

*“The Happy Employment of  
Means to Ends”:  
Frank Furness’s Library of the  
University of Pennsylvania and the  
Industrial Culture of Philadelphia*

**I**N 1885 THE PROVOST of the University of Pennsylvania, William Pepper, M.D., called for the construction of a new library building to form the centerpiece of his academic program to incorporate research methods into instruction. Restored in 1991 by Venturi, Scott Brown and Associates and reopened as the university’s Fine Arts Library, Frank Furness’s building has been cleaned of a century of grime to reveal fiery red hues that highlight its exuberant shapes and forms. Designed with the input of the era’s best-known library experts, it was initially hailed as the most successful college library of its day. However, its original style caused it to be almost immediately forgotten as a model for other libraries.<sup>1</sup> Frank Furness is now enjoying a surge of popularity, replacing Henry Hobson Richardson as the best-known American Victorian architect. But even today the *cognoscenti* have trouble understanding what Furness intended in his University of Pennsylvania Library. This article offers an explanation for Furness’s masterpiece as a manifestation of the city’s innovative industrial culture while also providing an important clue to Furness’s success in supposedly conservative Philadelphia.

In the 1880s the role of the college library was changing. No longer just

<sup>1</sup> Much of the research for this paper was undertaken a decade ago as the basis for the restoration of Furness’s library at the University of Pennsylvania. It owes much to the early interest in libraries of James F. O’Gorman, who taught at the university in the 1960s and early 1970s. In 1973 O’Gorman wrote the perceptive lead essay for the Philadelphia Art Museum catalogue *The Architecture of Frank Furness* (Philadelphia, 1973) that brought him back to popular attention. Susan Nigra Snyder pushed me to link Furness to the present and to note his contrast with Euro-modernism’s *industrialesque*.

a storehouse of collected wisdom, the new college library functioned as an agent of innovation in the development of the modern collegiate curriculum. Moses King's account of Harvard College described its new status: "The president [Charles Eliot], in a recent report, points out what an important position the library is expected in the future to take in that group of organizations which now constitute the University. While the library may supply to every department a source from which instruction may be drawn, it must of itself in any comprehensive system of training become the center of strong influences."<sup>2</sup> In 1884 William Pepper hired a librarian to encourage the use of the university's book collection. The following year Pepper requested that the community at large gather within the walls of a new library "a record of the busy work of the world to-day," placed where "students can use it and learn the methods of original investigations and research."<sup>3</sup> This call for action was at first only partly successful, spurring an enormous increase in the number of volumes that, in turn, overwhelmed the university's demonstrably inadequate facility—a single room in College Hall. Having precipitated the crisis, the provost then led the campaign for a new library, reporting that the onslaught of books

... renders more conspicuous the lamentable want of suitable accommodation for books and for readers. The time has now come when a separate fire-proof library building is imperatively demanded. It is a necessity for the instructors, over 148, and for the students, over 1048, who now have not good opportunity of using the library for reference still less for systematic study and investigations.<sup>4</sup>

Rather than simply adopting the model of other collegiate libraries of the day, Pepper called for the university's new library to be the best of its type in the world and established a committee to meet the challenge. The committee was headed by the university's pre-eminent scholar, Horace Howard Furness (1833–1912), who for a generation had been publishing a new variorum edition of Shakespeare, a labor at which he would continue until his death.<sup>5</sup> At a meeting on March 25, 1887, the committee resolved, first,

<sup>2</sup> Moses King, *Harvard and Its Surroundings* (Cambridge, 1882), 25.

<sup>3</sup> Letter to the community signed by Provost William Pepper, M.D., librarian James Barnwell, and Horace Howard Furness, chairman of the university's library committee, Joseph Clarke Sims scrapbook, University of Pennsylvania Archives (hereafter, UPenn).

<sup>4</sup> William Pepper, *University of Pennsylvania Provost's Report* (Philadelphia, 1885), 28, UPenn.

<sup>5</sup> For Horace Howard Furness's contribution to Shakespeare studies, see James M. Gibson, *The*

that the joint committee to which was entrusted the duty of securing competitive plans for a Library Building report that in their judgment it would be better for the Committee itself to secure all available information and to entrust the data so obtained to an architect to be appointed by the Board for putting the same into form. Second that the chairman of the Library Committee [Horace Howard Furness] be requested to collect all desirable information including plans, cost and reports on the actual efficiency of existing libraries and that these data be placed at the disposal of this Joint Committee for considering before the architect employed is asked to do any designing. Third that the Joint Committee recommends to the Board that Mr. Frank Furness [Horace's brother] be appointed architect for the Library Building under the above plan of action.<sup>6</sup>

Though the third step, immediately hiring an architect, appeared to subvert the first two steps, Frank Furness was hired and work began. Furness had already designed two libraries, the conversion of the 10th Street Market into the Mercantile Library and the new building at Juniper and Locust for Benjamin Franklin's creation, the Library Company.<sup>7</sup> He had a reputation as a capable and creative designer who could resolve the problems of the new buildings of the industrial age, using new materials and new technologies to advantage.

Instead of studying libraries of the past for a model, as Charles McKim would do when he based the contemporary Boston Public Library on Henri Labrouste's Bibliothèque Ste.-Geneviève, Furness took the up-to-date, business-like approach of using professional advisors to begin sorting out the design of the modern library. One of these advisors was Melvil Dewey, then professor of Library Economy and chief librarian at Columbia University, and one of the premier theoreticians on the role of libraries of his era. The other was Justin Winsor, who had with Dewey helped found the American Library Association and had for a decade been the head librarian of Harvard University, then the largest academic library in the country.<sup>8</sup> Winsor had faced the problem of collection growth at Harvard. Dewey was

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*Philadelphia Shakespeare Story: Horace Howard Furness and the New Variorum Shakespeare* (New York, 1990). Interestingly, the *Dictionary of American Biography* lists only Horace Furness for his scholarship, while ignoring the unclassical and therefore unimportant Frank Furness.

<sup>6</sup> Report, University of Pennsylvania Board of Trustees, April 5, 1887, UPenn.

<sup>7</sup> See George E. Thomas et al., *Frank Furness: The Complete Works* (New York, 1991).

<sup>8</sup> For a brief biography of Dewey, see *Who Was Who in America* (Chicago, 1942), 1:319; for Winsor, see Dumas Malone, *Dictionary of American Biography* (New York, 1936), 20:403-4.

working on a variety of solutions to those problems, beginning with his famous decimalized cataloguing system, developed nearly a generation before to organize the exhibits of the nation's Centennial Exhibition. In his role as editor of *Library Notes*, Dewey would have been familiar with the most innovative solutions to library issues.<sup>9</sup> Together these three men formed a remarkable team.

