Charles Willson Peale (1741-1827), artisan, artist, and museum keeper, was also an inventor and a reformer who fervently believed that man’s reason could be used as a tool to better his condition. He was influenced by a broad movement, associated with the Enlightenment and the economic and social changes resulting from eighteenth-century industrialism, which sought reform in the physical and material conditions of life. Leading scientific, literary, and religious figures such as Kant, Rousseau, Franklin, Rittenhouse, Rumford, Wesley, and Rush were involved in this reform movement. They wrote on hygiene, infant mortality, education, and poverty; they invented better stoves for healthier and more comfortable houses and experimented with new foods and ways of cooking to improve the diet of the poor; they were involved in temperance movements, sanitation, the founding of hospitals for the poor, and child welfare; they wrote articles in the Encyclopédie on the duration of life, hospitals, foundlings, and “political arithmetic” (national statistics). Peale believed that his age was “a time of great discoveries,
more prolific than in 10 of the former centuries," and his enthusiasm for technology and invention derived in large part from his faith that these "discoveries" would improve the quality of life.¹

Peale's inventions—his efforts at what in the eighteenth century were called the mechanical and technical arts—have, however, either been ignored or disparaged by historians. Peale himself expressed reservations concerning the time and energy he channeled into these efforts and away from his art and museum. He would become discouraged when an invention failed to win general acceptance and earn money; he would dismiss the invention as a "hobby horse" he rode for a time and then discarded. Peale's inventions are not generally found in histories of technology because they were not in the paths in which future technology developed. For example, his design innovations in fireplaces and mechanical copying machines came just before the era of central heating and carbon paper. The scholarly consensus is that the energies Peale devoted to mechanical pursuits were wrong turns, misguided efforts, and, most unfortunately, distractions from his artistic and scientific pursuits.²

To judge Peale as a successful artist and naturalist and a failure as an inventor is a presentist evaluation which fails to consider his total interests and expertise and the role of technology in the eighteenth-century Enlightenment. If historians are to escape a "whig" historiography of technology, they ought to study the "unsuccessful"


inventions, not only those leading more or less directly to the technology of our own era. Peale's efforts may be viewed as "wrong turns" from our perspective, but in his own time they derived from the felt needs and ideals of his society.

Peale was involved in mechanics and invention throughout his life. As a young man in Annapolis in the 1760s he was a saddle-maker, upholsterer, silversmith, and most significantly in terms of pre-industrial mechanics, a clock and watch repairer. Although he spent little time in this last trade, Peale was proud of the experience and detailed it with some fondness in his unpublished autobiography, commenting on the great amount of time he spent in learning to use the tools of this trade. As a young artist Peale expressed this sense of pride and accomplishment by placing "a clock taken to pieces" in the background of his first self-portrait. Peale's enthusiasm for clocks reflected the very special status attached to these objects since the second half of the sixteenth century. Until the advent of the mature steam engine in the late eighteenth century, the mechanical clock was viewed as the apex of technology. By Peale's lifetime the clock and its precision workmanship had become a popular metaphor for the world, the body, and the state. The clockmaker occupied therefore a very high position among artisans, and Peale, an artisan in mid-eighteenth-century Maryland, would still look to the clockmaker's workshop for the most advanced precision tools. These were the tools that he recalled learning how to use, tools he later in life adapted for his various mechanical pursuits. Throughout his busy life Peale was able to devote time and energy to mechanical pursuits. Even while studying painting with Benjamin West in London, his stay there limited by finances and the need to return to his family in Maryland, he found the time to repair his teacher's "lock and bells."

Peale lived in an age when it seemed that almost all great men—

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kings, statesmen, scientists, and literary figures—showed an interest in and displayed an aptitude for science and invention. Many of his friendships were based on that common interest. In 1776 he and David Rittenhouse experimented in the home manufacture of gunpowder and the development of better rifles with telescopic sights for Washington's soldiers. His friendship with Thomas Jefferson was strengthened in the late 1790s when they served on a committee of the American Philosophical Society to collect information on "American Antiquities," with a special mission "to procure one or more entire skeletons of the Mammoth." When Peale later had the opportunity to exhume such a skeleton, Jefferson, as president of the United States, was quick to offer government aid. He corresponded with Robert Fulton and Joel Barlow on a new device called a washing machine. He worked closely for many years with Benjamin Henry Latrobe and Jefferson to improve and promote the polygraph, a machine which duplicated writing. He and Thomas Paine discussed bridges more than politics. He was a signer of Oliver Evans's petition to Congress which sought to extend patent rights. He became acquainted with Patrick Lyon when he was requested by a friend in Annapolis to examine the inventor's new fire engine (he advised his friend to ignore Lyon's radical politics and purchase the fire engine). Peale and Alexander Wilson experimented with an old crossbow in an effort to determine "the true sustaining power of the bird in its flight." Even while painting Washington's portrait Peale discussed mechanical matters to make the time pass more quickly. 

When Peale moved to Philadelphia during the American Revolution, he located himself amidst a glittering array of scientific and technological resources. The American Philosophical Society, first established in 1743 and reorganized in 1769, had a great influence on Peale and his attitudes toward science and technology. Peale became a member in 1786, housed his museum in Philosophical Hall during the years 1794 to 1802, and was active in the Society throughout the remainder of his life. Despite the range of their differences, the active members of the Society shared a utilitarian view of science and technology. According to this view the Creator had designed nature for the use and benefit of man. The object of science was to understand this design, and the role of technology was to enable man to make use of that which was "furnished by the great and bountiful Author of Nature." Peale believed that all knowledge concerning the workings of nature would prove useful to man and could be used as a tool to better his condition.  

Philadelphia's other resources included the University of Pennsylvania, which with its medical school attracted scientists and other learned men to Philadelphia. Peale borrowed books from the Library Company of Philadelphia, the "father of American libraries." The federal capital was in the city from 1790 until 1800. The United Company of Philadelphia for Promoting Manufactures and the Society for the Promotion of Agriculture offered premiums or prizes for inventions or improvements. Philadelphia was also a center of commerce and manufacturing, boasting excellent brick kilns, an outstanding printing industry, breweries, nail and button makers, coppersmiths and hatters, and one of the most advanced shipbuilding industries in

29F4; Peale to Jefferson, February 26, 1804, F:IIA/29F5; Jefferson to Peale, February 27, 1804, F:IIA/29F13; for Evans's petition see, Peale to Hawkins, August 24, 1806, F:IIA/39C; for Lyon's fire engine, see Peale to John Muir, January 22, 1804, F:IIA/29D2.

the nation. These manufacturers and Philadelphia's inventors and scientists benefited from a direct exchange of information.

