From Art to Technology and Science

BROOKE HINDLE

ART IN THE PRESENT WORLD appears to be a different sort of creative enterprise from either technology or science. In fact, it is difficult to identify modern artists who have moved on to make important contributions to technology or science, but this was not always so. Three early Americans, Charles Willson Peale, Samuel F. B. Morse, and Rufus Porter, provide good examples of success in moving from art, where each attained his first achievements, to one or both of the other fields. Their multiple successes were neither unconnected nor unusual, and some understanding of the relationships among these three fields is essential for comprehending our early history.

In 1959, C. P. Snow created a stir by asserting that there are two different and sometimes conflicting cultures: science and the humanities. Not long afterward, critics blasted apart his claims and assumed that they had destroyed his position. Actually, Snow's own experience in science and in writing novels did identify continuing differences between science and the humanities that are real but remain unsatisfactorily explained.[1]

I experienced what seemed to be a similar cultural difference during a year in which I taught at the Massachusetts Institute of Technology. The students reacted in a totally unexpected way to my slide lectures. They always quieted down when the slide projection began, assuming that this was the essence of

[1] C. P. Snow, *Two Cultures and the Scientific Revolution* (Cambridge, Eng., 1959) and *Two Cultures and a Second Look* (Cambridge, Eng., 1964); F. R. Leavis, *Two Cultures? The Significance of C. P. Snow* (London, 1962).

the course. By contrast, they viewed other sessions, in which I lectured but also sought to spur discussion, as less important 'bull sessions.' That was exactly the reverse of the reactions that I had had for many years from history students at New York University. Those students had accepted my occasional slide lectures as entertainment sessions, which some occasionally skipped, confident that we would not return to the important work of the course until the following session.

Why this difference? It does reflect many complex differences between the humanities and both science and technology, but its most important revelation is of a difference in mode of thinking. Verbal, logical, cause-effect thought takes first place in the humanities, and especially in the work of graduate students in history, while visual or spatial thought is a major requirement of engineering and of most of the sciences. This difference in mode of thinking also offers the key answer to the relationships of art with technology and science, because art, even more than technology or science, depends overwhelmingly on spatial thought. That is the factor that connects the three fields and places them within what Snow sought to call a single culture. The dependence of art, technology, and science on visual or spatial thinking helps to explain how an artist, who would seem entirely unprepared, might be able to move into one of the other fields.

When one raises the question of artists who also contribute to technology or science, the name of Leonardo da Vinci usually comes first to mind—but with the caveat that he was a unique genius whose experience has little general meaning. During the Renaissance, however, other, less brilliant artists also contributed to technology or to some of the sciences. Brunelleschi was an architect and an inventor; Martini was a painter and an engineer; Bramante was a painter and an architect. The arts, then, included both the fine and the mechanic arts, and those who worked within one art lived also within the larger environment, which permitted some to move from one art to another. This pattern continued into the eighteenth and nineteenth centuries. American painters, sculptors, and silversmiths inherited the same facility for becoming artisans in other crafts, inventors, and even contributors to science.[2]

Another Renaissance pattern, too, has been somewhat misrepresented. One of Marshall McLuhan's generally accepted assertions, not much altered by the work of Elizabeth Eisenstein (despite her negative reaction to McLuhan), is that the rise of printing fixed the 'print culture'—the dominance of verbal thought—upon us. In fact, well before that development, the trivium of the seven liberal arts had already identified verbal thought as the first focus of education. On the other hand, however, even printed books were not wholly limited to verbal thought. An excellent example of books in which the visual rather than the verbal content was primary were the so-called 'theaters of machines' that appeared in Italy, France, and Germany from the sixteenth to the eighteenth centuries. The books were carried by drawings of machines, mechanisms, and new designs; the words that accompanied them were brief and merely explanatory. Still, of course, they were too few and too scattered to challenge the overwhelming concentration of published books upon the printed word.[3]

Both the spatial thought patterns of artists and craftsmen and the concentration of education and publication upon verbal thought were integral elements of the American community when Charles Willson Peale was born in Maryland in 1741 (fig. 1). Apprenticed there as a saddler, he soon afterward trained himself to repair watches and then began to experiment with painting. Portrait painting arose in his mind as a promising way to make money, and, in 1766, he went to England to

[2] Jacob Bronowski, *The Visionary Eye: Essays in the Arts, Literature, and Science* (Cambridge, Mass., 1978), pp. 50–52; Leonardo da Vinci, *Treatise on Painting*, trans. by Philip A. McMahon (Princeton, 1956); Ladislao Reti and Bern Dibner, *Leonardo da Vinci, Technologist* (New York, 1969).

[3] Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographic Man* (London, 1962); Elizabeth L. Eisenstein, *The Printing Press as an Agent of Change*, 2 vols. (New York, 1979).

improve his skill under the emigré American Benjamin West. He returned to become the leading portraitist of the Revolutionary era. Peale's paintings have been described as strong, spirited, and natural, and Peale himself as primarily a draftsman with little interest in color or, until late in his career, light. He sketched his sense of the individual on canvas and then covered it with paint. This process reflected an approach that was harmonious with his training as a craftsman and made it easy for him to move into further technological endeavors.[4]

Peale is remembered first as an artist and only in a minor measure as an inventor or creative mechanic, but his parallel work in both fields calls for attention (fig. 2). In 1795, he and his son Raphaelle were awarded a premium by the American Philosophical Society and, later, given a patent for an improvement to the Rittenhouse stove, which was itself an improved Franklin stove. Although never used commercially, this stove was typical of most of his technology in that it represented the 'rejuggling' of a known device.[5] His patent bridge was a more original design, but, at the same time, it was more unsatisfactory. It did not have sufficient trusses and stiffening to support it adequately and, fortunately, was never built except in model form. Actually, his most important contributions were in carrying forward and sometimes improving devices that had been designed by others. He drew up and advocated John Cam's 'fan chair'; he improved John Isaac Hawkins's polygraph, which duplicated papers as they were written; and he put Hawkins's physiognotrace into effective use, having an employee produce many silhouettes mechanically. Interest in rejuggling and redesigning mechanical devices was an inherent aspect of Peale apparent also in his other careers (fig. 3).

His contributions to natural history, primarily through his

[4] Edgar P. Richardson, Brooke Hindle, and Lillian B. Miller, *Charles Willson Peale and His World* (New York, 1982).

[5] Eliot Marshall, 'Japan and the Economics of Invention,' *Science* 228 (1985): 157–58.

museum, were broader and more important, and they involved art and technology as well as science. The connection between art and a natural history museum was initiated before Peale's move in that direction, most conspicuously by Pierre Eugene Du Simitiere, who, in 1782, established the American Museum in Philadelphia. Du Simitiere was an artist and amateur collector whose museum offered civil and natural history artifacts as well as written materials. It lasted only two years, ending with Du Simitiere's death in 1784.[6]

The move from art to a primary concern for natural history was clear-cut in the opening of Peale's museum, shortly after 1784. He had earlier maintained a collection of paintings in his art gallery, as did many other artists. The purpose was to inform and attract potential customers, but Peale began to wonder whether his gallery show might not be improved and turned into a profitable art museum. However, when he was commissioned to make drawings of fossil bones from Big Bone Lick, he decided to concentrate instead upon natural history. Still, he initially opened his museum inside his extended art gallery. In 1794, he was able to move it into the American Philosophical Society's Philosophical Hall on Independence Square and, in 1802, into Independence Hall itself (fig. 4). Peale never ceased to display his own portraits of American war and peace leaders in his museum, but natural history was the great strength of the museum.[7]

His tie to the American Philosophical Society and to leading Philadelphia scientists strengthened his efforts to emphasize the science of natural history and to use the museum for disseminating scientific understanding. Science was not his own greatest strength, but he did encourage and bring into the

[6] John C. Van Horne, et al., *Pierre Eugene Du Simitiere: His American Museum 200 Years After* (Philadelphia, 1985).

[7] Charles Coleman Sellers, *Mr. Peale's Museum: Charles Willson Peale and the First Popular Museum of Natural History and Art* (New York, 1980); Whitfield J. Bell, Jr., 'A Box of Old Bones: A Note on the Identification of the Mastodon, 1766–1906,' *Proceedings of the American Philosophical Society* 93 (1949): 169–77.

museum scene leading naturalists of the day, among them, William Bartram, Thomas Say, and Gerard Troost. As one means of forwarding science, he had the French naturalist, Palisot de Beauvois, begin a catalogue of museum holdings, but only a small portion was published before de Beauvois returned to France.

Peale's major museum contributions rested upon his design capabilities. He developed excellent methods for preserving and stuffing birds and mammals, displaying them within their natural habitats. He also presented minerals and ethnic cultural artifacts (fig. 5). Peale was particularly sensitive to the attractiveness and comfort of the museum, giving attention to heat and light and continuing to introduce improvements that would add appeal to visitors.

His most direct contribution to science reflected his capabilities in both art and technology. This was his 1801 *Exhumation of the Mastodon*, which he painted as well (fig. 6). Peale began by making drawings of mammoth bones found earlier at Newburgh, New York. He designed the water pumps, supervised the extraction of the bones, and then displayed in his museum the first mastodon skeleton to be put together in either the United States or Europe. This success revealed clearly the interrelations of Peale's seemingly diverse activities. It rested upon his ability to design mechanical devices, to reassemble many strange bones, and to communicate the results to the public and appropriate scientific groups. Design was Peale's strength—in art, in technology, and in science.

