Between Third and Fourth Avenues,
bounded by Astor Place and Seventh Street
New York, New York County, New York

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HISTORICAL AND DESCRIPTIVE DATA
PHOTOGRAPHS

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National Park Service
United States Department of the Interior
Washington, D.C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

THE COOPER UNION FOR THE ADVANCEMENT OF SCIENCE AND ART
HAER NY-20

Location:	Between Third and Fourth Avenues, bounded by Astor Place and Seventh Street New York, New York County, New York Latitude: 40° 43' 45" N. Longitude: 73° 59' 28" W. UTM: Brooklyn, New York 852089
Dates of Construction:	1853-59
Architect:	F.A. Peterson
Significance:	Founded by industrialist Peter Cooper, the Cooper Union was a pioneering institution in providing free private higher education. Its original building has historic technological importance because of its early use of iron beams in its construction, its early elevator shaft, and its early ventilation and plumbing systems.
Dates of this report:	Part I: June 1973, Part 2: November 1971

PART 1: PETER COOPER

Historical background

The pendulum of human attitudes and philosophies has always swung from optimism to pessimism and back again. In one era man is considered intrinsically and hopelessly evil; in another, his nature is considered fundamentally good. Actual conditions and circumstances both form and are explained by the philosophy of the moment.

The United States was born into a climate of almost unbridled optimism. The new nation, which found itself the possessor of almost unlimited natural resources, experienced a manufacturing boom when the War of 1812 cut off trade with Great Britain. An inevitable post-war slump followed when inflated supplies of paper money were suddenly contracted. However, in the 1820's the embryonic American industrialism reached maturation and ushered in an era of prosperity which, with periodic but only temporary setbacks, has never really stopped. This seemingly unending prosperity produced the attitude that wealth comes to the industrious and that poverty is largely a result of sloth.

The economic situation, both real and potential, had repercussions in the political, philosophical, and religious spheres. As early as 1776 the Scottish economist Adam Smith, in his Wealth of Nations, had advocated the laissez-faire concept of economics, by which unfettered individual competition and exploitation of resources would inevitably lead to social progress. This doctrine had enormous appeal in a land as materially blessed as the United States, where, ideally, everyone had the same possibilities of economic success. Throughout much of the nineteenth century the Jeffersonian-Jacksonian democrats waged a constant struggle against the pretentions to financial aristocracy of the Hamiltonian bankers and propertied classes. This struggle was focused on the question of re-chartering the Second Bank of the United States in the 1830's, and reverberated again in the 1870's when the "Greenback Party" espoused the cause of small farmers, debtors, etc., against the capitalists of both established political parties.

From the time of John Calvin, material success had often been explained as divine reward for virtuous conduct, with the corollary that poverty was a sin. As nineteenth-century capitalism mushroomed,

the religious justification expanded beyond the individual to the social body, culminating in the latter nineteenth-century "Gospel of Wealth." This attitude was basic to Mark Hopkins's The Law of Love and Love as Law (1868), whose three main tenets were "individualism, the sanctity of private property, and the duty of stewardship."[1] And in 1900, William Lawrence, Bishop of Massachusetts, reiterated the comforting concept of Christian capitalism:

> In the long run, it is only to the man of morality that wealth comes. We believe in the harmony of God's Universe. We know that it is only by working along His laws natural and spiritual that we can work with efficiency ... can the secrets and wealth of nature be revealed. ... Godliness is in league with riches. ... Material prosperity is helping to make the national prosperity sweeter, more joyous, more unselfish, more Christlike.[2]

Nurtured by the teachings of Locke and the Enlightenment, the Founding Fathers had regarded the world as a rational mechanism, functioning according to immutable laws which man could, through reason, come to understand. Man was thought to be perfectly at home in this well-regulated universe and could legitimately expect to enjoy his God-given rights to life, liberty, and happiness. Man and his mind were the chief protagonists on this stage; God was respected as an abstract principle -- Supreme Being, Deity, Infinite Goodness -- which had set the world in motion and then retired. No longer was man's role to prostrate himself before the terrible Jehovah; rather, it was his duty to discern natural laws and conform his conduct to them. In such a way he could assure his personal well-being and social harmony.

The deism and Enlightenment philosophy which had characterized Jefferson, Franklin, and generally, the eighteenth century, ultimately revealed an emotional sterility. As man cannot live by reason alone, the early nineteenth century witnessed a number of religious movements. Some were frankly a return to evangelical Christianity. Others were amalgams of the new and old: Transcendentalism appealed to men with mystic longings, while Unitarianism attempted a fusion of deism and Christianity. Like deism,

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1. Ralph Henry Gabriel, The Course of American Democratic Thought: An Intellectual History Since 1815 (New York, 1940), p. 149.

2. Gabriel, pp. 149-150.

Unitarianism regarded man as fundamentally good and as infinitely perfectible, but it placed this rather secular philosophy in a Christian framework. However, as its interests were far more ethical and social than theological, it could legitimately be termed a "humanistic religion, rational, ethical, individual, yet with deep and warm social sympathies."[3] It is not surprising that the Unitarians, like other liberal Christians, were less concerned with individual salvation than with reform of the social ills which were growing in direct proportion to the burgeoning cities and industrial slums.

This reform movement, often called Romantic Humanitarianism, was begun in the 1820's and embraced such issues as the rights of women, the poor, delinquents, criminals, and slaves; temperance; and education. The emphasis on broadened -- and often free -- education for the masses stemmed from the eighteenth-century conviction that Truth and Good can be reached through Knowledge, as filtered through the new concern for the downtrodden.

Like the original Humanism of the sixteenth century, the New Humanism went hand in hand with the advance of science. Traditional Christianity was hard pressed to refute the attacks of Darwinism. (The Origin of Species was published in 1859.) Unable to resolve the knotty problems and metaphysical conflicts between theology and science, many in the second half of the nineteenth century turned their attention to this world instead of the "other world" and concentrated on a humanitarianism in which they could use the fruits of the emerging sciences. Originating in the evolutionary theories of Darwin, the new "social sciences" began to see society as a changing, evolving -- and potentially progressive -- organism. Poverty was no longer regarded solely as divine punishment or necessarily as a moral failing, but rather as an economic condition which could perhaps be eradicated through practical social reform and legislation.

God, man, and science were viewed as partners, a triumvirate, working together to achieve progress and prosperity, and the potential had no horizons. Congressman Demas Barnes summed up the attitude of his age when he said in 1869, concerning the projected Brooklyn Bridge, "Babylon had her hanging gardens, Nineveh her towers, and Rome her Coliseum; let us have this great monument to progress."[4]

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3. Vernon Louis Parrington, Main Currents in American Thought (New York, 1927), Vol. II, p. 327.

4. Quoted by David McCullough, The Great Bridge (New York, 1972), p. 90.

Peter Cooper's early years

Peter Cooper epitomized this upward-and-onward spirit, reflecting both the eighteenth-century heritage of human perfectibility in a rational universe and the nineteenth-century climate of industrial progress and capitalism tempered by ethics of reform and stewardship. His guiding principle, reiterated throughout his long life, was "to give the world an equivalent, in some form of useful labor, for all we consume in it, and thus to fulfill that important requirement, to owe no man anything but the good we can do."[5]

His extraordinary life, which took "thirty years to get started, thirty years to amass a fortune, thirty years to dispose of that fortune wisely,"[6] was temporally extensive and geographically constricted. Born on 12 February 1791 in New York City and dying there on 4 April 1883, Peter Cooper rarely left the confines of the New York area, but he witnessed the advent of 21 American presidents.

Materially, he started life quite simply and humbly, for his father practiced a wide variety of trades without prospering financially in any of them. Because of his father's unstable economic fortunes, Cooper learned early that charity really does begin at home. From 1813 on, it was he who paid many of his father's debts and was the principal source of support for his family. While he assumed this responsibility willingly and cheerfully, the experience marked him with a "near-obsessive fear of debt"[7] which affected all his financial dealings throughout his life.

His paternal "spiritual" legacy was more positive. In an often-repeated story, Peter Cooper asserted that his father "believed devoutly that I should come to something; for he named me Peter, after the great Apostle, and maintained that he was told to do so

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5. Peter Cooper's address to the Arcadian Club in 1874, in Peter Cooper: A Tribute in Commemoration of the Hundredth Anniversary of his Birth ([New York], 1891).

6. Peter Lyon, "Peter Cooper, the Honest Man," American Heritage, Vol. X, No. 2 (February, 1959), p. 6.

7. Edward C. Mack, Peter Cooper: Citizen of New York (New York, 1949), p. 28.

in a sort of 'waking vision.'"[8] The son apparently believed in this omen of destiny and attributed much of his success to his attempts to live up to his parents' expectations.

Tradition says that the Coopers, opposed to the Stuart Restoration, left England in 1662 for the New World and settled at Fishkill-on-Hudson.[9] Neither landed gentry nor impoverished lower class, the Coopers were "master artisans and well-to-do farmers," accomplishing much through adherence to the family motto, "Perseverence conquers all things."[10] (This "perseverence" was foremost among Peter Cooper's own qualities; he explained many of his successes as "persistence," and his infrequent failures as "stubbornness.")

Peter, the fifth of nine children, led an extremely peripatetic existence as a youth. While the exact sequence of his activities is impossible to reestablish (because of his own contradictory versions), two chief factors emerge: many trades and little schooling. His entire academic career consisted of less than a year's class attendance, and he always felt acutely his lack of formal education. Indeed, this lack later became one of his chief motives in establishing the Cooper Union, a school which furnished poor youths with the opportunities he had missed.

What he lacked in book-learning he compensated for in practical experience. As a child he assisted his father in the latter's hat shop, country store and brewery, and brickmaking plant. At the age of 17 he apprenticed himself to the firm of Burtis and Woodward, New York coachmakers, where he remained for four years, filling his free time with woodcarving, Bible study, and the memorization of Pope and Burns, poets who reflected his optimistic faith in man and the world. That his employers were pleased with his work is proven by the raises he received: hired at an annual salary of $25, he received $50 the third year, and $75 the fourth. At the end of his apprenticeship, he wrote in his autobiography, "my employer offered to build me a shop and set me up in business; but, as I always had a horror of being burdened with debt, and having no

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8. [J.C. Zachos], "Autobiography of Peter Cooper," Old South Leaflets, Vol. VI, No. 147, p. 465.

9. Mack, p. 4, disagrees, suggesting that the family was more likely Dutch and probably did not arrive until later, since the first mention of the family occurs in the Albany directory of 1713 with the entry "Obadiah Cooper, tailer."

