

Drafting a Profession:
Drawings and Architects in the United States, 1880–1920

Jonathan R. Duval

A dissertation submitted in partial fulfillment of the requirements
for the Degree of Doctor of Philosophy
in the Department of History of Art and Architecture at Brown University

Providence, Rhode Island

September 5, 2025

© Copyright 2025 Jonathan R. Duval

This dissertation by Jonathan R. Duval is accepted in its present form
by the Department of History of Art and Architecture as satisfying the
dissertation requirement for the degree of Doctor of Philosophy.

Date _____

Dietrich Neumann, Advisor

Recommended to the Graduate Council

Date _____

Douglas R. Nickel, Reader

Date _____

Michael Osman, Reader

Approved by the Graduate Council

Date _____

Janet Blume, Interim Dean of the Graduate School

CURRICULUM VITAE

Jonathan Duval received a B.A. in Architectural Studies and Art History with honors from Tufts University in 2014. Before and during his graduate studies, he held curatorial positions in Architecture and Design at the MIT Museum, Art of the Americas at the Museum of Fine Arts Boston, and Decorative Arts and Design at the RISD Museum. Since 2021 he has been Assistant Curator of Architecture and Design at the MIT Museum.

ACKNOWLEDGEMENTS

The encouragement and support of faculty, colleagues, friends, and family have made this project possible.

Dietrich Neumann has been a tremendous advisor and an essential mentor. His encouragement of my ideas and enthusiasm for my interests are unmatched. Throughout my graduate studies, Dietrich has been exceptionally generous with his time, comments, and guidance, all of which have helped my work become more focused and balanced.

Doug Nickel provided the rare intellectual rigor and healthy skepticism that any graduate student would be lucky to receive. His seminars and mentorship are to thank for any slivers of thoroughness in my thinking. Michael Osman's work spurred some of the initial questions of this dissertation, and his involvement in the project has been an irreplaceable addition. I thank all my committee members for their patience with my progress.

Faculty and staff of the Department of History of Art and Architecture at Brown University have been supportive from the start, and coursework and independent study with Sheila Bonde was particularly formative. At Brown, I found a welcoming community among my fellow graduate students, especially Laura Chilson-Parks, Josie Johnson, and Matthew Kluk. Emily Hirsch, Jeanie Noto, and Pamudu Tennakoon have provided continued art historical entertainment. Allison Pappas has been uniquely encouraging, and she and Adam Baker have provided sustaining meals and conversations over many years.

A version of Chapter One was presented in 2022 in Montreal at the Society of Architectural Historians Annual Conference in the session “Administering Architecture.” I thank the session organizers, participants, and audience for their questions that ultimately helped refined my argument. Chapter Two began as a final paper at Brown for professor Lukas Rieppel, who fostered my scholarly interest in bureaucracy and paperwork. His and Kristen Iemma’s comments on that early draft helped to focus my thinking, and additional suggestions from Evelyn Ansel helped to broaden it. Other portions of Chapter Two were presented in 2019 in Brussels at the conference “Architecture and Bureaucracy,” organized by the Faculty of Architecture of KU Leuven, and in 2021 at the virtual Society of Architectural Historians Annual Conference.

I am indebted to the archivists and curators who have made a vast array of original materials and images available to me over the course of many years, and to the heroic efforts of the interlibrary loan offices at Brown and MIT. I am additionally grateful to Flori Pierri, Emily Hirsch, and Jeanie Noto, who offered invaluable comments and corrections to portions of this manuscript. Sincere thanks are due to Daniel Abramson, who kindled my early interest in architectural history and who has encouraged me for more than fifteen years.

This project was as much a product of the MIT Museum as it was of Brown University. The entire team at the museum has been supportive, especially my collections and curatorial colleagues who worked on our recent collections move. Gary Van Zante, former curator architecture and design, has been an encouraging mentor since my undergraduate years. Former MIT Museum director John Durant and former assistant director Mary Leen agreed to take me on as a permanent employee a few months into a

pandemic, and just a few weeks after I formally proposed this dissertation. Kathryn Wysocki Gunsch arrived as deputy director early in my time at the museum, and her steady leadership opened the path for me to finish my research and writing. Michael John Gorman, current MIT Museum director, has been supportive of my final work on this project. It is not an exaggeration to say that this manuscript would not be done without Deborah Douglas, senior director of collection and curator of science and technology, who has been singularly protective of my time for completing this dissertation.

The support and patience of friends and family have been essential. Amanda Ball, Mary Hartley, Matt Jund, Zak Leonard, Maryrose McGowan, Adam Pease, Emma Spero, Malani Sundaram, Mitchell Vartanian, Emma Westling, Jayden Ziegler, and Book Club have been important social anchors over the years. Sincere thanks are due to my parents, Don and Amy, who (usually) knew better than to ask too much about my progress, and to my sister Emily and nephew Wesley. This dissertation is dedicated to my grandmothers, Lillian and Irene, who have always been strong role models. Whenever things have seemed difficult, impossible, or even hopeless, I have remembered their fortitude.

TABLE OF CONTENTS

Acknowledgements.....	v
List of Figures	ix
Introduction	
<i>Drawings and Professionalization</i>	1
Chapter One	
<i>Francis Ward Chandler's Construction Details and Architectural Training at MIT</i>	30
Chapter Two	
<i>Duplicating Authority: Blueprinting and the Managerial Architect</i>	104
Chapter Three	
<i>Lettering and Architectural Identity</i>	171
Conclusion	218
Figures.....	222
Bibliography	283

LIST OF FIGURES

Chapter One

- 1.1 Charles D. Gambrill to William Robert Ware, 19 March 1866. William R. Ware Papers, MC-0014, Massachusetts Institute of Technology, Department of Distinctive Collections, Cambridge, Massachusetts.
- 1.2 Francis Ward Chandler, cover of *Construction Details, Prepared for the Use of Students of the Mass. Institute of Technology, Boston* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.
- 1.3 Francis Ward Chandler, “Details of Window Frames, Wooden Building,” plate 1, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.
- 1.4 Francis Ward Chandler, “Details of Framing,” plate 14, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.
- 1.5 Francis Ward Chandler, “Details of Framing and Flashing,” plate 17, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.
- 1.6 Henry Laxton, detail of “Fire Proof Floors, Wynyard Hall, Durham, The Late Phillip W. Wyatt Archt,” plate 18, from *Examples of Building Construction*, vol. 1 (London, circa 1860). Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.
- 1.7 William Robert Ware, plate 6 (part 1, plate 6), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.
- 1.8 William Robert Ware, plate 25 (part 3, plate 1), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.

- 1.9 William Robert Ware, plate 22 (part 2, plate 10), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.
- 1.10 Photographer unknown, "MIT Libraries, Boston, Pierce Building, Architecture Library," 1890s. MIT Museum, GCP-00081898, Biographical/Subject Files Collection. Courtesy MIT Museum.
- 1.11 Photographer unknown, "Plates and Models for Specifications & Working Drawings," Massachusetts Institute of Technology, Boston, 1890s. MIT Museum, GCP-00040570, Biographical/Subject Files Collection. Courtesy MIT Museum.
- 1.12 Photographer unknown, "Office Practice Drawing Room," Massachusetts Institute of Technology, Boston, 1890s. MIT Museum, GCP-00040558, Biographical/Subject Files Collection. Courtesy MIT Museum.
- 1.13 Advertisement for *Construction Details*, from *American Architect and Building News* 36, no. 856 (21 May 1892). Francis Ward Chandler correspondence, Ms. N-2009, Massachusetts Historical Society, Boston, Massachusetts. Collection of the Massachusetts Historical Society.
- 1.14a Advertisement for *Construction Details*, from *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895). Environmental Design Library, University of California, Berkeley.
- 1.14b Advertisement for *Construction Details*, from *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895). Environmental Design Library, University of California, Berkeley.
- 1.15 Isreal P. Lord, drawing over blueprint copy of "Details of Framing and Flashing," plate 17, from Francis Ward Chandler, *Construction Details* (Boston, 1892). MIT Museum, Israel P. Lord Collection, 2016.002.465, gift of Mary Ann Howkins. Courtesy MIT Museum.
- 1.16 Francis Ward Chandler, "Detail of Framing," plate 18, from Charles L. Adams, *Mechanical Drawing: Technique and Working Methods for Technical Students* (George H. Ellis, 1905), 163. Originally published as plate 14, from Francis Ward Chandler, *Construction Details* (Boston, 1892). MIT Museum, Reference Collection. Courtesy MIT Museum.
- 1.17 Frank E. Kidder, figure 59, from *Building Construction and Superintendence, Part 2, Carpenters' Work* (William T. Comstock, 1902), 79. MIT Libraries.
- 1.18 Frank E. Kidder, "Braced Frame," figure 30, from *Building Construction and Superintendence, Part 2, Carpenters' Work* (William T. Comstock, 1913), 93. MIT Libraries.

- 1.19 Samuel Sloan (author) and P. S. Duval (lithographer), “Details,” design 7, plate 28, from *The Model Architect* (Philadelphia, 1852). HathiTrust/Getty Research Institute.
- 1.20 C. G. Pope, “King Post Roof Truss,” plate 12, from Charles F. Mitchell, *Forty Plates on Building Construction* (London, 1891). Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.
- 1.21 Clarence Martin, “A Typical Double Hung Window,” plate 4, from *Details of Building Construction* (Boston, 1899). MIT Libraries.
- 1.22 Baldwin Coolidge (photographer), Exterior view of the Fletcher's Neck Life-Saving Station, Biddeford Pool, Maine, circa 1887. Historic New England, General photographic collection, PC001.02.01.USME.0210.0020.003.
- 1.23 Postcards depicting Life-Saving Stations, Francis Ward Chandler (architect), Lubec and White Head, Maine, circa 1880s. Author's collection.
- 1.24 Photographer unknown, “Boys in a house-framing class building small structures,” North Bennet Street Industrial School, Boston, circa 1890–1900. North Bennet Street Industrial School Records, MC269-VI-40-1, Schlesinger Library on the History of Women in America, Radcliffe Institute.
- 1.25 Photographer unknown, “A practical kind of woodworking having an intimate relationship to industry,” from *North Bennet Street Industrial School, 1881–1915* (Boston, 1915). North Bennet Street Industrial School Records, MC269, folder I10, Schlesinger Library on the History of Women in America, Radcliffe Institute.

Chapter Two

- 2.1 Sturgis & Brigham, “Front Elevation,” General S. M. Weld House, Dedham, Massachusetts, 1883. MIT Museum, 1992.012.001, transfer of Institute property (Institute Archives and Special Collections). Courtesy MIT Museum.
- 2.2 Sir John Frederick William Herschel, *Engraved Portrait of a Young Woman*, from The Brewster Album, about 1842. The J. Paul Getty Museum, Los Angeles, 84.XZ.574.84.
- 2.3 Anna Atkins, “Cystoseira granulate,” from *Photographs of British Algae: Cyanotype Impressions, Part I*, October 1843. Spencer Collection, b11861683, The New York Public Library.

- 2.4 Walter W. Sturtevant, “Original Tracing” (left) and “Blue Print” (right), from *How to Make Blue Prints* (Bruce Publishing Company, 1929). Author’s collection.
- 2.5 Benjamin James Hall, figure 3, from *Blue Printing and Modern Plan Copying for the Engineer and Architect, the Draughtsman and the Print Room Operative* (Sir Isaac Pitman & Sons, 1921), 21. MIT Libraries.
- 2.6 E. G. Soltmann, “Blue Printing Cases or Frames,” from *Price List of Drawing Materials, Architects and Engineers’ Supplies* (New York, 1885), 28. Library of Congress, ca07002818.
- 2.7 Daniel Paul Higgins, architectural office organization chart, from *American Architect* 115, no. 2246 (8 January 1919), 64. Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.
- 2.8 Sturgis & Brigham, detail of “South Elevation Frame,” General S. M. Weld House, Dedham, Massachusetts, 1883. MIT Museum, 1992.012.010, transfer of Institute property (Institute Archives and Special Collections). Courtesy MIT Museum.
- 2.9 Benjamin H. Thwaite, “Characteristic Hatchings for Heliographic Purposes,” figure 12, from *Transactions of the Federated Institution of Mining Engineers* 9 (London, 1895). MIT Libraries.
- 2.10 “Offices of Adler & Sullivan, Auditorium Building, Chicago,” from *Engineering and Building Record* 22, no. 1 (7 June 1890), 5. University of Michigan/HathiTrust.
- 2.11 “Arrangement of Draughting Rooms,” Union Iron Works, San Francisco, California, from *Engineering Record* 41, no. 10 (10 March 1900), 227. University of Michigan/HathiTrust.
- 2.12 “Details of George B. Post’s Office, New York,” figure 2, from *Engineering Record, Building Record & Sanitary Engineer* 24, no. 23 (7 November 1891), 363. University of Chicago/HathiTrust.
- 2.13 Baldwin Coolidge (photographer) and Channing Whitaker (designer), blueprinting apparatus, Massachusetts Institute of Technology, Boston, circa 1882. MIT Museum, Biographical/Subject Files Collection. Courtesy MIT Museum.
- 2.14 James H. Wagenhorst, drawing from patent application for “Blue Printing Apparatus,” filed 18 August 1903, patented 19 July 1904. Google Patents, US 765,406.

- 2.15 “Cross-Section of Blue-Printing Machine” (left) and “A Blue-Print-Making Machine” (right), from *Scientific American* 89, no. 3 (18 July 1903), 45. MIT Libraries.
- 2.16 C. F. Pease Company, “Peerless Blue Printing, Washing, and Drying Equipment in Operation,” from *Catalog B* (C. F. Pease, 1918). Gorham Manufacturing Company Archive, John Hay Library, Brown University.
- 2.17 Sample blueprint tracking card, from *Engineering Record, Building Record and Sanitary Engineer* 38, no. 16 (17 September 1898), 336. University of Michigan/HathiTrust.

Chapter Three

- 3.1 Henry S. Jacoby, plate 5, from *A Text-Book on Plain Lettering* (New York, 1895). MIT Libraries.
- 3.2 Henry S. Jacoby, plate 23, from *A Text-Book on Plain Lettering* (New York, 1895). MIT Libraries.
- 3.3 Nathaniel J. Bradlee, “Front Elevation, Boston Public Library, Plan No. 1,” March 1855. Vol. 3, Bradlee Architectural Collection, 1937.4, Boston Atheneum.
- 3.4 Nathaniel J. Bradlee, detail of “Framing Plan of 2nd Story,” Design for a Store Front for John Collamore Jr., Boston, 23 October 1854. Vol. 3, Bradlee Architectural Collection, 1937.4, Boston Atheneum.
- 3.5 Friedrich Soennecken, “Plan,” from *Methodical Text Book to Round Writing*, 6th ed. (New York, 1878), 32. Historical Textbooks Collection, Gutman Library, Harvard Graduate School of Education.
- 3.6 William Ford Stanley, “Lettering Set Square,” from *A Descriptive Treatise on Mathematical Drawing Instruments* (London, 1866), 158. MIT Libraries.
- 3.7 Job Springer, drawing from patent application for “Lettering Block,” patented 31 January 1888. Google Patents, US 377,090.
- 3.8 Lucian Rust, drawing from patent application for “Lettering Device,” patented 12 October 1897. Google Patents, US 591,697.
- 3.9 John C. L. Fish, “Styles Taken from Working Drawings,” plate 13, from *Lettering of Working Drawings* (New York, 1894). MIT Libraries.