The late 1880s was an appropriate moment to reinvent the college library. Unlike the relatively static collections of libraries of the past, the new college research library served a growing and disparate community of undergraduates, graduate students, and faculty with the aim of producing the "new knowledge" that was reshaping the modern world. New discoveries produced an ever-enlarging stream of publications that strained library shelves and sorting systems. This had prompted the recently formed American Library Association to make recommendations for a more functional library. Many of their principles can be deduced from the outline of the ideal modern library proposed in the *Encyclopedia Britannica* the following year. Separate reading rooms, book-storage rooms, work rooms, and offices should be

made to fall into the most convenient relations to each other. The reading room should be away from the main collection, and the lending department should be apart from the reference library. The basement should be vaulted. . . . As the storeroom, or that in which the main collection is deposited is one to which readers have seldom the right of access, the greatest economy as to the shelving and passageway may be effected. . . . No shelf should stand more than eight feet above ground. If the room be sufficiently lofty, it may contain one or more perforated iron floors. Spiral stairs are to be avoided. Lifts may be used with advantage.<sup>10</sup>

Each of these elements would appear in the new University of Pennsylvania Library.

Through the mid-nineteenth-century, library design, whether for academic or private facilities, was based on ecclesiastic or royal sources. This

<sup>9</sup> See "The System of Classification" in United States Centennial Commission, *International Exhibition, 1876* (11 vols., Washington, D.C., 1880-84), vol. 1, *Report of the Director-General* [A. T. Gosborne] (1880), 56-57.

<sup>10</sup> H. R. Tedder and E. C. Thomas, "Libraries," *Encyclopedia Britannica* (9th ed., New York, 1888), 14:536.

tradition is documented in an article by Charles Soule entitled "Modern Library Buildings" that appeared in the *Architectural Review* in 1902.<sup>11</sup> Despite the use of the word "modern" in his title, Soule's article began with an image of the Vatican Library and provided a retrospective of library history reaching back to the ancient world. According to Soule, the typical mid-nineteenth-century American library was based on European models, with a lofty main room lined "from floor to ceiling with tier upon tier of alcoves and galleries" in the fashion of the still-surviving Peabody Institute in Baltimore and the old Georgetown University Library. And indeed, Furness had followed a similar approach in his earlier libraries where he did not have the benefit of his consulting team.

Soule placed the Harvard Library at the center of the evolution of the new library form. Planned in 1838-40 with the responsibility to contain "the probable accumulation of books during the century," its exterior followed the form of King's College Chapel in Cambridge while the interior, with its "long, high room lined with alcoves and galleries," followed the model of European university libraries. Despite the ambitious goals of its designers, by the early 1870s the Harvard building's capacity had already been exceeded. This resulted in the decision to add a new book storage system to one side, the ancestor of the modern book stack. Designed by Ware and Van Brunt "in constant conference with the library authorities of the time and with President Eliot," the addition met the goal of storing the largest number of books in the smallest possible space with considerable potential for expansion. Published with plans, elevations, and details in the *American Architect and Building News*, the "compact cage of metallic shelving with narrow aisles between the shelves, story superimposed upon story to any desired height" became a standard part of the modern library building. Furness's plan for the University of Pennsylvania's new library included such a stack.<sup>12</sup>

<sup>11</sup> *Architectural Review* 9 (1902), 1 ff. Soule was a counselor and trustee of the American Library Association, author of "Points of Agreement among Librarians as to Library Architecture" presented at the Library Conference of 1891, and author of the "Library" entry in Russell Sturgis's *Dictionary of Architecture and Building* (New York, 1901-02).

<sup>12</sup> Soule, "Modern Library Buildings," 2; "Details of the New East Wing of the Library of Harvard University, Cambridge, Massachusetts," *American Architect and Building News* 4, no. 152 (Nov. 23, 1878), 172-73. It included sections and details of the new cast iron stack standards that made possible considerable expansion and continued to serve into the early twentieth century. Furness had studied with William Ware and Henry Van Brunt in Richard Morris Hunt's New York atelier in the 1850s and may well have corresponded with them about the book stack question.

Though the book stack provided a solution to the problem of storage, there were larger problems of circulation and function that were rarely addressed in contemporary libraries. At a time when library design focused more on aesthetics than on functional planning, Furness, Winsor, and Dewey came up with a strategy that placed spaces according to their functional relationship rather than within a predetermined form. The fruits of their conversation and its prospects for success were described by Melvil Dewey in a letter to Provost Pepper on April 20, 1887:

The plans I sketched with Mr. Furness late that evening, seem to me better than any college library has yet adopted. I should like to see your building by all odds the best model for similar institutions to follow and it will be a great pleasure if I can be of any service in that direction.<sup>13</sup>

Their plan was published the following year in the *Library Journal*, with an accompanying text by journalist Talcott Williams.<sup>14</sup> Reflecting the original intention of constructing the new building on the site at 36th and Spruce Streets presently occupied by the Wistar Institute, the plan showed an inverted version of the building that now exists. The 36th Street site would have required the placement of the round end of the building to the right of the main entrance stair, where it would have fit into the angle formed by Woodland Avenue's diagonal crossing of 36th Street (fig. 1). When proponents of the anatomical museum and laboratory for the Wistar Institute were successful in raising funds for their project first, they were awarded the site across from the Medical School. Furness then inverted the plan of the library so that it could be used at the different triangular site on the opposite side of the campus where Woodland Avenue crossed 34th Street.

Despite that modification, the core elements of the plan remained the same. The projecting entrance tower contained a generous porch and vestibule leading into a large stair tower. The interior of the entrance hall was described on the plan as a "lobby and conversation room." On one side was a toilet room, and opposite that, a coatroom. The great stair was to lead to a large amphitheater-shaped lecture room on the upper floor, whose form

<sup>13</sup> Melvil Dewey to Provost William Pepper, M.D., April 20, 1887, UPenn.

<sup>14</sup> Talcott Williams, "Plans for the Library Building of the University of Pennsylvania," *Library Journal* 13 (August 1888), 237-43.