10. Mack, pp. 6-7.

capital of my own, I declined his kind offer."[11]

His employers had reason to be pleased, for their apprentice had benefited their business by inventing a machine to mortise carriage hubs. Always a tinkerer and inventor, Cooper said of himself, "I was always fussing and contriving, and was never satisfied unless I was doing something difficult -- something that had never been done before, if possible."[12] As a child he had made a shoe and a "primitive washing machine, involving a geared wheel, double lever, and ratchet."[13] After leaving the coachmaking business in 1812, he worked for a concern which made cloth-shearing machines in Hempstead, L.I., and again improved his employers' product. Other early experiments and inventions included "the first machine for the cutting of steel plate to the required size ..., a machine for puddling and reducing iron ore to pig iron at a greatly reduced cost ..., (and) a torpedo boat" which he intended for the use of oppressed Greeks against the Turks in the 1820's. His pioneering belief in air travel led him to try lighter-than-air balloons; a regrettable experiment with chloride of nitrogen caused an explosion which almost cost him his sight.[14]

Cooper married Sarah Bedell of Hempstead, L.I., in 1813. By 1815 there were babies to be rocked[15] and he consequently devised a "Pendulous & Musical Cradle." This invention, which he patented, rocked mechanically through a pendulum arrangement, and included a music box and a cloth to "keep the flies off the little one." In this same period he began his experiments with power by endless chain and by rotary steam engine. Both concepts fascinated him for the rest of his life. When over 80, he tried to have New York's elevated railways adopt his endless-chain principle, and he attempted to outfit an Erie Canal boat with a rotary steam engine. Neither scheme succeeded.

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11. [Zachos], p. 466.

12. Lyon, p. 7.

13. Lyon, p. 7.

14. Charles Reynolds Brown, They Were Giants (Freeport, N.Y., 1968), p. 85.

15. Only two of his six children lived beyond childhood: Edward, born in 1824, and Sarah Amelia (later Mrs. Abram S. Hewitt), born in 1830. Mrs. Cooper died in 1869.

Making and expanding a fortune

Cooper continued to pursue a jack-of-all-trades-and-inventions career until 1821, when he bought the failing Vreeland glue factory in New York City for $2000 cash. He was able to buy low after the Panic of 1818-20 because of his solid pay-as-you-go financial policy based on gold instead of credit. Serving for many years as "his own stoker, secretary, bookkeeper, executive, and salesman,"[16] he introduced to his factory superior manufacturing techniques, expanded the line of products to include neat's-foot oil, isinglass, and gelatin, and proceeded to prosper with the manufacturing boom of the 1820's. By 1869 the company claimed to be the largest manufacturer of glue and gelatin in the world.[17]

With the purchase of the glue factory, Cooper was definitely launched, and the first thirty-year segment of his life ("to get started") was at an end. For the next three decades he amassed a fortune through a combination of luck, propitious times, and his own shrewdness and industry. The impressive growth of his assets was scrupulously recorded in his "little brown notebook": in 1833, he registered a net worth of $72,550; several years later, the sum had reached $123,459; in 1846, the total was $383,500; and in 1856 his fortune amounted to "more than $1,100,000, without counting the gift to education which he conservatively estimated at $500,000, and which really came to more than $600,000."[18]

In 1828, Cooper expanded his holdings with a $20,000 investment in 3000 acres of real estate in Baltimore. At first this appeared to be an unfortunate venture, for his two partners proved to be insolvent. However, Cooper was undismayed and let necessity be his muse of invention. Since the value of his real estate investment depended on Baltimore's prosperity, which in turn depended on the growth and success of the new Baltimore and Ohio Railroad, he determined to exploit the iron ore found on his Baltimore land

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16. "Peter Cooper," Dictionary of American Biography (New York, 1943), Vol. IV, p. 410.

17. Mack, p. 195.

18. Appendix II in Allan Nevins, Abram S. Hewitt: with Some Account of Peter Cooper (New York, 1967), pp. 604-605.

by building a locomotive which could negotiate the hilly and curving terrain of the B & O roadbed. To accomplish this formidable task, he erected the Canton Iron Works and went to work on the "Tom Thumb," a tiny engine which could pull a train on "curves with radii as low as 400 feet and grades of 18 feet to the mile,"[19] conditions which had been considered insurmountable by English experts.

Peter Cooper reminisced in 1882 about his daring exploit of a half-century earlier:

> So I came back to New York and got a little bit of an engine, about one horse-power and carried it back to Baltimore. I got some boiler iron and made a boiler about as big as an ordinary washerboiler and then how to connect the boiler I didn't know. ... I had an iron foundry and had some manual skill in working in it. But I couldn"t find any iron pipes. The fact is that there were none for sale in this country. So 1 took two muskets and broke off the wood part, and used the barrels for tubing to the boiler. ... I went into a coachmaker's shop and made this locomotive, which I called the Tom Thumb because it was so insignificant. I didn't intend it for actual service but only to show the directors [of the B & O] what could be done. I meant to show two things: first, that short turns could be made; and, secondly, that I could get rotary motion without the use of a crank. I changed the movement from a reciprocating to a rotary motion.[20]

The test run, held in August, 1830, proved the success of his first aim but the failure of the second; the rotary engine was then abandoned for the more conventional crank motion.

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19. "Our First Locomotive Tested a Century Ago," New York Times (December 15, 1929), p. 20.

20. Quoted from the Boston Herald (July 9, 1882) in Edward Hungerford, The Story of the Baltimore and Ohio Railroad, 1827-1927 (New York, 1928), p. 99.

Covering the 13 miles from Baltimore to Ellicott's Mills in one hour and twelve minutes and the return trip in 57 minutes, the Tom Thumb repeated its trip several times. On 18 September 1830 the Baltimore stagecoach owners organized a race between the Tom Thumb and a horse, hoping to nip their railroad competition in the bud. In the eight-mile race from Riley's Tavern to Baltimore, first one, then the other adversary drew ahead. Because of a broken blower on the engine, the horse won the race. However, the victory ultimately belonged to Cooper and the B & O, both of whom began to make a profit once the railroad's viability was established. While the Tom Thumb itself was not used in actual rail traffic, it was long remembered as a monument in early railroad history. At the Baltimore sesquicentennial celebration in 1880, Cooper, along with a model of the Tom Thumb, was honored as a "pioneer in the application of steam to American railways."[21]

His glue business and real estate investments were prospering when, in 1838, Peter Cooper once more broadened his horizons. A victim of the Panic of 1837 offered Cooper his wire factory in payment of a $5000 debt. Once again, as in the case of the glue factory, Cooper profited by a happy conjunction of circumstances and shrewdness. New railroads, iron bridges, and other industrial innovations were creating a demanding market for iron. In 1845 Cooper found it expedient to move his operation, which by that time included both a wire mill and a rolling mill, to Trenton, New Jersey, in order to be nearer his sources of raw materials. He renamed his factory the South Trenton Iron Company, but dropped the "South" in 1847. The Trenton Iron Company became prominent as "one of only five American companies that combined the whole process of iron manufacture, from ore to finished product."[22]

The year 1854 also signaled the beginning of the Atlantic Cable project. Spearheaded by Cyrus Field, this scheme elicited early and constant support -- both moral and material -- from Peter Cooper. As in most of his activities, Cooper saw himself as a

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21. Quoted in Mack, p. 117.

22. Mack, p. 212.

partner with God in contributing to the general welfare: improved communications between men and nations would inevitably lead to wider-spread truth, which would in turn bring men virtue and happiness. It was as simple as that.

The Atlantic Cable venture was fraught with deficits and disasters, but finally, in 1866, it met with success. The first words transmitted were the same as those which had marked the success of the telegraph 22 years earlier -- "What hath God wrought!" -- and amply described the feelings of an age which marveled at the feats of devine and human cooperation in industrial progress.

For the rest of his life Cooper continued to be involved with industry, inventions, and investments. In the 1830's and 1840's he patented "a machine to grind and polish plate glass and all other substances that required a true perfect surface" and devised a scheme -- "the most bizarre that ever came from his brain" -- to extract salt from the Erie Canal for domestic use.[23] As late as 1874 he continued to advocate his rotary-motion steam engine for use on the Erie Canal, adding, in a characteristic mixture of ethics and business, "I have reason to hope that the results will promote the general welfare."[24] His investments included an ever-widening variety of stocks -- railroad, fire insurance, bank, oil, iron, telegraph -- as well as patronage of numerous inventions, some of which constituted little more than charitable contributions.

Civic works and philanthropy

However, it was neither his investments nor his inventions that dominated the last third of Peter Cooper's life, after 1850, but rather his civic and philanthropic involvements.

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23. Mack, p. 184.

24. Mack, p. 320.

His political life began as early as 1828 when he was elected Assistant Alderman on the Common Council of New York City. Serving in this capacity until 1831 and as Alderman in 1840-41, he habitually voted as a party man with the Tammany Democrats. Nothing in his life, writings, or career would indicate the slightest taint of corruption that later became so intimately associated with the name Tammany. Rather, it seems that Cooper's unswerving faith in the goodness of man accounted for an extraordinary political naivete which allowed him to vote on opposing sides of an issue and to sit on committees with contradictory aims.

However hazy his political philosophy may have been, he participated in numerous philanthropic and reform movements, all devoted to the public weal. He headed the Common Council's project to ensure the city's water supply, and worked for the Public School Society, the Demilt Milk Dispensary, the New York Juvenile Asylum for delinquents, the New York Gallery of Fine Arts, the New York Sanitary Association, and for improved police and fire protection, shrewdly advocating "a plan for making it clearly for the pecuniary interest of the policeman to do his duty."

In the early 1850's, as Tammany malfeasance was becoming more rampant and more obvious, Cooper began to participate in movements to combat corruption in local politics. He became a member of the Chamber of Commerce in 1859 and served as president of the Citizen's Association of New York, "a reform organization which enlisted virtually every business and professional leader in the city,"[25] from 1867 until 1871. To Peter Cooper and his compatriots in reform should go at least partial credit for the downfall of the once invincible giant, "Boss" Tweed. The sixties and seventies were marked by Cooper's increased activity on behalf of the downtrodden -- Indians, immigrants, inventors -- and during the years of the Civil War he devoted the bulk of his energies to the eradication of slavery. Initially a Democrat, and opposed to coercion of any sort, he became the staunchest

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25. Nevins, p. 268.

possible supporter of Lincoln and of the war after Fort Sumter. He considered no effort too great or too small to ensure the preservation of the Constitution and the Union: he bought bonds, joined the Union League Club, paid for army substitutes, and helped finance the iron-clad Monitor. The passionate idealist lashed out against what he felt to be the morally repugnant stand of the South,

> [not only] determined on our destruction as a nation, but to build on our ruins a government devoted with all its power to maintain, extend, and perpetuate a system in itself revolting to all the best feelings of humanity, -- an institution that enables thousands to sell their own children into hopeless bondage.
>
> Shall it succeed? You say 'No!' and I unite with you in your decision. We cannot allow it to succeed. We should spend our lives, our property, and leave the land itself a desolation before such an institution should triumph over the free people of this country...
>
> Let us, therefore, unite to sustain the government by every means in our power, to arm and equip in the shortest possible time an army of the best men that can be found in the country.[26]

In 1876 Peter Cooper culminated his political career by becoming a candidate for President of the United States. At age 85, he hardly expected to win the election. Rather, he was making a symbolic and heartfelt gesture for his principles; a gesture which seems ironically quixotic when one considers that Cooper's son-in-law was Samuel Tilden's campaign manager in the same election, and that Cooper received only one per cent of the vote.