Unlike Peale, Samuel F. B. Morse is not remembered primarily for his art but for his invention and development of an electromagnetic telegraph; yet, Morse's first great success was also in art (fig. 7). He began painting on his own before college and continued sporadically during his years at Yale. In 1810, Morse went to England to study, as had Peale, under Benjamin West, whose lifestyle convinced him that he was correct in believing that artists had a good route to prosperity.

In the United States, Morse succeeded as a painter, although he did not attain the wealth he sought. He did, however, become the first art professor in the country, at New York University. Morse sought to raise American art to a new level by painting grandiose and sometimes imaginative scenes, but these demanding efforts yielded little monetary return (fig. 8). Much as he denigrated portrait painting, he had to devote most of his time to it in order to gain sufficient income, and today his portraits are regarded as his primary art achievement.[8]

Unlike most artists, Morse withdrew totally from that field never to return when, in 1837, he suffered a devastating defeat. He was not chosen, as he had reasonably assumed he would be, to paint one of the four scenes projected for the rotunda of the National Capitol. After a deep depression, Morse turned his full effort toward an interest upon which he had been working occasionally since his return trip from France in 1832. Morse had learned then of recent work in electricity and, incorrectly, believed that he was the first to conceive of the idea of an electric telegraph. To this project, he brought his college enthusiasm for science but, admittedly little capacity for working with wood or metal.

In 1837, Morse put together his first telegraph model, based upon the drawings he had made in 1832. Known as the canvas stretcher telegraph, it still survives, providing a remarkable symbol of a combination of art and technology (fig. 9). There was actually no other good reason for Morse to incorporate the canvas stretcher into his telegraph apart from the fact that one was always available to him to be used to hold the canvases upon which he painted. He placed the telegraph receiver and tape recorder in such a way that he would have only a few other pieces of wood to cut and fit into the device. It was not a well-designed machine, nor was his transmitter, which he called a portrule. Still, the system worked.

In order to bring the telegraph to commercial fulfillment,

[8] Brooke Hindle, *Emulation and Invention* (New York, 1981), pp. 85–125.

Morse spent many years on its development, not patenting it until 1840 and not attaining recognized success until 1844. Before then, Morse brought into partnership Leonard D. Gale, a science professor of broad interests, and Alfred Vail, a recent college graduate of great mechanical ability, who followed and improved Morse's designs in building the required apparatus. What emerged was the simple Morse key for transmitting the Morse dot-dash code and a much more elegant and efficient receiver-recorder.

Morse and his partners used his patent to bring themselves into a number of telegraph line companies, a move that returned rising income and finally brought to Morse the wealth he had always sought. Throughout, his contribution was to develop in his mind new designs for the variety of mechanisms required (fig. 10). Both he and Vail flourished in spatial thinking, Morse once commenting to Vail, 'I long to see the machine . . . you have been maturing in the Studio of your brain.'[9]

Morse's ability to design new mechanisms was excellent, but his relationship to science was less direct. His telegraph was not the first science-based invention, as is sometimes claimed, although Joseph Henry did believe that it was based primarily upon his own science. In fact, the telegraph did rest upon Henry's and others' work in science, and Henry helped Morse directly. On their own, Morse and his partners conducted various experiments, and Morse published one of his studies in the *American Journal of Science*. Morse understood that he was not a scientist, but he did reach out for all the applicable science he could find. He was correctly celebrated for his technology, as Christian Schussele did in his *Men of Progress* of 1862, placing Morse in the position of honor (fig. 11). Schussele, however, left open the science question by connecting Morse to Henry and to a portrait of Franklin.

It is necessary to reach beyond Peale and Morse, who were

[9] Samuel F. B. Morse to Alfred Vail, October 19, 1837, Vail Papers, Smithsonian Institution Archives.

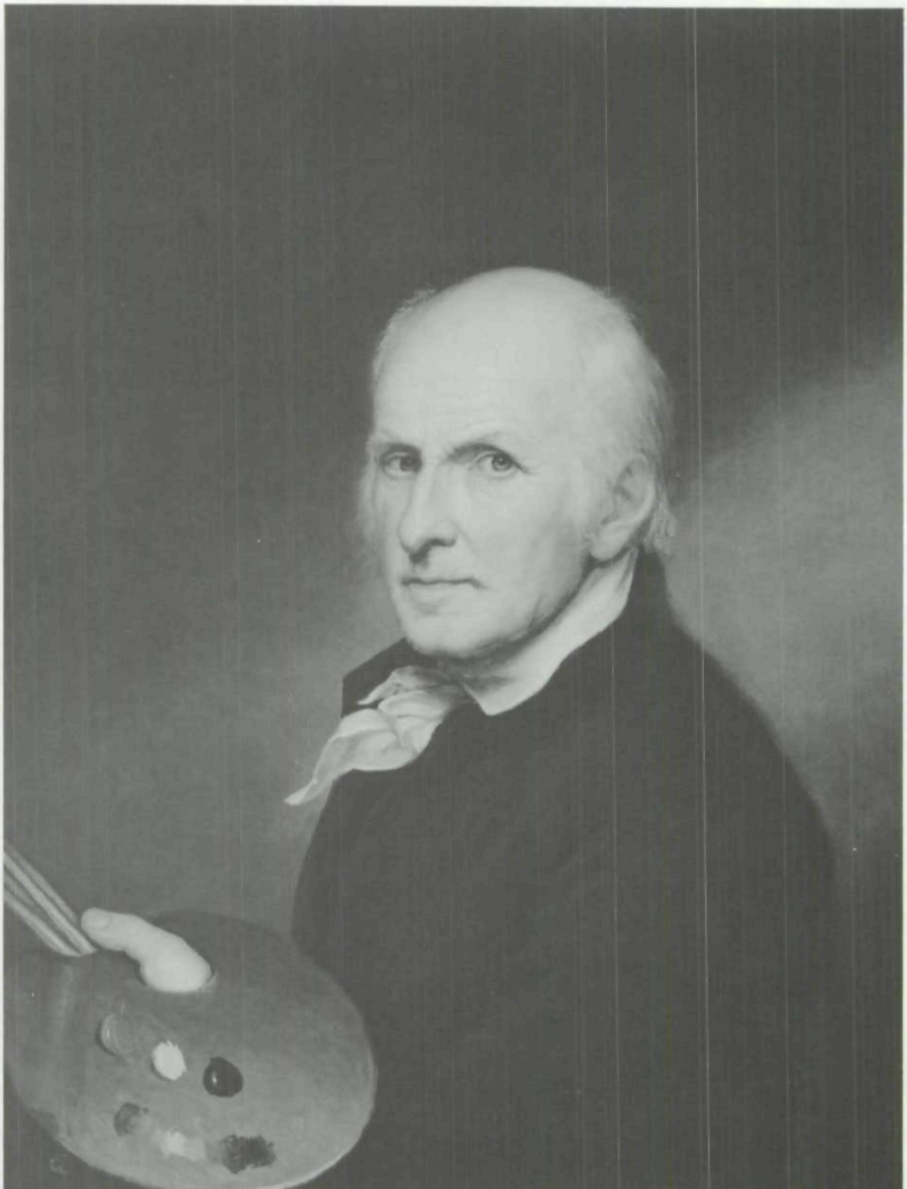


Fig. 1. Charles Willson Peale, *Self-Portrait with Palette,* 1822 (Private Collection).

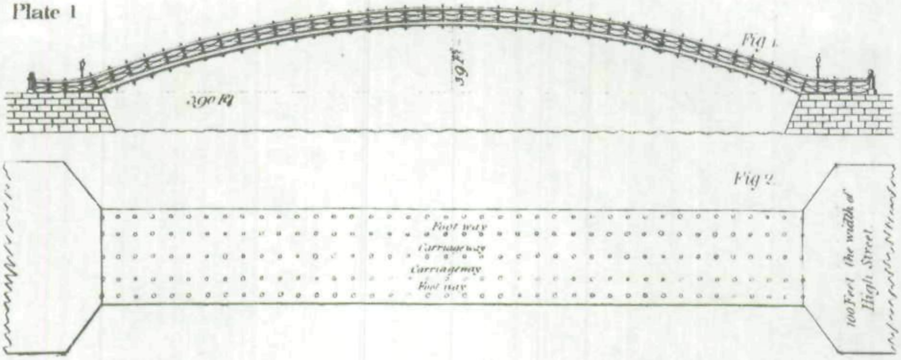


Fig. 2. Patent bridge (Charles Willson Peale, *Essay on Building Wooden Bridges*, Philadelphia, 1797).

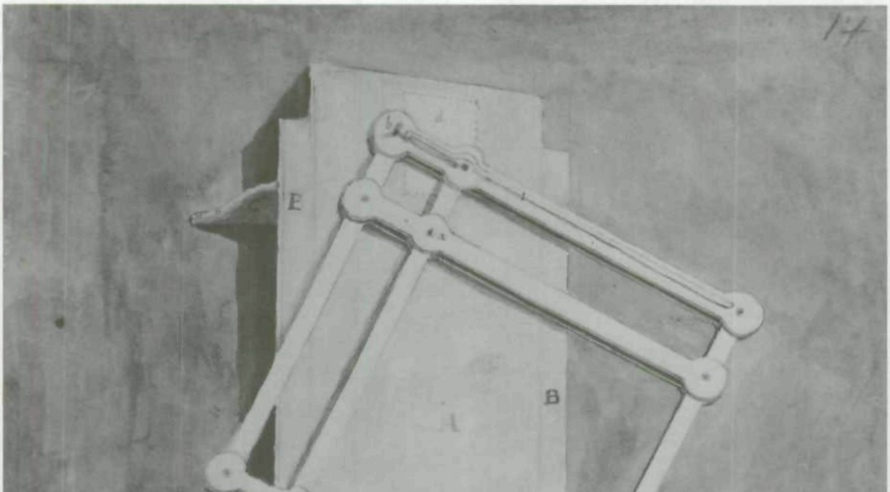


Fig. 3. Physiognotrace of John Isaac Hawkins (Library of Congress).