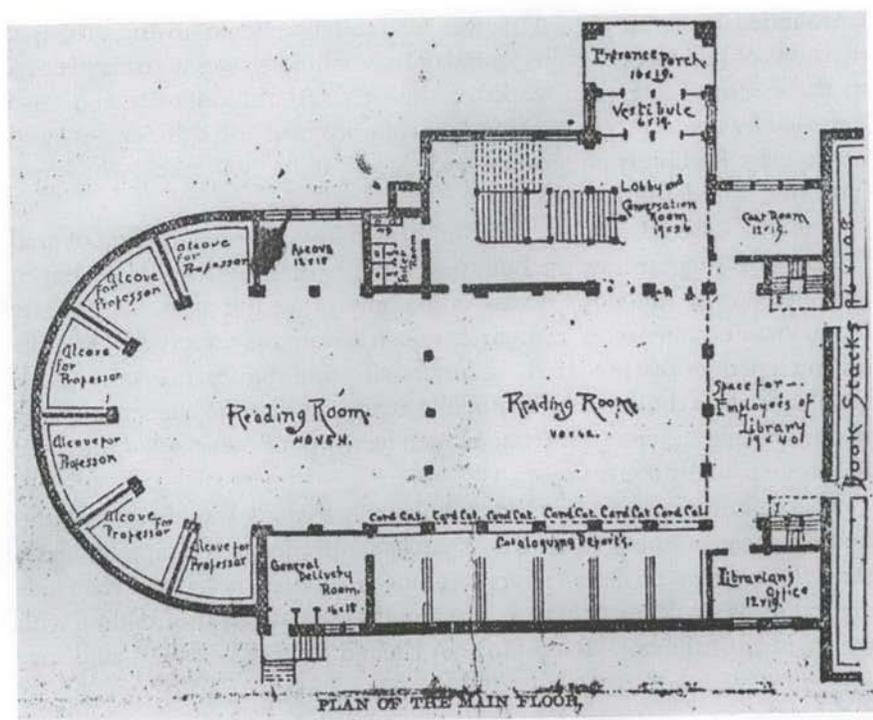


Fig. 1. Frank Furness, Preliminary Plan of the University of Pennsylvania Library, 1888. University of Pennsylvania Archives.

determined the rounded shape of the library. That great lecture room was intended as the place where new knowledge could be disseminated to the university and the wider community. From the stair tower, multiple doors opened into a large reading room. Directly opposite the entrance, in the far arcade that screened the cataloguing department, was the card catalogue.<sup>15</sup> The cataloguing department was terminated at the librarian's office at one end, while at the opposite end was the general delivery room, entered directly from 34th Street via its own stairs. A second reading room, screened from the main reading room by a masonry wall carried on columns, was

<sup>15</sup> As an added efficiency, the card catalogue drawers could be opened from either side so that the cataloguing department could pull drawers to their side, and general users could access the cards from the reading room.

surrounded by seven special alcoves for reference books in the principal divisions of knowledge. Here professors could hold classes with easy access to the essential reference works of the field. At the opposite end, also screened by a masonry wall carried on columns, was the delivery desk and office space for library employees, with access to the book stack, which was indicated as indefinite in size.

The plan offered only the location of windows and some hints of wall thickness to suggest how the building would look from the outside, but in arrangement of functions it was unlike any other library of its day. Its uniqueness became more evident as construction got underway. An ink-on-linen perspective prepared as a fundraising tool (fig. 2) shows the building essentially as built, with the notable exception that the book stack wing in the drawing has nine bays (one hidden by the porch) instead of the three that were actually constructed.

The building is unified architecturally by low-slung round arches. Carried on squat masonry piers, they span the entrance porch, and similarly shaped openings carried on short columns penetrate the walls of the reading room. At first glance these features might seem to ally the building with the manner of the late Henry Hobson Richardson (1839–1886), and spe-

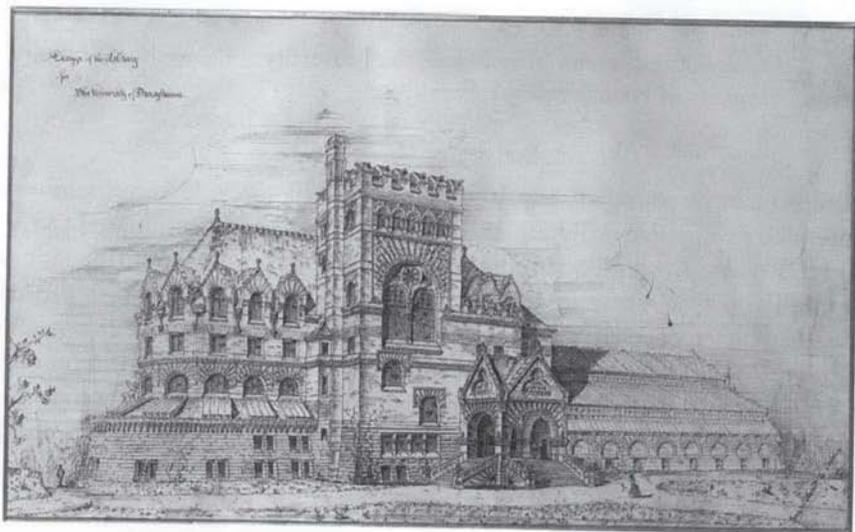


Fig. 2. Joseph Huston, Perspective of the University of Pennsylvania Library. Ink on linen, 1888. Architectural Archives of the University of Pennsylvania.

cifically with his Billings Memorial Library (1883–86) at the University of Vermont in Burlington. Like the Penn library, the Billings Memorial has a rounded, apse-like end, a central entrance with an arched portal opening into a reading room, a gabled wing balancing the “apse,” and book-lined alcoves on either side of a reading room. Richardson’s earlier Winn Memorial Library (1876–79) at Woburn, Massachusetts, also followed the same general scheme: a rounded wing serving as a museum, a central, towered entrance block containing reading rooms on each side, and a gabled library wing of book alcoves framing tables.

Despite superficial points of similarity with Richardson’s libraries in detail and picturesqueness of composition for the facade, Furness’s new university library was at odds with the Bostonian’s designs in every important aspect of functional planning. At Penn, book storage and circulation were separated from the reading room, rooms were arranged and organized according to the logic of use rather than for external composition, and staff space was separated from public space.

Though celebrated by his contemporaries and by twentieth-century architectural historians and critics, Richardson’s libraries were attacked by the American Library Association which, in noting his death, reported that his designs were “beautiful buildings, though not all perfect as libraries.”<sup>16</sup> Richardson’s type of library was specifically targeted by William Frederick Poole (1821–1894), who headed the Chicago Public Library. Poole took on the task of organizing the competition for a new library at East Saginaw, Michigan, in which Richardson was to be a competitor. According to James O’Gorman, Poole “had published a paper in the *Library Journal* on the small public library building. In accord with standards already advanced by the Library Association, Poole believed that the librarian should plan the building, after which the architect might cover its function with a picturesque exterior.”<sup>17</sup> A later issue of the *Journal* continued its critique of architects who valued style over logic with an attack on the Howard Library

<sup>16</sup> Quoted in James F. O’Gorman, *Selected Drawings: H. H. Richardson and His Office: A Centennial of His Move to Boston, 1874* (Cambridge, 1974), 172.