The National Independent ("Greenback") Party which he represented advocated the economic and moral philosophy which Cooper had long held. Post Civil War America saw once again the entrenched moneyed classes pitted against the farmers and laborers, at

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26. Quoted by Rossiter W. Raymond, Peter Cooper (Freeport, New York, 1972) p. 98.

loggerheads over the issue of "hard money," just as they had been in the 1820's. Once more severe deflation followed a period of inflation as the paper money supply was abruptly contracted. While it can perhaps be argued that Cooper did not fully grasp all the subtleties of the issues at stake,[27] he believed fervently in the 1870's, as he had 50 years earlier, in the Jeffersonian-Jacksonian principles that money should represent work done and that it should have fixed value. In other words, he advocated a managed currency, with legal tender issued and supported by the central government. In his economic system, paper currency, convertible into Federal bonds, would be the only legal tender for the nation and would be strictly maintained at a specific ratio to the population. When Congress refused to act on his recommendations, he accused the legislative body of representing only the moneyed classes: "I consider the persistent class legislation of Congress since the war, a worse despotism than that of Great Britain before the Revolution, because it reduces the laboring classes to periodic distress and starvation, that are worse than any despotism ever was; for monopolizing corporations, whether in the shape of banks or railroads, have no soul."[28]

While Peter Cooper's financial theories never gained acceptance among experts, they add to an understanding of his character by reflecting his fundamental and unchanging conviction that the "little man" must be protected and allowed to prosper. In keeping with this attitude was his advocacy of the protective tariff. Free trade was still possible in a utopian situation, but in practice it was only harmful to American industry and economics. According to Cooper, a high tariff would stop imports and therefore the drain on gold, which could thus be used to pay the nation's debts. As American manufacturing would necessarily prosper, so would all those involved in American manufacture, capitalist and laborer alike.

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27. Raymond, p. 101: "...his utterances and publications in this connection show him to be dealing with subjects which he did not understand." Mack and Nevins find more consistency in his thought.

28. Letter to Representative A. A. Hardenberg (June, 1882), quoted in Nevins, pp. 268-269.

It was not only economics that concerned Peter Cooper and the Greenbackers, but social legislation as well. The party platform was based on "financial reform and industrial emancipation." Like the political party he represented in 1876, Cooper was solidly in favor of legislation to benefit the working classes; however, he was utterly opposed to labor unions which ordered workers to strike and to agitate for an eight-hour workday. His ideal would have been more on the order of the medieval guild, an association of free and independent artisans and craftsmen, for he assumed, with his childlike faith in man, that all men were as clever, as motivated, and as persistent as he.

His ideal was a modified sort of feudal paternalism by which the rich would not only fulfill their obligations by caring for their underlings, but would also help the poor to become rich. His basic outlook naturally led him in time to espouse some patently socialistic ideas. He advocated strict control of western lands and railroads, institution of a postal savings bank system, a complete civil service, unemployment relief by public works, industrial schools, all under the watchful eye and generous hand of a benevolent central government. Summing up his philosophy in the last year of his life, he wrote, "I have always been, am, and ever shall be with the poor toilers and producers; therefore I desire Congress to legislate for the poor as well as the rich, who can take care of themselves."[29]

Cooper Union

The welfare of "the poor toilers and producers" dominated Peter Cooper's political, economic, and civic writings and activities during the last part of his life. Nowhere is this concern more evident than in the institution most intimately connected with his name -- the Cooper Union for the Advancement of Science and Art.

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29. From "Ideas for a Science of Good Government in Addresses, Letters, and Articles on a Strictly National Currency, Tariff, and Civil Service" [a collection of most of Peter Cooper's writings], in Nevins, p. 287.

Cooper had suffered from the lack of formal education in his own life and had long been determined to provide educational opportunities for the working classes of New York City. While Cooper Union actually opened its doors in 1859, it had been its founder's pet project at least since 1830. In that year he had first heard of the Ecole Polytechnique in Paris:

> I then thought how glad I should have been to have found such an institution in the city of New York when I was myself an apprentice. ... I determined to do what I could to secure to the youth of my native city and country the benefits of such an institution ... and throw its doors open at night so that the boys and girls of this city, who had no better opportunity than I had to enjoy means of information, would be enabled to improve and better their condition, fitting them for all the various and useful purposes of life.[30]

Even earlier, when an apprentice coachmaker in New York, Cooper had been impressed with the marvels to be seen at Savage's, Scudder's, and Barnum's museums. Together with the lectures at Federal Hall and the various lyceums, these delights to eye and ear inspired him to provide "rational recreation" for the poor youth of his city.

In addition to personal experience, Peter Cooper was motivated to found such an institution by the climate of the times and by his own beliefs in a "scientific humanism" whereby penetration of the mysteries of Science would ensure virtue, happiness, and prosperity. There was a movement afoot favoring free non-sectarian education for all: Cooper himself served on the Public School Society from 1839 to 1853; Rensselaer Polytechnic Institute had been founded in 1825; Lowell Institute, with its free evening lectures, in 1836; and lyceums, mechanics' institutes, and colleges were proliferating in the 1830's.

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30. Lyon, p. 104.

In 1839 he began acquiring land for his institute.[31] This aquisition, lot by lot, required years to complete. But by 1852, he owned "all that piece and parcel of land bounded on the west by Fourth Avenue, and on the north by Astor Place, on the east by Third Avenue, and on the south by Seventh Street."[32] The cornerstone, laid in 1853, contained a scroll wherein Cooper stated his aims for the Union:

> The great object that I desire to accomplish by the erection of this institution, is to open the avenues of scientific knowledge to the youth of our city and country, and so unfold the volume of nature, that the young may see the beauties of Creation, enjoy its blessings, and learn to love the Author from whom cometh every good and perfect gift.[33]

This constitutes a succinctly stated credo of a deist's theology -- cosmology and faith in man's perfectibility.

On 29 April 1859 Cooper Union was incorporated. According to the first by-law of the charter, its seal was to be "a circular disc upon the outer edge of which shall be the words 'The Cooper Union for the advancement of Science and Art, founded A.D. 1859, by Peter Cooper, a Mechanic of New York.' These words shall surround a medallion head of Peter Cooper, on the rim of which shall be the words, 'Whatsoever things are true.'" Cooper's son-in-law, Abram S. Hewitt, quoted the founder as saying, "I have called this building the Union for the Advancement of Science and Art. Against my wishes and against my will the legislature have, unfortunately, attached to it the name of Cooper. I did not want my name attached to the Union. I wanted

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31. Nevins, p. 113, says 1825.

32. Peter Cooper's letter to the trustees of Cooper Union in Charter, Trust Deed, and By-Laws of the Cooper Union for the Advancement of Science and Art, with the Letter of Peter Cooper accompanying the Trust Deed (New York, 1859).

33. Peter Cooper: A Tribute ..., p. 22.

this to be a union of all well-disposed people in New York who are willing to contribute to carry out the work of free education in the building I have created."[34] (Perhaps this was either self-effacing modesty after the fact, or justification for renting some of the premises, for there seems to be little evidence of any real attempt on the part of Peter Cooper to exclude his name from the title.) He had chosen the name "Union" carefully and, as he applied it to his institution, it had a three-fold meaning. First, it signified the conjunction of Science and Art, the useful and the agreeable, the philosophical and the practical. Second, he hoped it could serve in some way to hold the weakened Republic together at a time of increasing divisions. Third, it was to be the object of combined public and private effort.[35]

In a Deed of Trust of 29 April 1859 Cooper conveyed the property to a Board of Trustees, specifying in the first clause that the "premises, together with the appurtenances, and the rents, issues, income, and profits thereof, shall be forever devoted to the instruction and improvement of the inhabitants of the United States in practical science and art."

The desired curriculum was outlined with preeminence given to "social and political science." For Peter Cooper, the basis of good government lay in the "golden rule"maxim, and he remained convinced that with proper instruction in this "science and philosophy of a just and equitable form of government" men would naturally form the best possible regime for themselves, enabling them to live in peace and prosperity. Industry and thrift were natural corollaries of this approach to good citizenship. Hewitt said of his father-in-law:

> I have often heard him say that the first thing a young man should do was to save a little money; that no man could succeed in life who did not begin by saving; and that when a man

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34. "Abram S. Hewitt's Speech at the Annual Commencement of the Cooper Union, May 31, 1902," in [Zachos].

35. Mack, pp. 252-253, 264.

> had saved a little money and had acquired some property he was pretty sure then to make a good citizen.[36]

The mixture of philosophy and practicality which dominated Peter Cooper's concept of how to "improve and elevate the working classes of the city" was apparent in the Deed of Trust, which went on to specify "regular courses of instruction, at night, free to all who shall attend the same ... on the application of science to the useful occupations of life," a free reading room, art galleries, scientific collections, "a school for the instruction of respectable females in the arts of design," and "a thorough polytechnic school."

The last two articles of the deed reflected two of Peter Cooper's most fervently held convictions: financial solvency and religious tolerance. He specifically stated that the trustees must never be in debt more than $5000, and required that "religious tenets or opinions" never be considered to the discrimination of any teacher, student, or officer of the institute.

While Cooper was strongly opposed to sectarianism and bigotry, religion in the broader sense played a strong role in his life. He seems to have accepted traditional Christian concepts through occasional references to the divinity and immortality of Jesus Christ and in allusions to a personal fatherly God, such as "If the Lord wants me to build it [Cooper Union], He will provide the money -- if He doesn't, He will withhold it!"[37] However, his general orientation was decidedly more theistic, as seen in his letter to the trustees of Cooper Union, dated 29 April 1859, which accompanied the Deed of Trust. This letter is Peter Cooper's credo and reflects the amalgam of its formative elements. His Methodist childhood is evident in the bow to "orthodox" Christianity:

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36. "Abram S. Hewitt's Speech ..."

37. Quoted in Nevins, p. 114.

> Mankind will always require the great controlling principle of Christianity to be permanently fixed in the intellectual heart as the guide of life. We need a firm and unshaken belief in the inherent immortality of the soul; we need a solid conviction that God is love -- love in action -- love universal.

Unitarianism, which he adopted in 1838, is basic to the profession that "The life and teachings of Christ, showing God a father and the world of mankind our bretheren, must forever stand pre-eminent over all forms of instruction, either ancient or modern."

And yet the bulk of the letter reflects Cooper's eighteenth-century heritage, complete with a reverence for its "saints":

> I hereby direct to have placed in the lecture-room [of Cooper Union], in a suitable position, full-length likenesses of Washington, Franklin, and Lafayette, with an expression of my sincere and anxious desire that all that behold them may remember that notwithstanding they are dead, they yet speak the language of truth and soberness.

This profession of faith is pervaded by the deism and the humanitarianism of the times, both persuasions holding that Deity is the spirit of good and that man is a social and perfectible animal:

> ... our Creator has used the best means possible in our formation or creation, and has given us the world, and all that in it is, with <u>life</u> and <u>breath</u>, and <u>all things richly to enjoy</u>. He has given all these blessings wrapt up in our capacity for an endless improvement and progress in the knowledge of our Creator, and in the power he has bestowed to receive and communicate happiness to all his intelligent creation. So that when we come really to know and feel that our God <u>is</u> love -- to realize that He <u>is</u> indeed the Infinite of all that is good; when we come to see that he is drawing all the elements and activities of the universe into himself, and

> constantly elaborating them into higher forms of grandeur and beauty, and thus calling every intelligent creature to wonder, to love and adore forever.
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> In this God I believe. I believe that he is a Spirit in whom we live and have our being; ... I believe that God is love, and that love worketh no ill. ... I believe that he will always work by wise and unalterable laws. ... I believe that man, to be an accountable being, must, of necessity, be intelligent and free. ... I believe mankind, throughout the world, require a religion founded on the highest idea that the human mind can form of all that is powerful, wise, pure and good.