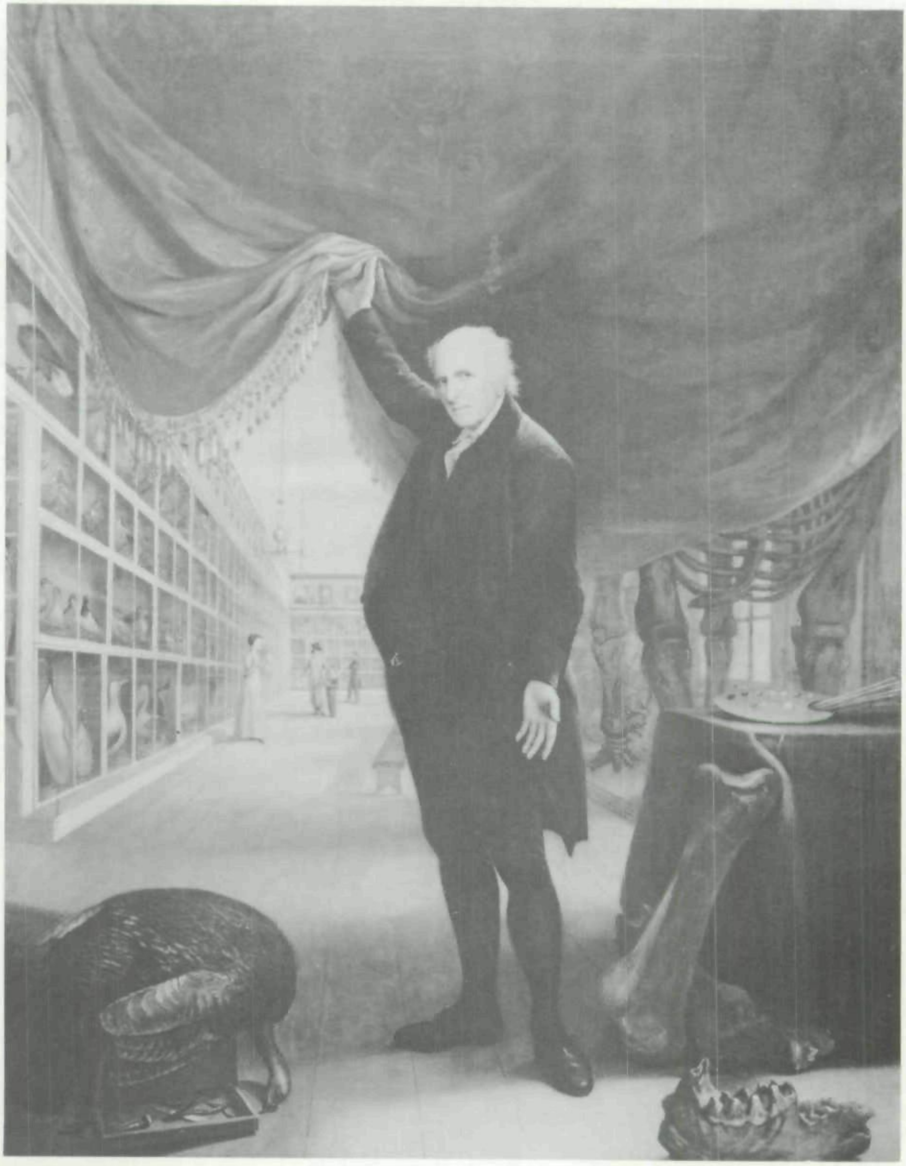


Fig. 4. Charles Willson Peale, *The Artist in His Museum*, 1822 (Pennsylvania Academy of the Fine Arts).

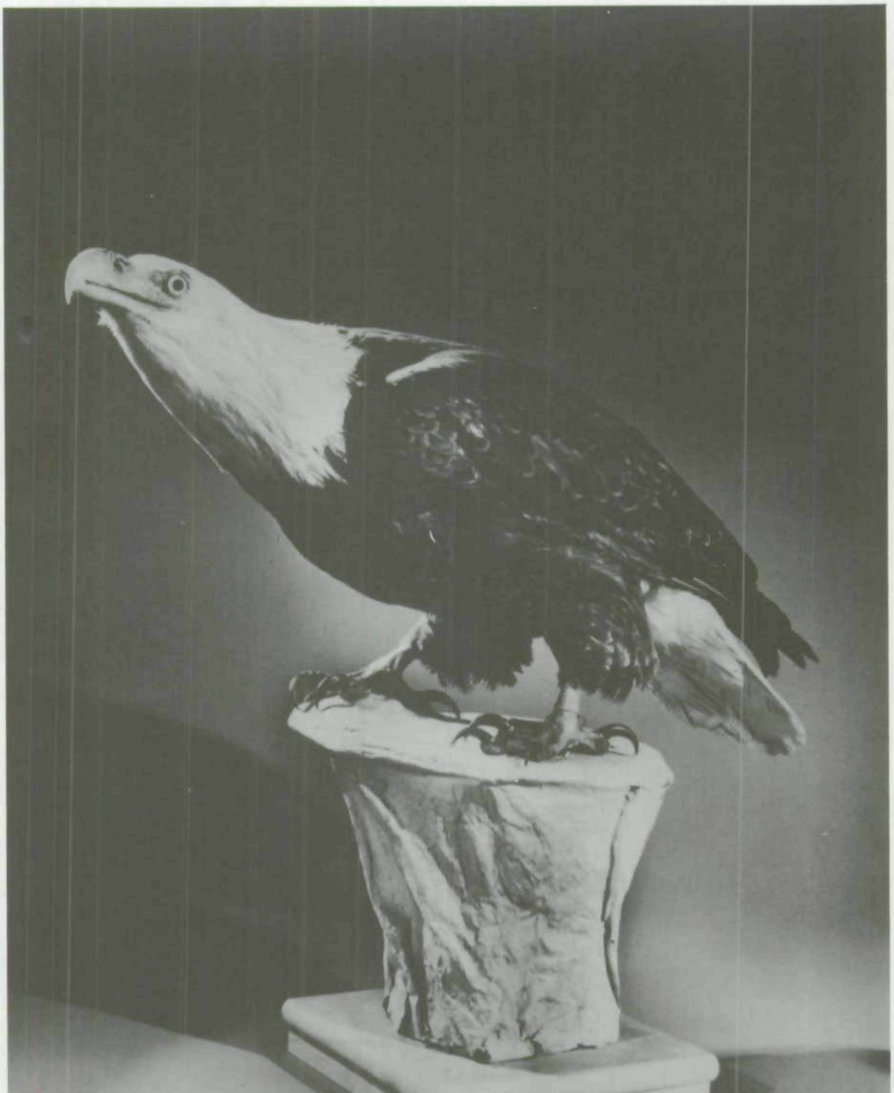


Fig. 5. Charles Willson Peale's white-headed or bald eagle (museum mounting) (Museum of Comparative Zoology, Harvard University).