- 3.10 Frank Chouteau Brown, “Letters for Architectural Office use,” figure 10, from *Architectural Lettering* (American School of Correspondence, 1906), 13. MIT Libraries.
- 3.11 Frederick E. Giesecke, “Letters for Architectural Drawings,” plate 9, from *Mechanical Drawing, Part I* (pub. by author, 1903). Historical Textbooks Collection, Gutman Library, Harvard Graduate School of Education.
- 3.12 Alton L. Smith, figure 63, from *Notes on Technical Sketching and Free-Hand Lettering for Engineering Students* (pub. by author, 1912), 123. Author’s collection.
- 3.13 William A. Radford, “A Dignified Type of Letter for Inscriptions, General Notes, etc.,” figure 92, from *Radford’s Architectural Drawing* (Radford Architectural Company, 1912), 335. Texas Tech University Libraries.
- 3.14 George W. Seaman, “Hints on Lettering Technique etc.,” plate 35, from *Progressive Steps in Architectural Drawing* (Manual Arts Press, 1919), 58. Harvard University Libraries.
- 3.15 Frank Chouteau Brown, “Modern American Letters, for Rapid Use,” figure 138, from *Letters and Lettering* (Bates & Guild, 1902), 124. Harvard University Libraries.
- 3.16 Claude Fayette Bragdon, “Modern American Italic, for Plans, etc.” figure 139, from Frank Chouteau Brown, *Letters and Lettering* (Bates & Guild, 1902), 125. Harvard University Libraries.
- 3.17 Frank Chouteau Brown, “Title from Detail,” figure 9, from *Architectural Lettering* (American School of Correspondence, 1906), 12. MIT Libraries.
- 3.18 George Perkins Bissell Alderman & Co., detail of “Front Elevation of a Two Family House for Mr. L. B. White, White Terrace, Newark, NJ,” circa 1900. MIT Museum, George P. B. Alderman Collection, 2025.010, gift of Dorrie Alderman Blakney, Granddaughter. Courtesy MIT Museum.

INTRODUCTION

Drawings and Professionalization

Between 1902 and 1914, architect D. Everett Waid published a series of sixteen articles in *The Brickbuilder* on “The Business Side of an Architect’s Office” and “How Offices Work.”¹ Waid gave attention to what he called the “mundane” work of the architect: the production of working drawings, the filing of paperwork, and other aspects of the day-to-day bureaucracy and organization of professional office work. Predicting resistance to this unglamorous focus, Waid noted the pervasive “old contention that creative art and business system do not travel together in harmonious relation,” but reassured his readers that “it takes only a hasty consideration of the architects of this country, whose efforts have brought them success, not only in a business sense, but also in the creation of beautiful buildings, to entirely refute this long nurtured opinion.”² This same long-nurtured opinion, that art and business are incompatible, meant that any aspect of architectural work that was not creative or artistic was often obscured from view, both then and now. The general downplaying of the “mundane” tasks of practice—by

¹ For the first series of “Business Side” articles, see D. Everett Waid, “The Business Side of an Architect’s Office,” *Brickbuilder* 11, nos. 4, 5, 8 and 9 (April, May, August, and September 1902); vol. 12, nos. 2, 11, and 12 (February, November, and December 1903); and vol. 13, no. 1 (January 1904). For the second series of “Business Side” articles, see D. Everett Waid, “The Business Side of an Architect’s Office,” *Brickbuilder* 22, nos. 9, 11, and 12 (September, November, and December 1913); and vol. 23, nos. 2 and 3 (February and March 1914). For the series of articles on “How Architects Work,” see D. Everett Waid, “How Architects Work,” *Brickbuilder* 20, no. 12 (December 1911); and vol. 21, nos. 1 and 2 (January and February 1912).

² D. Everett Waid, “The Business Side of an Architect’s Office. The Office of Mr. Donn Barber,” *Brickbuilder* 22, no. 9 (September 1913): 197.

architects at the time as well as by subsequent historians—does not mean they were not important to the development of the modern architectural profession in the United States. In fact, they were central to it.

This project examines drawings as a means of historicizing the professionalization of architecture in the United States from about 1880 to about 1920. Working drawings (scale drawings produced by a designer for use in construction) are central to a set of techniques, technologies, conventions, practices, and methods of office work employed by architects, and are thus key documents in the historical study of the architectural profession. While this project is about process and work, it is not about an individual architect's iterative design process, nor is it a history of construction and building. Instead, my focus is on elements of an increasingly managerial profession where control in and out of the office was essential to establishing and maintaining authority, accountability, and status. It looks to drawings—the context of their production, their content, and, especially, the discourse around them—to propose a history of the shifting professional role, status, and self-conception of the architect.

Fundamentally, I treat professionalization as a contingent and ongoing sociological process rather than an inevitable end result, and the three case studies in this project highlight that there is a vast constellation of actors in that process. The first chapter looks to architectural education to trace the history of practical instruction in the business side of architectural work, especially the drawing of construction details, which had historically been left for determination on the construction site. The second chapter looks to the photoduplication of drawings by the blueprint process. This was not only a method of increasing efficiency in copying, but it also was a means of cementing an

architect's authority and control over various workforces and is an example of the widespread adoption of a technology in the process of professionalization. The final chapter looks to lettering on drawings as a vehicle through which creativity and artistic expertise were expressed by architects. In contrast with blueprinting, it shows how mechanical technologies may be rejected by consensus as part of professionalization. The chapters highlight a selection of trends and controversies that surround drawings as key documents and commodities of practice, or "instruments of service," as late nineteenth century American architects referred to them.³ Beyond examining drawings as objects of design and communication, though, I aim to historicize how drawings as an idea came to play a role in the self-conscious organization of a modern American architectural profession. This project by no means constitutes a comprehensive history of drawing or of the profession, but the chapters are nonetheless instructive in understanding the ways in which professional control was exerted over architectural production via the work of "mundane" drawings.

Historical Scope and Context

The beginning and ending points of the temporal scope of this project, 1880 and 1920, do not represent single flashpoints or ruptures. Demarcating scope with specific historical events, although neat, almost always overnarrativizes and implies causal relationships that are, at best, incomplete explanations. Instead, the dates I have chosen are porous posts that stand amid an array of significant political, economic, social, and

³ See, for example, Richard Upjohn and A. J. Bloor, "Professional Practices and Charges of Architects," *American Architect and Building News* 2, no. 75 (2 June 1877): 174.

architectural shifts and trends. By 1880, the United States had reached a record gross national product after recovering from the economic tumult of the early and middle 1870s. A political detente in 1877 halted the national conflict around reconstruction, further easing tensions and prompting growth. Telegraph and railroad networks—key systems for facilitating the flow of information and materials—had reached an unprecedented level of relative completeness.⁴ This also coincides with the beginning of an era of upheaval in the ways corporations were organized, management was executed, and information was gathered, stored, retrieved, and used. American cultural consensus shifted around 1880 to accept competition and social exclusiveness and its associated values of mobility and growth.⁵ The growing population, economic booms, improvement in communication, rising urbanization, and unabated growth of large corporations, combined with new materials and building technologies, led to an increase in the number, size, and complexity of architectural projects. Furthermore, new financing practices demanded shorter construction timelines for building projects.⁶ This situation spurred a need for architectural services on an unprecedented scale and resulted in a variety of new solutions for organizing architectural work.

Amid all of this, architects were vying for control and recognized authority among a crowded landscape of structural engineers, contractors, developers, builders, and

⁴ Alfred Chandler uses this as a justification for his periodization of 1880–1920 in his classic *The Visible Hand*. See Alfred D. Chandler Jr., *The Visible Hand: The Managerial Revolution in American Business* (Belknap Press of Harvard University Press, 1977).

⁵ See Samuel Haber, *The Quest for Authority and Honor in the American Professions, 1750–1900* (University of Chicago Press, 1991), especially Part III.

⁶ For an early twentieth-century perspective on the role of architects in finance, see S. J. T. Straus, “The Businessman-Architect,” *American Architect* 111, no. 2156 (18 April 1917): 237–239.

others.⁷ Then, as now, most new buildings in the United States were not designed by an architect, so their dominance and control in design and building was by no means guaranteed. It was in this landscape that we see, for the first time, the true differentiation and separation between design and building processes. The traditional American architect–builder became the architect–designer, the actual work of the architect moving from the building site to the drafting room. It is also in this period that architectural culture expanded to include, for the first time, large, recognizable corporate firms like Peabody & Stearns (1870), McKim, Mead & White (founded in 1877, White joined in 1879), Holabird & Root (1880), and Adler & Sullivan (1883). The title “architect” was not protected in any way, and a significant part of the late-nineteenth century professionalization effort was a push from an elite group who saw themselves as knowledge workers to prevent a class they deemed “builders” from using the title. In reality, the built work and construction drawings of the two groups might be indistinguishable, so it was the title that would hold key importance.

The reach of government in the United States was relatively minimal through the beginning of the period I am considering. Administration and governance were shaped more by the exigencies of business and economics than by cohesive governmental policy or structure. The absence of central regulation for setting expectations and enforceable standards combined with the political reality of relatively independent states in a vast territory make the United States an excellent arena in which to study the complexities of

⁷ For recent architectural histories of some of these actors, see Chelsea Ann Spencer, “The Contract, The Contractor, and The Capitalization of American Building” (PhD diss., Massachusetts Institute of Technology, 2024); Alexander Wood, *Building the Metropolis: Architecture, Construction, and Labor in New York City, 1880–1935* (University of Chicago Press, 2025); and Sara Stevens, *Developing Expertise: Architecture and Real Estate in Metropolitan America* (Yale University Press, 2016).

professionalization. A government can play a key role in professionalization, by either supporting (or at least not interfering with) traditional guild systems or passing and enforcing modern licensure laws. For a long time, federal and state governments in the United States did neither. Although even by 1920 only a fraction of architects had been licensed, it was in the preceding forty years that the foundation for professional licensure was laid. In *Dent v. West Virginia*, decided in 1889, the United States Supreme Court upheld that strict, almost monopolistic licensure laws (here in the case of medicine) were permitted, paving the way for additional professions to pursue similar measures.⁸ Illinois became the first state to pass an architecture licensure law in 1897. Although it took another half-century before all states had similar laws, the Illinois statute brought licensure, accreditation, and professional expertise to the forefront of architectural debate at the turn of the twentieth century both within the profession and, more broadly, with a general American public that was becoming the passive urbanized consumer of more and more buildings.

Unlike most European contexts, where government sponsorship and regulation played a major role in professionalization, institutions and organizations took a larger role in the United States.⁹ Although I will soon explain how an overemphasis on governments and institutions can unduly flatten and skew a history of professionalization, an overview of institutions and associations can provide a helpful measure of a profession's reach and

⁸ United States Supreme Court, *Dent v. West Virginia*, 129 U.S. 114 (1889), <https://supreme.justia.com/cases/federal/us/129/114/>.

⁹ For examples that treat professionalization and differentiation beyond the United States, see Antoine Picon, *French Architects and Engineers in the Age of Enlightenment*, trans. Martin Thom, Cambridge (Cambridge University Press, 1992); and Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (Yale University Press, 2008).

aspirations. The first academic program in architecture in the United States was established at the Massachusetts Institute of Technology (MIT) in the mid-1860s. Additional programs were slow to arise, especially before the profession was well-established, but by 1900 there were fifteen more schools of architecture in the United States. Engineering education experienced a similar rapid expansion, largely due to the Morrill Land-Grant College Act, which increased the number of collegiate engineering programs more than tenfold between 1862 and 1888.¹⁰ The American Institute of Architects (AIA) was founded in New York in 1857. It was not until the 1880s, though, that the organization had any real national importance or cohesion, for example establishing a Uniform Contract (a longstanding goal) only in 1888. The Western Association of Architects, founded in Chicago 1884, was finally absorbed into the AIA in 1889, and by 1900 the AIA had relocated to Washington, truly representing architects at a national scale.¹¹ The Society of Beaux-Arts Architects, founded in New York in 1894, offered an elite artistic parallel to the legal and financial concerns of the AIA and makes evident the strong French influence in the American architectural profession at the time.

The situation was very different by the end of the First World War, when the reform movements of the Progressive Era drew to a close and a notable degree of professionalization, standardization, and reorganization had been achieved across many

¹⁰ Peter Meiksins, “Engineering in the United States: A House Divided,” in *Engineering Labour: Technical Workers in Comparative Perspective*, ed. Peter Meiksins and Chris Smith (Verso, 1996). For the public college movement’s impact on architectural education and its settler colonial implications, see Maura Lucking, “Settler Campus: Racial Uplift, Free Labor, and Land Tenure in American Design Education, 1866–1929” (PhD diss., UCLA, 2023).

¹¹ Here I agree with Andrew Saint, who has written that “Nevertheless by 1900 it [the AIA] stood as the nationally recognized representative of a nationally recognized profession.” See Andrew Saint, *The Image of the Architect* (Yale University Press, 1983), 92.

industries and disciplines. At this point, the United States economy was larger than that of France, England, and Germany combined, and the types of management and production made famous by scientific management had become fully implemented in many instances. Politically and culturally, there was a dwindling atmosphere of liberal reform following the disillusionment and upheaval of World War I. Among architects, too, the formerly triumphant mood was crushed by the war, during which the government turned to engineers and contractors for building rather than to architects.¹² Although inherently contingent and unstable, professionalization in architecture by 1920 had evolved to a state that would have been unrecognizable to a practitioner in 1880. Regional or independent trends in architecture were coalescing at a national scale, as evidenced by the establishment of important groups such as the Association of Collegiate Schools of Architecture, founded in 1912 to coordinate the pedagogical aims of architectural training, and the National Council of Architectural Registration Boards (NCARB), founded in 1919 to standardize architecture licensure among states. By 1920, the number of architects working in the United States had almost tripled in per capita proportion from 1880, and the profession had reached a critical mass for government attention, market influence, and the public acknowledgment of specialized knowledge, skills, and services.¹³

¹² See, for example, the letters to the editors published in *Architectural Forum* in early 1918. “In What Manner and By What Means Can the Practice of Architecture be Developed in Order to Win a Larger Recognition?” *Architectural Forum* 28, no. 3 (March 1918): 59–66. For an analysis of the impact of World War One on the profession of architecture in the United States, see Paul Louis Bentel, “Modernism and Professionalism in American Architecture, 1919–1933” (PhD diss., Massachusetts Institute of Technology, 1992).

¹³ Calculated from United States Census Bureau, *Compendium of the Tenth Census, June 1, 1880* (1895) and United States Census Bureau, *1920 Census: Volume 4. Population, Occupations* (1923), <https://www.census.gov/library/publications.html>. In 1880 there was roughly 1 self-identified “architect” per 14,870 people; in 1920 there was roughly 1 architect per 5,830 people. The number and proportion of people who

Drawings in the Profession

Architectural drawings have been a longstanding subject of academic inquiry, and there is a substantial body of literature on the topic. Scholarship about architectural drawing tends to fall on a spectrum from the highly theoretical to the highly technical. On the theoretical side, one major preoccupation is about drawing as a vehicle for creativity and a place for the iterative evolution of design.¹⁴ Another substantial camp is interested in the nuance of graphic projection and the history of strategies for representing a three-dimensional world on the two-dimensional plane of a drawing.¹⁵ Scholarship at the other side of the spectrum is technical and descriptive, focusing on the materiality of drawings and their production from a practical perspective rather than a creative, psychological one.¹⁶ While I recognize the importance of these conceptualizations, for my purposes, drawing is not solely a locus of the generative mental activity of design, nor is it solely a technical, material object. In other words, *drawing* is not only a verb or a noun. My aim

self-identified as “builder” increased even more dramatically over the same period, from about 1 per 4,645 to about 1 per 1,177.