This philosophy-theology was the underlying principle for Cooper in founding his Union for individual and social betterment:

> My earnest desire is to make this building and institution contribute in every way possible to unite all in one common effort to improve each and every human being, seeing that we are bound up in one common destiny and by the laws of the continued acts of kindness we receive from each other.

The building, its curriculum, and program

The Cooper Union building itself was actually completed in 1858, but not officially opened until the following year. Architect F. A. Peterson had drawn the plans, under the inspiring and supervisory eye of Peter Cooper. They bear many touches of Cooper's individual genius. A great lecture hall was in the basement, exploiting the advantages of easy access, isolation from street noises, and use of otherwise wasted space. The first and second floors were to be rented as stores and offices, providing a source of income to help support the institute. The third floor contained a large room designed as a museum, and the fourth floor was to house a cosmorama, which would "exhibit

in the clearest and most forcible light the true philosophy of life."[38] Much of the rest of the building was devoted to smaller meeting rooms where profitable lectures, debates, and discussions were to take place. Safety exits and water supply were amply provided for.

Peter Cooper's son Edward designed an extremely efficient ventilation system which was run by a steam engine. According to a story in the New York Daily Times of 21 January 1853 (eight months before the cornerstone was laid), "a small engine" would direct "a constant supply of pure air through the entire building by a shaft 10 feet diameter, extending from basement to the roof."[39]

The information for the newspaper article was supplied by the architect, and perhaps he was misinformed as to the intended use of the shaft; or perhaps Peter Cooper later amended facts to suit an evolved situation. At any rate, he later claimed that he had provided the round shaft anticipating the day when he "could put machinery in there to carry people."[40] His choice of shape was based on the premise that "an oval space offers more room than a square."[41] However, those who eventually installed an elevator in the space used a conventional shape, and at present a square carrier travels up and down the round shaft.[42]

One use Peter Cooper envisaged for his elevator was to carry people to his projected roof garden. By the 1850's workingmen's quarters of the city were teeming with people, filth, and disease. Cooper proposed to offer workers escape from their unpleasant surroundings by creating a balustraded roof garden to exploit the space, view, and open air of its setting. (In the same vein, J.A. Roebling planned an elevated walkway for his Brooklyn Bridge in 1869.)

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38. Letter accompanying the Deed of Trust.

39. John G. Waite, ed., Iron Architecture in New York City: Two Studies in Industrial Archeology ([Albany, N.Y.], 1972), p. 48.

40. Quoted in Mack, p. 262.

41. Nevins, pp. 178-79.

42. As part of a renovation of the building in 1973, a round carrier is to replace the present square car.

Construction of Cooper Union began in 1854, utilizing rolled wrought-iron beams from the Trenton Iron Works. Work stopped soon after the second floor was laid to allow the foundry to furnish beams for Harper & Brothers' new offices -- "the first large fireproof building for commercial purposes in the country"[43] -- and then for the Federal government's Assay Office in New York. Because of the enormous success of the beams and girders, the Trenton Iron Works was swamped with orders and production again was diverted away from Peter Cooper's pet project. Realization of the Cooper Union dream was delayed thereby, but funds for bringing it to fruition were greatly increased. By the end of 1856 all the beams were in place, but another year and a half were required to complete the stone, brick, and iron building. Its construction costs totaled $630,000 (including land) plus another $30,000 for equipment and teachers.

The building as completed in 1856 reflected several changes from the original plans. The roof garden project was abandoned; the museum became a free reading room; the cosmorama gave way to a laboratory; the discussion rooms became classrooms. In general, the balance of the useful and the agreeable was tilted toward the useful. In their First Annual Report (1860), the trustees prided themselves on having organized their various course offerings with an eye toward "solid utility rather than empty display and temporary attraction."

The Cooper Union for the advancement of Science and Art was officially opened on 1 July 1859. Speaking at the ceremony, Peter Cooper reiterated many of the ideas found in his letter to the trustees of several months earlier as well as his long-lasting devotion to this project.

> This building has scarcely been absent from my thoughts for a single day for nearly thirty years. I have labored for it, by night and by day, with an intensity of desire that can never be explained. ...

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43. Nevins, p. 116.

> I trust that the time will come when the knowledge and application of science and art will elevate the hearts of men above the tinseled toys and groveling pursuits that now so effectually engross their thoughts.[44]

Efforts to impart that uplifting knowledge began on 7 November 1859 with the opening of classes. The First Annual Report of the Trustees of Cooper Union recounted in detail the establishment of the Union as an educational institution for the deserving poor of New York. Guided by the two basic principles that everything should be geared to "the intellectual wants and improvement of the working classes" and that the Union's offerings should not duplicate those of other institutions in the city (such as night schools, the Astor Library, etc.), the trustees set out to implement Peter Cooper's plan by providing instruction in the fields of practical job training, hygiene, social and political science, and aesthetics.

Within the general framework of mixing the "useful and practical" with the "agreeable and the recreative," specific course offerings included "architectural, free-hand, and mechanical drawing, (including the designing of furniture), chemistry, mechanical philosophy, mathematics, and music." These classes, under the auspices of the Department of Night Instruction, were to be completely free with registration on a first-come-first-served basis. Other features of the Union were the School of Design for Females, which had occupied the building since 1858, and the Reading-Room, to be open "from 8 A.M. until 10 P.M., free to all persons, male and female, of good moral character, who comply with the regulations." Further, one room was to be reserved for the students every Saturday evening "for the purpose of debate and mutual instruction."

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44. Peter Cooper: A Tribute..., p. 25.

Success

Public response was overwhelming. About 2000 people registered immediately for the classes; their ages were between 16 and 59, and their occupations reflected such disparate fields as clerks, engineers, students, teachers, coachmakers, umbrellamakers, melodeon makers, physicians, plumbers, janitors, and lawyers, to mention but a few. During its first year of operation, the Reading-Room had an average of 3000 visitors a week.

The students were to be awarded for their various accomplishments: certificates to be given to all those completing a year's study, diplomas and medals to those completing the five-year program. There was also $250 to be set aside each year to "assist such pupils of the Female School of Design as shall ... by their efforts and sacrifices in the performance of duty to parents or to those that Providence has made dependent on them for support, merit and require such aid."[45] Although Peter Cooper believed that a woman's place was in the home, he made this provision because he wished to ease the plight of those women who were "dependent on honest labor for support," help them avoid bad marriages contracted for economic reasons, and "encourage the exercise of heroic virtues."

At the end of the first year, several provisions of the trust deed remained to be put into operation: specifically, the organization of courses in political and social science and in personal hygiene, the establishment of a Polytechnic School, and the founding of a "Society of the Associates of the Cooper Union for the advancement of Science and Art." This Association was to include many influential citizens (especially editors of the press), who would be "brought into direct union and cooperation with [the trustees] in executing the grand design of the institution -- the elevation and improvement of the working classes of this city and country." For some reason it never materialized. During the 1860's it was hoped that the Polytechnic School would be established in conjunction with Columbia College, but this plan also fell through.

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45. Letter accompanying the Deed of Trust.

The trustees concluded their First Annual Report on a note of slightly paternalistic, if well-deserved, self-satisfaction:

> The sphere of its influence may be humble, addressing, as the Union does, mainly the working classes, but let it be remembered that there is no soil more grateful for the seeds of knowledge, or more responsive to intellectual culture, than the industry and the mechanical skill of our common country. Esto perpetua.

The trustees were happy, the students were happy, but there were some elements of the population far less enthusiastic about the Union. Some objected to educating the lower classes; some found the venture simply foolish; others suspected Cooper's motives, decrying the Union as a tax dodge and the Board of Trustees as an incipient dynasty. It is true that 50% of the board members were in the family (Peter Cooper, his son Edward, and his son-in-law Abram S. Hewitt) and that the Deed of Trust provided that "the oldest lineal male descendant of Peter Cooper shall be a Trustee ex gratia" unless already appointed or elected. While this may have provided cannon fodder for Cooper's enemies, empire-building was quite foreign to his character. It is much more in keeping with Peter Cooper's nature to see this family-oriented service enterprise as a manifestation of paternalistic attitudes of "richesse oblige."

Any opposition to the Union which may have been voiced initially proved short-lived. The lecture hall, especially, gained the approval of the public and won fame for Cooper Union. Serving as a forum for much divergent thought, it hosted such speakers as Susan B. Anthony, Horace Greeley, Mark Twain, Ulysses S. Grant, Victoria Woodhull, Henry Ward Beecher, Booker T. Washington, and Woodrow Wilson. However, the most famous speech made there was doubtless Abraham Lincoln's address on 27 February 1860. Treating the issues of slavery and secession and the necessity of preserving the Union, this speech established Lincoln's fame in the East, where he had been virtually unknown. It made him a serious and worthy rival to New York Senator William H. Seward for the Republican presidential nomination, and contributed greatly to his winning the presidency.

So great was the success of the Cooper Union that in the late 1870's Peter Cooper had the idea of establishing a southern "branch" to help rehabilitate that conquered region. The idea was to set up a trade school for women in Limestone Springs, S.C., but the project never came to fruition.

Until his death in 1883, Peter Cooper remained devoted to his institute, visiting the classes and reading room almost every day and attending the lectures every Saturday night. His involvement with the Union was so intimate that he refused to move the Trenton Iron Works further west in order to get closer to raw materials and avoid costly freight charges. He gladly sacrificed greater business success on the altar of his educational and cultural institution. The Union was the personal fiefdom of this liege lord and his most prized "possession." However, he was constantly on guard against imposing his own will on the teachers, students, and officials, and always fought against letting his interest become interference.

Postscript

When Peter Cooper died on 4 April 1883 at the age of 92, he had become "the Saint Peter of the popular imagination."[46] Because of his longevity, philanthropy, and prominence in so many fields, he had been honored by numerous organizations and was revered by nearly all segments of the population. Despite his requests for a simple burial, about 12,000 admirers filed by to see his body lying in state at All Soul's (Unitarian) Church; flags were placed at half-mast; many shops were closed; and an enormous cortege accompanied the hearse to Greenwood Cemetery in Brooklyn.

In his funeral oration, the Rev. Dr. Robert Collyer held up the Christian capitalism of the deceased as an example for the robber barons of the times, asserting, "Here lies a man who

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46. Mack, p. 292.

never owned a dollar he could not take up to the Great White Throne."[47] The New York Chamber of Commerce resolution passed at the time reflected the sentiments of nearly all the pulpits and publications commenting on Peter Cooper's life and death: "He was one of the most remarkable men of his time, a man who was perhaps more widely known and more universally and sincerely mourned than any other private citizen in the whole history of our country."[48]

The tributes continued after his death. In 1891 the Alumni Association of the Cooper Union published Peter Cooper, A Tribute in Commemoration of the Hundredth Anniversary of his Birth. On 29 May 1897 he was honored with a monument in New York, erected by popular conscription. Fittingly, it was sculpted by Augustus St. Gaudens, a graduate of Cooper Union. He also was entered on the original Hall of Fame list. In the latter nineteenth and twentieth centuries, he figured prominently in such edifying books for the young as How Success is Won (1885), Poor Boys' Chances (1900), Peter Cooper, Friend of Boys (1917) and Lives of Poor Boys who Became Famous (1922). Charles Reynolds Brown's They Were Giants (1934) subtitles the chapter on Peter Cooper "Diligent in business, serving the Lord."