Inventions that "do good to our bodies"

The "Natural life of man," Peale believed, would be "200 Years," if we were to "Reform in our Eating drinking & practice of Phisick." Peale studied and experimented with various eating and drinking regimens, and was a close observer and sometimes a practitioner of "Phisick." In 1803 he published a pamphlet containing his observations on health and longevity, and his letters and diaries reveal a continuing interest in the subject. Throughout his life he invented or designed various devices to improve health, extend life, and increase comfort. He manufactured artificial teeth, ground lenses for spectacles, and built an artificial arm for a member of the Pennsylvania state legislature. When Caspar Wistar, one of Philadelphia's leading physicians and a lecturer at the University of Pennsylvania's Medical School, introduced models of human organs to teach students, he turned to Peale to construct a wax and papier-maché model of the human throat and windpipe.

Peale's enthusiasm for mechanics often led him to view the human body as a complex machine—a view put forward by many prominent eighteenth-century medical authorities. George Wallis, for example, author of a popular medical work published in London and New York in the 1790s, defined the body as a "human machine." Physicians such as William Shippen lectured in Philadelphia on the anatomy of the human "machine." Peale wrote that an "improper mode of living," would derange the "machine" rather than allow it gradually and naturally to "wear out." The last phrase might be read as a loose comparison to a clock. Others in the seventeenth and eighteenth centuries were more specific in comparing the pulse to the ticking of a clock. Peale had artisan friends who treated back and spinal problems, broken limbs, and other "mechanical" dislocations and injuries. He believed that a good mechanic was preferable to a

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Physician in treating dislocated and broken bones, and he once recommended a maker of carpentry tools as the best person to treat a broken leg.\(^7\)

Regular bathing was a central idea in Peale's concept of good health and cleanliness. In the 1790s he used cold baths to treat himself and his family for yellow fever. Peale's outlook, however, was not typical in the eighteenth and the early nineteenth century. Standards of cleanliness varied, and for many the washbowl and pitcher were quite sufficient. The all-over bath was often considered a frivolous amusement or a sinful luxury, and in the winter months, a dangerous practice. Attitudes toward public bath houses had also undergone change. In sixteenth-century Europe the fear of syphilis closed many public baths. The Reformation and religious climate of the seventeenth century associated bathing with sin, and one result was a general de-emphasis on personal cleanliness and care of the body. As late as the 1760s proposals to establish public baths in Philadelphia were met with opposition from Quakers and other religious groups who considered such places as "unfriendly to morals." There was a gradual change of opinion regarding bathing and public bath houses in the eighteenth century. The Enlightenment engendered a renewed sense of the importance of the human body and cleanliness, and physicians also began to view the bath as a therapeutic measure. Epidemics, most physicians believed, were transmitted by airs, waters, and food, and thus personal hygiene was stressed as an effective way of saving lives.

\(^7\) Quotations are from Peale to Gabriel Furman, September 16, 1799, F:IIA/22F10-11; _An Epistle to a Friend, On The Means of Preserving Health, Promoting Happiness; And Prolonging The Life of Man To Its Natural Period_ (Philadelphia, 1803); for Peale's work with teeth, see below, and Miller, Hart, Appel, eds., _The Selected Papers of Charles Willson Peale_, 194; Peale to Rembrandt Peale, May 10, 1809, F:IIA/46G1; for Peale's eye glasses, see Peale to Jefferson, March 12, 1807, F:IIA/40D13; for Peale's models of the human throat and windpipe, see Peale to Wistar, March 15, 1809, F:IIA/46B1; for Peale's artificial hand, see Peale to Rubens and Rembrandt Peale, February 22, 1811, F:IIA/50A7-8; for his recommendation of an artisan to treat "mechanical dislocations," see Diary 20, F:IIB/19B14; Peale, _An Epistle to a Friend_, 11, 14, F:IID/27; George Wallis, _The Art of Preventing Diseases and Restoring Health_ (New York, 1794), 19; for the human body as a machine, see Richard H. Shryock, "Eighteenth Century Medicine in America," _Proceedings of the American Society_, v. 59, pt. 2 (1950), 289; Arturo Castiglioni, _A History of Medicine_ (New York, 1941), 584; for the human body as a clock, see Otto Mayr, "A Mechanical Symbol for an Authoritarian World," 4.
The first home bathing devices in America began appearing in the latter part of the eighteenth century. In the 1790s Governor Thomas Johnson of Maryland may have had the first bathtub in the state in his home near Frederick. In 1790 Joseph Carson, a merchant and shipowner, paid four pounds and fifteen shillings for a shower bath, the first recorded in Philadelphia. The Drinker family of that city installed a shower bath in their backyard in 1798, although it was not until July, 1799 that Mrs. Drinker overcame her fear, and for the first time in twenty-eight years experienced being “wett all over at once.” By the end of the eighteenth century a few more families owned shower baths and even tin-lined wooden bath tubs. In the first decade of the nineteenth century bathing and the installation of private bathtubs were encouraged by the establishment of municipal water systems in many cities on the eastern seaboard. However, the large-scale use of bathtubs in private homes was not possible until the development of more adequate municipal water systems in the 1830s.

Peale acknowledged the difficulty of “getting water to fill” the “plunging bath” and enthusiastically turned his attention to an easier way of bathing when, in the 1790s, he learned from Joseph Priestley that London hospitals were using vapor baths. In 1801 he patented a portable vapor bath for home use (Figure 1). The invention was noted with approval in a University of Pennsylvania medical school dissertation on bathing. The writer explained that the warm bath would act as a stimulus to remove “constriction induced on the blood

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Peale's vapor bath. In Peale's device the bather sat on a bench surrounded by oil cloth on a hinged frame. A small kettle of boiling water conveyed steam to a metal tube which was attached to the bottom of the bath. The bather used a draw cord to pull the oil cloth tightly around his neck, so that the steam would immerse his body. (Henry Wilson Lockette, *An Inaugural Dissertation on the Warm Bath* [Philadelphia, 1801], American Philosophical Society.)

"vessels" in the initial stages of fevers when the patient was in a debilitated state. Peale's design was among the first of many portable baths to be developed in the nineteenth century. Although he did not profit from his invention, his donations of vapor baths to the City Hospital, the College of Physicians, the Pennsylvania Hospital, and to friends and relatives were much appreciated.⁹

Peale continued to design and invent devices to improve health until the end of his life. In 1826, when he was 85, Peale placed advertisements in the Philadelphia newspapers notifying the public that he was engaged in the production of porcelain teeth. Not uncommonly for that era, Peale had begun losing his own teeth at an early age. Seeking a remedy when he was thirty-four, he borrowed a French text on dentistry and began making artificial teeth out of animal substances. Peale continued making teeth and experimenting with new substances throughout his life. He finally became convinced that he could manufacture superior teeth out of porcelain.  