¹⁴ See, for example, Paul Emmons, “Demiurgic Lines: Line-making and the Architectural Imagination,” *Journal of Architecture* 19, no. 4 (2014): 536–559; Paul Emmons, *Drawing Imagining Building: Embodiment in Architectural Design Practices* (Routledge, 2019); Gevork Hartoonian, ed., *Architectural Theory Review* 14, no. 3 (2008); Eugene S. Ferguson, *Engineering and the Mind’s Eye* (MIT Press, 1992); and Zeynep Çelik Alexander, *Kinaesthetic Knowing: Aesthetics, Epistemology, Modern Design* (University of Chicago Press, 2017).

¹⁵ A key example is Robin Evans, *The Projective Cast: Architecture and its Three Geometries* (MIT Press, 1995). See also Mario Carpo and Frédérique Lemerle, eds., *Perspective, Projections and Design: Technologies of Architectural Representation* (Routledge, 2008); and Massimo Scolari, *Oblique Drawing: A History of Anti-Perspective* (MIT Press, 2012). See also Harold Belofsky, “Engineering Drawing: A Universal Language in Two Dialects,” *Technology and Culture* 32, no. 1 (January 1991): 23–46.

¹⁶ See, for example, Lois Olcott Price, *Line, Shade and Shadow: The Fabrication and Preservation of Architectural Drawings* (Oak Knoll Press and Winterthur Museum and Garden & Library, 2010); and Eva Glück et al., eds., *Papier – Linie – Licht: Konservierung von Architekturzeichnungen und Lichtpausen aus dem Hans-Scharoun-Archiv* (Akademie der Künste, 2012).

is to go beyond this range and begin to historicize drawings as key sociological instruments, as sites and source of debates, deliberations, and negotiations in the formation and solidification of architecture as a profession in the United States.

My project draws from existing scholarship on the metaphysical and the material nature of drawing, but more so it introduces practice (use) to the equation, activating drawings in their historical context. Triangulating between content, material, and use allows for a richer and more productive analysis for the purposes of studying the history of architectural professionalization. Of course, drawings are widely understood and conceptualized as tools of communication, and other scholars have brought the technical and theoretical together in this way, but satisfactory examples of drawings historicized and contextualized in practice and use are scant. One recent and useful example of scholarship that considers drawing more holistically is *Design Technics*, edited by Zeynep Çelik Alexander and John May, which gathers essays on topics ranging from rendering to specification writing. The editors' interest is not in technology per se, but rather in technics, which Alexander defines as “a constellation of interrelated practical, artifactual, and procedural material conditions.”¹⁷ By focusing “in the middle between the object and the subject and between the instrument and its user,” the volume aims to emphasize “historical continuities” rather than rifts.¹⁸

Working in a similar space between object and maker, I am also interested in the possibilities of drawings not only as material things but also as conceptual entities

¹⁷ Zeynep Çelik Alexander, “Introduction: Architecture and Technics”, in *Design Technics: Archaeologies of Architectural Practice*, ed. Zeynep Çelik Alexander and John May (University of Minnesota Press, 2020), ix.

¹⁸ Alexander, “Introduction,” x and xvii.

constructed by debate, discussion, and circulation.¹⁹ To this end, I bring to the surface contemporaneous discourse around drawings as part of their historicization. Though the drawings I consider were made within the walls of drafting rooms, these documents were outward facing, involved in the complex delineation of the boundaries of the profession. Because of this significant position, I am concerned with the practical and idealist discourse around such drawings. In other words, I consider what architects thought, believed, and said a drawing was, could be, ought to be, or should not be, and how this is deeply intertwined with architects' views of themselves as individuals and as a group. These debates about the materials and techniques of practice tell more than a story of tools and workflows: they reveal the aspirations and anxieties of a profession in a significant period of change and redefinition.

Professions and Professionalization

In the following chapters, I make no attempt to provide a comprehensive list of features that define a profession, nor do I systematically measure architecture in the United States against these characteristics. The former has been done and risks devolving into unprovable minutiae, and the latter exercise is of similarly questionable utility.²⁰ That being said, broader definitions and considerations of professions from a variety of historical and sociological perspectives are useful in the initial framing of this project.

¹⁹ Drawings have been treated in this way in engineering history in the context of nineteenth-century machine-building companies. See John K. Brown, "Design Plans, Working Drawings, National Styles: Engineering Practice in Great Britain and the United States, 1775–1945," *Technology and Culture* 41, no. 2 (April 2000): 195–238.

²⁰ For a classic, systematic definition of professions, see Morris L. Cogan, "Toward a Definition of Professions," *Harvard Educational Review* 23, no. 1 (Winter 1953): 33–50.

Some of the earliest scholarly works in this vein, from the 1930s, note the connection between professions and associations, the state, and training. In a highly structuralist explanation, many early historians of professions contended that institutions were fundamental to any professionalization process, including in architecture.²¹ A flurry of sociological scholarship from around the 1980s sought to go beyond the earlier structural approaches by putting professionalization in its sociohistorical context. Many of these works built on the foundational book *The Rise of Professionalism* by sociologist Magali Sarfatti Larson, who brought to studies of professionalization a dimension she called the “monopoly of credibility.” Professions had to work to create the market for their expertise in society, framing what they had to offer as a unique and necessary commodity, largely intangible. In short, Larson sees “professionalization as the process by which producers of special services sought to constitute and control a market for their expertise.”²² This approach allows for a richer understanding of professions and professionalization as something more than a top-down story of formal associations, governments, and degrees.

One of the most incisive works following Larson is Andrew Abbott’s *The System of Professions*, and a few points he makes about professions are worth bearing in mind in the context of architecture. Prompted by what he sees as a historical overreliance on structural, narrative explanations of professionalization (licenses, journals, schools), Abbott instead argues that one should look at the actual work performed, especially in relation to surrounding and adjacent professions and, importantly, in broader historical

²¹ See A. M. Carr-Saunders and P. A. Wilson, *The Professions* (Oxford University Press, 1933; repr., Frank Cass, 1964). See also Martis S. Briggs, *The Architect in History* (Oxford University Press, 1927).

²² Magali Sarfatti Larson, *The Rise of Professionalism: A Sociological Analysis* (University of California Press, 1977), xvi.

context. Abbott writes that “the development of the formal attributes of a profession is bound up with the pursuit of jurisdiction and the besting of rival professions. The organizational formalities of professions are meaningless unless we understand their context. This context always relates back to the power of the profession’s knowledge systems, their abstracting ability to define old problems in new ways.”²³ The interrelated system of professions also includes the general public, and Abbott correctly notes that “in America it is ultimately through public opinion that professions established the power that enables them to achieve legal protection.”²⁴ Like Larson, Abbott’s model “shows how professions both create their work and are created by it.”²⁵ A profession, after all, is a social relationship, and I hold that is the relationship to knowledge, to other professions, and to the public that largely defines a profession.

When I gesture to professionalization throughout the following chapters, I am referring to the contingent yet often increasingly stable sociopolitical relationship between architects and non-architects, the law, education, and institutions. Although materials, technologies, and technics play a large role in this project, they are used as a way to elucidate sociohistorical phenomena in the business of architecture. While I do attempt to draw out some general contours throughout this dissertation, I do not seek to force a unified, overarching narrative on the material. The adoption of certain methods, conventions, and ideas was not a synchronized, cohesive process with a single cause or

²³ Andrew Abbott, *The System of Professions: An Essay on the Division of Expert Labor* (University of Chicago Press, 1988), 30.

²⁴ Abbott, *The System of Professions*, 60.

²⁵ Abbott, *The System of Professions*, 316.

unified logic, but rather was a complex and multivalent set of developments. I suggest that what might emerge from the somewhat disparate examples of construction details, blueprinting, and lettering is a history of the shift toward an increasingly managerial profession. It was this shift that made the modern architect.

Drawings in Professionalization

Historically, in the period I am examining, debates about drawings are inextricable from debates about professionalization and identity. As such, drawings provide an excellent, perhaps unique, point of access to the history of the profession in these formative years. Design and production can happen in tandem when the artisan is the designer. When the designer is no longer the maker, though, intent and instruction must somehow be conveyed. In architecture, this is done through drawings and specifications. Although a similar distance-via-drawing phenomenon has been observed in other architectural contexts beginning with early modern Italy, it was not widespread until the nineteenth century with the industrialization of building and the increased specialization and separation of various workforces with different training, skill, and expertise.²⁶ In the United States, it was also in the middle of the nineteenth century when we begin to see the fragmentation of the historic role of the architect–builder into its constituent parts. The expanded, separated cast of participants began to include, in the words of Catherine W. Bishir, “a client who had turned full design authority over to the

²⁶ For labor divisions and specialization in building, see Tom F. Peters, *Building the Nineteenth Century* (MIT Press, 1996); and John Fitchen, *Building Construction before Mechanization* (MIT Press, 1988). Mario Carpo places the intellectual origins of the office/worksite divide with Leon Battista Alberti at the turn of the fifteenth century. See Mario Carpo, “Craftsman to Draftsman: The Albertian Paradigm and the Modern Invention of Construction Drawing,” in *The Working Drawing: The Architect’s Tool*, ed. Annette Spiro and David Ganzoni (Park Books, 2013).

architect; an architect who might not even appear at the building site; a contractor who might manage work without laying a hand to plane or trowel; and finally, an artisan charged with executing unfamiliar work he had no part in conceptualizing. In such circumstances, drawings and specifications assumed a new purpose and took on a new and more explicit form.”²⁷ It was this very physical and intellectual distance of the architect from the building site that was part and parcel of professionalization and industrialization.²⁸ Communication of design that was fixed over time and place was required for this arrangement, and thus drawing took on new importance as an administrative tool. Similarly, Michael Osman has convincingly shown that specifications can reveal “the methods for managing the value of architectural design as separate from the construction business.”²⁹ This scheme required literacy in writing and drawing which, although steadily increasing over the course of the nineteenth century in the United States, was not a given.

Architects, in the modern sense of the profession, make drawings, not buildings.³⁰

It was in the period under consideration in this dissertation that this first became the

²⁷ Catherine W. Bishir, “A Spirit of Improvement: Changes in Building Practice, 1830–1860”, in *Architects and Builders in Carolina: A History of the Practice of Building*, ed. Catherine W. Bishir et al. (University of North Carolina Press, 1990), 173.

²⁸ Charlotte V. Brown makes essentially this argument in the same volume as Bishir’s essay. See Charlotte V. Brown, “The Advance in Industrial Enterprise: Building with the New Technology,” 273.

²⁹ Michael Osman, “Specifying: The Generality of Clerical Labor,” in *Design Technics: Archaeologies of Architectural Practice*, ed. Zeynep Çelik Alexander and John May (University of Minnesota Press, 2020), 139.

³⁰ This idea originated at least in the sixteenth century with Giorgio Vasari, who wrote: “Their [design drawings’] chief use indeed is in Architecture, because its designs are composed only of lines, which so far as the architect is concerned, are nothing else than the beginning and the end of his art, for all the rest, which is carried out with the aid of models of wood formed from the said lines, is merely the work of carvers and masons.” See Giorgio Vasari, *Vasari on Technique*, trans. Louisa S. Maclehorse, ed. G. Baldwin Brown (J. M. Dent, 1907), 206–207.

wider reality in the United States, and the proliferation of drawings goes hand in hand with contemporaneous professionalization. As architecture moved from an artisanal craft to a knowledge profession, the work of drawing, framed as mental, intellectual, and highly specialized and skilled, became the very thing that distanced architects from the manual labor they were ultimately directing. Profession formation is dependent on control and recognized authority, and drawings are a venue for testing, exerting, expressing, and exercising that control and authority. In this sense, the authority of architectural drawings is truly tied to their authorship, and drawings can be key sites of professional delimitation and self-conception. A major issue for architects at the end of the nineteenth century, perhaps even apparent in this brief overview, is that any number of actors (architect, builder, engineer, contractor) could make the types of drawings that divide the intellectual work in an office from the manual work on a building site. The way architects *said* their work was different, even if in reality it often was not, becomes even more important in historicizing their project of professionalization.

In this dissertation I mostly consider working drawings: drawings made by architects as the last drafting room phase in the planning of a building. As the last step in the design process, they are the chief means of design communication between an architect (or other designer) and the vast network that will ultimately produce a building.³¹ It is these drawings that represent—in the sense of “stand in for”—the architect and his or her instructions in this vast array of actors. Since I am more interested

³¹ In reality, design often continued in the course of construction, whether under the revised direction of the architect or based on assumptions or decisions of workers. Even in the late nineteenth century “as built” drawings were produced to document these changes, and change orders, bulletins, and other design clarifications from architects to builders became more commonplace into the twentieth century. For more on working drawings, see Spiro, *The Working Drawing*.

in drawings as instruments of outward communication than in drawings as tools of inward design development, construction drawings rather than preliminary sketches logically form the body of material I analyze. This project, though, is not a history of working drawings and I make no claims at completeness. Instead, I examine several practices, technologies, and techniques that manifest through and around working drawings as a way to consider the work of architecture and its professionalization. I am interested in the way that the qualities of a drawing—the level of detail, the reprographic medium, or the style of lettering—might represent an architect and his or her ambitions of professional control and authority.

Models and Methodologies

In addition to the historians and sociologists mentioned above, I draw on models and precedents from several fields, building upon a number of scholars, trends, and disciplines including architectural history, the history of technology, and historical sociology, as well as business, management, and economic history. Each individual chapter, furthermore, draws on a specific corpus of work related to the topic in question.

A handful of architectural historians have written on professionalization, control, drawing, and the architecture office in a similar period. Mary Woods's *From Craft to Profession* is an astute social history that traces the expansion and professionalization of architectural practice in the United States to about 1900. In addition to examining typical, long-studied organizations and institutions like the AIA, Woods adds to her scope smaller, regional organizations as well other forms of instruction like apprenticeship, mechanics institutes, and correspondence schools. Additionally, Woods was one of the

first scholars to take seriously the spatial and material world of the architect's office as a subject of inquiry.³² The book is in many ways a response to two decades of scholarship on the history of the architectural profession as well as sociological and anthropological perspectives on professions and practice more broadly.³³ Woods collects important sources and lays the groundwork for future research, including this project, by contextualizing the key individuals, formal institutions, and informal associations that both produced and were produced by architectural culture in nineteenth-century America. As Erik Carver has noted, while her aim was to challenge the previous generation's tendency toward myth and monograph, she still relied on metanarrative and the archives of the elite individuals and universities she was seeking to look beyond.³⁴

A number of scholars have written on the internal organization and working methods of specific architectural offices, including those of George B. Post, Daniel Burnham, Albert Kahn, and McKim, Mead and White.³⁵ Office practice is also the concern of two books by George Barnett Johnston, each organized around a landmark

³² Mary N. Woods, *From Craft to Profession: The Practice of Architecture in Nineteenth Century America* (University of California Press, 1998).

