly technical, but it is presented well and so can be useful to the general reader:

[http://www-user.cibola.net/~kasch/the\\_moon/HistoryofComputers/index.html](http://www-user.cibola.net/~kasch/the_moon/HistoryofComputers/index.html)

The CHAC History Pages offer a plethora of links, divided into general categories, from the Computer History Association of California:

<http://www.chac.org/chhistpg.html>

A History of Computers from Maxfield & Montrose Interactive Inc. gives a concise history of developments in personal computers:

[http://graphicscity.intergraph.com/articles/9710/history/ref/history\\_book.htm](http://graphicscity.intergraph.com/articles/9710/history/ref/history_book.htm)

The Computerseum lists many sites related generally to older computers:

[http://granite.sentex.net/~ccmuseum/hist\\_sites.html](http://granite.sentex.net/~ccmuseum/hist_sites.html)

The Obsolete Computer Museum offers a variety of images celebrating older computer products:

<http://www.ncsc.dni.us/fun/user/tcc/cmuseum/cmuseum.htm>

The Home Computer Hall of Fame has images and specs of several computers from the 1980s:

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<http://dSPACE.dial.pipex.com/town/square/chriss/hchhof/hchhof.html>

Doug Coward's Museum of Personal Computing Machinery has images and specifications of computer equipment that the author has collected:

<http://www.best.com/~dcoward/museum/>

GaK's Historical Computer Collection is another site to document a personal collection. It also has images and specifications for his own machines:

<http://www.sojourn.com/~gak/>

Apple specific resources:

Glen Sanford has put together a remarkable web page dedicated to Apple's computers from the Lisa to the PowerBook G3 - it shows how very similar ideas and intentions for a web page can be far better implemented. It includes on-going opinions, history and some great images:

<http://www.apple-history.com/>

Andrew Molloy has compiled a bibliography of accessible Apple-related literature, along with links to related resources :

<http://web.syr.edu/~awmolloy/applebks/index.html>

The Cult of Macintosh page mostly has resources for Macintosh users, but also some historical information:

<http://cult-of-mac.utu.fi/>

The Museum of Apple Computer (The MAC) has an uncritical arrangement of facts about Apple and their products:

<http://www.seastar.net/the-mac/>

The Macintosh Museum gives individual specifications for various Macintosh models:

<http://www.macintoshos.com/macintosh.museum/index.shtml>

Apple Lisa Web Page is largely a resource for users of "Apple's most eccentric flop", including repair information and software, but it also has facts (SAQs or Seldom Asked Questions) about the Lisa:

<http://galena.tjs.org/~tom/>

Apple II History is a site dedicated to the development and uses of Apple IIs, expressing a genuine love of these machines.

<http://www.hypermall.com/History/>

MacAntiques gives advice and resources to users of the very early Macintosh computers:

<http://www.uwm.edu/~thig/plus.html>

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