Although Peale was not the first in America to manufacture porcelain teeth, his work was pioneering. In the first quarter of the nineteenth century American dentistry was burgeoning. The Revolutionary War, which provided many young dentists with field experience, enabled the emigration of French dentists who had come with the French army and remained in America. These French dentists brought to America information and techniques from the most advanced nation in dentistry. Nonetheless, during this time there were few dentists even in the larger cities and no dental schools and professional associations. Training was by apprenticeship; there were no licenses or state regulations, and anybody could open a shop and call himself a dentist. Treatment often meant tooth extraction by methods characterized as "heroic."  

Until the late eighteenth century, the most commonly used materials for teeth were hippopotamus ivory, which was porous and stained easily; human teeth, which had to be obtained from the poor; and animal teeth, which broke easily. In 1789 Louis XVI granted

\[\text{and Decent, 16-63; Peale to Philip DePeyster, April 23, 1801, F:IIA/24B4; DePeyster to Peale, May 7, 1801, F:IIA/24B7; Peale to Dr. Dorsey, October 6, 1803, F:IIA/28F11; Peale to the College of Physicians, April 7, 1801, F:IIA/24B3; Peale to Managers of the Pennsylvania Hospital, November 30, 1808, F:IIA/45A4.} \]

\[\text{10 Charles Coleman Sellers, *Charles Willson Peale* (New York, 1969), 427; Peale, Diary 2, F:IIIB/2E4; the French work was Claude Jacquier de Geraudy, *L'art de conserver les dents* (Paris, 1737); Peale to Rembrandt Peale, May 10, 1809, July 9, 1826, F:IIA/46G1; 72C8; Peale to Evan Thomas, January 12, 1827, F:IIA/72G3.} \]

the first patent for porcelain teeth. Glazed porcelain, durable and
stain resistant, had obvious advantages. However, because the successful
manufacture of porcelain teeth was dependent on the skill of the
craftsman, porcelain teeth were utilized only to a limited extent in
France and later in England.\textsuperscript{12}

In 1813 Peale viewed Edward Hudson’s small collection of
French-made porcelain teeth which the Philadelphia dentist had pur-
chased for two thousand dollars. A few years later Peale viewed a
set made by Hudson, and judged them to be poorly manufactured.
In January 1816 he wrote Thomas Barnes and a Mr. Holmes, dentists
in Boston who apparently had had some success with porcelain; he
inquired the price of their teeth but did not purchase any. In 1817
porcelain teeth were being made by Anthony Plantou, a French dentist
who had settled in Philadelphia. Plantou’s teeth were later described
by an American dentist as “very imperfect [and] brittle.”\textsuperscript{13}

In 1822 Peale purchased a set of teeth made by Plantou, but was
dissatisfied with them. He felt that although Plantou had made some
good teeth he was a “Mechanic.” “They do not please me,” he wrote,
“and I believe I can make a better sett after I can determine on the
composition & proportion of methods.” Peale experimented with
different porcelain compositions and furnace improvements through-
out the hot Philadelphia summer. At one point the furnace produced
too much heat and discolored the enamel. In October he had an
accident, destroying several teeth and damaging the furnace. Finally
in December he arrived at a formula using “equal quanties of felspar
found near Germantown & White Clay found at White Hill N.
Jersey” which made a “fine Porcelain for teeth.”\textsuperscript{14}

Peale’s letter to his son Rembrandt in February 1823 described

\textsuperscript{12} Bremner, The Story of Dentistry, 60-61; James E. Dexter, History of Dental and Oral
Science in America (Philadelphia, 1876), 20-21; Bernhard Wolf Weinberger, An Introduction
to the History of Dentistry, 2 vols. (St. Louis, 1948), 1, 369-81; Guerini, A History of Dentistry,
344-47.

\textsuperscript{13} Peale to Angelica Peale Robinson, November 12, 1813, F:IIA/52E7; Peale to Jefferson,

\textsuperscript{14} Peale to Rubens Peale, June 14, July 9, October 4, 1822; January 19, 1823, F:IIA/67B10, 67C13, 67E6, 68A10; Peale to Angelica Peale Robinson, November 30, 1822,
the laborious process of crafting porcelain teeth for his daughter, Sophonisba, who at thirty-eight, had only "2 teeth in her upper Jaw, and four front teeth in the lower." He first took impressions of the gums and jaw with beeswax and made plaster of Paris casts from the wax. The teeth were carved separately out of the porcelain and glazed in the furnace. The beeswax cast of Sophonisba's jaw was taken to a brass founder who produced a cast from which a silver or platinum base was made. The teeth were then riveted or screwed to the base. The manufacture and the fitting took two weeks. A few years later Peale developed a further refinement, making the teeth and base out of a solid porcelain block, an advanced technique earlier used by the French but abandoned because it was too difficult.\textsuperscript{15}

In 1826 Peale decided to make his porcelain teeth production a "business of profit." He was determined to free himself of debt and had concluded that he could earn more money by making teeth than by painting portraits. Peale charged $150 for a set of teeth, too much money for many who wanted his services, but, he asserted, "lower than other artists charge for such work" and that in London the price was $35 a tooth. He would try to reduce his price later, but would "not be confined to any such business" if he could not get "a handsome reward for . . . [his] labor." Peale met early opposition from the dentists in Philadelphia, but in July he received an important public endorsement from the Philadelphia medical community. By late summer, after his newspaper advertisement had appeared in other cities, he began receiving many inquiries. Unfortunately Peale did not live long enough to profit from his new profession, although he does receive recognition in histories of dentistry. His work on dentures came to an end just as dentists in Boston and New York were beginning to experiment with porcelain teeth, and it was not until another decade had passed that the process became commercially successful.\textsuperscript{16}

\textsuperscript{15} Peale to Rembrandt Peale, February 9, 1823, F:IIA/68B11; Peale to John S. Miller, July 30, 1826, F:IIA/72D7; Peale to Rubens Peale, July 9, 1826, F:IIA/72C10; Bremner, \textit{Story of Dentistry}, 61; Weinberger, \textit{An Introduction to the History of Dentistry}, 2, 283-88.