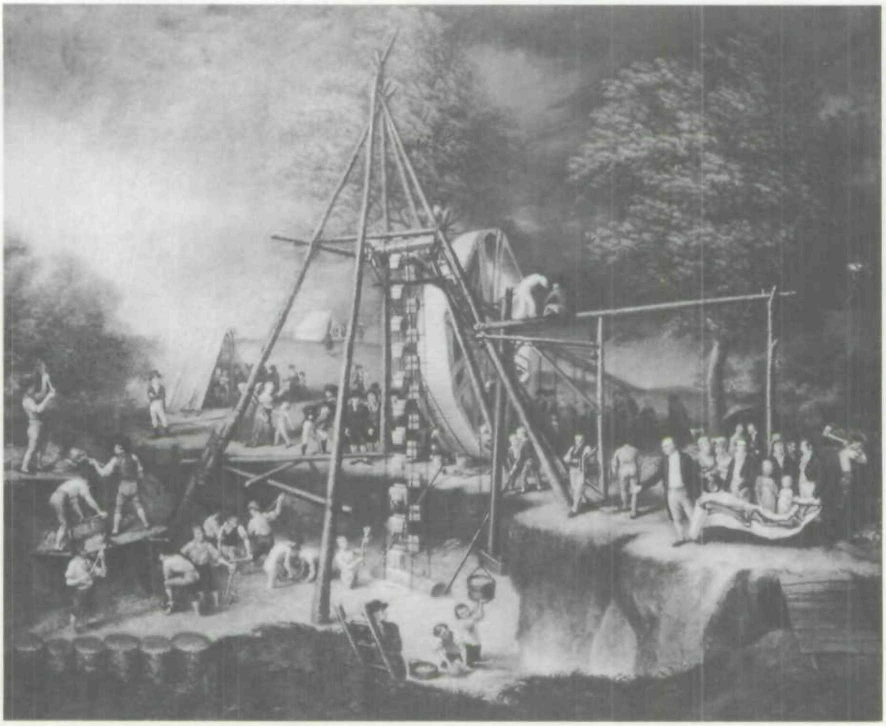
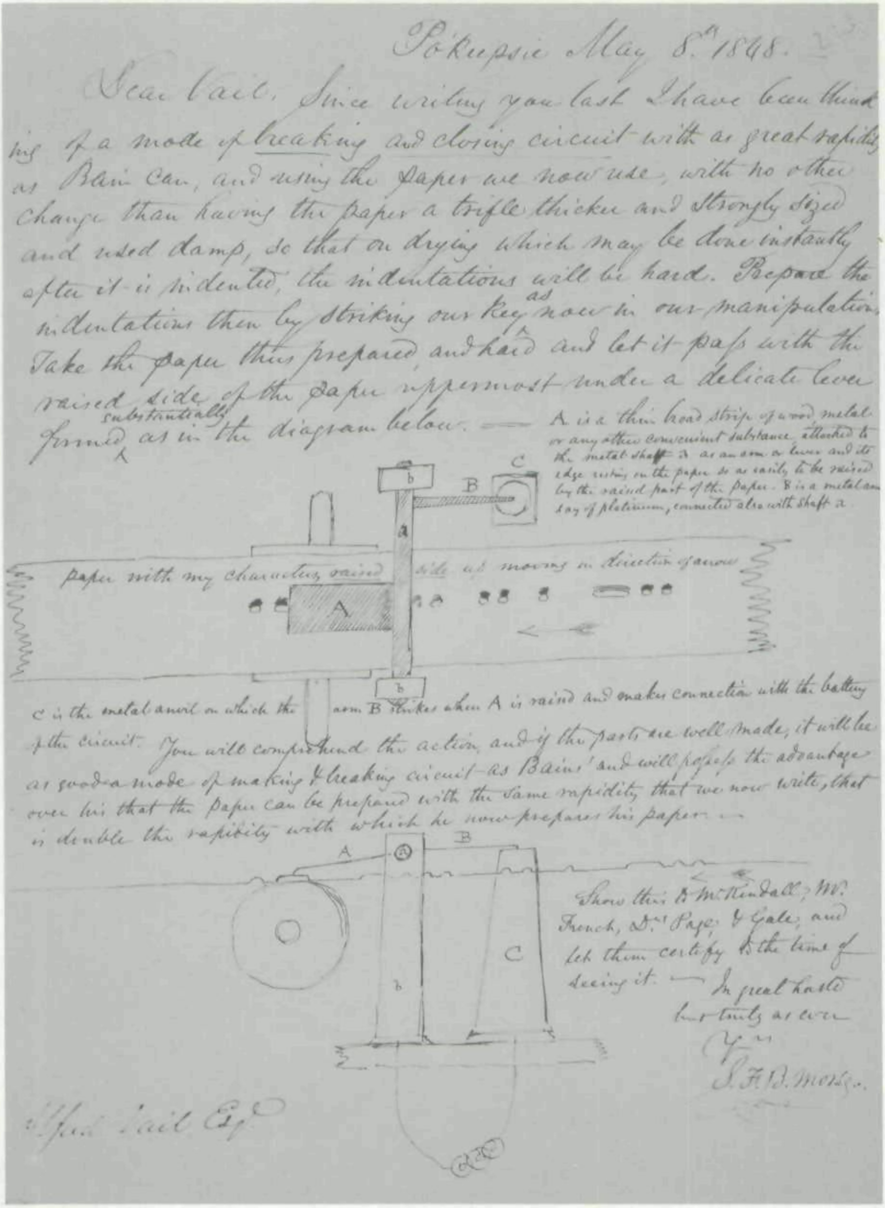


Fig. 6. Charles Willson Peale, *The Exhumation of the Mastodon*, 1806–8 (The Peale Museum).

Fig. 7. Samuel F. B. Morse, *Self-Portrait*, ca. 1809 (National Academy of Design, through Frick Art Reference Library).

Fig. 8. Samuel F. B. Morse, *The Old House Chamber in the Capitol*, 1823 (Collection of the Corcoran Gallery of Art)

Fig. 9. Canvas stretcher telegraph, 1837 (National Museum of American History).



Pokeepsie May 8th 1848.

Dear Vail. Since writing you last I have been thinking of a mode of breaking and closing circuit with as great rapidity as Bain can, and using the paper we now use, with no other change than having the paper a trifle thicker and strongly sized and used damp, so that on drying which may be done instantly after it is indented, the indentations will be hard. Prepare the indentations then by striking our key as now in our manipulation. Take the paper thus prepared and hard and let it pass with the raised side of the paper uppermost under a delicate lever formed substantially as in the diagram below. —

A is a thin hard strip of wood metal or any other convenient substance, attached to the metal shaft a as an arm or lever and its edge resting on the paper so as easily to be raised by the raised part of the paper. B is a metal arm say of platinum, connected also with shaft a

C is the metal anvil on which the arm B strikes when A is raised and makes connection with the battery of the circuit. You will comprehend the action, and if the parts are well made, it will be as good a mode of making & breaking circuit as Bain's and will possess the advantage over his that the paper can be prepared with the same rapidity that we now write, that is double the rapidity with which he now prepares his paper. —

Show this to Mr Kendall, Mr French, Drs Page, & Gale, and let them certify to the time of seeing it. — In great haste but truly as ever Yrs

S. F. B. Morse.

Alfred Vail Esq

Fig. 10. Samuel F. B. Morse to Alfred Vail, May 8, 1849 (Smithsonian Institution Archives).

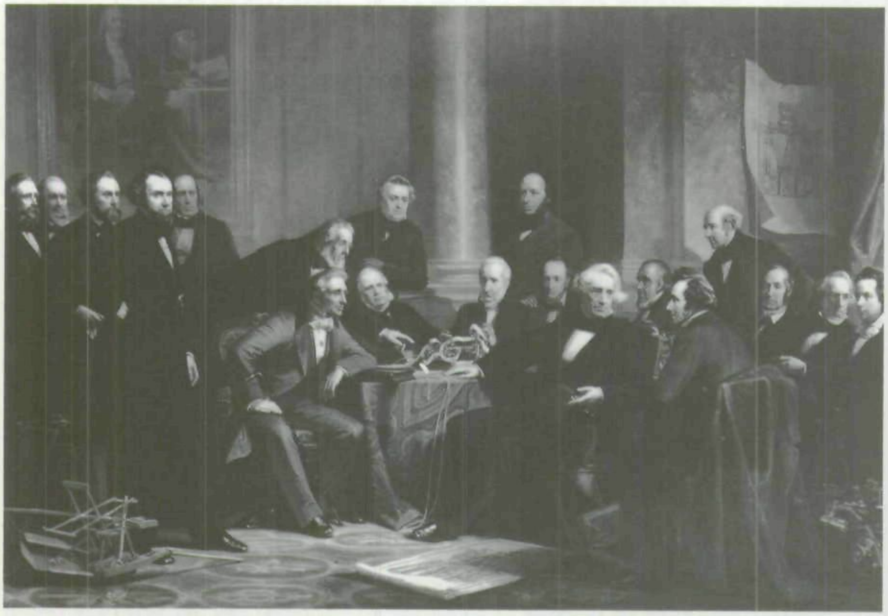


Fig. 11. Christian Schussele, *Men of Progress*, 1862 (National Portrait Gallery).

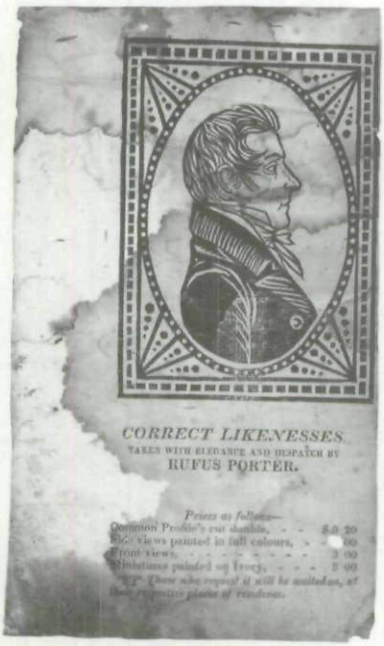


Fig. 12. Rufus Porter handbill, Early 1800s (American Antiquarian Society).

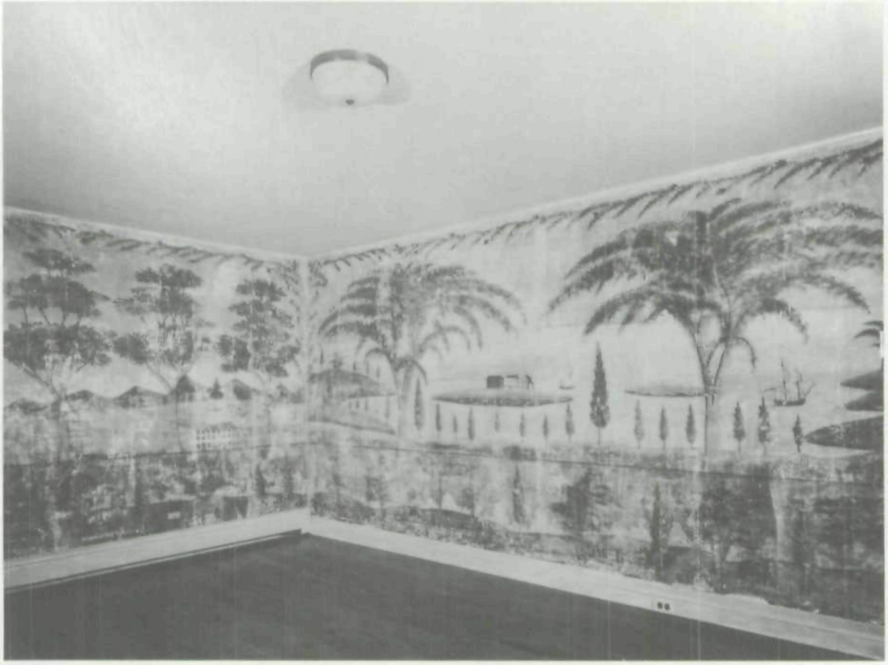


Fig. 13. Rufus Porter mural at Richard Gradin House, East Jaffrey, N.H., ca. 1825 (Jean Lipman Papers, Archives of American Art, Smithsonian Institution).