³³ This began with Spiro Kostof, ed., *The Architect: Chapters in the History of the Profession* (University of California Press, 1977). See also Judith R. Blau, *Architects and Firms: A Sociological Perspective on Architectural Practice* (MIT Press, 1984); Judith R. Blau et al., eds., *Professionals and Urban Form* (State University of New York Press, 1983); and Robert Gutman, *Architectural Practice: A Critical View* (Princeton Architectural Press, 1988).

³⁴ Erik Carver, "'This Whole Maze of Evidence': Revisiting Professionalism and Property through *Hunt v. Parmlly*," in *Writing Architectural History: Evidence and Narrative in the Twenty-First Century*, ed. Aggregate (University of Pittsburgh Press, 2021), 262.

³⁵ Diana Balmori, "George B. Post: The Process of Design and the New American Architectural Office (1868–1913)," *Journal of the Society of Architectural Historians* 46, no. 4 (December 1987): 342–355; Jay Wickersham, "Learning from Burnham: The Origins of Modern Architectural Practice," *Harvard Design Magazine* 32, Design Practices Now (Spring/Summer 2010): 18–27; Claire Zimmerman, "Albert Kahn in the Second Industrial Revolution," *AA Files* 75 (2017): 28–44; and Alexander Wood, "Teamwork at McKim, Mead & White," *Journal of the Society of Architectural Historians* 83, no. 3 (September 2024): 340–357.

publication intended for use as a drafting room manual. The first, *Drafting Culture*, examines Charles George Ramsey and Harold Reeve Sleeper's classic *Architectural Graphic Standards* (1932). Johnston traces the origins and evolutions of the authors' ideas and, more importantly, uses *Architectural Graphic Standards* to frame a social history of the profession around the large and understudied class of architectural draftsmen.³⁶ Johnston's more recent book, *Assembling the Architect*, looks to the AIA's *Handbook of Architectural Practice* (1920) to organize a history of the profession in the United States. Although he gestures to numerous historical examples that show the negotiated territory among architect, owner, and builder, the breadth of the study is not matched by depth.³⁷ While Johnston begins his later book by presenting the blank form of the 1888 AIA Uniform Contract, the last chapter of Michael Osman's *Modernism's Visible Hand* shows how a deep historical treatment of paperwork can be rich and rewarding. More specifically, Osman examines the use of paperwork in the offices of Albert Kahn in his expansive study that posits regulation as the theme that connects processes of modernization. He extends this analysis beyond the traditional realm of architectural history and shows how regulatory models also shaped work in other fields and movements. *Modernism's Visible Hand*, although not strictly about professionalization, is nevertheless a key model of the weaving together of various examples that tie architecture to questions and practices of expertise, technology,

³⁶ George Barnett Johnston, *Drafting Culture: A Social History of Architectural Graphic Standards* (MIT Press, 2008).

³⁷ George Barnett Johnston, *Assembling the Architect: The History and Theory of Professional Practice* (Bloomsbury Visual Arts, 2020).

efficiency, and management.³⁸ A final model to note is Basile Baudez's *Inessential Colors*, which looks to the use of color in architectural drawings, prints, and paintings in early modern Europe. In doing so, Baudez carefully examines drawings in context and connects drawing practices, both technical and social, to the then-nascent professionalization of architecture in Europe.³⁹

Histories and theories from the interdisciplinary field of Science and Technology Studies (STS) are also indispensable to this project. Historians of architecture have drawn from and contributed to the history of technology for decades, but these scholars tend to be concerned with structural, material, and building system technologies—like the steel frame, reinforced concrete, or air conditioning—and occasionally the secondary technologies that play a role in the construction process—like cranes or the mass production of plate glass.⁴⁰ In the historiography of modern architecture, technology is treated most often in terms of aesthetics, whether the result of mass-produced modular elements or the self-conscious embodiment of machine-age theory. Although technologies and techniques can reshape the production of the built environment and even form and reform the minutiae of office work, architectural history still has much to learn from STS in terms of understanding and interpreting networks. Theorists like Bruno

³⁸ Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America* (University of Minnesota Press, 2018).

³⁹ Basile Baudez, *Inessential Colors: Architecture on Paper in Early Modern Europe* (Princeton University Press, 2021).

⁴⁰ Older and more recent examples of this work abound. See Reyner Banham, *The Architecture of the Well-Tempered Environment* (Architectural Press and University of Chicago Press, 1969); Cecil D. Elliott, *Technics and Architecture: The Development of Materials and Systems for Buildings* (MIT Press, 1992); Thomas Leslie, "Built Like Bridges: Iron, Steel, and Rivets in the Nineteenth-century Skyscraper," *Journal of the Society of Architectural Historians* 69, no. 2 (June 2010): 234–261; and Peters, *Building the Nineteenth Century*.

Latour are perhaps an obvious place to start, especially for historians of architecture interested in social and material relations. Latour, trained as a sociologist, is committed to explaining associations among humans and between humans and nonhumans. Nonhuman actors, even those that seem automated and mechanical, are never purely technical. His Actor-Network Theory (ANT) posits that self-inscribing networks of actors, broadly defined, are independent of a total controlling force and that these networks become visible to us by “following the actors.”⁴¹ While some take issue with ANT as anti-critical or non-humanist, it does provide a useful way of extending to the material realm the types of analysis and attributions of agency typically reserved for the social and sociological examination of human actors.⁴² Although many applications of ANT to architecture are oversimplified and ahistorical, I find it helpful in thinking about broad networks of practice that include documents and drawings in sociohistorical context.

Documents themselves, in the field of media studies and elsewhere, have been fruitfully theorized. Historian Ben Kafka, a leading figure in the interdisciplinary field of paperwork studies, has called on historians to look *at* documents, rather than just *through* them.⁴³ For generations, architectural historians have looked *through* drawings to study the built environment, the work of a particular architect, or the iterative, creative process

⁴¹ For a brief introduction, see Bruno Latour, “On Actor-Network Theory: A Few Clarifications,” *Soziale Welt* 47, no. 4 (1996): 369–381. For an expanded manifesto, see Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford University Press, 2005). The theory was largely laid out in Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard University Press, 1987).

⁴² For one of many critiques of ANT, see Frédéric Vandenberghe, “Reconstructing Humans: A Humanist Critique of Actant-Network Theory,” *Theory, Culture and Society* 19, no. 5/6 (2002): 51–67.

⁴³ Ben Kafka, “Paperwork: The State of the Discipline,” *Book History* 12 (2009): 340–353. Kafka’s book on paperwork and bureaucracy in the French Revolution is a model of the effective application of these theories and methods. See Ben Kafka, *The Demon of Writing: The Powers and Failures of Paperwork* (Zone Books, 2012).

of design. Rarely, however, have they looked *at* them.⁴⁴ I contend that architectural drawings, as primary instruments of the profession, warrant dedicated attention as such. Many of the sources used in this dissertation are unusual not because they are rare, but because they are ubiquitous. Expansive definitions of documents, such as Lisa Gitelman's, which treats documents as a genre (as opposed to a medium or a format), are useful in thinking about the broader material culture of architectural practice.⁴⁵ Conceptualizations of documents from the field of paperwork studies have modeled an approach to the history of bureaucracy that is grounded in documents and documentary practice, an approach I will use occasionally in this project. Documents and paperwork fall under the rubric of what Peter Becker and William Clark have called "little tools of knowledge." In their system, "in order to unveil the role and relevance of these little tools, we have to look closely though with some estrangement at quotidian practices and routines of scientific and administrative endeavors in relation to the issues of authority and objectivity."⁴⁶

The history of management and business history also play a role in my thinking about architectural practice and professionalization. The publication of Alfred D. Chandler Jr.'s *The Visible Hand* in 1977 ushered in countless studies of the techniques of management and their role in the modernization of American industry and the expansion

⁴⁴ A number of architectural historians have been making similar calls for over a decade. See, for example, Tilo Amhoff, Nicholas Beech, and Katie Lloyd Thomas, "Further Reading Required," *arq* 16, no. 3 (2012): 197–199.

⁴⁵ Lisa Gitelman, *Paper Knowledge: Toward a Media History of Documents* (Duke University Press, 2014).

⁴⁶ Peter Becker and William Clark, "Introduction," in *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*, ed. Peter Becker and William Clark (University of Michigan Press, 2000), 1.

of corporate capitalism. Although he explained the management revolution as essentially a “rational market response” and relied on an overly structural argument, Chandler’s work formed an important basis for the continued study of business and bureaucracy.⁴⁷ James Beninger subsequently formulated that the turn to becoming an “information society” at the end of the nineteenth century was a response to the “crisis of control” that resulted from the need to coordinate large, collective activities. In other words, control through bureaucratization is the essence of what he and others have named the “control revolution.”⁴⁸ Of all of Chandler’s students and followers, JoAnne Yates is the most relevant to this project. In *Control Through Communication*, Yates analyzes both the content and techno-material aspects of internal corporate communication and its role in systematic management.⁴⁹ Although she does not address architecture or drawing, I use Yates as a model for approaching that material as a tool of communication and control. Many attempts to introduce architecture into discussions of systematic management have fallen short, tending to overemphasize the International Style and the role of Fordism and Taylorism in simplified, monolithic views of architectural modernism.⁵⁰

⁴⁷ Chandler, *The Visible Hand*. For historiographic reflections on the book’s influences and impacts, see Richard R. John, “Elaborations, Revisions, Dissents: Alfred D. Chandler, Jr.’s, *The Visible Hand* after Twenty Years,” *The Business History Review* 71, no. 2 (Summer 1997): 151–200; and Steven W. Usselman, “Still Visible: Alfred D. Chandler’s *The Visible Hand*,” *Technology and Culture* 47, no. 3 (July 2006): 584–596.

⁴⁸ James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Harvard University Press, 1986), 279. See also Peter Jeffrey Booker, *A History of Engineering Drawing* (Northgate 1979), especially chapters 5 and 14.

⁴⁹ JoAnne Yates, *Control through Communication: The Rise of System in American Management* (Johns Hopkins University Press, 1989).

⁵⁰ See Mauro F. Guillén, *The Taylorized Beauty of the Mechanical: Scientific Management and the Rise of Modernist Architecture* (Princeton University Press, 2006); and David Gartman, *From Autos to Architecture: Fordism and Architectural Aesthetics in the Twentieth Century* (Princeton Architectural Press, 2009).

Many historians have worked to add other subjective dimensions to the phenomenon Chandler identifies. Oliver Zunz, for example, argued convincingly that new management structures could only be implemented effectively with the emergence of a new workplace culture with shared values.⁵¹ In this sense, Zunz is indebted Harry Braverman's pathbreaking *Labor and Monopoly Capital*, which opened up labor under capitalist bureaucracies to a new form of analysis and scrutiny and sparked a flurry of research on deskilling and the "degradation of work" that came with the rise of capital.⁵² Marxist views on labor and capitalism have been brought to discussions of architectural labor in particular. Drawing on Hannah Arendt's distinction between work, labor, and action, Peggy Deamer has written extensively on the "immaterial labor" of architects and other creative professionals.⁵³ I contend that drawings are a place where immaterial labor is materialized. If the work of the architect is mental, intellectual, creative, and

⁵¹ Olivier Zunz, *Making America Corporate 1870–1920* (University of Chicago Press, 1990).

⁵² Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, 25th anniversary ed. (Monthly Review Press, 1998). For a discussion of Braverman's impact on historical sociology and social history, see Vicki Smith, "Braverman's Legacy: The Labor Process Tradition at 20," *Work and Occupations* 21, no. 4 (November 1994): 403–421. For a summary of responses to Braverman's theories, see Clifford L. Staples and William G. Staples, "Rereading Harry Braverman's *Labor and Monopoly Capital* After Twenty Years," *Social Thought and Research* 23, no. 1/2 *Social Thought in America* (2000): 227–238.

⁵³ See Peggy Deamer, "Architectural Work: Immaterial Labour," in *Industries of Architecture*, ed. Katie Lloyd Thomas et al. (Routledge, 2016); Peggy Deamer, ed., *The Architect as Worker: Immaterial Labor, the Creative Class, and the Politics of Design* (Bloomsbury Academic, 2015); Peggy Deamer and Phillip G. Bernstein, eds., *Building (in) the Future: Recasting Labor in Architecture* (Yale School of Architecture and Princeton Architectural Press, 2010); and Peggy Deamer and Tsz Yan Ng, "Work," *Journal of Architectural Education* 73, no. 2 (Fall 2019): 138–140. For Arendt's distinctions, see Hannah Arendt, *The Human Condition* (University of Chicago Press, 1958); Hannah Arendt, "Labor, Work, Action," in *Amor Mundi: Explorations in the Faith and Thought of Hannah Arendt*, ed. James W. Bernauer, Boston College Studies in Philosophy 7 (Martinus Nijhoff, 1987); and Melvyn A. Hill, ed., *Hannah Arendt: The Recovery of the Public World* (St. Martin's, 1979), especially the essays by Mildred Bakan, Kenneth Frampton, and Robert W. Major.

organizational, rather than physical or practical, in the strictest sense of the word, then it is drawings that are key documents of their work.

Within the fields of the history and sociology of science, the example of engineering has been analyzed extensively to understand both how professions organize internally as well as how they position themselves within society. Novel theorizations about the profession of engineering within the constructs of a managerial bureaucracy emerged around 1980. David Noble identified a managerial elite that emerged at the end of the nineteenth century and argued that engineers, subsumed in this system, were integral to the shaping of the modern American capitalist economy.⁵⁴ Edward Layton, rejecting the inevitability suggested by Noble's scheme, suggests that there were more nuanced discussions and negotiations among engineers about their relationship to managerial bureaucracy and their moral obligations to society.⁵⁵ Although far from unified, architects did not exhibit the fragmentation into discrete segments like engineers, who organized themselves into training, jobs, and professional societies based on a division between electrical, mechanical, chemical, and civil branches.⁵⁶

⁵⁴ David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford University Press, 1977).

⁵⁵ Edward T. Layton Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Johns Hopkins University Press, 1986). For a contemporaneous reaction, see Peter Meiksins, "The 'Revolt of the Engineers' Reconsidered," *Technology and Culture* 29, no. 2 (April 1988): 219–246. For a musing on the book's impact after thirty years, see Ronald R. Kline, "From Progressivism to Engineering Studies: Edwin T. Layton's *The Revolt of the Engineers*," *Technology and Culture* 49, no. 4 (October 2008): 1018–1024. Both Layton and Nobel were responding implicitly to Monte A. Calvert, *The Mechanical Engineer in America, 1830–1910: Professional Cultures in Conflict* (Johns Hopkins Press, 1967).

⁵⁶ See Calvert, *The Mechanical Engineer in America*, especially chapter 11. See also Meiksins, "Engineering in the United States," in *Engineering Labour*.

Education in Professionalization

Although architectural education is only foregrounded in one of the following three chapters, a few words about the role of institutional training in professionalization are warranted. Anyone can be knowledgeable, but what distinguishes a profession is the exclusivity of that knowledge. Following this, knowledge transfer often plays a substantial role in models of professionalization. Larson, for example, locates a large part of the monopolistic boundary-drawing project of professionalization in education. As a profession develops more regular systems and methods of work,

the educators themselves develop a consciousness of their interests and become concerned with professional autonomy and professional privileges, their role increases in the profession as a whole. A growing number of future practitioners is exposed to their influence and formed by a body of knowledge which educators define into which they often contribute directly.⁵⁷

Abbott ascribes a similar power to education, noting that “the academic knowledge system of a profession generally accomplishes three tasks—legitimation, research, and instruction—and in each it shapes the vulnerability of professional jurisdiction to outside interference.”⁵⁸ Although schools, societies, clubs, and associations are useful markers of and venues for interaction in the history of professionalization, I follow Larson and Abbott’s plea to reinsert sociopolitical, relational dimensions to the study of professionalization, especially in the context of education.