\textsuperscript{16} Peale, Diary 24, F:IIB/24; Peale to Rubens Peale, April 1, 1826, F:IIA/72B5; Peale to Rembrandt Peale, July 9, 1826, F:IIA/72C8; Peale to George Lauer, July 5, 1826, F:IIA/72C12; Peale to Rembrandt Peale, July 19, 1826, F:IIA/72D3; Dexter, \textit{History of Dental and Oral Science in America}, 24-26.
Peale's concern with health and comfort accounts in part for his interest in stoves and fireplaces. In the eighteenth century the challenge to provide efficient heat for public buildings and private dwellings attracted many of the best scientific and technical minds. Prior to this time, Anglo-Americans preferred open fireplaces and radiant heating, which produced a feeling of warmth near the hearth, but did not heat the air, which was regarded as unhealthy. In 1744 Benjamin Franklin introduced his small open iron stove, an efficient mechanism designed to be placed inside the large American fireplace. The Franklin stove provided an open fire and radiant heat, but it also employed an air box which heated the air and circulated it into the room. Gradually the principle of warmer interior temperatures during the winter months was accepted as not only beneficial for health but necessary for comfort. This change of attitude came about partly as a result of technical developments, such as Franklin's invention, but it was also a product of the new interest and concern with human comfort. By the last quarter of the eighteenth century, stoves were in increasing demand in Philadelphia not only for private homes but for schools, government buildings, and even churches, which had never been heated before. One historian has estimated that by the 1790s "probably every public building in Philadelphia that could afford it was heated by stoves."

Peale's residence in Philosophical Hall placed him in a milieu where many fireplace and stove improvements were being examined and encouraged. Since the introduction of Franklin's stove there had been continuing interest and discussion, stimulated by Franklin and other members of the Society, concerning new inventions and improvements in heating. One of these improvements was the work of David Rittenhouse, who in the 1780s developed a smaller, simplified...

version of the Franklin stove. In the 1780s and 1790s many Philadelphia homes, including the Peales', had a Rittenhouse stove.  

The need to heat the museum efficiently made fireplace and stove design of more than humanitarian or theoretical interest to Peale. In the mid-1790s he became especially interested in finding efficient heating devices, because he had decided to keep his museum open during the evenings. He read an account of a successful new brick stove in France that he hoped to use in his museum. Peale built the French stove and tested it. Using a specified amount of wood, Peale kept an hourly record of the outside and inside temperatures on a cold January day. With an outside temperature just above freezing, he achieved a maximum temperature of 54 degrees, while using only a small amount of wood. Peale viewed the experiment as a success.  

In 1797 Peale and his son Raphaelle entered a contest sponsored by the American Philosophical Society with a prize of $60 for the best fireplace design affordable to the poor. The Society's contest might have originated in part out of the fears of Philadelphia's wealthy and powerful who were becoming concerned with the deteriorating condition of the city's lower classes during these years. The legacy of the city's radically democratic politics during the American Revolution convinced many wealthy Philadelphians that there would be social unrest if the situation of the poor worsened. The difficulties of the poor in heating their dwellings increased as the price of firewood climbed steeply in the mid-1790s, and city regulations were necessary to prohibit the purchase of firewood for resale in Philadelphia between September and March. Local wood was scarce and had to be shipped from New Jersey and the Delaware Valley; and there were recurrent demands to regulate shipping and carting rates. As firewood prices increased in Philadelphia there were charity drives to provide fuel for the needy. By 1793, a privately financed fund was established to buy wood for the poor in the winter.

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19 Aurora General Advertiser (Philadelphia), January 12, 26, 1796.
21 John K. Alexander, Render Them Submissive, Responses to Poverty in Philadelphia, 1760-
Peale and Raphaelle experimented with several designs for chimney modifications and open fireplaces. One design contained the placement of a stove in a niche built into the front wall of the chimney; another had a "honey-combed" back wall which circulated warm air in much the same way as the Franklin stove. The Peales' fireplace designs contained improvements developed in Europe in the last decades of the eighteenth century, the most significant of which were the designs of Count Rumford. In 1796 Rumford published "Chimney Fire-places" which contained designs for smaller, more efficient fireplaces which would conserve heat. Peale and his son were aware of at least some of Rumford's designs and incorporated such components as slanted jambs, which reflected heat into the room. The Peales' design also included a sliding metal cover to be lowered from the mantel (to increase the draft or diminish the fire) and a damper (to open against the back of the chimney and prevent smoke from returning to the room). The Peales were the first to emphasize safety in a fireplace design, and they indicated that the fire could easily be extinguished by closing both the metal cover and the damper.

In 1799 the Philosophical Society finally awarded its prize for new fireplace designs to the Peales. Peale and his son also received the first patent in America for fireplace improvements (Figure 2). The Philosophical Society did not consider the designs entirely original but awarded the prize because of the skill with which the components "were combined and applied to domestic purposes." The Society also took into account the fact that the Peales' entry had been submitted in 1797 and the Society's award made two years later, when many


The Peale family’s fireplace design was patented on Nov. 16, 1797. (Charles Willson Peale and Raphaelle Peale, “Description of Some Improvements in the Common Fire-Place,” in American Philosophical Society, Transactions, vol. 5, 1802.

of the improvements developed in Europe had become well known in America. The Peales’ achievement in fireplace design should be viewed more in terms of application than in innovative theory. Peale himself emphasized the “practicing hand,” “utility,” and “due management” of the invention. The patentee had a “duty,” he wrote, “to make his invention as useful as possible to the public generally.” The Peales charged $10 for the use of their design, defending the cost as payment for their time to supervise the construction of the fireplace.24

24 American Philosophical Society . . . Manuscript Minutes . . . , 280, 282; Charles Cole-
Peale continued to experiment with new designs for stoves and fireplaces. On March 8, 1801, he wrote Thomas Jefferson, four days after Jefferson had been inaugurated President of the United States. An ardent Republican, Peale offered his congratulations and expressed his hope that the new President would “still find leisure to devote some attention to the Minutiae of public good, in objects which promise the economy, convenience, and comforts of Life.” The subject of his letter was the waste and inefficiency of the large American fireplace in the kitchen. He had studied Rumford’s design for an elaborate brick-work structure, honeycombed with flues connected to small wood stoves, each designed for a particular-sized pot. The principle was to break down the large open fireplace into small, easily regulated stoves. Other refinements consisted of insulated double covers for pots; the use of pressure cookers, steam cooking, double boilers; an efficient roaster; and smoke conveyance through tubes to heat additional pots. Peale designed one of these stoves for his own use, built them for friends and relatives, and offered his design and assistance to such institutions as the Pennsylvania Hospital.