It is this tribute to his Christian Capitalism which would doubtless have pleased Cooper most. Nearly all his life he had asserted that wealth is a trust. In the long tradition of Protestantism, he regarded work as a duty and success as the legitimate reward for fulfilling that duty. However, since God sanctioned success and society contributed to it, Cooper believed that the prosperous man should keep only enough of his wealth to serve his family's needs, devoting the rest to the betterment of God's other creatures, his fellow men. Cooper's social conscience and dedication to the betterment of the human community was the chief tenet of his ethical philosophy.

That this attitude was not limited to his life alone but served to influence other industrialist millionaires was one of Peter Cooper's greatest accomplishments. Matthew Vassar, Ezra Cornell,

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47. Quoted in Nevins, p. 445.

48. Quoted in Brown, p. 81.

and George Peabody all acknowledged their indebtedness to the founder of Cooper Union when they established their own educational institutions; Drexel, Pratt, and Armour, too, were influenced by Cooper. But his greatest influence probably was expressed through the philanthropies of Andrew Carnegie, who not only followed Cooper's example, but also made sizable contributions to Cooper Union.

Despite Cooper's generosity -- he contributed about $900,000 in all -- the Union was always in financial straits. Rents and endowments were inadequate to cover the expenses of the ever-growing institution, and the public had not responded monetarily as Cooper had hoped and expected. The Union limped along primarily with Cooper family money until 1899, when the situation improved dramatically. In that year the Union received a $300,000 donation from Carnegie. A second $300,000 bequest from Carnegie was followed by generous donations from others, and by 1902 the Union was able to stop renting its premises and thus devote its entire area to the distribution of knowledge, and even to expand its programs.

Throughout his life Peter Cooper operated under the aegis of an idealism which frequently was tempered by the practical exigencies of real life, but never to the point of disillusionment. He saw the universe as fundamentally good, but improvable. Following the counsel of his family motto, "Perseverance in all things," he set out to make the world a better place than he had found it. The Cooper Union is a monument to his success.

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PART 2: THE COOPER UNION BUILDING

Early developments in iron beam construction

Railroad rails, iron ship construction, and bridge girders were precursors to the installation of the first wrought iron beams in buildings during the 1850's. The history of the development of structural iron has been given a thorough initial inquiry by Jewett[1] and his findings are summarized here.

The railroad rail, developed by Robert Stevens for the Camden and Amboy Railroad, led to the 8-inch I beam rolled at the Trenton Iron Works by Abram Hewitt and Edward Cooper. On his way to England in 1830, Stevens had whittled the shape of the Birkenshaw rail, and soon perceived the advantage of adding to it a bottom flange. The Birkenshaw rail, which was of wrought iron, had twice the load carrying capacity of previous cast iron rails, and with Stevens's improvements it became even stronger. It was also easier to place since the added bottom flange allowed the rail to stand upright, unsupported by rail chairs.

These rails were small, however, (3-1/2 inches high) and short, due to the difficulty of producing enough material for a large bloom. [A bloom represented the amount of wrought iron that was required to produce a single beam. A puddling furnace yielded a spongy mass of wrought iron, a bloom, that was then shaped, by rolling, into a rial. The puddling furnaces were producing blooms of only 150 pounds.[2]] To overcome this, balls were rolled into flat bars, which were stacked to form a pile approximately 6 inches by 6 inches by 3 feet, which was then raised to welding heat and rolled into a completed rail.

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1. Robert Jewett, "Structural Antecedents of the I Beam, 1800-1850," Technology and Culture, Vol. VII, No. 3 (July, 1967), pp. 346-362.

2. Douglas Alan Fischer, The Epic of Steel (New York, 1963), p. 98.

Because the procedures were so crude, the welding was never complete, and the rails usually delaminated before they wore out.[3]

The earliest known attempt to produce an I beam was probably made by Ferdinand Zores of Paris in 1849, who was unsuccessful in his effort to have mills roll a 4-inch beam.[4] Previously, in 1844, a patent had been granted to Messrs. Kennedy and Vernon of Liverpool, England, for a 7-inch bulbed tee rail, as well as a 7-inch I shape. Their rail was similar to the later Camden and Amboy 7-inch rail of 1849, and their I beam was similar to the beam later developed at the Trenton Iron Works.[5]

Whether the young Edward Cooper and his Columbia College friend and tutor, Abram Hewitt, knew of these developments is not clear, but they did visit England in 1844, and in the spring of 1846 contracted with Stevens to produce a 4-1/2 inch rail.[6] By 1849, the year Zores was unable to have any French mills make the attempt, the Trenton Iron Works had rolled a 7-inch rail weighing 90 pounds per yard. The equipment at Trenton soon broke down however, and it was not until 1854 that the mill was able to roll 7-inch rails in quantity.[7]

Iron beams of various kinds and sizes had been used before 1854 however. Princeton University had bought some rails from the Trenton Iron Works for use in Old North Hall some years before.[8] Another type of beam was fabricated in 1840 and installed in Sedgewick Hall in Lenox, Massachusetts.

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3. Robert Jewett, "Solving the Puzzle of the First American Rail-Beam," Technology and Culture, Vol. X, No. 3 (July, 1969), pp. 371-391.

4. Fischer, p. 104.

5. Jewett, "Solving the Puzzle...," op. cit., p. 383.

6. Jewett, "Solving the Puzzle...," op. cit., p. 375

7. Jewett, "Solving the puzzle...," op. cit., p. 386.

8. Frank Culver, "Great Hall," (Press release marking Cooper Union centennial)(New York, 1959).

> These were each made of three plates, a top and a bottom one, both horizontal, with a vertical corrugated web plate between, the corrugations running up and down. The three pieces were fastened together with vertical bolts extending through the top and bottom plates, about 20 inches apart, and alternating, one on this side and the next on the other side of the vertical plate, the transmission of strains from the web to the flange depending entirely upon friction.[9]

The developments at Trenton eventually made such early ingenious devices outdated.

Peter Cooper and the Union

In his autobiography, dictated in 1882, Peter Cooper told how he came to want to build the Cooper Union.

> Some fifty-one years ago... I became acquainted with a gentleman who had lately returned from Paris, who informed me that while he was in Paris he had attended the institute or the School of Arts and Trades, as it is called, an institution that was gotten up by Napoleon the First. What interested me most of all was his description of the consummate ability of the teachers and the wonderful appliances they had to illustrate all branches of science. And what interested me most deeply of all was, he said he found hundreds of young men living on a bare crust of bread a day in order to get the benefit of that course of lectures. I then saw that in every great city there would be a great many poor boys

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9. Joseph Kendall Freitag, Architectural Engineering (New York, 1909), p. 3.

> who would gladly turn in to an institution that would offer them instruction in the application of science to all the useful and necessary purposes of life, something that I had felt the want of so much myself in all my business life that I determined that if I could ever get the means I would build an institution and have its doors open at night so that boys no better off than I was could attend and get the benefit of such knowledge of science as would be applicable in the various trades and callings that they would fill in after life.[10]

As Cooper's finances grew, so did his idea. The following announcement appeared in 1852, describing his philanthropic plans.

> It is said Mr. Cooper has appropriated the sum of $300,000 for the erection of an institute known as the 'Union.' It will be six stories in height, the upper story being occupied as an observatory with choice astronomical and microscopic apparatus. In the basement will be a hall 135 feet long and 84 feet wide intended mainly for a lecture room. ... To become a member and a student of this institution, will require no other credentials than a good moral character. Laws for the government of the students will be made by themselves and expulsions will be made only by a majority vote of the whole body.
>
> One of the most remarkable features of the institution will be a large room set apart for the use of ladies who may wish to meet for the discussion of natural and practical sciences. For further encouragement a sum of $500 is annually set apart to be given by a vote of the members of the institute to the female who is proved to have exhibited the truest heroism or the greatest self sacrifice in the cause of suffering humanity.[11]

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10. Peter Cooper, "Autobiography, 1791-1883" (unpublished manuscript, 1882), C-2D-A-F.

11. The New York Daily Times, November 27, 1852, p. 2.

Soon after, architect F. A. Peterson made public the following information concerning the building.

> We are indebted to the kindness of Mr. F. A. Peterson, architect, for a view of the elevation and plans, which enables us to give our readers some idea of the building as it will appear. The building will cover an entire block, having a frontage on Third-Avenue of 195 feet, on Fourth-Avenue, 155 feet, 143 feet on Eighth-Street and 86 feet on Seventh Street. The idea of Mr. Cooper of producing from the building a revenue to meet the yearly expenses of professors & etc., and thereby render the institution self sustaining has been carried out with remarkable ability by the architect -- preserving the unity of effect and proportion of the building as a public structure, while affording the utmost convenience on a commercial point. The 'Union' will be based on a remunerative sub-structure, which is calculated to bring in a large amount of revenue, and yet in appearance, injurs not the general effect of beauty and solidity. For this purpose the basement is intended as a large public hall 125 by 80 feet, and 21 feet high, having two wide entrances on Eighth-Street, one on Third and one on Fourth-Avenues. There will be a very spacious Lecture Room, and when all the entrances are thrown open, can be emptied in a minute. On the Third-Avenue side, will be a refectory. Here too, it may due to mention that, in addition to the general ventilation, which must be unusually good, from Loftiness and from communication, a small engine will be employed to form a constant supply of pure air through the entire building by a shaft 10 feet diameter, extending from basement to the roof.

The first story is intended for stores, which will run through from Third and Fourth-Avenues supported on iron pillars, with this exception the entire building will be composed of stone and brick. The second story will also be set apart for stores or offices.

With the Third story, then, commences the 'union', and in the elevation this the public character of the building is admirably maintained. A lofty row of windows run to the full height of the Exhibition Hall and picture galleries, giving, on the outside, an appearance of magnitude, very striking in effect. The story is appropriated to the exhibition room, 30 feet high and 125 x 82. A large dome sheds light through a well 22 feet in diameter. The fourth story may properly be considered a part of the third, being a continuation of galleries, with alcoves intended for painting and sculptures. These galleries are so designed that pictures may be placed to obtain the required light.

On the fifth story will be the lecture room and library. One lecture room on Eighth-Street side will be 82 X 52, the other 52 X 62 feet, and the library consists of five rooms communicating with each other and with both lecture rooms freely. Connected with the smaller lecture room is a room for physical experiments and instruments; and facing on the Third Avenue are five rooms intended to be rented to artists.