The education and training of architects outside the walls of major academies and universities has been the subject of architectural historical scholarship, especially in

⁵⁷ Larson, *The Rise of Professionalism*, 44.

⁵⁸ Abbott, *The System of Professions*, 56–57.

recent years.⁵⁹ Most young Americans attempting to enter the field of architecture in the later nineteenth century worked in an office without prior higher training and almost always without a university degree.⁶⁰ Conversely, some practicing architects were skeptical of what real benefit university training in architecture might offer (some even derided the idea). Rather than being an outlier in the self-constructed conceptions of the professional architect, university-based instruction in architecture sits at the center, triangulating between the existing profession such as it was, the real needs of training for students, and the future-looking, aspirational version of the profession.

Chapter Summaries

In this project, I explore differing locations of agency within a sociological process as enabling agents of change. The first chapter takes a traditional path, examining the agency of a human individual embedded in an institution. The second chapter examines the possible agency of a technology in professionalization. The third chapter looks both at and beyond the first two levels to examine the agency of consensus-based practices. Each chapter looks to the ways architects related to drawings, both in terms of genres of labor and in terms of their conceptions of themselves as professionals.

⁵⁹ See Peter L. Laurence, ed., *Histories of Architecture Education in the United States* (Routledge, 2024), especially Michael J. Lewis, “The Philadelphia Way of Making Architects: The Birth and Birthplace of American Architectural Education.” For an earlier example, see Jeffrey A. Cohen, “Building a Discipline: Early Institutional Settings for Architectural Education in Philadelphia, 1804–1890,” *Journal of the Society of Architectural Historians* 53, no. 2 (June 1994): 139–183.

⁶⁰ For the general decline of apprenticeship in the United States, see Bernard Elbaum, “The Persistence of Apprenticeship in Britain and its Decline in the United States,” in *Industrial Training and Technological Innovation: A Comparative and Historical Study*, ed. Howard F. Gospel (Routledge, 1991).

In Chapter One, I trace one publication (*Construction Details*, 1892) by one individual (Francis Ward Chandler, 1844–1926) in one university architecture department (MIT). Histories of academic architectural education in the United States tend to emphasize the design studio or the influence of the École des Beaux-Arts.⁶¹ Framed this way, the history of the academic discipline of university-taught architecture becomes a history of elite training in the creative, intellectual work of design and is distanced from the contemporaneous reality of architectural practice. In tracing Chandler’s *Construction Details*, I instead aim to emphasize the practical (though decidedly not manual) dimensions of architectural education. Chandler was of course sensitive to the importance of design, having studied at the École himself, but he was also acutely aware of the realities of practice from his experiences at a variety of scales in a variety of arrangements. While still part of the growing elitism of university training, these aspects of architectural education were still deeply connected with the ongoing business of architecture and the increasing control of building by the evolving profession.

In Chapter Two, I follow the discourse around blueprints and blueprinting to reveal the aspirations of architects in one of many periods in which they were seeking control in building. Blueprinting, for the first time, allowed for exact duplicates of an architect’s drawings to be produced mechanically, bypassing the previously necessary and often unreliable work of an intermediate draftsman. While a simple technologically determined explanation of efficiency fits neatly in the metanarrative of modernization, I

⁶¹ See, for example, Hyungmin Pai, *The Portfolio and the Diagram: Architecture, Discourse, and Modernity in America* (MIT Press, 2002); James Phillip Noffsinger, “The Influence of the École des Beaux-Arts on the Architects of the United States,” (PhD diss., Catholic University of America, 1955); and Michael Pause, “Teaching the Design Studio, A Case Study: MIT’s Department of Architecture, 1865–1974” (PhD diss., Massachusetts Institute of Technology, 1976).

contend that the widespread adoption of blueprinting was also wrapped up in the profession's contemporaneous preoccupation with control and administration both in and out of the office.

While working drawings and specifications distanced the architect from the physical work of construction, it conversely and brought him into the minutiae of its technical planning. The third chapter looks to lettering on drawings as a possible vehicle for the expression of artistic expertise in a drafting practice that was otherwise highly mechanical and technical. Through their style of lettering, architects might convey at a glance their ineffable creative expertise. In these cases, lettering was not only a mode of textual communication, but also a way for architects to define their relationship to drawing, both for themselves and for others.

CHAPTER ONE

Francis Ward Chandler's Construction Details and Architectural Training at MIT

Professionalization is a process of delimitation. This boundary drawing is also necessarily a process of exclusion. In architecture the United States, professional specialization and territory claiming began in earnest after the Civil War, catalyzed by western expansion and an economic boom in which architects might play a role. Architectural professionalization was a complex and contingent sociological process among a constellation of entities and was rhetorically and discursively constructed. Debates and discussions about education, training, and pedagogy loomed large in the negotiations of profession formation. If a profession is to be understood as a restricted group of individuals with common, specialized knowledge that will dominate a certain field, then the aims, scope, and methods of education can have a primary organizing and defining role. The establishment of the first academic architectural programs in the United States coincides exactly with the peak decades of ambitions of professionalization among architects. Architectural education, in fact, was a major arena for architects to test, self-define, and project a practical yet aspirational vision of themselves as a professional community. While the American Institute of Architects (AIA) remained weak and relatively small and licensure continued to be optional and uneven into the mid-twentieth century, it was in and around schools of architecture that the domains of future professional knowledge and practice were debated and defined.

This chapter focuses on the role of architectural education in profession formation through the example of the Massachusetts Institute of Technology (MIT) and, more specifically, through a close examination of *Construction Details*, an 1892 publication by MIT professor Francis Ward Chandler (1844–1926). *Construction Details* can be interpreted as a forceful step in relocating the embodied, practical knowledge of a builder from a construction site to the drafting room of a specially trained, technical and creative expert called an architect and the people who worked for him. Although part of a longer lineage and wider spectrum of distinctly American nineteenth-century architecture publications, *Construction Details* is fundamentally different in its scope, audience, and aims. The motivations behind the creation of the publication, the ambitions of its author, its use in an evolving curriculum, and its reception by the profession, taken together, can be used to sketch the contours of the changing role of the architect through the lens of the type of drawing and work the publication tacitly promoted. The content of *Construction Details*, highly specialized yet generalized information about building construction, is an exemplar of the type of knowledge and control architects sought to wrest into the drafting room (and university curricula), fix in their working drawings and specifications, and therefore ultimately brought within their domain of professional control.

The Beginning of Architectural Training at MIT

An overview of the history of the pedagogical aims and curriculum of the architecture program at MIT is necessary before considering Chandler's 1892 *Construction Details*, which is in many ways the culmination of thirty years of concerted effort. Ultimately, I will show how the publication is situated in and a product of the MIT

curriculum, and, more importantly, how it is indicative of and a participant in the professionalization and bureaucratization of architecture in the United States.

Construction Details is a concrete exemplar of how the curriculum of architectural training was an instrument in the larger project of professionalization, creating an architectural profession where expertise was paramount and instructions were recorded in documents produced in a drafting room.

The MIT program in architecture was founded in the 1860s by William Robert Ware (1832–1915), the prominent Boston architect then in partnership with Henry Van Brunt.¹ In his practice, Ware observed the absence of, and need for, a system of architectural education in a rapidly expanding nation where the demand for qualified architects far outstripped the supply. Ware and Van Brunt were known in the region for training young architects in their office atelier, so Ware was a logical contact from whom to solicit advice when MIT leadership was first contemplating instruction in architecture just a few years after the institute was chartered in 1861. In an April 1865 letter to John Runkle, one of MIT’s first faculty members, Ware wrote: “There is not now in the country any adequate instruction in Construction and Design none whatever, while the demand for skilled draughtsmen and competent architects is rapidly increasing in every

¹ For the early period of architectural education at MIT and Ware, see John Andrew Chewning, “William Robert Ware and the Beginnings of Architectural Education in the United States, 1861–1881” (PhD diss., Massachusetts Institute of Technology, 1986); John A. Chewning, “William Robert Ware at MIT and Columbia,” *Journal of Architectural Education* 33, no 2 (November 1979): 25–29; Kevin P. Block, “The Ware Course: Architecture as a Useful, Liberal, and Fine Art,” (PhD diss., University of California, Berkeley, 2019. For Ware and Van Brunt’s partnership, see Kimberly Alexander-Shilland, “Ware and Van Brunt: Architectural Practice and Professionalization (1863–1881)” (PhD diss., Boston University, 1999).

part of the county.”² Demand for architects and draftsmen was high, and Ware saw instruction in architecture as a natural extension of MIT’s existing general common curriculum in physics, chemistry, mathematics, mechanical drawing, and other topics. For a curriculum specific to architecture, Ware identified two additional necessary categories of study. The first consists of history, design, proportion, aesthetics, and other areas “upon the side of the Fine Arts.”³ The second, and according to Ware the one MIT was best situated to teach, would focus on practical skills:

Upon the other side instruction ought to be given by Lectures, laboriously prepared, upon the various mechanic arts employed in building, so as to impart a theoretical knowledge of their principles and processes, and practical + useful information in regard to estimating and surveying work, and the organization and superintendence of workmen, the keeping of accounts and regulation of payments, the drawing up of specifications and contracts, and the customs which regulate the intercourse of architects with their clients and with the mechanics they employ and the laws upon which they ultimately rest. The more strictly scientific subjects of lighting, heating, ventilation, and acoustics would of course have to be included.⁴

Ware goes on to state that many of these subjects can be taught by a “literary method,” but notes repeatedly that existing treatises are insufficient, and that the better, more comprehensive ones from Europe are not suited to an American context.

Ware holds that this architectural instruction could serve an important function of creating, defining, and cohering a community. “The profession is at present in a very inchoate and amorphous condition,” he continued:

At present building is in the hands of the mechanics, few of whom are first rate, of contractors and superintendents who are mechanics with talents for

² William Robert Ware to John Runkle, 27 April 1865, William R. Ware Papers, box 1, folder 2, Massachusetts Institute of Technology, Department of Distinctive Collections (hereafter cited as Ware Papers).

³ Ware to Runkle, 27 April 1865, Ware Papers.

⁴ Ware to Runkle, 27 April 1865, Ware Papers.

affairs and many of whom take the name of Architect, of architects proper few of whom have an adequate training in the higher branches of their calling while they are of course vastly inferior to the others in a knowledge of the lower branches, and lastly of architects' assistants and draughtsmen. It is upon these last that the whole system turns, and in any community the character of the work done depends in a great degree upon their attainments and qualifications. The 'practical' architect of course relies upon them for his designs, and the educated architect is hardly less dependent upon them. Any prosperous architect must leave nine drawings out of ten to be made entirely by his subordinates under supervision of course more or less minute. If they are ignorant the work suffers. Even the best we have require an amount of overseeing which prevents the architect from giving to his own proper work.⁵

What begins to emerge here is Ware's true intention in architectural instruction: not necessarily to produce high-caliber architects in charge of design, but rather to produce an army of architectural workers able to assist an architect in carrying out his designs, whether through making their drawings or supervising construction. In short, the goal was not to train architects, but rather to train draftsmen or architectural assistants. Certainly, some of these students could continue their training and become leading architects themselves, but that was beyond the immediate scope of responsibility of MIT under Ware's scheme.

Ware most lucidly and famously articulated his idea for the MIT curriculum in a December 1865 speech to the MIT Society of Arts that integrated many of the ideas and phrases he had written to Runkle several months before.⁶ Ware's self-declared goal is monumental: he not only justifies the necessity of architects for safety, good taste, moral uplift, and patriotism, but also explains what types of knowledge and skill a qualified

⁵ Ware to Runkle, 27 April 1865, Ware Papers.

⁶ The speech was published early the following year in pamphlet form. See William Robert Ware, *An Outline of a Proposed Course of Architectural Instruction* (Boston, 1866).

architect must possess and, most importantly, how those qualifications might be imparted through a combination of formal instruction and practical experience. This was a unique experiment in the United States, where training in architecture was an uneven system of apprenticeship, often intermixed with skills of building and carpentry. Several Americans had studied architecture internationally at the École des Beaux-Arts in Paris, first and perhaps most notably Richard Morris Hunt. After returning to the United States, Hunt established an architecture academy modeled after an École atelier, where instruction focused on drafting and design, but it was neither comprehensive nor academic.

Ware had actually worked in Hunt's office beginning in 1859, and it was there that he was introduced to a version the École and its curriculum. When seeking models for establishing an American system of architectural education five years later, then, it is not surprising that Ware looked especially to the École des Beaux-Arts. Often overlooked by historians, it is essential to also note that Ware overtly examined to other models, too, such as the Government School of Design (now the Royal College of Art) in London and architectural training in Italian schools. Although not explicitly acknowledged his 1865 speech, the Bauakademie in Berlin and, more generally, the German tendency toward combining *Bildung* and *Wissenschaft* in university training, were also key models.⁷ Ware was acutely aware that none of these European systems could work in the United States, which had neither a comparable network of architectural professionals nor strong government support, among other issues. In devising a new program and curriculum, Ware recombined elements of all the educational systems he had observed in his own

⁷ Ware did make passing references to German and Italian models in his letter to Runkle. Ware to Runkle, 27 April 1865, Ware Papers.

training, professional experience, and European travel. The result, infused with the emphasis on quality technical training offered by the new MIT, was a novel roadmap for architectural education in the United States.

As Ware explained it, the founding purpose of the three branches of MIT—the School, the Museum (then not yet realized), and the Society of Arts (which Ware was addressing in his speech)—was “the application of Science to the Useful Arts . . . by means of Technology; that is to say, by the discovery, collection, and dissemination of technical knowledge.”⁸ Ware asserted that this type of education had been heretofore unavailable to architects in the United States. Apprenticeship, the only format of training that might be called architectural education in the first seventy-five years of United States, was “unsuited to the temper of the time,” according to Ware.⁹ The other path to practice—simply styling oneself “architect” after experience in carpentry and housebuilding—was exactly what Ware and the first generations of members of the AIA were arguing against, attempting to establish architecture as a legitimate, restricted profession with specific standards, modeled after the older professions of law and medicine.

One of the greatest disadvantages and shortcomings of American architectural practice, according to Ware, was the fragmented nature of the profession. Ware acknowledged that architecture is in many ways a social, collaborative profession, requiring close interface with builders and clients, but lamented the lack of a free-flowing exchange among the country’s disparate practicing architects. Contact among architects

⁸ Ware, *Outline*, 5.

⁹ Ware, *Outline*, 7.

would result in a socially strengthened professional network and facilitate the sharing of ideas and techniques that would improve the quality and efficiency of work and this the status and, perhaps most significantly, public perception of the architectural profession. The lack of systematization and cohesion was noted by many architects, but, in Ware's view, it was rarely acted on: "in the whole detail of building affairs, those who are the most experienced in them are the most ready to complain of the want of system, of recognized forms of procedure, of well-digested and approved methods."¹⁰ One related goal of establishing architectural teaching at MIT was to create a community of practicing professional as lecturers and instructors.