For his museum of natural history Peale designed the “smoke-eater” (Figure 3), a fascinating and complex mechanism that not only supplied sufficient heat but became an exhibit itself. The basic principle, earlier employed by Franklin and the French, was to draw the smoke and soot particles down to the fire where they would undergo combustion a second time. A pipe drew the warm air under the floor to the outside of the building. Astonished visitors to the museum were able to look through a vent in the pipe and see a stream of smokeless hot air leaving the stove. The “smoke-eater,” a marvel...
Peale's "smoke-eater." Peale built his stove in brick, favoring its heat radiating qualities over iron; he covered the brick with plaster, which was whitewashed and then painted to look like marble. The bust on top was initially Cicero, but Peale later sought to replace it with one of Linnaeus. The smoke rose to the top of the stove and was then sucked down a pipe, which was perforated at the level of the fire, at which point it underwent further combustion. The hot air would then continue along a horizontal pipe under the floor to the outside of the building. *The Weekly Magazine*, vol. 2, no. 25 (July 21, 1798), American Philosophical Society.

of efficiency, was (like the Franklin stove before it) too intricate a mechanism for the average person to build and maintain.²⁶

A historian of technology has viewed all of the heating improvements sponsored by the Philosophical Society in this era, especially Peale's devices, as exercises in late eighteenth-century technological virtuosity, incapable of being produced for wide distribution. The

delight in technological complexity characterized some of these devices, such as Peale's "smoke-eater," made them too costly as well as too complex for most people. But in any case, the undeveloped industrial and marketing base of the United States at this time would hardly have lent itself to the "wide distribution" of any invention. Peale realized that he would have had to sacrifice both his painting and his museum in order to travel around the country and promote his inventions, a sacrifice he was unwilling to make. Nevertheless, when his in-laws, the DePeysters, a prosperous New York mercantile family, arranged for him to demonstrate his fireplaces and stoves to the New York City government, he did sell and supervise the construction of many of them. Also, although Peale was strongly in favor of inventors' obtaining a profit from their creativity and labor, his interest was really in the creation and design and not in the economic development of the invention.

"an easy means of preserving copies . . . two perfect originals"

In 1803 John Isaac Hawkins was granted a patent for a pantograph mechanism which could trace profiles, copy drawings and music, and copy letters. Having emigrated from England at an early age and eventually settled in Philadelphia, Hawkins pursued his mechanical interests in the workshop of Peale's museum. Peale encouraged the young inventor and was especially enthusiastic about a device designed to copy letters, which Hawkins called the polygraph (Figure 4). He offered "hints" to improve the invention, and when Hawkins returned to England in 1803, Peale agreed to refine and market the polygraph in the United States. During the almost five years he spent "perfecting" and marketing the machine, Peale was constantly advised by friends that the invention was "unprofitable" and that the extensive time he spent on it resulted in the "neglect of the Museum." Peale, however, viewed the polygraph as an invention which "deserves attention," because it added to the "conveniences of life" and would "economise our time." It would, he believed, prevent quarrels and

lawsuits, aid widows and orphans, and improve morals, “since none can be so lost to character as not to wish to be thought well of, by those who may view transactions so faithfully given by their correspondance.” He was convinced that once the polygraph was made reliable his fellow citizens could not fail to recognize that such a “writing machine, which enables a person to make two three or more originals exactly alike . . . scarcely with more labor than in writing with a single Pen, is certainly belonging to this class of meritorious inventions.” In 1804 he wrote Hawkins that they had “reason to rejoice, for it is clear as sun shine to me, that the great utility of writing 2 or 3 pens with ease and at the same time correctly alike will finally secure a very extensive sale.”

The quotation, “an easy means . . . ” is from Peale’s advertisement in *Poulson’s Amer-
Peale's enthusiasm for the polygraph derived in part from the demand in the eighteenth century for more accurate and efficient copying machines, primarily for technical or engineering drawings. Drawing machines had become important to designers during the late Renaissance, when the development of new ways of achieving perspective and depth made possible more realistic and accurate engineering drawings. In the eighteenth century, drawing techniques rapidly improved throughout Europe, and, particularly in France, objective drawings became an important means of expression to describe, catalogue, and quantify the natural and man-made world. This use of drawings, especially in depicting machines, found its highest expression in the hundreds of illustrations reproduced in the *Encyclopédie*. In England, British naval and architectural designers produced drawings that were not merely presentations of the product but were actually used in the construction phase. Perspective drawing in England was considered an important skill, and drawing machines were in demand. George III was tutored in perspective drawing when he was Prince of Wales and owned a drawing and perspective machine made for him by the King's instrument-maker, George Adams, an eighteenth-century London craftsman.29

In 1780 James Watt was granted a patent for a copying press, which he hoped to use for his engineering drawings as well as for his correspondence. Watt's device did not trace the original, like the pantograph; it offset the original by pressing it against a dampened sheet of paper. In 1799, a patent was granted to English engineer Marc Isambard Brunel for the application of the pantograph to making “two or three similar writings or drawings at the same time and by the same person.” The beauty and quality of the workmanship impressed many artisans, but the machine could not be made to operate efficiently. In 1804 Jefferson obtained one of Brunel's pantographs from Peale in order to “make a trial” of the device. Like others who

saw the machine, Jefferson was charmed by its ingenuity, but he soon wrote Peale that although he understood the workings of all the parts and could find no fault, "he could not produce a copy of a single letter distinct," and gave up on it "as a beautiful bagatelle."

In the United States, especially from the 1780s on, copying machines seemed to be most valued by statesmen. Jefferson, who owned a Watt copying press in 1785 urged James Madison to buy one and wrote that he would have paid ten times the price if he could have had one from the date of the Stamp Act. Madison responded that he would buy a machine when he could afford it and added that government offices should have them. Benjamin Franklin ordered three machines from James Watt as soon as they were available, and Franklin sent one of them to Charles Thompson, the clerk of the Congress. In 1782 George Washington received a copying press as a gift and used it and another that he purchased at a later date for the remainder of his life.30

In creating a pantograph mechanism which could copy writing, the challenge confronting Hawkins and Peale was to design the parallel machinery of the pantograph so that both pens would move precisely with the same motions and with as little effort as writing with a pen. The writing surface had to be "a perfect plane," the rulers, "perfectly parallel," the joints had to move "freely without any play." The pen holders had to be capable of fine adjustments, and pens had to be found or made adapted to the requirements of the polygraph; even the ink had to have the right chemical composition. Peale considered the perpendicular support or the "vertical parallelograms" as the key to the successful operation of the polygraph. This part had to be designed so that the pens touched down simultaneously and moved with ease and precision over the length of the paper. Previous designs had failed because they could not solve this problem. Peale made a major contribution to solving the problem of equalizing pen pressure when he "hinted to Mr. Hawkins" that

"vertical parallelograms" would help equalize the touch of the Pens.” During the years 1803-1804, when Hawkins was in England, Peale occupied a great deal of his time with the polygraph—adding springs, bars, rollers, pulleys, and joints that would better enable the vertical parallels to move the pens in tandem.31