... The entire building will be of stone and brick. The style will be that of the Roman Italian, with sufficient elaborate ornamental work to express its chaste beauty without unnecessary expenditure. On Eighth and Seventh Streets the elevation presents a grand effect of beautiful stability, the commercial in no way appearing to interrupt its character as a private institution. The principal entrance, or front, will be on Eighth Street, through a lofty portico reaching to the top of the building, supported on two rows of columns, connected with semicircular arches, and forming two covered balconies, one from the Exhibition Hall, the other level with the second story. In the frieze of the principal cornice is

> the inscription 'To Science and Art', and it as well as the front on Seventh Street, is furnished in a full pediment. The portico leads to a large vestibule 42 ft. square from which a hall 20 ft. wide extends through to a smaller vestibule on Seventh Street. Two flights of stairs each 10 ft. wide lead from story to story giving easy access to the various departments -- sculpture gallery, picture gallery, exhibition hall, library, lecture-rooms, and observatory. The large vestibule and passage will be repeated on each landing. Smaller stairs lead from the exhibition rooms.
>
> The Architect has displayed great talent in the design. As a public building it will be unrivaled in the city, when completed. The estimated cost will be about $150,000. The purchase of the ground amounted to $150,000. Books and chemicals and othe apparatus are also to be provided.
>
> The income to be derived from the stores, lecture hall, refectory &c., it is expected will amount to about $25,000 annually which will be appropriated in meeting the expenses and furthering the intents of the institution.[12]

This account makes no reference to iron beams. In fact, it twice states that the entire building would be composed of stone and brick, except for some iron pillars on the first story. Nor is there any reference to fireproof construction. The decision to use iron rails in the Cooper Union probably came early in 1853. A few months before, in November, 1852, the Trenton works had issued a letter of intent to roll 1000 tons of 7-inch rails at 90 pounds per yard.[13] Meanwhile, the equipment to manufacture the rails was being developed. Soon another client was obtained for them. Abram Hewitt wrote to his brother Charles at Trenton,

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12. The New York Daily Times, January 21, 1853, p. 1.

13. Letter dated November 25, 1852, Cooper-Hewitt Papers, Book 10, No. 19291.

> The U. S. Government wants some beams for the Assay Office, and desires to know what is the strength of the beams you have made for Mr. Cooper. You will therefore test the matter by placing a beam on supports as far apart as the beams will admit, say 15 or 16 ft. in the clear, and then weigh it, until it deflects 3/4 of an inch. You can do this conveniently with rails because their weight is easily calculated.[14]

The architect

On September 17, 1853, the cornerstone was laid for the Cooper Union and Mr. Cooper and Mr. Peterson both spoke. Mr. Peterson, in his turn, said that he had been "charged by Mr. Cooper to give artistic shape to the design which he in the first instance conceived, and to embody in stone and mortar the idea first formed in his own mind."[15] Peterson freely admitted that the design of the building was Cooper's, while he basically had determined the "style." References to him and to how he came to work on the Cooper Union are difficult to find. The most thorough description of him appeared in 1885, shortly after he died:

> The New York Graphic tells an interesting story about the life of Mr. F. A. Peterson, an architect well known among the older members of the profession, who died in New Jersey a few days ago. Mr. Peterson, according to the account, was born in Prussia in 1808, and was educated for the army. While stationed, as a lieutenant of engineers, on the staff

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14. Letter dated September 19, 1893, Cooper-Hewitt Papers, No. 2703.

15. The New York Daily Times, September 19, 1853.

> of the general commanding the Dantzic district, an inundation took place, and Lieutenant Peterson was sent to the spot to render what assistance he could. ...
>
> While holding his position he was sent repeatedly to England, and there imbibed notions of popular government, which finally led him to an avowed sympathy with the revolutionists of 1848, and he was arrested, and thrown into prison to await trial. Fortunately, with the help of his wife and a few friends, he managed to escape from prison, and gained the shelter of an American ship, which brought him to New York. Here he began business as a civil engineer and architect, and was entrusted with many commissions of considerable importance, his best-known building being perhaps the Cooper Institute, at the junction of Third and Fourth Avenues and the Bowery.[16]

Various sources have been used to determine the whereabouts of Peterson, as follows:

Year	Office	Home	Reference
1808		Prussia	N.Y. Daily Graphic
1850-1851 (in partnership with Henry Hoffman)	363 Broadway	Court St., Brooklyn; Hicksville residence	Doggett Moriarty (letter in Cooper Union Library)
1865-1866	5-1/2 Pine St.	New Jersey	Doggett
1870	176 Broadway		Doggett
1880	21 Park Row Room 57	New Jersey	N.Y. Building Department Files

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16. Henry Saylor, "The Late F. A. Peterson, Engineer and Architect," The American Architect and Building News, Vol. XVII (May 30, 1885), p. 253.

Peterson is also listed as one of the organizers of the American Institute of Architects, on February 23, 1857.[17]

Little is known of the relationship between Cooper and Peterson; no correspondence or contracts between the men has been found, nor has any documentation of the drawings by Peterson survived except the rendering he made of the building which still hangs at the Cooper Union.

Description of the original building

The following account, written c. 1919, describes Peter Cooper's acquisition of the land for the Cooper Union, and his supervision of its construction.

> He bought the land lot by lot, and it seems surprising that nobody attempted to hold up his project by an extortionate demand for a single corner. Availing himself of a favorable opportunity when prices were low, he secured a quantity of building material and stored it on the ground ready for use. ...
>
> It was with keen interest and the closest attention to every detail that the founder of Cooper Union watched the laying of every brick and beam in the work of construction. A practical mechanic himself, his long experience and inventive powers made this supervision an intense pleasure to him, and he is said to have inspired his workmen with something of his own spirit of zeal. Twice during the constructive period he sustained falls which would have proved serious, if not fatal, to almost any other

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17. "The A.I.A.'s First Hundred Years," Journal of the American Institute of Architects, May, 1957, Part 2, p. 4.

18. James L. Ford, "Cooper Union" (New York, c. 1919), pp. 6-7.

> man of his advanced age, for he was now nearing his seventieth year.[18]

However much of the workmen may have been inspired, work progressed no faster than it does today. Ever hopeful, Cooper wrote in 1855, "My building is not progressing so rapidly as I could wish -- it will take about a year from this time to complete it."[19]

New Yorkers were informed often about the building. The following description is especially revealing.

> We present on this page an accurate view of this building, which was commenced in 1853. It stands opposite the new Bible House, at the corner of Astor Place and Fourth Avenue not far from the Astor Library Building. It extends 195 feet on Third Avenue, 86 on Seventh Street, 162 on Fourth Avenue, and 183 on Astor Place, covering an area of nearly 20,000 square feet, including the inner court. The edifice is six stories in height, the upper story being appropriated for an observatory, with choice astronomical and microscopic apparatus. In the basement is a hall 135 feet long and 84-1/2 feet wide, to be used as a lecture room. Peter Cooper, Esq., a well known merchant of New York, appropriated $300,000 to the establishment of this institution, designed as a free gift to the city of New York. The plan as proposed by him was as follows: -- The objects of the institution are the physical, mental and moral improvement of the people, and particularly of the young. There will be lectures and debates upon all useful sciences in its halls. In order to unite all kindred institutions in a common bond of interest, the

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18. James L. Ford, "Cooper Union" (New York, c. 1919), pp. 6-7.

19. Letter dated March, 1855, Cooper-Hewitt Papers, C-4A-C778CH-X.

halls of the edifice are to be opened free of charge for anniversaries, commencements, etc. A feature of the new institution will be a large room always open and free for the use of such women as may wish to meet for the discussion and consideration of the application of natural and practical sciences to their own benefit, or who have the talent and knowledge which will enable them to add anything to the treasures of science already known. There will also be an office in the institution for the benefit of those seeking scientific, educational or professional employment, where their names will be registered, and applications received and recorded for the benefit of all. For further encouragement to women a sum of five hundred dollars is annually set apart to be given by the vote of the members of the institute to the female who is proved to have exhibited the truest heroism, or the greatest self-sacrifice in the cause of suffering humanity. It is hoped in this way to draw public attention to the thousand self devoted acts which characterize the sex, and to make the young men of the institute more observant of the virtues which true humanity calls out. Another large room in the building is appropriated to general discussion among the members of the institute of philosophical and other appropriate matters; and notes and copies of such discussions are to be preserved as the property of the institution. The institution will be under the government of a board of trustees, comprising the judges of the United States Court residing in New York, the three judges of the Superior Court, the mayor, the eldest male member of Mr. Cooper's family, the president of the Free Academy, the president of the Mechanics' Society, and the editors of the principal daily and weekly papers of the city, who have one vote in the board. The trustees have power to appoint the professors, and a superintendent, who must make an annual report to the board, to the corporation, and to the legislature. Professors may be removed, on good cause, by the trustees, or by a vote of

> three-fourths of the students. To become a member and a student of this institution requires no other credentials than a good moral character. Laws for the government of the students will be made by themselves; and expulsions will be made only by a majority vote of the whole body. The plan thus sketched is entirely original; we are not aware of any existing institution in the world so constituted.[20]

Cooper's financial arrangements for his building were damaged by the Panic of 1857, but following a long-held view of constructive paternalism, he insisted that the work proceed. Even at great financial risk to himself, the building continued during the depression because, according to Cooper, "these men [the workmen] and their families must not be allowed to starve."[21]

By the fall of 1859, the first students entered the Union, and the building itself became a landmark of first importance.

> When built it was, with the exception of certain churches and the City Hall, the tallest edifice in the town, the original of the modern sky-scraper. It was the first thoroughly fireproof building of steel [sic] and cement [sic] construction. It contains the first elevator shaft running from the top to the bottom of the building ever seen in New York and the first public hall built with such a view to safety as to render disaster from panic practically impossible. This was done by placing the hall in the basement and all means of egress leading upstairs over stone steps instead of down, so that those fleeing for safety could not be trampled underfoot. This hall was also the first [sic] forum for free speech in America,

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20. "The Cooper Institute -- New York," Ballou's Pictorial Drawing Room Companion (1856), p. 240.

21. Quoted by Ford, p. 9.

> and it has remained ever since open to all orderly assemblies. Had the roof been utilized as first planned for an open air place of recreation, it would have been the first roof garden of the city. Not until a quarter of a century later was the first one built on top of a New York theater.[22]

The style of the exterior of the building was described by Peterson as Roman Italian. The building's three upper stories were articulated over the lower two, and there was a portico at each end. The basic material of the exterior walls was brownstone facing with "best brick in cement" backup and terra cotta trim.[23] The foundation walls were originally 29 feet deep, 36 to 42 inches thick, and rested on granite footings.[24] The upper walls were 16 to 32 inches thick.

Some contemporary descriptions of the interior of the building are known. One described the appearance of the Great Hall.

> The Great Hall is not equalled by any room of a similar nature in the city or the United States. Even Exeter Hall in London, in everything but its superb organ, is its inferior. It contains 2,500 iron chairs, beautifully ornamented and bronzed, and furnished with revolving seats with soft cushions and backs covered with red leather. Pending from the ceiling are 28 glass chandeliers each with six (gas) burners. In the walls of this gigantic apartment are inserted mirrors which reflects the audience and apparently double the actual size of the Hall.[25]

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22. Ford, p. 8.

23. New York City Building Department Application No. 190, February 24, 1880.

24. New York City Building Department Approval No. 1346, June 24, 1884.

25. The New York Daily Times, May 10, 1858.

The ground floor of the building originally was used for shops, while the second floor was rented as office space. In this way, revenue was produced which helped maintain the school. Fees were also paid by groups using the Great Hall.

The remainder of the building followed descriptions already given.

The Union, with its shops, offices, library, and public lecture hall, offered so many activities for every citizen that it is unlikely that many did not come to use it for one thing or another. It stood then, as it does now, at the confluence of separate neighborhoods, and was the focal point of each of them. It was the place where each neighborhood began and ended and intermixed with others.