<sup>17</sup> O’Gorman, *Selected Drawings*, 171–72. According to O’Gorman, the *Library Journal* was staunchly opposed to Richardson’s designs. In the program for the East Saginaw library, Poole called for a cruciform plan to maximize natural lighting with the reading room being lighted from the north, if possible, for evenness of illumination. Book storage, according to Poole, should be separated from the reading room while functional planning was the primary goal of the plan. Because Richardson’s design did not adhere to Poole’s criteria, it did not win the competition for the East Saginaw library, which went instead to Van Brunt and Howe, also of Boston.

in New Orleans designed by Richardson's successors, Shepley, Rutan and Coolidge, stating, "We can safely say that the architect is the natural enemy of the librarian."<sup>18</sup>

By contrast, when it was completed in 1891, library professionals rated the University of Pennsylvania Library the best new library in America, and encouraged other institutions to follow its lead.<sup>19</sup> The Penn planners were pleased as well. Though Furness's industrial design was panned by out-of-town critics who attacked local architecture as "the Furnessic reign of architectural terror," Penn's leaders were undismayed.<sup>20</sup> At the dedication of the library, Horace Furness concluded his remarks with the perceptive comment that, unlike most libraries based on historical forms and conventions, "our whole building may stand as a model of the happy employment of means to ends."<sup>21</sup> Over the next few years, they constructed a power plant adjacent to the library and commissioned Furness to design an auditorium which, unfortunately, was never constructed. The designs of each of these buildings reiterated the architectural themes of Furness's library. Clearly, Penn's leaders were comfortable with these buildings at the heart of their campus.

Horace Furness's account of the method of the library as a "model of the happy employment of means to ends" suggests that goals other than the conventional idea of beauty and means other than the customary reliance on historic forms underlay the architect's design. Fortunately for our understanding of Frank Furness's goals, if not for a contemporary critic's comprehension of the University of Pennsylvania campus, the library was soon joined by another building that lay outside the canon of high architecture—the above-mentioned power plant, which provided both electricity and heat to the university. Its juxtaposition to the library and College Hall provides a telling commentary on Philadelphians' attitudes toward appropriate design in the industrial age.

The power plant was designed by the Wilson Brothers and Company, Furness's chief regional contemporaries. The Wilson Brothers' firm (here-

<sup>18</sup> O'Gorman, *Selected Drawings*, 172.

<sup>19</sup> For an account of Furness's declining reputation, see Michael J. Lewis's "The Arc of Fame" in Thomas et al. *Frank Furness: The Complete Works*, 121–36.

<sup>20</sup> Talcott Williams, "New Library of the University of Pennsylvania," *Harper's Weekly*, Feb. 14, 1891, found little to fault and much to praise in the highly original design.

<sup>21</sup> Horace Howard Furness, "Dedicatory Address," *Proceedings of the Opening of the Library of the University of Pennsylvania* [Feb 7, 1891] (Philadelphia, 1891), 8.

after, the Wilson Brothers) had gained a national reputation for institutional, commercial, and industrial designs that ranged from New York's subway-elevated system to prefabricated market buildings in British Guyana.<sup>22</sup> Though less well known now than Furness, the Wilson Brothers were nationally important in the years after the Centennial. The leader of the firm, Joseph Wilson, had trained as an engineer at Rensselaer Polytechnic Institute, studied chemical metallurgy for two years under Professor Frederick Genth at the University of Pennsylvania, then served as engineer of bridges and buildings for the Pennsylvania Railroad. No one in the United States had his depth of scientific understanding and practical experience in the use of the new materials of the age. His partners included civil and hydraulic engineers, as well as architects. Their business circular stated that they offered their services to the public because they believed that "the time had arrived for combining the professions of engineering and architecture in such a manner that corporations and individuals could avail themselves of the best professional advice without having to maintain an expensive staff."<sup>23</sup> Offering "professional services, disconnected from and independent of the business of building or contracting," the Wilson Brothers' practice stretched from coast to coast within a decade of its creation in 1876.

When the university trustees determined in 1890 to build a combined power generation and heating plant, the Wilson Brothers were the logical choice to design it. Several of the trustees had personal experience with the firm, having hired it to design industrial plants, houses, and office buildings. Although the site was prominently located adjacent to both the library and College Hall, the Wilson Brothers made no effort to disguise the power plant's industrial purpose with extraneous ornament. The principal building housing the boilers and dynamo was a long, low, brick structure interrupted at regular intervals by brick piers that marked the structural bays of the building (fig. 3). Within each bay large windows provided light and much needed ventilation. The industrial character was further clarified

<sup>22</sup> The range of their work is illustrated in Wilson Brothers and Co., *Catalogue of Work Executed, Accompanied by Illustrations* (Philadelphia, [1885]). This is one of the most remarkable books of its era, listing and illustrating hundreds of projects that spanned the nation and the hemisphere and demonstrating the link between engineering and the new architecture of the era. Joseph Wilson's specialized training in engineering and metallurgy made him the pre-eminent specialist in iron and steel construction in the nation.

<sup>23</sup> Wilson Brothers and Co., *Catalogue*, 3.



Fig. 3. Wilson Brothers and Company, University of Pennsylvania Heat and Light Plant, c. 1892. University of Pennsylvania Archives.

by the raised clerestory in the roof that augmented ventilation and by the gigantic brick smokestack that towered over the entire campus. An adjacent three-story, brick block housed the Engineering School and took the form of the office buildings of modern industrial complexes.<sup>24</sup> These forms would have been familiar to Philadelphians who saw similarly explicit buildings in the giant industrial complexes that dotted the city. Tellingly, no one on the university board rejected the power plant as inappropriate to the main campus of an institution of higher learning or sought to place it in a less obvious but necessarily less efficient location.

A comparison to the frankly industrial design of the power plant highlights the industrial elements of the library building. Raised clerestories like those of the power plant interrupt the glass roofing along the library's book stack wing. Sheathed in operable metal panels that were linked by iron rods, the library windows could be opened for ventilation in a manner not unlike

<sup>24</sup> In a more trusting day, Penn students were permitted to use the dynamo for experiments!

the clerestory of Wilson's boiler house or, for that matter, a greenhouse. Both the greenhouse and the power plant used roof shapes and ventilating panels to control the build-up of heat. In the library, the goal was to protect bookbindings from excessive heat.

Within, the light steel and iron framing that supported the book stack and carried the glass shingles of the roof was similar to the trusses of railroad train sheds and the roofs over erecting sheds and foundries that were part of contemporary factories. Furness simply adapted common industrial forms to the book storage portion of the library.

Sources for many of the elements of the library facade can also be found in industrial design. Richardson linked entrances, stairs, and other elements to make the architectural frontispiece of the library an artistic composition of balancing elements. Furness simply abutted the oversized stair tower with its attached toilet rooms and chimney stack to the front of the building (fig. 4). By making little effort to integrate the tower into the overall massing, Furness treated it as a discrete service element, juxtaposed against the larger volume of the reading rooms. To Philadelphians even to the present, such shapes and relationships are familiar, forming part of the dialogue about design of the later Philadelphia master Louis I. Kahn.



Fig. 4. Furness, Evans and Company, University of Pennsylvania Library, c. 1891. University of Pennsylvania Archives.