The polygraph prototypes experienced many mechanical problems, but Peale’s belief in the value and utility of the machine determined him to perfect the model. On August 7, 1803, he wrote Hawkins that he would produce a top quality product before any of the machines were sold. “Two or three persons,” he wrote, “have been anxious to have them, but my answer is that it is for their Interest that I keep them longer on hand, that they may receive them as perfect as possible.” Peale sold two of the first models of the polygraph to Latrobe and Jefferson at a price far below his costs of producing the machines. Both men agreed to help Peale perfect the machine. It was an ideal arrangement: the two men were mechanically inclined and friendly to new inventions, and they would help Peale transform a temperamental prototype into a marketable product which would work for those with little or no mechanical aptitude. “You will oblige me,” he wrote Latrobe, “whether you think anything to be done, before we send the Polygraph into the world amongst fools and knaves.”32

Peale’s solution to most of the polygraph’s mechanical problems was to design specialized tools which produced uniform parts for the machine. His work in this aspect of the invention reveals his considerable skill as an artisan. In early 1804 he had discovered faults in the alignment of the pen arms. Painstaking care with the workmanship and strict supervision of his workers failed to correct the problem.


Finally, he traced the problem to his drill. Peale then designed an accurate bow drill in an iron frame. He had perhaps encountered this sophisticated tool when he had repaired watches, or perhaps Peale saw it used by sculptors, who needed such a tool to control the depth of the hole. Peale encountered additional mechanical difficulties related to the angle and uniformity of the writing surface. For this part, Peale designed a spirit level hinged to a "rack-quadrant" which enabled him at a glance to check the finished product. Special hard-woods, expensive brass for key parts, collets and other materials and techniques used by clock makers—all were employed for the parts requiring precise adjustments. By the fall of 1804 Peale had developed an entire workshop with specialized tools for each process in the manufacture of the polygraph, and he was optimistic that his quality control problems were solved. He wrote Hawkins that "every piece has its Lock or place formed which it must be made to fit into to be drilled &c." so that they did "not depend on the accuracy of the sight of the workmen as formerly."33

Peale received public endorsements from both Jefferson and Latrobe, who throughout their lives praised the invention, and he sold several of the machines in 1804 and 1805. Hawkins did only slightly better in London. However, by the middle of 1806 Peale had to admit that the polygraph would not be a commercial success. He wrote Jefferson that it had been "an expensive and unprofitable business," but that he had persisted in improving it because it had been a "favorite Machine." He had "persevered," he insisted, "in the hope of making them perfect and highly useful."34

The standard explanation for the polygraph's failure is that it was


too delicate a machine. It seems likely, however, that historians have been given this impression as the result of the initial correspondence between Peale, Latrobe, and Jefferson concerning the problems of the prototype. The Latrobe and Jefferson endorsements only came, as Peale had said, after the problems were solved. Jefferson continued to be a satisfied user of the machine for the rest of his life, and when he was President, Jefferson recommended its use to government officials and ordered several polygraphs as gifts for friends and foreign dignitaries as a model of American workmanship and ingenuity. Latrobe became completely dependent on the machine to maintain his business records and used the polygraph until bankruptcy forced him to part with it in 1817.35

More than a decade later Latrobe wrote Jefferson about the polygraph:

Notwithstanding the convenience, & great utility . . . which I find from the Polygraph, it is a fact, that Peale never could dispose of more than 60, 40 of which about, as his Son tells me . . . were sold by my recommendation . . . I have often recommended them to Merchants, but they object that their Clerks “are always sufficient for the copying of their letters, & would otherwise be unemployed, & moreover never write a good hand for want of practice: & that they must copy their letters into books, for safekeeping, & for production in courts of justice.”36

Latrobe acknowledged that these reasons accounted somewhat for the commercial failure of the polygraph, but more fundamental in his opinion was the conservative nature of merchants, whom he characterized as “generally a sort of Machines.” Lawyers behaved in a similar manner, governing themselves by the “practice of their business.” Thus, the polygraph could not be introduced to “the most writing class of men, & is used only by a few literary men.”

36 Latrobe to Jefferson, July 20, 1817, DLC.
Perhaps the fundamental reason for the polygraph’s commercial failure had as much to do with the nature of the American economy as with the invention itself. At a time when there was no national advertising (newspaper printers in other cities were "requested" to insert advertisements), no network of distribution, and no techniques of large-scale production, marketing the polygraph would have required an enormous commitment of Peale’s own time and energy. When advised that traders could sell the polygraph on commission, Peale replied that he did not like “keeping accounts” and that he feared the “risk of losses by failures.” He was “determined to avoid all such trouble.”

“Easy and safe passages over the waters of the United States”

In his autobiography Peale analyzed his mechanical interests as sudden moments of inspiration when his “fancy” would be “struck” by an “Idea” of an “improvement, which he conceived had a chance of becoming advantageous to the Public.” At such times he would “instantly” channel his energy and time “to accomplish such invention.” Peale explained his interest in bridges as the result of a conversation with a friend on the importance of walkways to good health. When the friend regretted that the walkway in the State House garden was not longer, he was “struck” with an “Idea” to design a bridge which would connect the garden to a field across the street.

During the summer of 1796 Peale built a model of the bridge and placed it in the “passage of the Philosophical Hall.” The twenty-foot model received its most difficult test when “12 Indians and all stout men” stood on it at once. The bridge held, “although at the same time it looked so light that very frequently men have been fearful to cross it singly.” The ends of the bridge rose when one person jumped on the middle of it, a movement described as “deformation” by a modern commentator. However, the model was free-standing and lacked abutments, which Peale rightfully considered crucial in an arched structure. By the fall of 1796 Peale was convinced that

37 Peale to Jefferson, June 22, 1806, F:IIA/38G3.
his design had great applicability for America's "numerous creeks and rivers" and could support an arch of 500 feet. 39

Peale never indicated what influenced his bridge design, but its two most salient characteristics—the single arch and the wood planking—may be traced to incidents from a decade before he built his model. On a winter day in 1784, Thomas Paine, an old friend and political ally of Peale during the Revolution, went to view the great accumulation of ice on the Schuylkill River. Paine wondered whether the river's floating bridges would survive another winter, and he later wrote of a vision he had that day of a new "American" bridge—an iron, single-arch structure—designed to withstand American rivers. There is no evidence that the two men discussed bridges in the 1780s, but after Paine returned to America in 1802, Peale wrote and encouraged him to place his bridge models in the museum, and he agreed with Paine that only single arch bridges would be useful and an honor to the country. 40

The other influence for Peale's design may initially be found in Thomas Jefferson's letter of October 12, 1786, to Maria Cosway, containing Jefferson's famous dialogue between his "head" and "heart." Jefferson, in Paris, had gone to study the architecture of the Halle aux Bleds, where he met Cosway. While his "heart" recalled the meeting with a charming woman, his "head" was engrossed with the architecture of the grain market. The structure had a remarkable roof, using an innovative method of construction originally conceived by the Renaissance architect Philibert Delormé. The roof was not supported by heavy timber trusses but by arched ribs made of wooden planks. The design allowed the large amount of space between the ribs to be filled with windows, flooding the market with daylight, and providing a breathtaking sensation of graceful strength without massive bulk, much the same aesthetic feeling that Peale claimed for his bridge.