STEAM-CARRIAGE FOR COMMON ROADS.

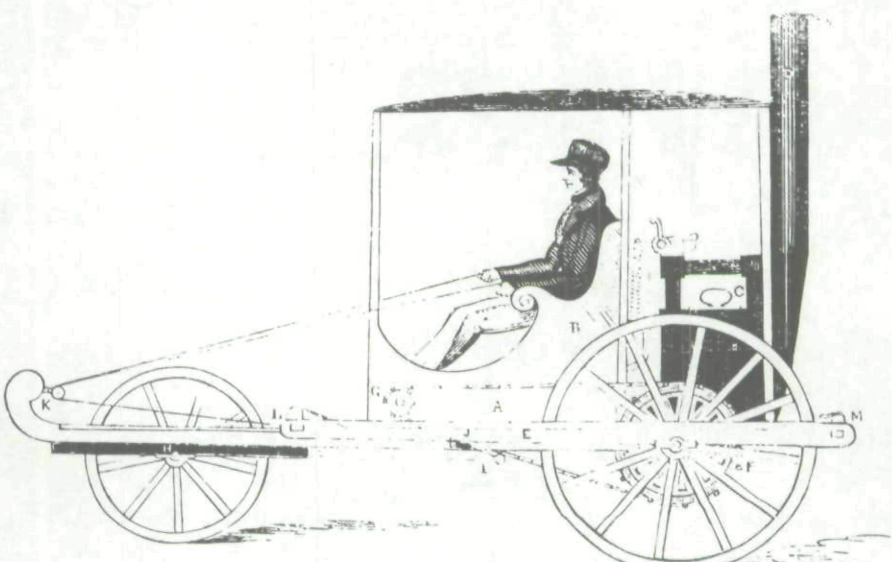


Fig. 14. Rufus Porter, steam carriage for common roads (Jean Lipman Papers, Archives of American Art).

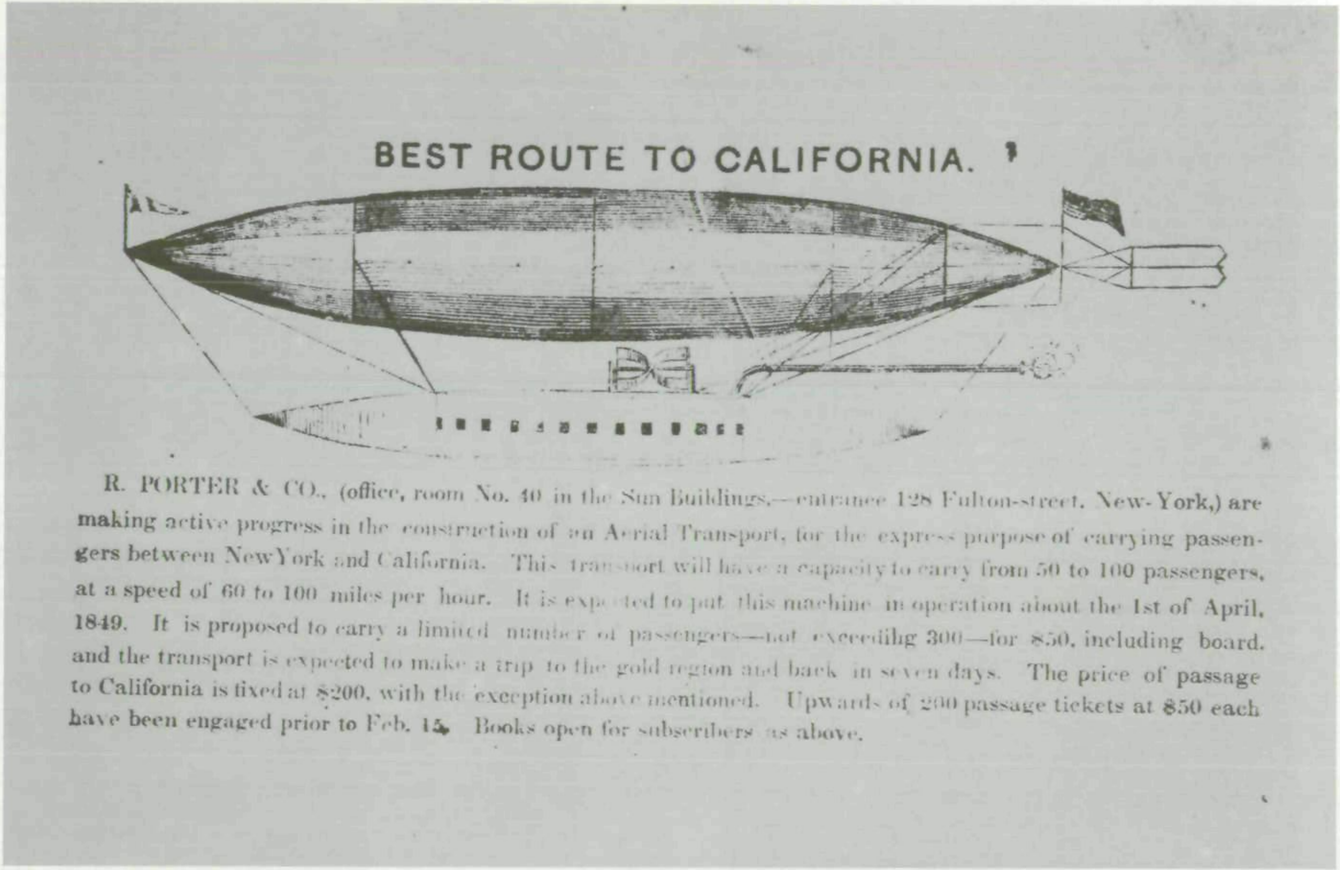
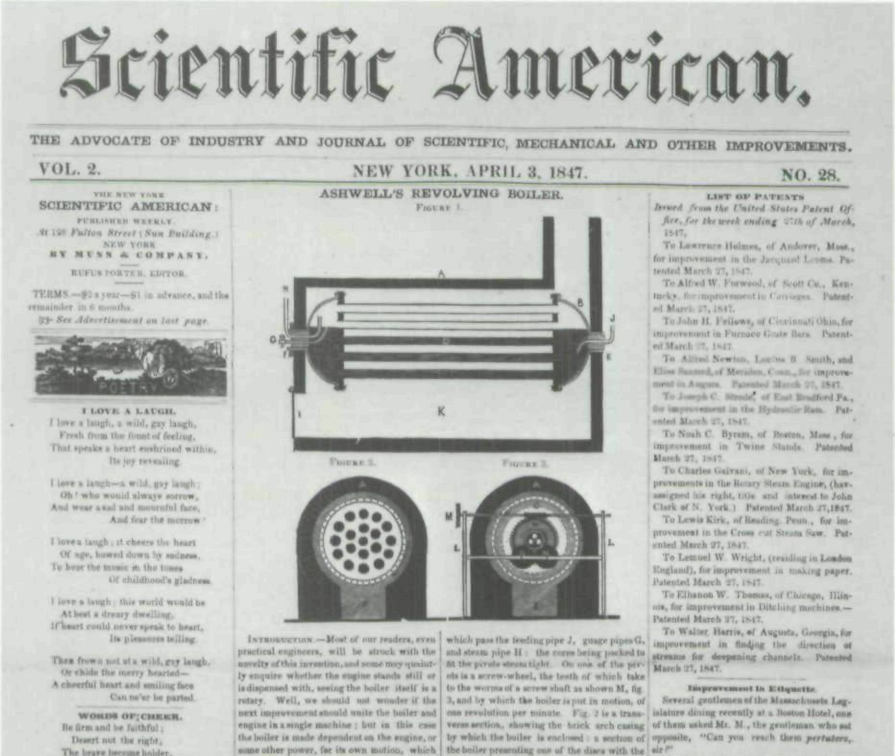


Fig. 15. Rufus Porter aeroport (Rufus Porter, *Aerial Navigation* [New York, 1849] back cover).



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See Advertisement on last page.

POETRY

I LOVE A LAUGH.

I love a laugh, a wild, gay laugh,
Fresh from the fount of feeling,
That speaks a heart enshrined within,
Its joy revealing.

I love a laugh—a wild, gay laugh;
Oh! who would always sorrow,
And wear a sad and mournful face,
And fear the morrow!

I love a laugh; it cheers the heart
Of age, bowed down by sadness,
To hear the music in the tones
Of childhood's gladness.

I love a laugh; this world would be
At best a dreary dwelling,
If heart could never speak to heart,
Its pleasures telling.

Then frown not at a wild, gay laugh,
Or chide the merry hearted—
A cheerful heart and smiling face
Can ne'er be parted.

WORDS OF CHEER.

Be firm and be faithful;
Desert not the right;
The brave become bolder,
The darker the night:
Then up and be doing,
Though cowards may fail;
Thy duty pursuing,
Dare all, and prevail!