One man has a brief and neat way of getting out his quantities; another, for jumping at his sum-total; another has an admirable system in his specifications; another, a convenient trick in perspective, or in making working drawings. But, in most particulars, every one [sic] knows that there is room for improvement; and he would gladly go about and exchange ideas with his fellows, if time and opportunity offered. But time and opportunity do not offer. Architects are not, as we have seen, brought together in their work.¹¹

The goal of architectural instruction at MIT, then, was "not only to give to draughtsmen and students a sort of training they cannot easily find else where [sic], but it may act through them as a sort of professional exchange for builders and architects."¹² In other words, to create a network of professionals working together to refine and improve the knowledge encompassed by architecture.

¹⁰ Ware, *Outline*, 8.

¹¹ Ware, *Outline*, 8.

¹² Ware, *Outline*, 9.

Ware suggest a seemingly straightforward approach in his speech, stating that “all the School need do is to separate and classify the topics that occur in the practice of the art, and give them out, to the classes, as subjects of study and investigation.”¹³ The nineteenth-century tendency of dividing, classifying, and systematizing everything from beetle species to languages to geological strata was also apparent in the curricula of MIT’s original courses of study. Division and classification are deeply rooted even in the earliest ideas about MIT via its founder William Barton Rogers. The son of an Irish botanist, Rogers was previously professor of geology at the University of Virginia and led the state’s first systematic geographic survey. When Ware called for a curriculum to “separate and classify,” he was looking to the MIT model that had been applied to other areas like civil engineering, where the required knowledge and skills were divided and arranged into a sort of evolutionary development where a man with a solid background in algebra, geometry, drawing, and English could emerge with a greatly enriched and sufficient professional skillset.¹⁴ The very idea that a comprehensive architectural curriculum might exist is a nineteenth century flowering of rational enlightenment thought.

Despite the division of the skills of architectural practice into courses in an academic curriculum, Ware acknowledged that, of course, there were still certain lessons that would be best learned in an office. This does not, however, mean that the basics and

¹³ Ware, *Outline*, 9.

¹⁴ For more of Rogers and the founding of MIT, see A. J. Angulo, *William Barton Rogers and the Idea of MIT* (Johns Hopkins University Press, 2009); Julius A. Stratton and Loretta H. Mannix, *Mind and Hand: The Birth of MIT* (MIT Press, 2005); and Merritt Roe Smith, “‘God Speed the Institute’: The Foundational Years, 1861–1894,” in *Becoming MIT: Moments of Decision*, ed. David Kaiser (MIT Press, 2010).

theoretical foundations of specification writing, business relations, and the working out of construction drawings should not be a subject of formal coursework.

Such studies and researches would make the student more conversant with every variety of the practical and business affairs with which he is expected to be familiar, than he could probably otherwise become, except by a personal experience in each. [. . .]

A certain amount of experience is of course necessary, at last, to transform the student into the man of business: this he must obtain while serving as an assistant or draughtsman in an architect's or builder's office; and the more complete his previous theoretical knowledge of his subject, the more rapid will be his progress in this practical schooling. Enough experimental acquaintance with it to make these studies and researches intelligible and really instructive can be gained from the systematic study of buildings actually in progress, from laboratory manipulations, which should be made to embrace as great a variety of work as possible, and especially from the collections of illustrative drawings and models which must form an essential part of the equipment of the School.¹⁵

In architecture, various published books and guides existed by the 1860s on topics such as specification writing and ventilation technology, and notes on specifications and contracts regularly appeared in the published proceeding of the AIA, but no educational intuition had attempted to create a formalized system of instruction in these areas.¹⁶ As we will see, Ware and, especially, Francis Ward Chandler attempted to formally integrate the basics of this type of work—making working drawings, writing specifications, superintending construction, managing an office, and studying current works in progress—into the MIT curriculum. Graduates could get thousands of hours of practice in these areas working in an architect's office, but it was in school that they could first learn

¹⁵ Ware, *Outline*, 10.

¹⁶ See, for example American Institute of Architects, *Proceedings of the Annual Convention of the American Institute of Architects, Held at the Rooms of the New York Chapter, October 22nd and 23rd, 1867* (New York, 1867).

from select examples and understand overall principles. The curriculum presented the general outlines of this type of work in theory, but it also served a normalizing and indoctrinating function: the top-down control of drafting and superintendence was here the mental work of architecture, and the only legitimate way to design and build. The manual work is done by others, under the direction and administration of a rational, intellectually developed architect

Establishing a course of architectural study within an institute of technology that addresses practical, practice-based concerns furthered Ware's unsurprisingly self-conscious and profession-defining and -preserving agenda. Ware outright states that the domain of technical knowledge must be kept under the control of the architect, in contrast with contemporary tendencies and temptations.

It has of late been attempted to avoid the difficulties of either alternative, by giving buildings in charge of contractors, and employing architects merely as a superior sort of draughtsmen and clerks, to make out the drawings and papers they require. This system affords the employer a guarantee of value, and has obvious advantages over the old system; but it is very injurious to the future prospects of the profession, not only in that it discourages first-rate talent from entering it,—since, by subordinating the architect to the contractor, it diminishes the dignity and the emoluments of his calling,—but in cutting him off from a knowledge of practical details.¹⁷

The attention Ware gives to the business and practical, constructive dimensions of architecture is not merely a small component of his proposed curriculum. Instead, their inclusion is essential to the consolidation of knowledge and tightening of control under the architect imagined as an increasingly top-ranking managerial individual in the production of the built environment and of architecture as an increasingly bureaucratic

¹⁷ Ware, *Outline*, 12.

profession characterized by an ever-broadening authority. In addition to delimitation, Ware's concerns about social status and reputation are key elements of any professionalization process.¹⁸ To Ware and to others attempting to fashion a profession, the ideal situation would be to have the architect in control, above all others involved in the production of architecture in terms of knowledge, governance, expertise, and prestige.

By emphasizing the portion of Ware's tract that focuses on architecture as a "Useful Art" with day-to-day office work, I do not mean to suggest that he does not address other dimensions of the discipline. The second half of his *Outline* is dedicated to his views of architecture as a fine art, most akin to poetry, and he explains that practitioners must have a deep understanding of harmony, proportion, and design more broadly. In fact, this aspect of architectural education, as Ware lays it out, "would be the aesthetic training, and the useful should accompany it," rather than the other way around.¹⁹ But it still holds that his entire plan for architectural education and, more expansively, his entire hope for a nationally solidified and professionalized practice of architecture would fall apart without the inclusion of technical knowledge under the architect's conceptual purview and intellectual domain. To paraphrase John Chewing from his exhaustive dissertation on Ware's MIT years, the purpose of teaching architecture at the institute in its first decades was not to produce theorists or world-class designers, but rather to produce a flock of competent individuals with training that was

¹⁸ For classic examples of this point, see Samuel Haber, *The Quest for Authority and Honor in the American Professions, 1750–1900* (University of Chicago Press, 1991); and Magali Sarfatti Larson, *The Rise of Professionalism: A Sociological Analysis* (University of California Press, 1977).

¹⁹ Ware, *Outline*, 20.

both liberal and technical.²⁰ According to Ware, the two functions of graduates were to make construction drawings and, secondarily, to superintend work at construction sites. These two aspects of their role would serve to reinforce and circumscribe the administrative function of the architect—an individual who could direct most aspects of building while reserving most their time and talent for design. Or, as Ware put it, “his own proper work, . . . that elaboration and perfection of design which no one else can do for him.”²¹ Ware had no illusions that the MIT program would miraculously produce fully formed, perfectly competent professional architects. Incremental change in architectural culture was the more reasonable goal for Ware, not necessarily producing upon graduation the next generation of architects but rather producing a cadre of men who were prepared to gain the skills to eventually become his imagined version of an ideal American architectural professional. For Ware, the goal of all this instruction and preparation was to generate, in his words, “competent assistants and well-informed and trustworthy draughtsmen.”²² These assistants and draftsmen, coming out of a program that was both theoretical and technical, would have been primed to accept the assumption that the architect was in control of building.

Ware’s scheme was not universally praised, as evidence by a lengthy letter in the form of a satirical booklet from Charles D. Gambrill (Fig. 1.1).²³ Gambrill and Ware moved within the same small circle of American architects. Gambrill and Henry Van

²⁰ Chewning, “William Robert Ware, 1861–1881.” See also Chewning, “William Robert Ware at MIT and Columbia.”

²¹ Ware, *Outline*, 12.

²² Ware, *Outline*, 13.

²³ Charles D. Gambrill to William Robert Ware, 19 March 1866, Ware Papers, box 1, folder 2.

Brunt had both trained in the office of architect George Snell and went together to study in Richard Morris Hunt's New York atelier, where Ware also studied. Van Brunt left with Ware to form a partnership and Gambrill did the same with another Hunt student, George B. Post. In short, Gambrill writes, "So to my private opinion of your scheme I must say that I am altogether opposed to it, in my present mind."²⁴ He chastises Ware for ignoring the goals and accomplishments of the AIA in his MIT scheme, calling him out for not using the standard "AIA" after his name on the title page and not mentioning it in the body of his tract.²⁵ Gambrill reasons that, for Ware, discussing the AIA would be "too damaging an admission against your argument," which had similar aims of strengthening the profession nationally, by sought to achieve them by different means²⁶ Here he specifically takes issue with Ware's claim that architects are "never brought together in their work or have leisure to attend to activities of mutual improvement," which was a major goal in the founding of the AIA. The other main objective of the AIA was to standardize how architects got paid for their work and to theorize their work as necessary, expert, and unique. For Gambrill, Ware's focus on teaching new skills is misguided. Gambrill believes instead that "the main thing at present, moreover, is not for us to learn more, but to contrive methods to get paid for what we do know."²⁷ He even anticipated "an avalanche of indignant scorn in reply to these hints."²⁸ One of Gambrill's core

²⁴ Gambrill to Ware, 19 March 1866, Ware Papers.

²⁵ Gambrill acknowledged that Ware alludes to the AIA in his prefatory note, "which, of course, is never read." Gambrill to Ware, 19 March 1866, Ware Papers.

²⁶ Gambrill to Ware, 19 March 1866, Ware Papers.

²⁷ Gambrill to Ware, 19 March 1866, Ware Papers. Emphasis in the original.

²⁸ Gambrill to Ware, 19 March 1866, Ware Papers.

anxieties and complaints is revealed in his cutting remark to Ware: “Perhaps the end you seek of benefiting the profession would be best attained by turning the tables, so that the members of the Institute of Architects would become the assistants of your graduates.”²⁹ Gambrill’s writing reveals unease within the profession and suggests there was critical opposition to Ware’s pedagogical project. Although the inverse of Ware’s intent, Gambrill’s point reinforces rather than undermines the fact that Ware’s project was really about training a different class of architectural workers, not architects themselves. Ware’s work to educate individuals and impart new skills is seen as too open to Gambrill. Instead of putting the AIA and its members at risk, Gambrill suggests Ware turn his attention back to his earlier efforts to teach the public about the role of the architect: “Let your efforts rather be directed to the instruction of the masses in the mysteries of the craft.”³⁰

William Robert Ware’s Curriculum at MIT to 1888

Despite protestations from some AIA architects, Ware implemented his curriculum and led MIT’s architecture course until 1881, at which point he left to start the architecture program at Columbia University. Popular and scholarly interpretations of the founding ethos of the MIT architecture program tend to overemphasize the influence of the French *École des Beaux-Arts*, describing the American program in terms of its emphasis on rendered drawings and on non-technical, liberal, and humanistic training. Not only is this emphasis a misrepresentation of Ware’s plan, it is also based on a misunderstanding of the curriculum of the *École des Beaux-Arts*. Of course, Ware had

²⁹ Gambrill to Ware, 19 March 1866, Ware Papers.

³⁰ Gambrill to Ware, 19 March 1866, Ware Papers.

worked under Richard Morris Hunt and hired École-trained Eugène Létang to lead architectural design teaching at MIT, the first French instructor of architecture to work outside of Europe, and so certainly had strong connections to the École. It is my aim to reinsert into this discussion of MIT's curriculum the equally emphasized technical dimensions and, especially, courses and instruction that might be called professional training. That is, academic preparation in the basics of what a graduate might regularly encounter in their work in the office of an architect: writing specifications, making working drawings, superintending construction, understanding business law, negotiating contracts, and implementing other office processes and systems.

Ware's 1865 speech outlining an American architectural curriculum, although grounded in real concerns and serving as a model for the future development of architectural instruction at MIT, is idealist and aspirational. In order to better understand the balance, breadth, and depth of coursework in Ware's tenure and its role in forwarding professionalization, it is essential to look to the actual courses offered and taught. Although neatly laid out as a four-year course of study, it is important to note that early in MIT's history full, four-year attendance was uncommon. It was a goal of Ware's (and Rogers's) from the outset that MIT embrace a variety of enrollment models for a variety of students. Many architecture students had worked in the offices of local architects and enrolled at MIT for two years as special students, the most common path under Ware's tenure. Within architecture, it was even possible to test into the fourth year of the program and attain only one year of instruction.

The first published description of the architecture program under Ware echoes the statements from his 1865 speech with little variation:

The course will, however, be practical, as well as theoretical, and will embrace the scientific study of construction and of materials, in connection with the courses of Engineering above described, as well as that of composition and design, and of the history of the art. It will consist chiefly of a series of projects in construction and design, to be worked out by the student. These will be illustrated by lectures upon the theory and practice of the art, pertinent to the subjects in hand.³¹

Ware's general description of his wide and varied program is backed up by the stated required courses. The specific coursework required of fourth year architecture students enumerated in the follow year's course catalogue, for example, consisted of "Extended study of French and German" and "Mental and Moral Philosophy" as well as "Study of Structures of Stone, Wood, and Iron; Trusses, Arches, Girders, Roofs, and Bridges" and "Lectures on Warming, Ventilating, and Lighting."³² Although it may be tempting to divide courses into the "practical" or "theoretical" categories that Ware describes, this would be a misunderstanding of Ware's idea, in which all building knowledge was both practical and theoretical. In a correct interpretation of Ware's words, any given class—or, more accurately, every class—addresses both *why* something is a certain way and *how* it is done. I will return to the quagmire of this categorical elision when situating Chandler's *Construction Details* in its curricular context.

What about the day-to-day work of professional architectural practice? Or the "business" of the profession that Ware refers to and that is most relevant to a discussion about curricular profession formation within a larger consideration of nascent

³¹ Massachusetts Institute of Technology, *First Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1865–1866* (Boston, 1865), 23–24.

³² Massachusetts Institute of Technology, *Second Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1866–1867* (Boston, 1866), 22.

professionalization? This was mentioned in early descriptions of the curriculum but noted for its intentional absence rather than its inclusion. In the 1866–1867 course catalogue quoted above, Ware writes: “It will be the object of the course to furnish the instruction and discipline that cannot be obtained elsewhere, rather than to cover the whole ground of architectural study. Much of the ordinary detail of work must necessarily be left for students to acquire in architects’ offices.”³³ Ware’s position, then, reflected in the curriculum, is that certain skills are best obtained in post-graduate employment, but following his declaration that training must be “practical as well as theoretical,” the rudiments should at least be introduced during academic training. Ware’s entire project for setting up an academic system of architectural instruction in the United States is based on the claim that American architecture offices were not sufficient places to learn and train. Here, however, in the day-to-day operations of an office, Ware confirms that those same offices are the best venues in which to acquire these skills. Rather than undermining Ware’s project, this admission serves to secure acceptable territory for university architectural education. It is a clever political move, ensuring that established professionals—those who must necessarily buy in to the perceived value of a system of academic architectural education that they themselves are not a product of if it is to take hold as a standard—also remain key participants in the system. It also confirms yet again that Ware’s goal at MIT was to train men to work in offices under architects.