While in France, Jefferson acquired Delormé's 1561 study of

timber framing. After he returned to America in 1789, Jefferson became a strong advocate of the architect’s arch structure, proposing its utilization in American buildings and even mentioning its potential use in a bridge across the Schuylkill. Although there is no evidence that Jefferson and Peale ever discussed bridge design, Jefferson resided in Philadelphia in the early 1790s, became acquainted with Peale at the American Philosophical Society, and was associated with the museum. Given the relationship between the two men, with so much common ground in their interests in mechanics and inventions, it is likely that the subject was discussed.\(^{41}\)

The direct influence accounting for Peale’s interest in bridges was the widespread enthusiasm and public support in the 1790s for internal improvements. State legislatures were inundated with petitions and bills for the construction of turnpikes. The first successful long-span bridges in America were built as links in this new system of roads. In 1794 the Lancaster Turnpike was completed, linking Philadelphia to the rich farm lands of eastern Pennsylvania. A tremendous increase in the settlements in western Pennsylvania and along the Ohio River made it evident that Philadelphia’s continued prosperity and its ability to compete with such cities as Baltimore hinged on the construction of a reliable system of roads and bridges. It was also apparent that the vulnerable links in Pennsylvania’s east-west routes were the floating bridges on the Schuylkill River and that a suitable design and sufficient funds were needed to construct a permanent bridge across the river.\(^ {42}\)

In the fall of 1796 Peale published articles in Philadelphia newspapers announcing his invention and requested that the Select Council

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view the model of his bridge. In January 1797 he was granted the first patent in the United States for a bridge design. Peale had come to the conclusion that his design could be used for the long-awaited permanent Schuylkill River bridge (Figure 5).43

In many respects Peale's approach to bridge design was similar to the major American bridge builders in this era—Timothy Palmer, Lewis Wernwag, and Theodore Burr. Like them he used a scale model to test load capacity because there was in America no science of structural materials and no predictive and verifiable information on the strength and the elastic properties of materials, no accounts of how materials would react when used in bridges. European architectural and carpentry manuals were the only reference works available to American bridge designers. Such works as William Pain's The Practical Builder (1774) instructed the builder in the basic prin-

43 Aurora General Advertiser, September 23, 27, 1796; Philadelphia Gazette, September 22, 1797; Select Council Minutes, PPDR; Peale to Timothy Pickering, December 27, 1796, F:IIA/21A5; Leggett, Subject Matter Index of Patents for Invention 1:149. Peale's patent was granted on January 21, 1797; A Statistical Account of the Schuylkill Permanent Bridge (Philadelphia, 1815). The city of Philadelphia was too financially strained to build the bridge, and in 1798 a company was incorporated by the Pennsylvania state legislature, which chose an English engineer to design and construct a stone bridge.
Fig. 1

The bending of the bridge ribs. Peale instructed the builder to make a scale drawing of the chord of the arch and to draw perpendicular lines at equidistant points along a line until they intersected the curve of the arch. This would determine the points along the curve where it would be necessary to place uprights which would bend the planks to the desired curve. Charles Willson Peale, *An Essay on Building Wooden Bridges* (Philadelphia, 1797), American Philosophical Society.

Peale’s choice of wood also placed him in the mainstream of American bridge design. The contrast with England is significant. In 1800 a committee of the House of Commons reporting on the planned construction of a new London Bridge considered only iron and stone as suitable building materials, because “a Work of such importance ought to be constructed of the most solid and durable Materials, and it is safer to depend on a Structure which, though more expensive in its Erection, is calculated to last for Ages without any considerable Decay.” American communities were not concerned about the “Ages” but built the best bridge they could afford.

Peale’s use of the arch also reflected common usage, but his uti-
lization of Delormé’s construction departed significantly from other bridge design in the United States. The challenge to American bridge builders during this time was to span a broad expanse of water with a wooden structure that had a minimum number of piers. Although only a few visionaries attempted single-span bridges, bridge designers agreed that American rivers, often filled with ice in the winter and destructive freshets in the spring, could not be spanned successfully by bridges with many piers.  

Palmer, Wernwag, and Burr designed their structure with massive timber arches combined with a truss. Wernwag, in his design of the “Colossus,” which realized Paine’s vision of a single-arch bridge over the Schuylkill, used three massive timber ribs, each “4 feet deep and one foot thick.” His arch was also braced with a truss made of heavy timbers. The ribs of Peale’s 390-foot arch would consist of only “six layers of plank, each two inches thick.” Peale recognized that a truss was needed to provide rigidity; he believed that the curved boards of his rails would answer that purpose and save the expense of massive timber bracing.

In 1800 Peale received an analysis of his design from the French Academy of Sciences. The authors of the analysis, Charles Augustin Coulomb and Gaspard-François-Clair-Marie Riche De Prony were two of France’s prominent experts in engineering, applied mechanics, and large-scale public works. The authors were critical of Peale’s effort, mainly because of Peale’s lack of experience in bridge design and construction; but they were unwilling to pass final judgment and pointed to the necessity of several trials before any definitive evaluation could be made of such a novel design. They questioned if many of Peale’s design features were sufficiently strong to support an extended arch. Significantly, the analysis compared Peale’s design with Delormé’s. The French engineers favored Delormé’s technique of placing the planks on their sides, a distinction of which Peale seems to have been aware. Peale believed that part of the originality of his patent was the turning of the planks horizontally so that they could

be combined in a laminated construction. Coulomb and Prony praised Peale’s originality and characterized him as an “ingenious artist,” “rich in resources.” The analysis concluded that Peale’s bridge had been studied with interest, and that the combination of Peale’s “inventive mind” and further experience “will lead him to useful results.”