If scorn be thy portion,
If hatred and loss,
If stripes and if prison,
Remember the cross!
God watches above thee,
And he will requite;
Desert those that love thee,
But never the right!

TO YOUNG MEN.

Young man in broadcloth sleek and fair,
With shining whiskers and long hair,
With vest so white, and boots so bright,
Beware.
The goblet sparkles fair and bright,
And give the joy you feel to-night;
Give it a throw, and let it go,
To-night.

The yawning pit gaps wide for you,
And demons try what they can do
To draw you in, through thick and thin—
'Tis true.
O! cheat the devil of his prey,
By throwing ardent drinks away;
With all your might—then all is right,
To-day.

When this you cheerfully have done
Go straight enjoy your mirth and fun;
But keep away from ruin, I say,
From Rum.
But when the tempter comes so sly,
And on you fixes that red eye,
And says 'tis good—I wish you would
Beware.

ASHWELL'S REVOLVING BOILER.

FIGURE 1.

FIGURE 2. FIGURE 3.

INTRODUCTION.—Most of our readers, even practical engineers, will be struck with the novelty of this invention, and some may quaintly enquire whether the engine stands still or is dispensed with, seeing the boiler itself is a rotary. Well, we should not wonder if the next improvement should unite the boiler and engine in a single machine; but in this case the boiler is made dependent on the engine, or some other power, for its own motion, which is produced for the purpose of preservation of the boiler, which would be otherwise liable to injury. The inventor, Mr. Thomas Ashwell, of Stockbridge, Mass., has had one of them in operation, and is satisfied that it produces much more power in proportion to the expense of fuel, and the space occupied, than any other kind in use.

EXPLANATION.—Fig. 1, is a longitudinal section of the boiler and the brick casing A, in which it is enclosed. The boiler consists of a series of horizontal iron tubes D, secured at each end in cast iron discs (originally cast upon the tubes by a peculiar process) and to the rim of each is attached by rivets or screw bolts the flange of a convex head B, from the centre of which projects a tubular pivot F, by which the boiler is supported on its bearings. These pivots are about six inches in diameter (for a boiler 7 feet long) and within each pivot is a stationary core or centre piece, through which pass the feeding pipe J, guage pipes G, and steam pipe H: the cores being packed to fit the pivots steam tight. On one of the pivots is a screw-wheel, the teeth of which take to the worms of a screw shaft as shown M, fig. 3, and by which the boiler is put in motion, of one revolution per minute. Fig. 2 is a transverse section, showing the brick arch casing by which the boiler is enclosed: a section of the boiler presenting one of the discs with the tubes, and the furnace or fire chamber K, below. Fig. 3, is a view of the front end of the boiler with its core, perforated for three pipes (steam pipe and two guage pipes) with the screw-wheel H, and the screw C, and the friction wheels on which the pivot rests. The brick arch work presents the escape by radiation, of the heat, while the surface of each tube is subjected to its action. One end of the boiler is a little elevated to enable the steam to escape with facility, and the uppermost tubes, being above the surface of the water, serve as channels for the steam, but are not kept out of water long enough to get highly heated: and by their constant change of position, are kept from incrustations or sediment. The inventor has extended his plan to a guage dial and index: but that should be the subject of another description. He intends to apply for a patent as soon as he has sufficiently matured and proved the invention.

The Young Prussian.

Frederick, king of Prussia, one day rang his bell, and nobody answering, he opened his door and found his page fast asleep in an elbow chair. He advanced towards, and was going to awaken him, when he perceived a letter hanging out of his pocket. His curiosity prompting him to know what it was, he took it out and read it. It was a letter from this young man's mother, in which she thanked him for having sent her a part of his wages to relieve her misery, and finished with telling him that God would reward him for his dutiful affection. The king, after reading it, went back softly into his chamber, took a purse full of ducats, and slipped it with the letter into the page's pocket. Returning to the chamber, he rang the bell so loudly that it awakened the page, who instantly made his appearance. "You have had a sound sleep," said the king. The page was at a loss how to excuse himself; and putting his hand into his pocket by chance, to his utter astonishment he there found a purse of ducats. He took it out, turned pale, and looking at the king, shed a torrent of tears without being able to utter a single word. "What is that?" said the king; "what is the matter?" "Ah! sire," said the young man, throwing himself on his knees, "somebody seeks my ruin! I know nothing of this money which I have just found in my pocket!" "My young friend," replied Frederick, "God often does great things for us, even in our sleep. Send that to your mother; salute her on my part, and assure her that I will take care both of her and you."

The census of St. Louis recently taken, exhibits an increase of 11,56? souls during the past two years.

LIST OF PATENTS

Issued from the United States Patent Office, for the week ending 27th of March, 1847.

To Lawrence Holmes, of Andover, Mass., for improvement in the Jacquard Looms. Patented March 27, 1847.

To Alfred W. Forwood, of Scott Co., Kentucky, for improvement in Carriages. Patented March 27, 1847.

To John H. Fellows, of Cincinnati Ohio, for improvement in Furnace Grate Bars. Patented March 27, 1847.

To Alfred Newton, Lucius B. Smith, and Elias Sanford, of Meriden, Conn., for improvement in Augurs. Patented March 27, 1847.

To Joseph C. Strode, of East Bradford Pa., for improvement in the Hydraulic Ram. Patented March 27, 1847.

To Noah C. Byram, of Boston, Mass., for improvement in Twine Stands. Patented March 27, 1847.

To Charles Galvani, of New York, for improvements in the Rotary Steam Engine, (having assigned his right, title and interest to John Clark of N. York.) Patented March 27, 1847.

To Lewis Kirk, of Reading, Penn., for improvement in the Cross cut Steam Saw. Patented March 27, 1847.

To Lemuel W. Wright, (residing in London England), for improvement in making paper. Patented March 27, 1847.

To Elhanon W. Thomas, of Chicago, Illinois, for improvement in Ditching machines.—Patented March 27, 1847.

To Walter Harris, of Augusta, Georgia, for improvement in finding the direction of streams for deepening channels. Patented March 27, 1847.

Improvement in Etiquette.

Several gentlemen of the Massachusetts Legislature dining recently at a Boston Hotel, one of them asked Mr. M., the gentleman who sat opposite, "Can you reach them *pertaters*, sir?"

M. extended his arm toward the dish and satisfied himself that he *could* reach the *pertaters*, and answered,

"Yes sir."

"And will you stick my fork into one of 'em?" asked the Rep.

"O, certainly," said Mr. M., as he took the fork, carefully stabbing it into the potatoe, where he left it.

At this the Rep was somewhat vexed, and asked, rather tartly—

"Will you pass me my fork?"

"Ah!—your fork!—yes—oh, yes sir!"—and taking hold of the fork, he drew it from the potatoe and passed it back to the Rep, whose nerves seemed not a little shocked.

"Waiter!—*waiter!* I say!"—cried the Rep, —"will *you* pass the pertater! I've been tryin' for half an hour to get one, and if you don't pass 'em along purty sune, I'll report your conduct to my constiterwents!"

"Fashionable" Informalities.

On churching a titled lady and leader of *ton* a tuft-hunting clergyman is said to have emulated other pretended reformers of the Book of Common Prayer, and essayed a polite "adaptation" of its serious and solemn ritual: "O Lord, save *this woman*, Thy servant," by substituting "save *this lady*, Thy servant;" while the conceited clerk, determined not to be outdone in sycophantish politeness, gravely interjected the response, "who putteth her [*ladyship's*] trust in Thee."

Too Rich by Half.

The infant Don Maria, son of Don Carlos, born March 13, 1822, will, it now seems arranged, marry the Arch Duchess Maria Beatrix D'Este, born February 18, 1824. They have between them a fortune of a hundred millions of florins ($40,000,000.)

Fig. 16. *Scientific American*, April 3, 1847.

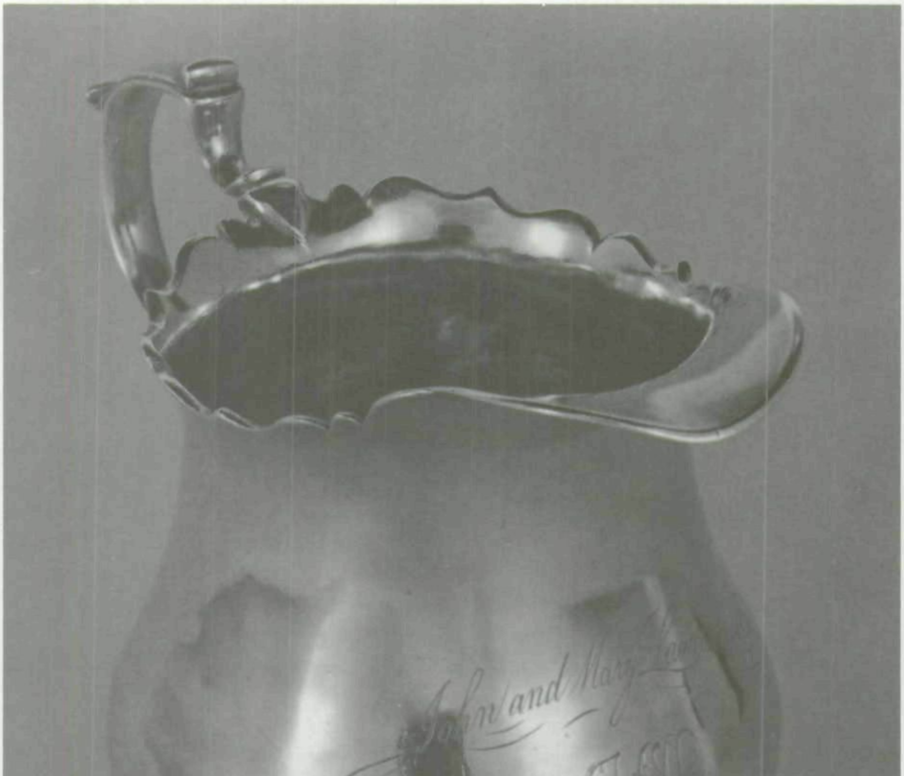

Fig. 17. John Fitch creamer, ca. 1775 (Historical Society of Pennsylvania).