The separate stair tower was a familiar part of the planning of mid-nineteenth-century Philadelphia factories. Such a plan had the advantage of keeping the work floor unencumbered by internal projections, permitted some degree of fire separation between floors, and made it possible for the mill operator to keep an eye on the workforce. Often these functions were all placed in the stair tower, as they were in Furness's library. By making the multifunctioning, vertical factory tower and the clerestoried roof of the foundry-like book stack the central features of the facade of the library, and by using the fireproof red brick and terra cotta building materials of regional industry, Furness allied his design with the industrial architecture that was remaking Philadelphia. Unlike later Euro-moderns, Furness understood that he was building a library, not a factory, and provided a level of ornament appropriate to the purpose. Seventy years later Louis Kahn would revisit similar themes in his design for the Alfred Newton Richards Medical Research Laboratories on the University of Pennsylvania's medical campus.

An analysis of the plan that Furness and his consultants developed for the library shows that instead of being based on historical models, it was organized like a factory floor to order the flow of its different "product streams," books and people. Books were routed from 34th Street through an entrance that faced the street and provided access directly to the cataloguing department. After they had been catalogued and numbered, they could be delivered directly into the book stack. The general user entered on the other side of the building through the main entrance portico that faced the main campus. Within the entrance tower, as we have seen, two routes were provided, one up the great stair for those attending public lectures and the other directly into the main reading room where the card catalogue formed the target. By separating those who were not intending to use the library from those who were, the library remained a preserve of quiet and work undisturbed by unnecessary traffic.

The 1880s was an important decade in the evolution of industrial architecture, just as it was in the evolution of library planning. As Lindy Biggs has recently pointed out, post-Civil War industrialists were shaping factory buildings to become an asset in the work process, in effect making the building the "master machine of the plant."<sup>25</sup> In contrast to the backward-

<sup>25</sup> Lindy Biggs, *The Rational Factory: Architecture, Technology and Work in America's of Mass Production* (Baltimore, 1996), 47-53.

looking classical culture which still ruled academia, regional industry used every method from trial and error to engineering strategies to foster efficiency, economy of material, and rationalization.

Furness's plan for the library was as rational as a factory. When Horace Howard Furness described the book stack as a "provision for the present and prevision for the future" he linked it to the goals of local industrialists who also sought "flexibility and specialization."<sup>26</sup> Where McKim, Mead and White's Boston Public Library was symmetrical and unexpandable, Furness's extendible book stack was analogous to the "self-adjusting" components of Philadelphia machines. Instead of being static, Penn's library was a dynamic creation, the first library that could adapt to the future, again paralleling goals that industrial designers achieved in their plants.

A comparison of the library with contemporary Philadelphia factories proves that new design ideas flowed back into industrial buildings as well. For those Penn alumni who rode the Chestnut Hill Local train during the past century, one factory must have struck a particularly responsive chord—the red brick mill adjacent to the North Philadelphia Station built in 1902 for the Compton and Knowles Loom Works (fig. 5). As in the library, each of the various functions of the Loom Works was strongly differentiated. At one end was a shipping department. In the center of the complex, marked by a great chimney, was the power plant. In the background, along Glenwood Street, was the main, multi-story mill building where looms were assembled. The mill building's polygonal eastern end was countered by a multi-story stair tower and toilet stack to the west. Round arched windows light the upper story and a central clerestory and skylight poke up above the parapet. From the right perspective, with the chimney juxtaposed against the stair tower and the round end of the building to the left, the result is eerily like Furness's library.

The similarity between the two buildings was more than coincidence. The architect of the mill was Joseph Huston, who in the 1880s and early 1890s had worked in Furness's office and was responsible for the ink-on-linen perspective of the library. At the loom works, Huston applied the lessons he had learned from Furness's siting and planning of the library. The polygonal end fits into the angled site, while the architectural expres-

<sup>26</sup> Furness, "Dedicatory Address," 8. The contrast between Philadelphia regional industrial structures and the buildings of Lowell and Lawrence in Massachusetts is discussed in Philip Scranton, *Proprietary Capitalism: The Textile Manufacture at Philadelphia, 1800-1885* (New York, 1983). See particularly chap. 9, "Flexibility and Specialization," and esp. p. 329 ff.

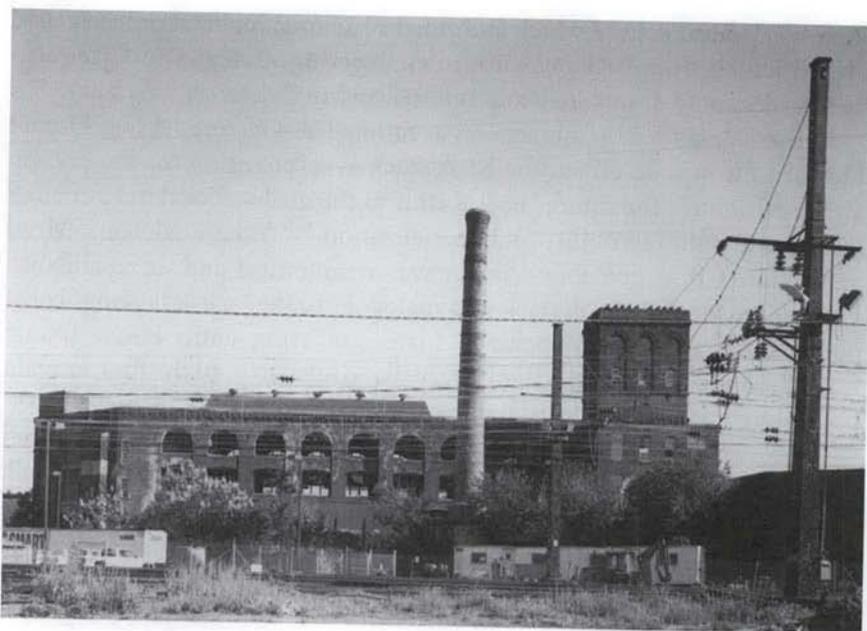


Fig. 5. Joseph Huston, Compton and Knowles Loom Works, Philadelphia, 1902. Photo, George E. Thomas, 2001.

sion of function is allied with Furness's incorporation of contemporary functional planning. What Furness had borrowed from industry, Huston returned a decade later.

In order to comprehend the confidence of Penn's leaders in Furness's designs, it is necessary to understand their cultural values. Unlike the trustees of the New England universities, who were usually ministers of their founding denominations, the leadership of the University of Pennsylvania was aligned with the contemporary scientific and industrial community of the city. Its provost, William Pepper, M.D., was trained as a scientist, practiced his profession throughout his tenure, and relied on the counsel of fellow scientists such as John Shaw Billings, M.D., to refine designs for medical buildings. In the 1870s Pepper had seen to it that laboratories for medical research were incorporated in the university's new hospital. His advocacy of laboratory training was reflected in the construction of new facilities throughout his time as the head of the university. Also, Pepper used consultants both in his medical practice and in running the university.