There are subtle changes year to year in the listing of required courses for architecture, but the differences are minimal refinements rather than revolutions. In the catalogue for the 1867–1868 academic year, we see a course on “Professional Practice”

³³ MIT, *Second Annual Catalogue, 1866-1867*, 22.

for fourth year students that covers topics such as “Specifications, Contracts, Estimating and Measuring, [and] Superintendence.”³⁴ This is the first explicit, course-based reference to this type of architectural work at MIT and in the United States. Other changes appear over the years, such as the addition of “Elements of Business Law” to the fourth year curriculum for the 1871–1872 academic year, or in the 1875–1876 academic year when “Specifications and Working Drawings” moved from one semester of the third year to both semesters of the fourth year.³⁵ “Contracts” was formally added to instruction on specifications in 1878–1879.³⁶

The end of Ware’s time at MIT was tense and complex. In preparing for his departure in 1881, he wrote of one of his recent curricular changes: “The tendency of this is to make the work of the department rather more practical and scientific, as is natural and proper in a school of applied science.”³⁷ At his departure, the “methods and apparatus of instruction” of the architecture department remained more or less unchanged from his first years at the Institute:

It is the object of this department to give to its students the instruction and discipline that cannot be obtained in architects’ offices. The course is, however, practical as well as theoretical, and, besides the scientific study of construction and materials, it comprises the study of building processes,

³⁴ Massachusetts Institute of Technology, *Third Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1867–1868* (Boston, 1867), 16.

³⁵ Massachusetts Institute of Technology, *Seventh Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, 1871–1872* (Boston, 1872), 27; and Massachusetts Institute of Technology, *Eleventh Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, 1875–1876* (Boston, 1875), 24.

³⁶ MIT, *Eleventh Annual Catalogue, 1878–1879*, 26.

³⁷ William Robert Ware to unknown correspondent at Massachusetts Institute of Technology, 10 September 1881, Ware Papers, box 1, folder 3.

and of professional practice and procedure, as well as that of composition and design, and of the history of the art.³⁸

This description was not immediately changed the following academic year when Ware was replaced by Theodore Minot Clark as head of architecture at MIT, but change would come soon. Clark was brought in not as a theoretician or reformer, but rather as an individual who could carry out the desires of administration and other faculty to do more than train draftsmen in the architecture program. Under Clark's leadership in the 1883–1884 year, the first line of the description quoted above was removed. Instead, later in the description of architectural instruction, we read: “It is so arranged as to meet the wants not only of young men who purpose to pursue a comprehensive course of architectural study, but of those who are looking only for such an elementary training as shall qualify them for positions as draughtsman.”³⁹ Unlike Ware's earlier descriptions, the first stated aim of the department is now broader architectural training. The training of draftsmen, although still explicitly part of the department's scope, is deemphasized and secondary. Rather than being the overarching organizing pedagogical principal from which all classes and curricular decisions (and sentences) follow, the place of office work and drafting training is shifted in relation to a fuller academic treatment of architecture. Unlike under Ware's scheme, the catalogue describes a department that foregrounds “comprehensive” study in architecture, rather than imparting select skills needed to work in an architectural office.

³⁸ Massachusetts Institute of Technology, *Sixteenth Annual Catalogue of the Officers and Students, with a statement of The Courses of Instruction, and a List of the Alumni, and of the Members of the Society of Arts, 1880–1881* (Boston, 1880), 49.

³⁹ Massachusetts Institute of Technology, *Nineteenth Annual Catalogue of the Officers and Students, with a statement of The Courses of Instruction, and a List of the Alumni, and of the Members of the Society of Arts, 1883–1884* (Boston, 1884), 53.

The post-Ware shift in emphasis away from the work of architectural assistance is also reflected and neatly summarized in the naming of the program itself. Ware's initial lecture and the pamphlet that resulted from it refer to the topic in its title as a "Course of Architectural Instruction." In the first printed Annual Catalogue of MIT that includes architectural instruction, though, the course is specifically listed as "Building and Architecture."⁴⁰ The selection of both words is intentional, not only making the academic training program attractive to the type of "practical men" who might attend a new Institute of Technology, but also to begin articulating curricularly that the two are related but distinct. The naming also better reflects Ware's broad aim of training the middle and bottom tiers of architectural workers, distinct from construction laborers, who would operate under the authority of an architect. The name of the course of study is only simplified to "Architecture" in the 1883–1884 academic year where it is part of a suite of courses that are described as being "of a distinctly professional character."⁴¹ The disappearance of "Building" in the name marks several events and trends. First, this is clearly part of the immediate post-Ware shift in architecture at MIT, the name change coming the same year as Theodore M. Clark's shifted program description quoted above. In addition to the changing desires of institute administration and faculty, it also suggests a sufficient subsumption of building under architecture, reflecting the slightly more solidified, though still shaky, status of the profession in the 1880s versus the 1860s. The change to "Architecture" alone also reflects a significant shift in training both at MIT and at other institutions. At MIT, there was a general expansion of the liberal curriculum for

⁴⁰ MIT, *Second Annual Catalogue, 1866–1867*, 10, 18, and 21–22.

⁴¹ MIT, *Nineteenth Annual Catalogue, 1883–1884*, 14.

all courses of study, and in general the emphasis shifted away from the training of skill-based practitioners and towards the formation of more well-rounded students via full, four-year programs in all disciplines. This is one of the complex reasons Ware chose to leave MIT, and he ultimately left Columbia in part because of institutional resistance to his plan to expand training to include night courses for draftsmen. Outside MIT, the market niche for schools in drafting and mechanical drawing were filled by emerging institutions. The curriculum at MIT, as a university, could therefore be more dedicated to liberal formation rather than mechanical skill. While the mechanical in architectural training was deemphasized almost to the point of total exclusion, *knowledge* of the mechanical was foregrounded. This technical awareness was essential to the version of architectural professionalization in which architects, as elite knowledge workers, direct the manual, mechanical work of a subordinate worker.

Despite the updated overall framing of the program of study, students still did receive training on the day-to-day work of architecture such as making working drawings, writing specifications, managing business relations, and writing contracts and understanding relevant laws. Overall, this overtly professional emphasis was unique to the Architecture program within MIT.⁴² A detailed analysis of course catalogues to 1915 finds no similar breadth of practice-focused classes in any other department. Other courses of study at MIT, such as Civil Engineering, certainly trained students who would become professionals, and students took classes in which they studied and practiced work like surveying, for example. More established than architecture, however, both

⁴² General classes in business law were offered for other departments. See MIT, *Second Annual Catalogue, 1866–1867*.

intraprofessionally and in terms of public perception of expertise, engineering training did not need to have the same emphasis on office work and professionalization. That the architecture curriculum did can be taken as a signal of several simultaneous things: that the architectural profession was not yet well- or clearly established; that the exact role of university instruction in architecture was not well-defined or universally accepted; that the architectural profession and university architectural training were acting in tandem to establish architectural authority and domains of knowledge; and, to that end, that Ware's project was ultimately missionary and proselytizing.

Francis Ward Chandler's Early Years at MIT

Ware's foundational role in MIT's architecture curriculum—a model for most architecture schools in the United States in his lifetime—and his later involvement at Columbia University are well documented and acknowledged.⁴³ Francis Ward Chandler's role, however, has received no serious attention despite his employment at the firm Ware and Van Brunt at the time of Ware's curricular development and despite his briefly held position as Ware's first assistant at MIT. After serving as an engineer for the Union Army in the Civil War, Chandler joined Ware and Van Brunt's office where he worked as a draftsman from 1864 to 1866. He was steeped in the pair's approach to atelier architectural instruction and their views on the nascent organization of American architectural practice at exactly the moment when Ware was working with Rogers and

⁴³ See, for example, Chewning, "William Robert Ware, 1861–1881"; Chewning, "William Robert Ware at MIT and Columbia"; Theodore K. Rohdenburg, *A History of the School of Architecture, Columbia University* (Columbia University Press, 1954); Richard Oliver, ed., *The Making of an Architect, 1881–1981: Columbia University in the City of New York* (Rizzoli, 1981); and Caroline Shillaber, *Massachusetts Institute of Technology School of Architecture and Planning 1861–1961: A Chronicle* (Massachusetts Institute of Technology, 1963).

Runkle to establish the architecture program at MIT. Probably encouraged by Ware, Chandler then studied in Paris from 1866 to 1868. Ware even visited Chandler in Paris in 1867, staying in the apartment Chandler was sharing with Robert Peabody.⁴⁴ Ware and Chandler also probably spent time with Rogers, who was in Paris that summer representing MIT at the Exposition Universelle. Upon his return, Chandler worked as Ware's assistant at MIT in 1869. Chandler was an active participant in Ware's thinking about architectural pedagogy and played an essential role in its early execution at MIT.

Chandler was recruited to lead the MIT Architecture Department in 1888. Chandler not only provided continuity from Ware, but he also brought valuable experience in architectural practice beyond that which Ware could offer. Chandler had established an architectural partnership with the older and more experienced Edward Clarke Cabot around 1874, and continued practicing with him until just before the start of his tenure at MIT in 1888, mainly designing houses in Boston's Back Bay and in wealthy suburbs like Beverly Farms and Newton alongside several larger projects outside the region such as at Johns Hopkins Hospital in Baltimore, Maryland, and at Doane College in Crete, Nebraska. Before that, from 1871 to 1874, Chandler had worked in the Office of the Supervising Architect of the Treasury where he learned skills of practice and administration that I will return to later in this chapter. Ware and Van Brunt had dissolved their partnership in 1881 when Ware moved to New York to establish the architecture program at Columbia. Between the late 1860s and then, though, Ware's attention was

⁴⁴ Francis W. Chandler to unknown correspondent, 3 November 1867, Chandler Family papers, box 1, folder 1, Massachusetts Historical Society (hereafter cited as Chandler Family papers). In the letter Chandler notes that he looks forward to Ware's departure so he and Peabody can finally settle into their apartment and purchase a piano, who their mutual friend and fellow École prospective student Charles McKim would be able to play for them.

mainly directed at administration and teaching at MIT as opposed to practice with Van Brunt. Chandler, therefore, had much more recent, varied, continuous, and up-to-date contact with the requirements of full-time architectural practice and office work. Furthermore, Chandler continued to design buildings and supervise or advise on construction in Boston through the early 1900s in projects such as the Pierce Building at MIT, the restoration of Faneuil Hall, and the Peter Bent Brigham Hospital campus. Chandler was a moderate candidate following Ware. He had his design bona fides, having studied in Paris and worked in various architecture offices, but also had a background in engineering and clearly understood the practical skills and knowledge that were necessary to teach aspiring members of an architectural profession.

Chandler suggested and oversaw generally gradual curricular change. Under Chandler, however, we do see a concerted focus on more explicitly developing the practice-related conceptual components of the curriculum. Chandler's 1889–1890 description of the architecture department, probably the first he had the opportunity to edit after joining MIT, changed the order of emphasis from the earlier descriptions under Ware and Clark: "The instruction in this subject comprises the scientific study of construction and materials, the study of building processes and of professional practice, as well as that of composition and design, and of the history of the art."⁴⁵ Courses in the first few categories were mostly taught by Chandler himself. In his first year of teaching, third year students were required to take a one-semester course on "Working Drawings" and fourth year students were required to take a one-semester course on "Specifications,"

⁴⁵ Massachusetts Institute of Technology, *Twenty-Fifth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a List of the Alumni, 1889–1890* (Cambridge, 1889), 81.

another on “Specifications and Contracts,” and two semesters of “Problems in Construction,” all taught by Chandler and totaling seventy-five hours of instruction.⁴⁶

Published descriptions of classes do not appear in MIT course catalogues until the 1903–1904 academic year, but Chandler occasionally made notes in preparation for classes, scattered throughout his memo books and diaries, that allow us to confirm the content of his classes. In a few cases, we have some sparse detail in the form of what appears to be a rough lesson plan.⁴⁷ One class in 1890 on “Specifications” begins with “A few hints about drawings” before moving into discussions of “Paints, etc.,” “Construction Spec.,” “Finishing Spec.,” and concluding with Chandler “At table” taking questions.⁴⁸ A class in “Construction” the same year starts with an overview of “How a Back Bay house is built,” followed by “Showing the various plans of a Back Bay house,” then reviewing “a framing plan of 1st story of house,” an hour of review, and finally “Draw on Board all details of framing” before ending “at table” for questions and consultation.⁴⁹ Chandler is clearly teaching the skills and presenting examples that would define the typical day-to-day work in the office of a professional architect in 1890.

⁴⁶ Massachusetts Institute of Technology, *Twenty-Fourth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, and a List of the Alumni, 1888–1889* (Boston, 1888), 29 and 100.

⁴⁷ First printed for the 1866–1867 academic year, course bulletins, referred to at length above, provide general descriptions of departments and courses of study and lay out the required classes for four-year degrees. Beginning in the 1883–1884 academic year, we see an appended tabulated “Schedule of Topics,” which gives a better sense of the actual classes thought and by whom.

⁴⁸ Francis W. Chandler Diary, 1890, Henry Daland Chandler papers, box 4, folder 7, Massachusetts Historical Society (hereafter cited as H. D. Chandler papers).

⁴⁹ Chandler Diary, 1890, H. D. Chandler papers.

Construction Details: Description and Origins

Chandler continued to make changes to the curriculum that emphasized practice-related topics. I will return to some of those specific developments later to summarize his wider pedagogical philosophy, but one publication in particular stands at a key indicator in the process: Chandler's own *Construction Details, Prepared for the Use of Students of the Mass. Institute of Technology, Boston*. A close reading of the development and impact of this one course-based instructional instrument produces a rich depiction of the content and aims of the curriculum under Chandler.

Construction Details is a portfolio of twenty-five large, 20-inch by 14-inch plates plus a preface sheet. The sheets were sold in a custom folio with brown board covers, a fabric tie at the open end, and a title plate affixed to the front (Fig. 1.2). Printed by the Heliotype Printing Company, one of Boston's preeminent publishers of art and architectural books and images, *Construction Details* was a higher-quality, larger-format production than the average reference book and, consequently, cost more. At a time when many architecture books on construction were available for two or three dollars, *Construction Details* sold for ten.⁵⁰

As the title suggests, the plates are mostly dedicated to the details of construction. Although many areas are addressed, the overall focus is on the intricacies of timber-frame buildings, especially windows and several other common elements like gutters and interior finishes. Plates 1 through 7 illustrate details of window frames in wooden buildings (see Fig. 1.3); plates 8 through 11 illustrate the same in brick buildings; plates

⁵⁰ For comparison, tuition for one year at MIT in 1892 was \$200. See Massachusetts Institute of Technology, *Twenty-Eighth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1892–1893* (Cambridge, 1892), 133.

12 and 13 illustrate details of gutters; plates 14 through 19 illustrate details of framing, including chimney flashing, iron hangers, and dormer construction (see Figs. 1.4 and 1.5); plates 21 through 23 illustrate details of interior finishing, with a focus on doors; plate 24 illustrates details of fireplaces and floor deafening; and plate 25 illustrates details of bulkheads.