Fig. 18. William Thornton, Scottish scene, probably of Ben Nevis (per Charles M. Harris) (Library of Congress).

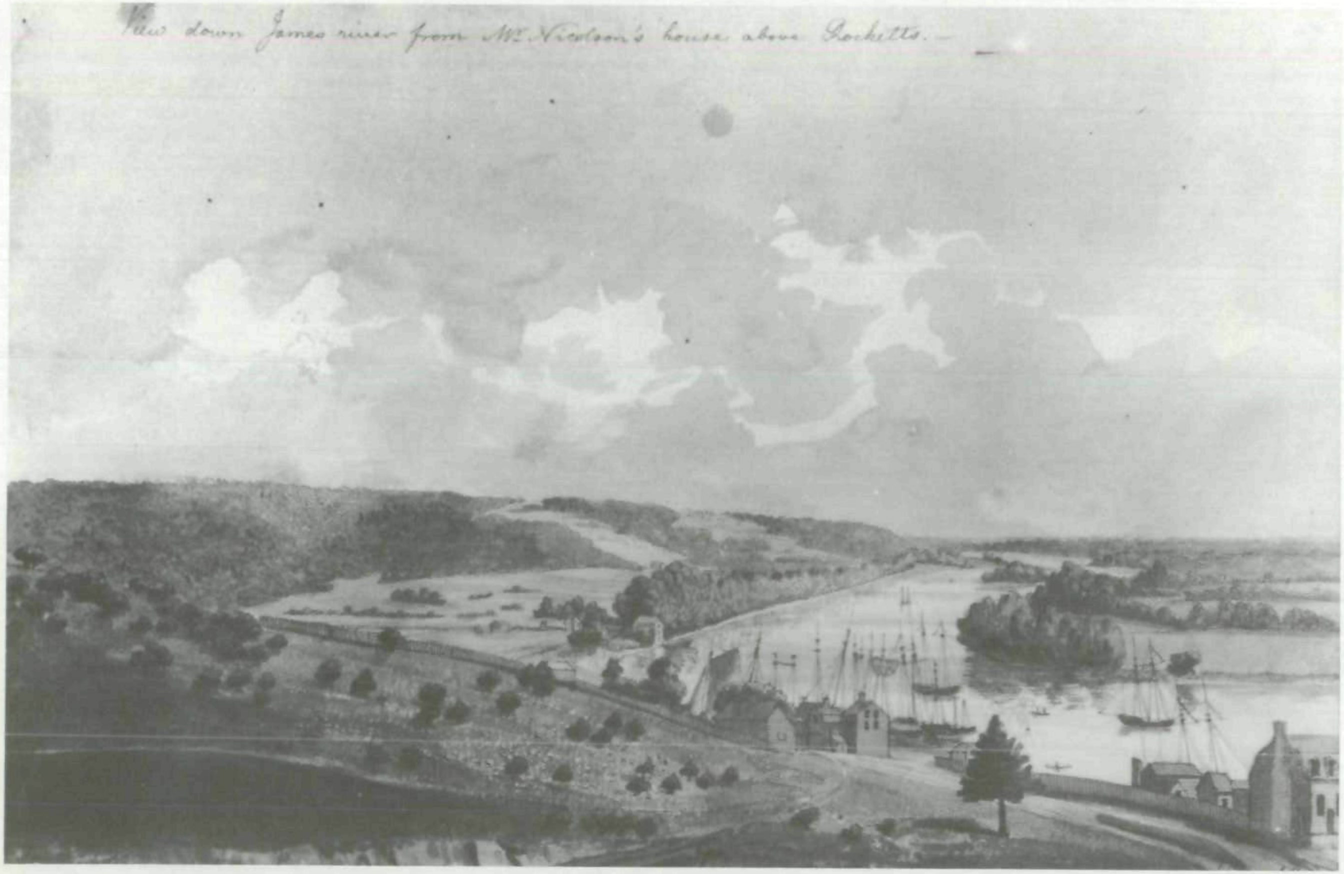

Fig. 19. Benjamin Henry Latrobe, *View down James River from Mr. Nicholson's House above Rocketts* (Papers of B. H. Latrobe, Maryland Historical Society).

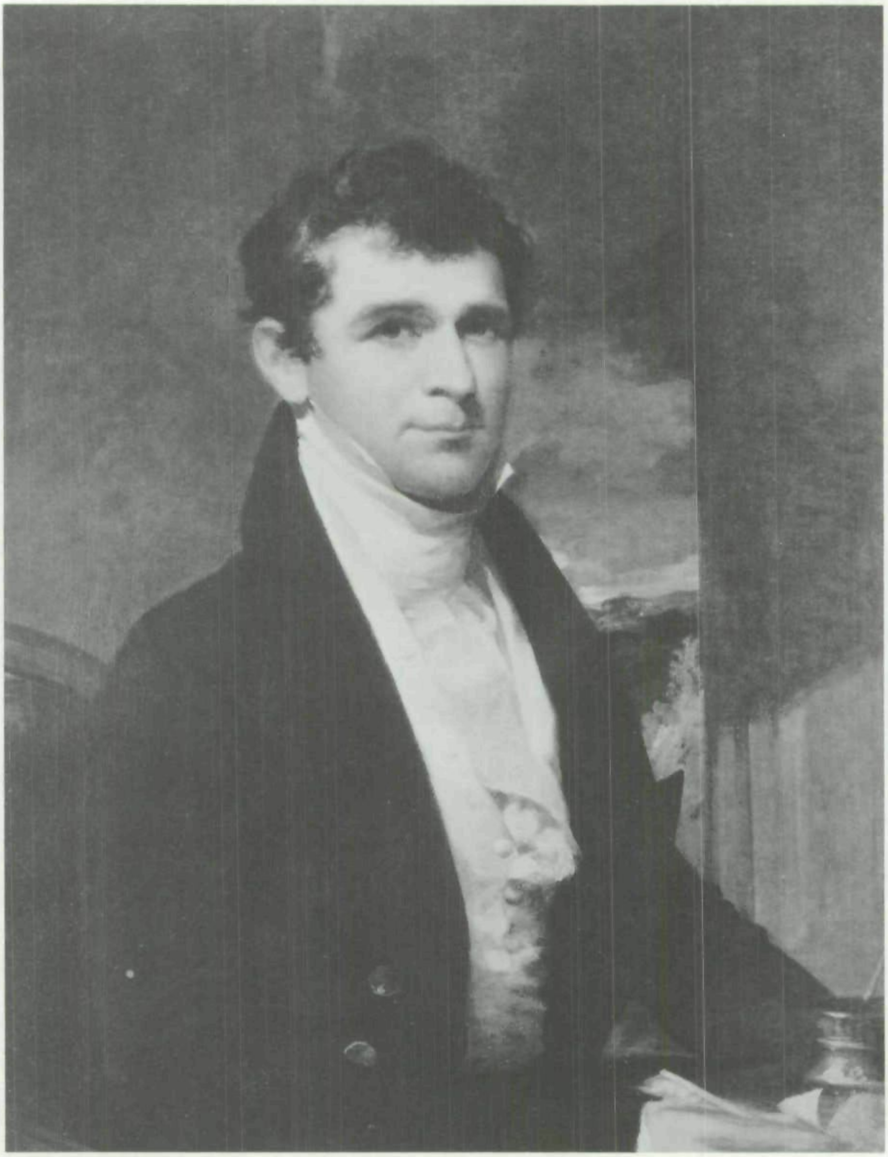

Fig. 20. Robert Fulton, *Self-Portrait*, ca. 1807 (William Rockhill Nelson Gallery of Art).