The leading members of the board of trustees after 1868 were machine tool maker William Sellers and civil engineer Fairman Rogers. Rogers had studied civil engineering at the University of Pennsylvania, where he later taught the subject. During the Civil War he spent his summers as a field engineer for the Union Army and solved the problem of compass deviation in steel ships, making it possible to navigate the USS *Monitor*. In the 1880s Rogers, with Provost Pepper, backed Eadweard Muybridge's animal locomotion photography project and he himself was an early experimenter in motion pictures. As a board member of the Pennsylvania Academy of the Fine Arts, Rogers had already hired Furness, and he was an advocate of the teaching and work of Thomas Eakins at the Academy. With an engineer's precision, Rogers analyzed Eakins's approach to art. "Most artists," Rogers noted, "work from the real to the ideal but Eakins works from the ideal to the real."<sup>27</sup> Thomas Eakins's tribute to Rogers, *The Fairman Rogers Four-in-Hand*, incorporated Muybridge's new information about the footwork of horses, as well as such observable phenomena as the greater speed of rotation of small wheels compared to large ones as evidenced in their relative blurring.

The president of Penn's board, William Sellers, was also president of the Franklin Institute, Philadelphia's scientific counterpart to the classically-attuned Athenaeums of New England. In the 1870s he had been vice president of the finance committee for the Centennial Exhibition, with particular responsibility for its buildings. His world was centered in the smoky and noisy confines of his factory, which was in turn surrounded for ten blocks by the Baldwin Locomotive Works, the nation's largest industrial agglomeration.<sup>28</sup> Highly original as a mechanical designer, Sellers was remembered in the twentieth century for reforming machine design. According to industrial historian Joseph Roe, "Almost from the first, Sellers cut loose from the accepted designs of the day. He was among the first to realize that red paint, beads and mouldings, and architectural embellishments were false in machine design. He introduced the 'machine-gray' paint which has become universal, made the form of the machine follow the

<sup>27</sup> For a fuller discussion of the relationship between the engineering culture and fine arts, see George E. Thomas, *William L. Price: From Arts and Crafts to Modern Design* (New York, 2000), 25-29.

<sup>28</sup> For a revealing portrait of Sellers, see John K. Brown, "When Machines Became Gray and Drawings Black and White: William Sellers and the Rationalization of Mechanical Engineering," *Journal of the Society for Industrial Archeology* 25 (1999), 29-54.

functions to be performed. . . ."<sup>29</sup>

At the Centennial Exhibition, British and American judges singled out Sellers's machines for their "originality, without parallel in the past history of international exhibits. . . . Characteristics include the *beautiful outlines that are imparted to each structure by the correct proportions that have been worked out in determining of strength and form and the disposal of material to take the full share of the duty.*"<sup>30</sup> The same judges used the word "beauty" to describe Philadelphia-made Baldwin Locomotives. Beauty was to be found not in ornament but in the "*adaptation of the various parts to their uses.*" Sellers's aphorism, "A machine looks right when it is right" was based on the appreciation of a new type of organic beauty that reflected the relationship between function and form. Certainly, it was not a coincidence that Sellers's aphorism paralleled Louis Sullivan's "Form follows function," an idea he could have learned during his time in Furness's office in 1873. When Sullivan claimed in his *Autobiography of an Idea* that Furness made buildings like the library "out of his head" rather than from books, he linked his mentor to the design culture of progressive Philadelphia industrialists.<sup>31</sup>

Throughout his career, Furness allied himself with industrial designers in his use of iron and steel. Iron had been the topic of theoreticians and designers for decades and had preoccupied Furness's fellow students in Richard Morris Hunt's studio in the 1850s. As recently as 1853, however, John Ruskin had treated the issue of the "probable use of iron, glass, and such other materials in our future edifices" in a lecture in Edinburgh. Ruskin opposed building with iron on cultural and Biblical grounds. The force of important Biblical images, he felt, depended on humankind sharing a general understanding of stone as a building material. Ruskin feared that those images would be "lost, if the Christian and civilized world were ever extensively to employ any material other than earth and rock."<sup>32</sup> The classical model of architecture, which depended on historical sources, therefore excluded new materials and new forms.

Industrial Philadelphia took a different tack. With Philadelphia institu-

<sup>29</sup> Roe, 1915, quoted in W. H. Mayhall, *Machines and Perception in Industrial Design* (London, 1968), 15.

<sup>30</sup> Emphasis added. United States Centennial Commission, *International Exhibition, 1876* (11 vols., Washington, D.C., 1880-84) [vols. 3-8, *Reports and Awards*, ed. Francis A. Walker (1880)], 6:236.

<sup>31</sup> Louis Sullivan, *Autobiography of an Idea* (1924; reprint, New York, 1956), 194.

<sup>32</sup> John Ruskin, *Lectures on Architecture and Painting Delivered at Edinburgh in November, 1853* (New York, 1884), 53-54.

tions shaped by the great industrialists, by the early 1870s it was common for iron to be used as an integral part of a design. For example, in 1871 Furness used exposed steel trusses to carry the second floor gallery above the first floor studios of the Pennsylvania Academy of the Fine Arts. Nine years later he created light trusses using steel tie rods and cast iron struts to span the interior of the Undine Barge Club and to carry the broad spans of porches of suburban stations on the Reading lines. At the Baltimore and Ohio Terminal (1886) on Chestnut Street, he had created waiting rooms entirely of modern materials—steel, glass, and concrete.<sup>33</sup> Contemporary Philadelphia architect James Sims used exposed iron flying buttresses for the side of Holy Trinity Chapel in 1874. When Charles Wheeler of the Morris, Tasker Iron Works offered to fund the Church of the Redeemer in Bryn Mawr in the 1880s, he requested that the “Columns must be of Iron or Steel and treated as metal.”<sup>34</sup> Hence Furness followed local practice when he created a demonstration piece showing the characteristics of the various types of iron—cast, wrought, and steel—in the stair hall of the Penn library (fig. 6); cast newels took advantage of the material for economical ornament; wrought iron was twisted and turned as ornamental infill between the stairs and the railings; steel girders carried the stairs and spanned the second reading room and steel plates stiffened the trusses of the main reading room.

These interests were not restricted to elite institutions and their boards. Similar forms and sources are found in Philadelphia public school buildings which also incorporated motifs and systems from industrial architecture. Beginning with Samuel Sloan’s model school designs of the 1850s, operable partitions separated rooms but could be opened to create larger rooms for assembly purposes (fig. 7).<sup>35</sup> In the 1880s such industrial features as attached stair towers incorporating toilet rooms were commonplace, and the separation of services from served spaces was an underlying principle. Massive industrial chimneys, some of which were part of the ventilation

<sup>33</sup> Numerous other Furness commissions that show the same frank acceptance of contemporary issues of function and expression include the Veterinary Hospital of the University of Pennsylvania, the industrial wings of the Pennsylvania School for the Deaf and Dumb, and the Hospital for Jefferson Medical College.