Structural description

As originally constructed, the main bulk of the Cooper Union building was supported on cast iron columns over the Great Hall, with wrought iron rails used as beams which were supported by built-up girders. The triangle of rooms along 3rd Avenue was supported on wrought iron rails spanning north-south on bearing walls, and the south lobby portion was supported by a combination of both columns and bearing walls.

Some of the original beams and girders have been removed through the years, but much of the nature of the original material and construction is now known. The following excerpt gives an interesting first-hand account of the lower floor construction of the Cooper Union.

> Hollow burned clay tiles were used in this country as soon as I beams were rolled, though their employment cannot be considered as having been anything more than experimental. They were invented for the Cooper Institute, and used in the first story only, by Frederick A. Peterson, the architect of the building whose name, by the way, appears among the 'Founders' of the American Institute of Architects in the

> last printed Proceedings. These, according to the best evidence obtainable, were the first hollow burned clay tiles for floor construction ever designed, made, and put into a building, and the invention and introduction can be fairly claimed as American. As proof of this assertion I will add that I am in possession of the records of two important lawsuits involving the authenticity of the invention of flat hollow arches and the fire-proofing of I beams, and that the records of all inventions and publications bearing on the subject were exhaustively searched by the parties in interest for evidence affecting their respective sides. The patent taken out by F. A. Peterson, April 3, 1855, anticipates all others, and while it would in these days likely be considered impracticable, it was put in use in this one building through the perseverance of the architect and the determined pertinacity of Peter Cooper. When a schoolboy I remember seeing the work set. When involved in a lawsuit in which it was thought necessary by my attorneys to present evidence of what was then done, I found the building in process of alterations and was enabled not only to make drawings of the construction on the spot, but to remove some of the tiles. I found that they were all made of a semi-fire-clay and molded by hand.[26]

A detail of the construction used in the upper floors of the Cooper Union is shown on HAER sheet 17. It is important to note that the columns in the building had a considerable amount of material removed. Girders made up of railroad rails bolted

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26. Peter Bonnett Wight, "Origin and History of Hollow Tile Fire Proof Floor Construction," The Brickbuilder, Vol. VI (March, 1897), pp. 53-54.

together were fitted into slots cut into the columns as were the beams which sat on the girders. Thus, 75% of the effective area of each 12-inch column was removed at the joint. Fortunately, the columns were still thick enough to support the applied loads, but the detail shows the boldness of early approaches to iron construction.

The beams in the Cooper Union generally had no positive mechanical connection to the girders, and for the most part were simply laid on top of their supporting members and secured in place by brick arches. The fact that they were not measured exactly when set can be seen today in the slight misspacing from one beam to another.

The original roof construction is described in an 1879 building department application by F. A. Peterson as "tin, painted then slate bedded in aspheltum and a gravel roof upon that."[27]

Exact descriptions of the first elevator are still somewhat obscure. Cooper initially spent ten thousand dollars for a system he subsequently replaced, and it is thought that it may have been of the water-balance type, which probably would not have been installed before 1870 since the first patent on such a device, by William E. Hale, was not granted before 1860.[28] In any case, Edward Ringwood Hewitt, Cooper's grandson, gave the following description of an elevator installation by his uncle.

> At that time, there were no passenger elevators but Mr. Cooper insisted on putting in the elevator shaft saying that if there were no passenger elevators when the building was ready, he would build one. As there were none available, Edward Cooper, his son, designed a special steam engine with the appropriate winding drum for the rope.[29]

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27. New York City Building Department Approval No. 1293, December 24, 1879.

28. Frank Culver, "Building" [Press release marking Cooper Union centennial] (New York, 1959).

29. Quoted by Culver, "Building".

The first elevator consisted of an iron cage furnished with a carpet and a leather divan, none of which have survived. In 1914, it was replaced by an Otis electric elevator with a square cage that was fitted into the round shaft.

The main space of the original building was the third floor exhibition hall with its fourth floor gallery. It is shown on HAER sheet 18. Part of the original structure is reconstructed in the drawing.

Changes after 1859

With the following words, Peter Cooper gave the Union to the trustees, Abram Hewitt, Edward Cooper, Daniel Tremann, Wilson Hunt, and John Parsons.

> Here is the building, I want it appropriated as soon as possible to the education of the young men and young women of New York City and appropriated to free education. There must be no fee paid in the Cooper Union, for education ought to be as free as air and water. ... Hence you will have to rent as much as is necessary of this building in order to maintain the classes and the reading room.[30]

In 1882, when Cooper dictated his autobiography, he gave the following accoung of changes at Cooper Union after 1859.

> In the course of my efforts to enlarge the usefulness of Cooper Union I concluded one of the best means of doing it was to build two partial stories on the top of the building, and a dome, where there is a clock with a six foot face which lights itself at night and puts itself out in the morning at

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30. Quoted by Allan Nevins, "Abram S. Hewitt" (unpublished manuscript).

the proper time, which can be seen as far as the eye can reach down the Bowery. The addition has proved to be an admirable accommodation for seven or eight hundred additional pupils of both girls and boys. That addition embraces the class in typography, the class in plaster and clay mouldings, with a class in freehand drawing, and drawing from cast in life. Putting these stories above enlarged greatly the accommodations of the ladies in the lower story, where there is a class in art in its various forms, and in the same story is a class in engraving on wood. These changes have been made by the additions on the top of the building.

In order to get the scholars conveniently up and down the great height of the building I expended some ten thousand dollars for an elevator which did not work to my satisfaction, and after having a great deal of difficulty with it I concluded to take it out and put in another one, which I have done, which the builder says is as good as others in the country, if not as good as could be found anywheres, which will carry from thirty to forty persons at one time. It enables us to pass the scholars up and down with great facility and convenience. It may be worthwhile to mention that the tower in which that elevator works was a part of the original plan of the building. When it was built in the first place, I expected to have either a garden or a museum of the arts on the upper story and I knew that that could not be successful unless I could put machinery in there to carry people and, therefore, I provided a tower going from the bottom to the top of the building, circular in form, and ten feet six inches in diameter, which is now over a hundred and twenty feet high. ... In order to make the building more secure than I could otherwise do, after having provided a three inch pipe in connection with a three foot water main on Third Avenue, which supplied the city, I connected with this arrangement a

passage pipe which extends from the top of the building, which is constantly kept in order and made to work every day so as to be sure and have it in order to keep the tanks full in the upper part of the building. This is so arranged that the whole power of the fifty-horse engine can be made to press water and send it to any part of the building, with wbich expectation the janitor has made many experiments and finds that when he rings the bell, he says, he has never failed to have the water in any part of the building, when called for, in less than a minute.

In order to have still greater security for the building I obtained the privilege from the city authorities to undermine and arch over the whole of Seventh Street from Fourth to Third Avenue. This gives a splendid room, well lighted, for certain purposes in connection with the institution which are not yet positively determined but which will be used to the best advantage. In addition to this, I had a further excavation under Fourth Avenue of size sufficient to receive some two hundred tons of coal. In that room I have had a tank made that will hold some twenty or thirty barrels of petroleum, instead of burning coal for the purpose. This large room under Seventh Street enabled me to remove the steam boilers which were partially under the building before, and are now situated near the corner of the little park just south of the building. No possible accident can now occur to the building from the bursting of the boiler or the burning of a large quantity of fuel, which are now surrounded by iron and brick which will not burn.

I regard the improvements that I have made as forming a very important item in the adaptation of the building for all the purposes for which it was intended.

In addition to that, as a further means of security, I have two fire extinguishers of the most approved kind, so placed on a frame that is conveniently arranged for a man to put his hands in the straps and put the extinguisher on his back and run with it to any room in the building where a fire may be discovered. Also, each extinguisher has with it two pails of water always ready, made of zinc, and so covered so that they will not evaporate, and if the ladies' clothes should take fire these pails of water are always at hand. I think pails of water should be placed in every building and kept always in a convenient spot so that a pail of water can stop a fire at the instant of an alarm. The benefit of such a provision was wonderfully verified on one occasion when the Bank Note Company had made some change in their gas arrangements and the man who had done it had left off the cap on one of the traps of the ceiling in one of the halls leading directly into the United States Bank Note Company's rooms, and when the gas was lighted at night on one of the other burners the man went down the steps and, before he got down, he saw a light and he ran right back and saw the flame was running right against the wall; when he took this pail of water and held it over his head and stood on a chair to make himself high enough to hold this water so that this gas jet was in the water, and his cry for help brought others who came and turned off the gas. This escape from fire was all from the having a pail of water near.

While on the subject of the danger of fire from gas, I will relate another narrow escape that the institution had. On one occasion, going down to the large hall underground I thought I smelled the escape of gas. I called the engineer to get a light, when we went to look for it. We followed the smell until we found that it came out of a lead pipe and I smelled the orifice, when it was most noticeable, it being not much larger than a pinhole. When we went with a candle we set it on fire. The

> engineer thought this was so small a thing that he went on another errand, and while he was gone this small flame continued to burn and soon melted the lead pipe so that it bursted and soon there was a large hole from which the gas escaped. Had not the room all around this been brick stone and iron, the building would have taken fire and nothing could have saved it. A wet coat was thrown over this hole in the pipe as the only means at hand to stop this fire. And now this shows the danger of leaving the least spark of fire burning in a lead pipe as a warning to any others.[31]

Many visitors wrote articles on the building during its early years, and one such article mentioned that "The building is heated by steam throughout, and for the purpose twelve miles of steam pipe are used. The lighting requires four miles of gas pipe."[32]

In March, 1861, the Cooper Union was referred to as "a fire proof building of stone, brick and iron, containing seven floors."[33] Thus within two years of the building's opening, the first of many successive additions and alterations had been accomplished. It is suspected that the additional floor mentioned above was partial, and was later removed and replaced.

Significant changes to the building came in 1885, made necessary by the added load of additional stories which had been added by that time. An article in Scientific American described the repairs involved.

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31. Peter Cooper, "Autobiography," pp. 195-200.

32. "The Cooper Institute," Life Illustrated, June 19, 1860.

33. "The Cooper Union for the Advancement of Science and Art," Harper's Weekly, March 30, 1861, p. 200.

Originally, there were but five stories and a basement, the latter containing the large lecture room which is 125 by 82 feet and 21 feet high, but a few years since an additional story was placed over the entire building, two stories were raised over a part of the Third Avenue side and the southern end ... was raised to a total of eight stories. This additional load together with errors in the design made necessary the extensive repairs which have been in progress for several months, and which are now nearing completion.

The piers supporting the walls facing the avenues were placed beneath the center of the window spaces of the third or reading room story, and also beneath the piers of the third story. The piers under the window spaces thus had but little or no load to carry beyond their own weight, and as a natural consequence, the lintels and window sills were fractured by the strains produced by the bearing piers moving downward thereby causing the upward reaction through the line of the intermediate ones, or those having no load. To remedy this defect, which is by no means an uncommon one, even in buildings of recent date, all the bearing piers were removed and others were built having a larger section and an increased area of foundation, while the flat lintels of the second story were replaced by segmented stone arches. During the work the walls were supported upon shoring. ... Beneath the lower portion of each of the third story piers were placed two pairs of heavy iron I beams, 15 inches deep and two sets of heavy yellow pine timbers. The interior shores extended from floor to floor to the basement where they rested upon a crib formed of timbers; the large foundation area thus obtained rendered easy the adjustment of the shores by the screws. Outside there were two shores to each needle, and where there were vaults under the sidewalk, the arches were centered, and held by shores. Struts were wedged across the lower part of each window space.