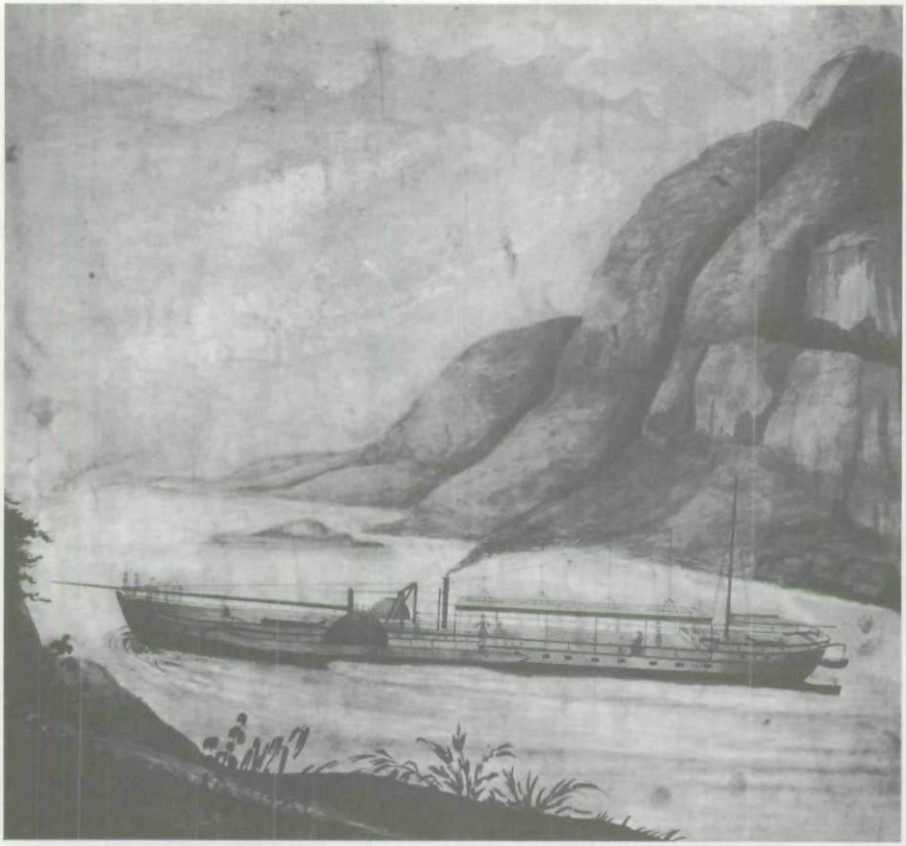

Fig. 21. Robert Fulton steamboat, 1809 patent drawing (American Society of Mechanical Engineers).

leading artists in their day, to a folk artist like Rufus Porter. Porter was raised in New England. He never completed his shoemaking apprenticeship but moved into odd jobs as a fiddler and then into portrait painting and dancing instruction (fig. 12). His major art work became the painting of frescoes which he produced on an itinerant basis throughout New England. His murals presented American scenes in a highly stylized manner, making use of stencils and his own techniques for completing the work quickly and sharply (fig. 13). In 1825, he published *A Select Collection of Valuable and Curious Arts*, explaining his approach to painting, and thereafter he continued to write up his ideas. Porter published his clear understanding of the mode of thought behind art, remarking once, 'The learner, for the purpose of acquiring the art of designing, should . . . imagine various scenes in his mind.'[10]

Porter entered his career in mechanics and invention some time after he began his art work, but, off and on, he continued to engage in both. He claimed at one point to have made over one hundred inventions, several of them patented (fig. 14). Nearly all were mechanical devices, most of which he pictured and described in newspapers or magazines, but he did not carry them through to operational success. Some he sold, including his revolving rifle, which Samuel Colt bought; others he simply made available to interested mechanics. Porter's most spectacular concept was a steam-powered, hydrogen airship that he called an aeroport (fig. 15). He began working on balloons as early as 1820 and published one version of the aeroport in 1843 and another in 1845. Porter did make extensive efforts to carry this design through to fulfillment, building a working model propelled by a spring-driven mechanism in 1847 and advertising the aeroport as a means for getting to California after the Gold Rush of 1849.[11]

[10] Quoted in Jean Lipman, *Rufus Porter Rediscovered: Artist, Inventor, Journalist, 1792–1884* (New York, 1980), p. 87.

[11] Thomas B. Settle, *Rufus Porter and his Aeroport* (Yonkers, 1980).

Porter moved through a third parallel career in journalism and publishing to found the *Scientific American* in 1845 (fig. 16). Like Peale and Morse, he, too, was an effective writer and verbal thinker. The subtitle of his periodical, *The Advocate of Industry and Enterprise, and Journal of Mechanical and Other Improvements*, was more descriptive than the title, for the journal was almost wholly concerned with invention and mechanics, plus occasional how-to-do-it art pieces from his past experience. Science was evident only in the broadest sense.

As with his inventions, Porter failed to carry the *Scientific American* through to the success it later attained. Instead, he sold it within a year to Alfred Ely Beach and Orson D. Munn, remaining as editor for a few months. Under Munn and Company, the journal rose from a circulation of two hundred to ten thousand by 1848, and to thirty thousand by 1860. Munn and Company soon became the leading patent soliciters in the country and sought to stimulate patent applications by encouraging the process of manipulating in the mind well-understood components of intended mechanisms.[12]

No more than Leonardo were Peale, Morse, and Porter unique artists in contributing to other fields of spatial thinking. For example, four other artists contributed to American success in the beginning of steamboating. Like Peale, John Fitch did not start out as an artist, but his move from clockmaking to silversmithing brought him to achievement in the fine arts, as did his later mapmaking (fig. 17). He always drew out his engines and boats before building them. These drawings lacked finesse, but his 1789 steamboat succeeded to the point of running over two thousand miles on commercial schedules. Two other contributors, William Thornton and Benjamin Henry Latrobe, are remembered principally as architects, architecture, of course, being a profession that requires both fine and mechanic arts input. The two men sketched and painted effec-

[12] Munn & Co., *The United States Patent Law: Instructions How to Obtain Letters Patent for New Inventions* (New York, 1866).

tively, designed important buildings, and worked on steamboat development—Thornton with Fitch and Latrobe with Fulton (figs. 18, 19). In technology, Thornton took charge of the Patent Office, and Latrobe served widely as an engineer. In science, Latrobe contributed to geology and geography.

Robert Fulton was the only one of the four trained initially as a painter, first in Philadelphia and then under West in London (fig. 20). He moved from painting to canal and military engineering and then to steamboat development. Fulton's inventive contributions were limited, but he, too, drew up his designs, including the Boulton and Watt engine that he ordered for his 1807 steamboat; that boat effectively launched steamboating as a continuing part of life in the United States (fig. 21). Better than most technology designers, Fulton understood his fundamental reliance on spatial thinking; his classic comment was, 'The mechanic should sit down among levers, screws, wedges, wheels, etc. like a poet among the letters of the alphabet, considering them as the exhibition of his thoughts, in which a new arrangement transmits a new Idea to the world.'[13]

The early American artists who moved into technology, and occasionally toward science, provide important insights into history. It is easy, however, to read into them the wrong conclusions. Work in art, for example, was not a good way to prepare for mechanical or scientific work. Similarly, any individual active in one field was not automatically competent to enter either of the others, as some who tried it discovered. The correct conclusion, as suggested earlier, is that the mode of spatial thinking was a common fundamental in each of these fields. That sort of thinking, however, does not stand in opposition to verbal thinking. Indeed, the most successful individuals, including Peale, Morse, and Porter, were successful writers as well.

[13] Quoted in Alice Crary Sutcliffe, *Robert Fulton and the 'Clermont'* (New York, 1909), p. 60.

The manner in which the arts and crafts were organized in early America also encouraged the ease of moving from one field to another. The basic pattern had long been a part of European life, and the close ties of the fine and mechanic arts had been transferred to America. One alteration, however, was the lessening of such constrictions as guilds and tight control over apprentices, journeymen, and masters. Americans could more easily move from one trade to another, even without going through an apprenticeship. Nevertheless, the marketplace remained the primary control.

Yet, if the basic historical connections among art, technology, and science rest upon a common necessity for spatial thinking, the question of why modern artists no longer move as easily to the other fields has to be answered. The decline of the arts and crafts communities is part of the reason, and that is related to the more important cause: heavily increased specialization and compartmentalization in almost every area of work and study. One can no longer enter engineering or any one of the sciences without extended and detailed study of mathematics and a complex of specifically required topics. The freedom early Americans enjoyed has been constricted in new ways. However, the thought pattern that dominated art as well as technology and science remains the same. All three share a deep and continuing relationship that is only recently coming to be recognized. One index of this is the International Society for the Arts, Sciences, and Technology, which is concerned not with history but with the present and the future.

The historical record is fully adequate to confirm art-technology-science relationships and dependence on spatial thinking, whether or not the cause of differences in thought processes is known. (In a similar manner, statistics demonstrated that smoking could cause cancer and heart disease before that process was understood.) Now at least, the cause and process behind spatial thinking is known, and it does help to explain the experiences of early American artists in a more concrete manner.

In the late 1960s, Roger Sperry conducted brain experiments for which he was awarded a Nobel Prize in 1981. Sperry discovered that, in most individuals, verbal thought is conducted primarily in the left hemisphere of the brain and spatial thought in the right. Everyone must use both modes of thinking, and most complex problems of any sort require input from both. Moreover, both hemispheres are in instant communication and intimately integrated. Still, certain activities demand more input from one hemisphere than from the other. This explains why an artist with extended experience in spatial thinking might be in a position to apply that thought process to work with three-dimensional mechanisms or with natural history or geological objects. It also confirms the fact that the heavy use of one mode of thought does not limit the development of similar capabilities in using the other mode. Not only did the three early American artists achieve this, but so did such scientists of the period as Benjamin Franklin and Joseph Henry.[14]

The experiences of Charles Willson Peale, Samuel F. B. Morse, and Rufus Porter represent case studies that offer important insights. They tell much about connections that were not at all unique between what are usually regarded as very different areas of creativity, a recognition that significantly improves our understanding of life in early America. It also provides a clear picture of connections that continue today, although these have become harder to observe since moving from one field to another has become much less feasible.

[14] Hindle, *Emulation and Invention*, pp. 36–38; Roger W. Sperry, 'Consciousness, Personal Identity, and the Divided Brain' (Doubleday Lecture delivered at the Smithsonian Institution, December 7, 1977); M. C. Wittrock, et al., *The Human Brain* (New York, 1974); Michael S. Gazzinaga, *Social Brain: Discovering the Networks of the Mind* (New York, 1985).