<sup>34</sup> The Committee on Plans of the Vestry of the Church of the Redeemer, Aug. 8, 1879, archives of the Church of the Redeemer, pointed out by Maria Thompson.

<sup>35</sup> Franklin D. Edmunds, *The Public School Buildings of the City of Philadelphia: 1845–1907* (7 vols., Philadelphia, 1913–33). Edmunds systematically recorded and published photographs, plans, and costs of all public school buildings.

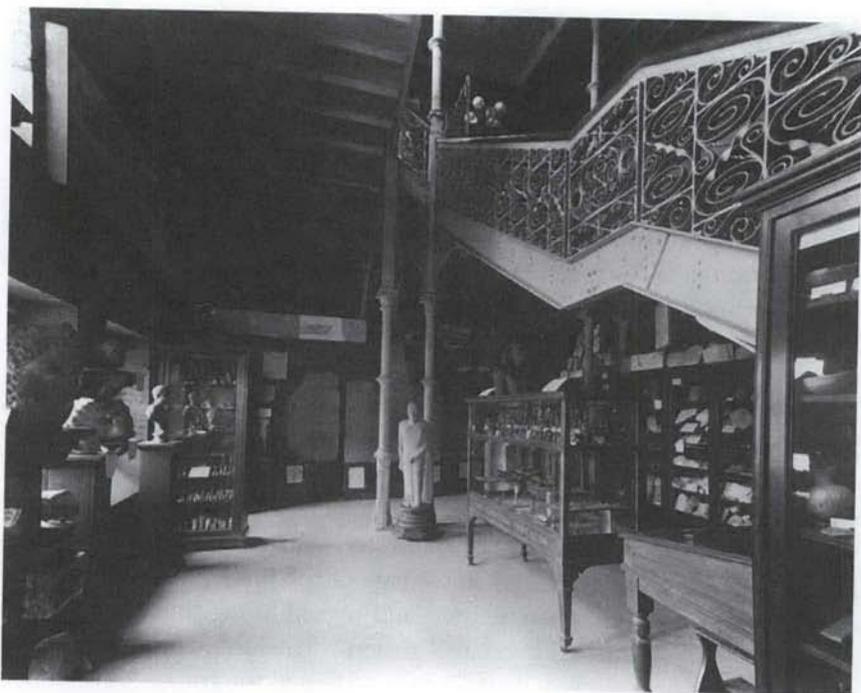


Fig. 6. Furness, Evans and Company, Stair Hall, University of Pennsylvania Library, c. 1891. University of Pennsylvania Archives.

system for classrooms, accented rooflines (fig. 8). In industrial Philadelphia, where industrialists sat on the boards of schools and cultural institutions, economy and adaptability were hallmarks of regional design.

There was another impetus to Furness's originality beyond his shared interests with the university leadership and the regional culture. After all, even the Wilson Brothers, who worked for similar clients and outside of the industrial sphere, only rarely arrived at forms that so powerfully expressed the meaning of the new age. The designs of such Furness contemporaries as Theophilus Parsons Chandler (1845–1928) were firmly rooted in the history-based architectural culture of the rest of the nation. Furness's home life, influenced by his father's closest friend, Ralph Waldo Emerson, introduced him to the idea of a nascent American culture. Emerson's lecture entitled "Young America," first given in 1839, the year that Frank was born, called for American arts that would reflect the values of our democratic

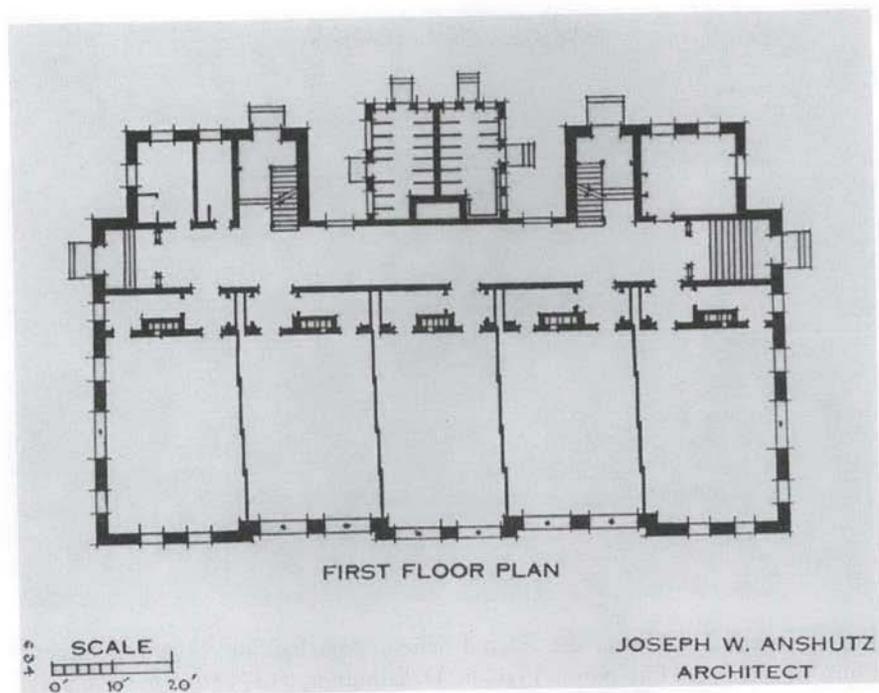


Fig. 7. Joseph W. Anschutz, Plan of the Levering School, Ridge and Monastery Avenues, Philadelphia, 1894. Photo from Franklin D. Edmunds, *The Public School Buildings of the City of Philadelphia* (7 vols., Philadelphia, 1931), 6:148.

political system.<sup>36</sup> In place of elitist European arts rooted in the service of royalty, Emerson envisioned new arts of the democracy that would reflect natural processes and the energy of the rising industrial age. These ideas were alive in the Furness household and expressed from the pulpit of the First Unitarian Church of Philadelphia, where Frank's father, the Reverend William Henry Furness, was minister from 1825 until his death in 1896. The Reverend Furness, a leading abolitionist and the author of numerous sermons calling for principled living based on personal beliefs, gave his son the courage of his own convictions about design.

The fruits of Emerson's aesthetic arguments were immediately apparent

<sup>36</sup> The relationship between the two men is treated in Thomas et al., *Frank Furness: The Complete Works*, 26-30.