Peale’s design, not considered for a bridge across the Schuylkill River, would have lacked the strength and rigidity necessary for such a distance. His design revealed his lack of experience in large-scale construction. The major American bridge designers, on the other hand, remained conservatively tied to the basic wooden arch and truss combination because the theoretical knowledge which could lead to new designs was largely unavailable in America at this time. The final selection of the design for the Schuylkill bridge is an illustration of this conservatism. In the initial construction of the bridge there were severe problems with the piers. Many proposals were submitted to discard the unfinished piers and span the river in a single arch. When a design ultimately was chosen which incorporated the piers, it was explained that while in “theory” an arch could be extended a great distance, “the point of practicability or discretion has never been precisely fixed,” and “practical men shrink at the danger” of extending arches beyond two hundred feet. Peale’s design might have been tried for small spans and probably would have worked. It seems likely that Raphaelle Peale, using his father’s patent, built one or several bridges in South Carolina in 1805-1806. Also, in February 1805 Peale noted in his museum Accession Book that, “Mr. Gallatin informs us that a Bridge something like C. W. Peales Patent was built 10 or 12 years since at the mouth of the Savage River emptying into the Potomac, on the road from Winchester, cheap and durable.”

There were other eighteenth-century men like Peale who dreamed of great bridges spanning rivers. In 1811 Thomas Pope proposed his

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48 Académie des Sciences, Procès-verbaux des séances, Tome 2 (Hendaye, 1800-04), 109; CWP to Timothy Pickering, December 27, 1796, F:IIA/21A5.
50 Peale to Rubens Peale, October 14, 1805, F:IIA/36C14; Peale to Raphaelle Peale, October 14, 28, 1805, F:IIA/36D5, D13; Peale to Angelica Peale Robinson, October 29, 1805, February 18, 1806, F:IIA/36E12, 38A3; Peale, Accession Book, F:XIA/3.
fantastic "flying pendent lever bridge," which was to span the Hudson River in a single 3000 foot arch. It, too, never was built. Like Pope, Peale took evident delight in attempting a bold new design and aspiring to be more than a good artisan or craftsman. In America the men who did build the bridges of this period were practical, experienced master builders who accomplished all that was possible in a society that had hardly begun to move beyond the older crafts. The graceful bridges spanning American rivers would be built—at a later time when the science and technology of the nineteenth century caught up with the aspirations of the eighteenth.

"to expand the mind and make men better; more virtuous and liberal"

Peale's inventions derived from the reform impulse of the Enlightenment and the eighteenth-century aspirations for technological advancement, neither of which included visions of large factories and industrialized urban areas. Not until the second decade of the nineteenth century, when Peale viewed "large Manufactories" did he become aware of the industrial and urban direction of technology. In 1804, before his first view of nineteenth-century industrialism, Peale wrote Jefferson that he had decided to use a part of his museum to "teach the mechanical arts" by exhibiting machines, models, and drawings "illustrative of various methods of workmanship." In this approach to technology Peale would use his museum in the same way as Diderot and the philosophes used their encyclopedias: to demonstrate and classify the various branches of technology. The idea was to take the mystery out of technology so that, as Peale expressed it, "Many trades which are thought difficult to those unacquainted with them, will here be found easy." The purpose of this exhibit was not to aid in the establishment of large factories but to instruct farmers to employ their "vacant hours" in learning crafts so that they could supply themselves with "vast quantities of manufactured articles, without

51 Condit, American Building Art, 86-87. On the aspirations and achievements of American science and technology in the eighteenth century, see Brooke Hindle, The Pursuit of Science in Revolutionary America 1735-1789 (Chapel Hill, 1956), 378-79.
the neglect of agricultural pursuits." Learning these skills would not only protect the morals of farmers, who in "winter and in stormy weather" are "Idle" and may develop "vicious habits" but would give them profit and supply the country with "vast quantities of manufactured articles."52

Others—such as Peale's friend Benjamin Latrobe, who had observed the course of industrialization in England—saw a different and far less bucolic future for technology. Since Latrobe had left that country (he wrote Peale in 1803), the government and manufactures had become "interwoven." Latrobe used Adam Smith's classic description of the division of labor and told Peale of workshops where the people were either "employed in making pinpoints" or in "making pin heads." He was appalled by this view of the future and hoped America would avoid such a society.53

But in 1803 Peale had not yet viewed such workshops, and he thought of machines only in terms of improving the moral and physical well-being of man and promoting "much good to the country." For Peale, technology and man's ability to invent and construct machines still remained a supreme indication of humanity's enormous potential, a divine mark of the Creator's favor:

The Supreme Creator in his goodness had indowed man with a reflecting mind... he can calculate the revolution of the Planets, he can produce by the labor of the hands various and wonderful works of art, and with the knowledge of the lever, the screw & the wedge, he can make machines to lessen labour, and multiply the conveniences of Life.54

In 1810 Peale left the day-to-day running of the museum to his son Rubens and "retired" to a farm in Germantown, Pennsylvania, to become a "gentleman farmer" like his friend Jefferson. Within a short time he became involved in the construction of mill machinery for use on his farm and to power machines for a cotton manufactory

52 Peale's statement, "to expand the mind," is in his "Autobiography" (379, F:IIC) and in this instance referred to discoveries of "natural substances" and the advancement of natural history, but it accurately reflected his belief that increased knowledge would make men better. Peale to Jefferson, February 26, 1804, F:IIA/29F5; Charles C. Gillispie, "The Natural History of Industry," 130-34.


54 Peale, Diary 20, F:IIB/19C6.
for his sons Franklin and Titian. In order to learn as much as he could on this subject, Peale visited mills and factories in the area, and some of what he viewed in Germantown might have reminded him of Latrobe's description of English working conditions. In 1815 he wrote Jefferson that it would be "more beneficial to our Country to manufacture with small Machines in families, then by large establishments—where numbers of each Sex are huddled together to the great derangement of their morals & virtue." He had seen in Germantown "the Children of all poor families . . . employed in the large manufactories," who were paid fifty cents a week and received little schooling. And he had conversed with "an intelligent Gentleman of New England (near Boston)" who told him "that some very extensive Manufactories in that country have experienced the disadvantage of employing so many hands together, and that they are now dividing those large establishments into 2 or 3 smaller ones." 

Yet these foreboding visions of nineteenth-century technology do not appear fundamentally to have changed Peale's optimistic faith in man's ability to use the machine for his own improvement. He always returned to the theme of the "mechanical arts" and the "conveniences," or "comforts" of life. The unity of technology, utility, and reform—one of the Enlightenment's major contributions to western civilization—directed the expression of Peale's mechanical and spatial talents to inventions which aimed to improve the material conditions of life. Peale's inventions were, in the end, not exercises in technological virtuosity or peripheral expressions of his artistic talents but expenditures of energy directed to pursuits he thought would make life better. In all of this activity he maintained the buoyant eighteenth-century belief that science and technology could be made the servants of man.

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55 Peale to Jefferson, June 18, 1815, F:IIA/55E1.