The ceiling of the lecture room was supported upon three rows parallel with Fourth Avenue -- of cast iron columns, 12 inches in diameter, spaced 18-3/4 feet apart; at right angles to the rows, the columns were 18 feet apart, and the outer rows were 20-2/3 feet from the piers. Upon adjacent columns and in a direction perpendicular to the avenue were two brick arches, the space between which was filled in; the lower arch was designed to carry the ground floor, and the semicircular one served to distribute the weight of the dividing walls and the piers and columns which extended upward through the several stories of the building to the columns. The piers upon which the outer line of arches rested were so narrow that the line of thrust fell outside the base and the pressure was not transmitted to the retaining wall, owing to the height at which the arch joining the wall and piers was placed. As repaired the foundations of the piers are 10-3/4 feet square, and the arch is so curved ... that the line of thrust falls well within the base. ... After this row of arches had been completed, the upper walls were found to be too weak to carry the load, the arches were then centered, and were supported by vertical and radial shores while the adjoining ones were put in. All of these arches are of cut stone.

The columns were originally supported upon foundations consisting of an upper granite block 2 feet square by from 11 to 12 inches thick and by an under block which in several instances was divided 4-1/2 by 4-3/4 feet and 16 inches thick. The upper block is now 4 feet 8-1/2 inches by 4 feet 10-1/2 inches and 1 foot 10 inches thick, the lowest course of concrete is 8 x 9 feet. (The entire building rests upon sand and in every case the foundations of the piers and columns have been increased in area and extended deeper). The columns are of cast iron, 16 inches in diameter.

... The columns in the reading room in the third story were directly over the center rows in the basement and that portion of the room between these columns -- 37 feet wide and 90 feet long, passes through the third and fourth stories. The ceiling over this space was held by girders supported at the end upon columns and at the center by rods from the roof. These girders at the ends of the reading room ... were made up of two deck beams each 7 inches deep put bulb to bulb and held by bolts through the flanges. A permanent deflection averaging about 2 inches had taken place. These are reentered by the placing of two heavy I beams, one at each side. ... To reduce the root a center row of columns has been erected. While the repairs in the reading room and the strengthening of the walls in lower stories were going forward the central portions of the floor were cut away. The columns in the reading room were carried by shores extending to the basement floor. About the upper part of the column were firmly bolted the carefully fitted sections of an iron jacket. ... The shores tore against the extended under side of this jacket and held the column during the building of the new wall.

In the foregoing we have attempted to describe only the main features of the principle changes and to briefly mention the causes making them necessary. This building was the first one in which iron was used extensively and owing to the experimental condition in which the use of this material then was, there crept into the design errors in form and proportioning which the experience of later years enables the builder to steer clear of. All such parts have been entirely removed and rebuilt or have been strengthened. During the repairs the load in every case has been carried to the basement of shoring always placed virtually in line, thereby obviating the risk of having an unusual weight brought upon the floors. All the division walls and the columns have been carried up virtually in line with the basement columns and have been made of such size as to insure ample strength.

> It is estimated that these repairs will cost in the neighborhood of $250,000, the building costing originally $650,000; this expense thus far has been borne by a few gentlemen whose names we are not a liberty to give, but to whom praise is due for their generous and unostentatious support of so good a work. The architect under whose direction the work has been most successfully prosecuted is Mr. Leopold Eidlitz. Mr. J. H. Smith is the builder and Mr. Isaac Whitenack the foreman of masons.[34]

The required reconstruction thus completely restructured the ground floor level. Eidlitz took the opportunity, while working on the foundations, to redesign the entire Great Hall, and the resulting auditorium with its ventilation system is shown on HAER sheet 20.

Alexander Jackson Davis and the Cooper Union

When the Cooper Union opened in 1859, the following account was published, which summarizes many interesting aspects of the building, including some which elicited severe criticism from Alexander Jackson Davis, noted architect of the day.

> Of the existence of a noble and fireproof structure known as the 'Union for the Advancement of Science and Art' our readers are aware, but, we doubt if one in a thousand of them have any just conception of the motives which led to its erection, and the progress it is making as an institution destined, at no very distant day, to become

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34. 'Repairing the Cooper Institute," Scientific American, Vol. LIII, No. 23 (December 5, 1885), p. 357.

one of the crowning glories of the Empire City.

The building more familiarly known as 'The Institute' has been more than 5 years in the course of construction. It covers the entire block bounded by Astor Place, Third and Fourth Avenues and Seventh Street. It is 90 feet high from the curbstone to the cornice and foundation is 25 feet below the curbstone. The building is fireproof throughout having iron beams with brick arches between to separate each story. Of the six stories into which the building is divided four are devoted to educational purposes. The larger part of the remainder is rented to furnish revenue for the support of the institution.

The basement contains a large hall which will seat 2500 persons. A steam engine in an adjoining room drives a fan 14 feet in diameter, by which warm or cold air may be thrown into the several halls at pleasure; the air being admitted to the large hall through small holes under each seat so that the most perfect ventilation is secured without disagreeable currents of air.

There are two main stairways both at the south end of the building. At each landing is a hall 36 feet square. These halls, six in number, are intended to receive collections illustrating the Arts and Sciences. As the institute doesn't at present possess such collections the casual visitor may suppose that all the space is thrown away. But in due time, no doubt, the friends and patrons of Natural History, Geology, Mineralogy, Chemistry, the fine and the useful arts, will fill every hall and gallery with collections which will do honor to themselves and secure the fullest success to this Institution.[35]

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35. "The Cooper Institute," The Cooper Survey, November, 1859.

The article dealt politely with the leftover spaces in the hallways, and mentioned that both stairways had been placed at the south end of the building. Such a layout required that a substantial percentage of the total floor area be devoted to corridors rather than to useable space. This aspect of the design was soon noticed by A. J. Davis who grew to know Peter Cooper and his family through his position after 1869 as librarian for the Association for the Advancement of Science and Art.[36] Davis took an active interest in the novel educational ideas of the Union, and thereby came to be familiar with the building itself. As an architect himself, he could not resist the temptation of improving on Peterson's design. For example, he criticized Peterson's plan for the Great Hall, saying,

> Observe the waste of room at the south end wholly taken up by stairs where might have been stores and offices with chemical laboratory 50x90 feet and well lighted rooms all around, upon the several streets.[37]

At the same time he put forward a proposal of his own which included two assembly halls in the same space that Peterson had put one, noting,

> Observe the economy of space by placing the stairs in the center, and by sections see the manner of introducing light to the basement. The two auditoriums are shaped on phonic principles.[38]

It is not known exactly when Davis drew his improved version, but it is assumed it was prepared after 1868 (the year of the watermark on his drawings) and probably in early 1869, soon after his appointment as librarian. Apparently, Davis's interest in the

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36. Alexander Jackson Davis, "Daybook," 1869.

37. Alexander Jackson Davis, Drawings of Cooper Institute.

38. Davis, Drawings

Cooper Union building was not limited to idle criticism, however, for in a letter to Abram Hewitt in 1891, he recalled his design suggestions for the Great Hall.

> I make these suggestions as merely complimentary to the family of my Whilom friend, Peter Cooper, whose memory I hold in high esteem, and for him and the public benefit, I made the proposal to alter the auditorium in the Institute, which was adopted and executed, Mr. Cooper shewing his mind for scientific truth, changed the arrangement and placed them as they now exist.[39]

Davis continued throughout his lifetime to be a friend of the Cooper Union, often attending meetings at the Institute, corresponding with the Cooper family, and making contributions for the support of the school.

Conclusion

During the 1850's basic formulas for the design of iron beams became generally known. In October, 1853, the British journal The Builder published "Calculations and Formulas for Wrought Iron Plate Girders,"[40] and even earlier, in June, had printed "A French System of Iron Floors," which showed a system of 6-inch beams one meter on center, which was similar to the system later used in the Cooper Union.[41] Peter Cooper was in constant communication with English iron manufacturers, while his son Edward did extensive studies of the tariffs that were critical to the importation of English rails. It is uncertain exactly whether Cooper knew of the English patents of Kennedy and Vernon

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39. Alexander Jackson Davis, letter to Abram Hewitt, January, 1891.

40. The Builder, October 15, 1853, p. 646.

41. The Builder, June 4, 1853, p. 346.

in 1844, of the work of Zores in 1849, of the iron works of Hittorff on the Rue de Rivoli in Paris, or even of the Crystal Palace. What is certain is that Peter Cooper was a major contributor to iron construction in this country, and a pioneer in skeleton construction.

When the skyscraper was newly established as a building type, skeleton construction was discussed in numerous articles. One such article, after commenting on the English admiration for "American go-aheadedness," stated,

> High buildings are demanded, and today there is simply no limit to the height that a building can safely be reached. The result has been reached mainly through three inventions, all of which are distinctly American.
>
> 1. The modern passenger elevator.
> 2. The flat arch system for fireproof floors.
> 3. The skeleton construction.[42]

It is important to realize that 30 years before William LeBaron Jenney's first use of true skeleton construction in Chicago, Peter Cooper had anticipated in his Cooper Union building the three criteria mentioned above.

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42. William Fryer, "Skeleton Construction," Architectural Record, October-December, 1891, pp. 228-235.

SIGNIFICANT DATES

1853	September 17, cornerstone laid
1859	May 10, Great Hall opened November 2, Cooper Union officially opened
1861	Additional story completed (later removed)
1880-81	Additional stories placed on entire building
1885-87	Extensive repairs made to foundations, made necessary by additional load of upper floors
1891-95	Upper floors reconstructed and skylights added over 6th floor on 4th Avenue side. Dome and part of 8th floor removed
1906	Alterations made in Great Hall area to meet requirements for public assembly
1911	Library stacks added to 3rd floor library. Outside fire escape built
1914	Otis elevator installed
1918	Extensive alterations to heating plant
1922	Change from gas to electric lights in library reading room
1925	Additional book stacks installed in library 3rd Avenue side
1926	Library ceiling floored over
1947	North stairwall installed to 2nd floor
1956	3rd Avenue basement wall moved in
1961	Renovation of 5th floor and book stacks installed in room 500
1968	7th floor art school office renovated
1969	502 lecture room renovated
1972-	Extensive renovation of entire building

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Prepared by William H. Rowe, III
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PROJECT INFORMATION

The Cooper Union Project is part of a long-range program by the Historic American Engineering Record (HAER) to document historic engineering and industrial works throughout the United States. It was cosponsored during the summer of 1971 by the National Park Service (HAER) and the Cooper Union for the Advancement of Science and Art. Field headquarters were located in the office of Professor John Hejduk, Dean of the Cooper Union School of Architecture.

The field work, measured drawings, historical data, and photographs were prepared under the general direction of Douglas L. Griffin, Chief, HAER, and William H. Rowe, III, Project Supervisor. The draftsmen were Willy Sclarsic and Dale Flick, architecture students at Cooper Union. The formal photography was done by Jack E. Boucher. Additional historical research was completed in 1973 by Bettye T. Chambers, HAER.