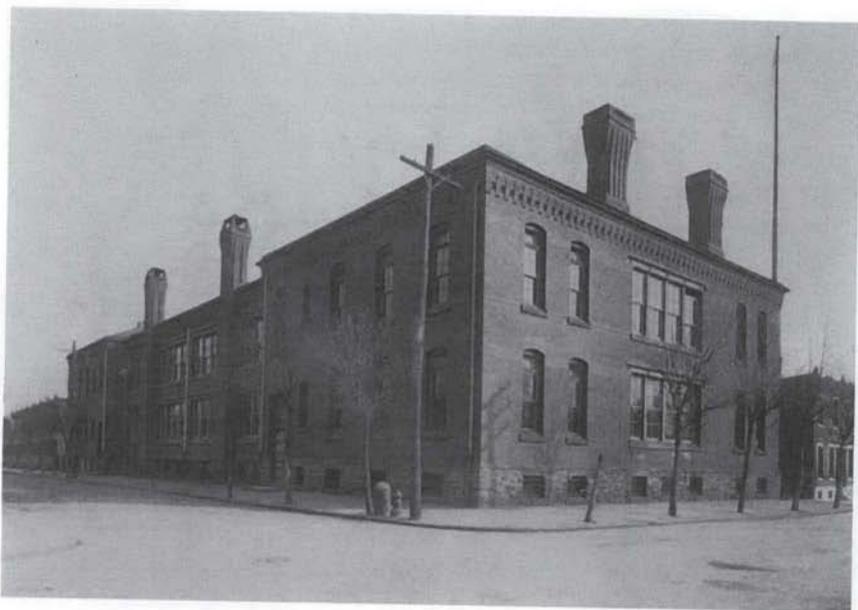


Fig. 8. Joseph D. Austin, the Fairhill School, Marshall and Somerset Streets, Philadelphia, 1886. Photo from Franklin D. Edmunds, *The Public School Buildings of the City of Philadelphia* (7 vols., Philadelphia, 1913-31), 5:161.

in Frank Furness's architecture. When Frank returned from New York after the Civil War, he formed a partnership with politically-connected architect John Fraser and with George Hewitt, who had studied with John Notman, the English-trained architect of Episcopal churches. In 1871 the two younger architects jettisoned Fraser as unnecessary baggage when they were competing successfully for the Pennsylvania Academy of the Fine Arts commission. Working for a board that included civil engineer Fairman Rogers, Furness and Hewitt incorporated iron trusses into the Academy building's Cherry Street facade. They used cast iron columns and iron beams to span the gallery interiors; roofed the building with glass, crowned with a central ventilator that carried off the heat of the industrial gas lighting illuminating the galleries; and devised a functional circulation plan rooted in the industrial architecture of the day.

From the account of the library planning process it is clear that Furness's method was far more complex than merely making—again, in Louis Sul-

livan's phrase—"buildings out of his head." Instead, Furness's core strategy had at its root the discovery of the requirements of the building followed by the arrangement of spaces to meet those needs. Working for industrialists, he was charged with that task, and he succeeded admirably. His success is most evident in the continuing use of his building as a library. Richardson's Billings Library, by contrast, was outdated within a year of its opening, requiring several enlargements, none of which had been anticipated in the original design. Now a student union, it is recognized more for its architecture than its planning.<sup>37</sup>

Because the design of the library of the University of Pennsylvania so closely approximated the directions of contemporary library science, it might have been expected to influence contemporary library planning. But as it was being finished, McKim, Mead, and White were completing the Boston Public Library. Although Talcott Williams criticized the Boston Public Library for its inflexibility and expense, it was allied with the aesthetic triumph of the Columbian Exposition's White City in Chicago. As public buildings turned toward the classicism of the Renaissance, and by extension Rome, Furness's nonconforming red brick and terra-cotta library came under attack. Its critics argued essentially on the grounds that "employment of means to ends" was not an appropriate strategy for so culturally important a building as a university library.<sup>38</sup>

In 1895, under a new provost and with a Beaux Arts-trained dean of the architecture school, Furness was fired as campus architect and replaced by Cope and Stewardson, whose academic Gothic dormitories reestablished the authority of history as the basis for design. Their historicism appalled Albert Kelsey, a veteran of Furness's office. Charging that the university that had nurtured the American Revolution had fallen for the "romance of an alien past," he mourned the lost opportunity to reflect what he termed

<sup>37</sup> Many of the libraries of the period have either been demolished or adapted to other uses, as in the case of the Chancellor Green Library at Princeton University, designed by William Potter in 1873, which was outdated by 1891 and is now a student union.

<sup>38</sup> Despite the hugely appreciative audience among library professionals, the shift in taste toward the classical eliminated almost any discernable impact of Furness's design on American library planning with the exception of the expandable stack wing. The 1902 library issue of the *Architectural Review* shows the idea of a separate book stack wing that could be enlarged becoming a commonplace feature. Several libraries followed Furness's general layout, including Frost and Granger's Lake Forest University Library and Thomas Kimball's competition design for the Rosenberg Library in Galveston, Texas. Ironically, the former followed Richardson's exterior for the Billings Library at the University of Vermont, while Kimball managed to impose a classical skin over the shapes of Furness's design. Clearly the library professionals once again had little impact on design.

"the poetry of the present." It would be sixty years before physicist Gaylord Harnwell, another university leader trained in the sciences, returned Penn's architecture to the modern age.<sup>39</sup>

In the twentieth century, it was common to assert that Philadelphia's peculiar architecture, typified by Furness's nearly eight hundred commissions, resulted from the region's Quaker origins and the presumed Quaker indifference to fashion that produced such outrageous designs. A better explanation lies in Furness's understanding of the goals of the industrialists who shaped Philadelphia culture in the nineteenth century. Furness's best pupils understood his message and found their success where the industrial culture thrived.

The dissemination of Furness's ideas is represented in the genealogy of American modern architecture. Furness's office provides the most direct connection to Emerson's ideas about an American culture. It was also a link to the poetry of Walt Whitman, who was supported by the Furness family when he moved to Camden, New Jersey, and whose early printing of *Leaves of Grass* was championed by Frank's father. In the Philadelphia region, modernism is represented in a direct line from Furness to William Price, whose reinforced concrete Traymore Hotel in Atlantic City made the transition to modern scale while maintaining the idea of functional representation that gave the building its life. It includes George Howe, whose landmark PSFS skyscraper at 12th and Market Streets continued the representational and descriptive themes of Furness's library. From Howe the line is direct to Louis Kahn and Robert Venturi. In the Midwest it continued from Louis Sullivan to Frank Lloyd Wright, and in the west it can be connected via Sullivan to Irving Gill, whose partner Frank Mead had worked with William Price in Philadelphia. At the core of this important body of work is the idea of Furness's generation that architecture, to be meaningful, must express the poetry of the present. What contemporary critics thought was the surviving aesthetic of retreating Quaker culture was in fact the beginning of modern architecture based on the progressive values of engineers.

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<sup>39</sup> For a discussion of the shifting design strategies of the University of Pennsylvania, see George E. Thomas and David B. Brownlee, *Building America's First University: An Historical and Architectural Guide to the University of Pennsylvania* (Philadelphia, 2000), 74.