The plates in *Construction Details* make use of color throughout to indicate materials: yellow and orange for wood; a range of grays and blues for metal, plaster, stone, and glass; and red and pink for brick. The drawings in the plates are primarily details in plan, section, and elevation, but carefully drawn isometric sectional illustrations are also used for clarity and emphasis. Some earlier publications such as Henry Laxton's *Examples of Building Construction* used cutaway isometric drawings to elucidate complicated arrangements of structural members (Fig. 1.6), but Chandler's use of isometric drawing was far more extensive and consistent.⁵¹ Drawings dominate the plates, but text in several forms appears throughout. Dimensions and scales appear on most drawings, labels indicate materials and identify structural members, and longer explanatory texts offer further details and advice in a conditional, advisory tone: "It would be better to specify studding . . ."; "It is always well to have the outside boarding . . ."; "Ridges had better be of 2" plank . . ."⁵² These notes are carefully composed and organized, taking advantage of the space between the illustrations without crowding

⁵¹ Henry Laxton, *Examples of Building Construction: Intended as an Aide-Memoire for the Professional Man and the Operative, Being a Series of Working Drawings to a Large Scale Exemplifying the Arrangement and Details Adopted in Carrying Out the Several Branches of Trade Requisite for Public and Private Edifices*, vols. 1–4 (London: 1857–1867).

⁵² Quotes from Francis Ward Chandler, *Construction Details, Prepared for the Use of Students of the Mass. Institute of Technology, Boston* (Boston, 1892), plates 5, 13, and 17.

them. It is reasonable to believe that Chandler drew the original plates for publication himself, although the lettered annotations may be in a different hand.

Chandler sought to bring to the profession what he thought it lacked and what he believed it needed: a modest compendium of more-or-less standard building details from roof to basement. His goal, stated most clearly in the portfolio's short prefatory note, was to bring into the orbit of the architect the elements of construction that in the past had been "very often left to the skill of the builder."⁵³ Chandler's understanding of architectural practice, then, saw the relocation of knowledge from the construction site to the drafting room, enabling the architect to administer the elements of construction that had historically been the domain of the builder, less delimited by credential and more reliant on applied experience.

Construction Details as a discrete publication resulted from lengthy preparation, complex negotiations, and years of consolidated experience. Tracing Chandler's trajectory in producing the publication reveals its connection to MIT's architecture curriculum and its role in professional architectural practice. Although following the circulation and reception of *Construction Details* will be important in understanding its impact and implications, "Construction Details" existed in a variety of forms well before it was officially published by the Heliotype Printing Company and entered for copyright in the week of May 9–14, 1892.⁵⁴ An earlier note to Chandler from William R. Cabot of the prominent Boston-based architecture firm Sturgis and Cabot notes, "I have been

⁵³ Chandler, *Construction Details*, n.p. (preface).

⁵⁴ *Catalogue of Title-Entries of Books and Other Articles Entered in the Office of the Librarian of Congress, at Washington, under the Copyright Law, from May 9 to May 14, 1892, inclusive* (Washington, 1892), 4.

searching high and low for a set of your plates on construction, for assistance in making full-size drawings. Will you please tell me where I can purchase them, as they seem to me one of the most desirable possessions an architect can have.”⁵⁵ The letter, dated September 25, 1891, comes a full ten months before *Construction Details* was officially published. This suggests that Chandler’s plates on the subject were known and perhaps even available in an informal or self-published form before 1892. Though preexisting, knowledge of the plates would have probably been limited to Chandler’s MIT students and close professional contacts. This firm’s Cabot was the son of Edward Clarke Cabot, Chandler’s former partner in Cabot and Chandler, so if a version of “Construction Details” existed before the 1892 publication, it is not surprising that the son of Chandler’s long-time architectural collaborator would have been aware of it.

The history of *Construction Details* extends not only months but years before its 1892 publication. On the pages for March 23 and 24 in his 1890 diary, Chandler wrote out a list of fourteen subjects, almost certainly titles for plates. The numbers and draft titles in the diary correspond directly to the numbers and titles of the first fourteen plates of *Construction Details* as published in 1892.⁵⁶ Though it is possible that Chandler had additional plates prepared or in mind in 1890, it is more likely that, originally, *Construction Details* was conceived of as set of only fourteen plates. In terms of subject matter, the first fourteen plates of the published *Construction Details* cohere as a group, focusing on window details in timber and masonry structures with a final, general plate

⁵⁵ William R. Cabot to Francis W. Chandler, 23 September 1891, Francis Ward Chandler correspondence, box 1, folder 1, Massachusetts Historical Society (hereafter cited as F. W. Chandler correspondence).

⁵⁶ Chandler Diary, 1890, H. D. Chandler papers.

on frame construction. Published plates 15 through 25 focus on a distinctly separate group of topics: floor construction details, door details, and details of interior finishes. Whether the contents were expanded due to pressures from the publisher or to Chandler's own expanding conception of the work and its role in architectural pedagogy, that the latter plates were a later addition is confirmed by Chandler's diary for November 2, 1891, where "Plates 15, 16, 18, 20, 21, 22, 23" appear as to-do items.⁵⁷ By April 1892, Chandler was sending out his final drawings for the plates and making his last revisions.⁵⁸

Even more significant than this evidence of a two-year preparation is additional correspondence which suggests an at least a twenty-three-year development in collaboration with Ware. A letter from Ware to Chandler dated May 23, 1892, confirms this: "This morning I found your letter awaiting me, & recognized this as the fulfillment of the dream of 'a quarter of a century.' This is I think the fifth incarnation of the idea which you first helped me to put into shape in 1869. They look very nice and ought to be welcome to the profession. I have had them all hung up at the school for the admiration and stimulation of my men."⁵⁹ Ware is, of course, referring to *Construction Details*, published just the week before. Several months later, in October, Ware continued his correspondence with Chandler on the plates: "I was looking yesterday at their originals,

⁵⁷ Francis W. Chandler Diary, 1891, H. D. Chandler papers, box 4, folder 8.

⁵⁸ On Wednesday, April 13, Chandler sent plates 1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 17, 19, 20, and 24. On Friday, April 15, he sent plates 6, 15, 16, 25, 22, and 23, and on Monday, April 18, he sent revisions for these same six plates. The last plates to be sent were 4, 18, and 21. See Francis W. Chandler Diary, 1892, H. D. Chandler papers, box 4, folder 9.

⁵⁹ William Robert Ware to Francis W. Chandler, 23 May 1892, F. W. Chandler correspondence, box 1, folder 2.

which we made more than 20 years ago, and at the intervening generations until they came again into your hands.”⁶⁰ These originals, assumed to be hand-drawn in the first few years of Ware’s MIT teaching, have not been located and probably do not survive. One rare publication by Ware, however, is a clear predecessor, and was almost certainly an iteration of the drawings he discusses in correspondence with Chandler. Ware’s *Examples of Building Construction*, published in four parts by L. Prang and Company in Boston in 1876, illustrated the standard construction of timber frame houses.⁶¹ About half of the forty-eight plates are dedicated to elevation, section, and plan drawings of model homes (Fig. 1.7). Some of the plates, however, include thorough drawings of details such as window sash construction (Fig. 1.8, compare to Fig. 1.3), and in several plates Ware employs schematic isometric views of construction (Fig. 1.9) that would later be further developed in Chandler’s *Construction Details*. Ware’s publication occupies a revealing middle point between pattern books and treatises like those by Asher Benjamin, Alexander Jackson Downing, and Samuel Sloane—all discussed later in this chapter—and Chandler’s later, more highly detailed *Construction Details*. Ware’s correspondence and his *Examples of Building Construction* confirm that Chandler did not develop *Construction Details* independently or from nothing and are significant in situating the publication in a longer arc of pedagogical and professional aims initiated by Ware and extended and adapted by Chandler.

⁶⁰ Ware to Chandler, 8 October 1892, F. W. Chandler correspondence.

⁶¹ William Robert Ware, *Examples of Building Construction, With Suggestions to Teachers and Pupils for Their Practical Use* (Boston, 1876). See also Katherine Pearl Dubbs, “‘A Great Civilizing Agent’: Architecture at MIT, Drawing Education, and Boston’s Cultural Elite, 1865–1881” (master’s thesis, Massachusetts Institute of Technology, 2021).

***Construction Details* at MIT**

Chandler's *Construction Details* was one of a number of publications made by MIT faculty and instructors for use in their classes, and its primary audience was MIT architecture students. Photographic evidence shows plates from *Construction Details* pinned up in situ in both lecture halls and drafting rooms, used as part of a suite of pedagogical techniques and apparatus. One photograph from the 1890s shows a room of the Architecture Department Library, located in MIT's Pierce Building (Fig. 1.10). Among the dozens of student drawings and photographs of ancient Greek architecture covering the walls, there are also at least nine plates from *Construction Details*.⁶² In another photograph from the 1890s, labeled "Plates and Models for Specifications & Working Drawings," we again see plates from *Construction Details* on display (Fig. 1.11). This time, all twenty-five plates are presented, and even the portfolio is placed on the floor. The plates, hung on strings with clips, are accompanied by a large framing model of a house on a nearby table. This photograph, depicting the plates with a contemporaneous caption, confirms that *Construction Details* was used specifically in teaching working drawings and specifications.

Another set of *Construction Details* plates can be seen hanging in a classroom in a photograph labeled "Office Practice Drawing Room" (Fig. 1.12). Only partly visible in the figure due to original overexposure and later fading of the print, the movable white

⁶² The four plates propped against the wall in the far corner are mounted to thick board. Part of a copy owned by Alexander Stoddard Jenney, they were property of the Architecture Department and survive in the collection of the MIT Museum (INV-700).

panels along the wall to the left display plates from the portfolio.⁶³ The plates are only one part of the classroom's instructional instruments. At the center of the back wall is a full-size model of portions of a timber frame building, showing parts of a window, wall, and roof. Just as Chandler's plates were meant to show the best examples of workmanship and design, these models demonstrated for students in full size, three dimensions, and accurate materials what these details should look like on a construction site. To similar ends, on either side of the mockup are glass cabinets containing samples of metal and terra cotta pipes, decorative plaster or marble details, and door and window hardware. Above the cabinets are full-sized samples of sliding pocket door mechanisms exactly like those illustrated in plate 22 of *Construction Details*. The goal of the training in this "Office Practice" drafting room was to produce architects and draftsmen who could specify and draw at an office and then go to the site to check the work, making sure their instructions were being carried out properly. Chandler's goal was similar to Ware's initial aim at MIT to train draftsmen who could work under the direction and control of an architect, although under Chandler's leadership this was only one dimension of a much more well-rounded non-manual curriculum.

Construction Details: Advertising, Circulation, and Reception

Although the immediate audience for *Construction Details* was Chandler's MIT students, his turning over of its production to an internationally known publisher and its extensive advertising in the most widely read architecture periodicals betray aspirations

⁶³ There are more plates visible in a much later print from the same negative. See MIT Museum GCP-00040557.

of a much wider audience. Although advertisements are meant for promotion to prompt sales and cannot be used to reveal use, they can still be read to glean something of the aims of the publisher, the author, or both. The first advertisement for *Construction Details*, a half-page, illustrated notice appearing in *American Architect and Building News* in May 1892, proclaimed that the “Twenty-five Folio Plates, showing in full, explicit and figured detail the best methods of every-day construction in American practice” were “For Students, Mechanics, [and] Practitioners. For One as Much as for the Other” (Fig. 1.13).⁶⁴ That students and practitioners are included on the list of audiences for a publication on the “best methods” in current practice is not surprising. The inclusion of “Mechanics,” or the carpenters, builders, and other workers who might do the manual work of construction, might seem less obvious. One could explain this away as a publishing company looking to increase sales by advertising a work to an expanded market, but educating the mechanic was an important obverse to Chandler’s scheme of professionalization. As Chandler would know, any arrangement that consolidated power and control still required something, in the range from complicity to indifference, on the part of the actors being controlled. Chandler’s knowledge of the “best methods of every-day construction in American practice” would have come in part from his experience on construction sites, observing and working with skilled builders.

Following this first advertisement and its initial release in 1892, *Construction Details* was available for purchase new for at least ten years and continued to be

⁶⁴ [Untitled advertisement], *American Architect and Building News* 36, no. 856 (21 May 1892): n.p. The same advertisement ran in issue nos. 857 (18 May 1892), 858 (4 June 1892), and 862 (2 July 1892). The illustrated advertisement clipping (Fig. 1.13) was retained by Chandler in his personal archive. See F. W. Chandler correspondence, box 1, folder 5.

advertised regularly in the professional press.⁶⁵ It was frequently noted alongside other titles that were focused on the intricacies and practicalities of professional practice, such as Frank E. Kidder's *Building Construction and Superintendence* (1896) and W. Frank Bower's *Specifications* (1896).⁶⁶ If we are to believe the language of these advertisements, by 1894 *Construction Details* was called "The best standard work on architectural instruction."⁶⁷ It was even used as an enticement to lure potential subscribers to *American Architect and Building News*, which offered a special combined discount price for a one-year subscription to the periodical along with a copy of *Construction Details*. Chandler's folio, "showing the best methods of American practice," they assured readers, "is just the work that every young practitioner, at least, should have in his office."⁶⁸

The most lavish advertisement for *Construction Details* appeared in multiple issues of the short-lived *Brochure Series of Architectural Illustration*, published by Bates and Guild, publishers of *The Architectural Review*. The two-page spread featured a reduce-size illustration from plate 2 of *Construction Details* on the left page and detailed text on the right (Figs. 1.14a and 1.14b). As in earlier advertisements, the broad audience,

⁶⁵ The latest advertisement for *Construction Details* is from December 1904, more than 12 years after its initial publication. See [Untitled advertisement], *Architectural Review* 11, no. 12 (December 1904): front cover.

⁶⁶ For example, see "Some Books Worth Having" [advertisement], *Architectural Review* 4, no. 8 (August 1897): ii.

⁶⁷ [Untitled advertisement], *American Architect and Building News* 46, no. 980 (6 October 1894): vi. The same advertisement appeared in issue no. 984 (3 November 1894).

⁶⁸ "Fair Offers of 1895" [advertisement], *American Architect and Building News* 46, no. 985 (10 November 1894): v. This advertisement also appeared in issue nos. 986 (17 November 1894) and 988 (1 December 1894). A similar combined advertisement for *American Architect* and *Construction Details* appeared in *Home Study Magazine* 2, no. 9 (October 1897): vi.

ranging from students to professionals, was appealed to, stating that the publication was appropriate “For Office Reference and the Use of Draughtsmen and Students.” It continued: “This most important work is the only collection of plates of its kind devoted to American methods of building construction, showing the best modern usages . . . on which are printed in color the different details of house building that enter into the everyday routine of an architect’s office.”⁶⁹ The earlier versions of the plates were meant for Chandler’s (and Ware’s) MIT students, who would have used them in the classroom, but purchasing the published portfolio could also be an investment: the graduates could take these portfolios to the offices they went to work in, ensuring that *Construction Details* was not only used by former students in their own drafting and specifying, but also that they would introduced to those already in the office who had not studied at MIT. This advertisement, with the goal of soliciting purchases from an interested audience, skips the MIT step and encourages direct use in the routine of architectural office work.

It is not possible to determine how many copies of *Construction Details* were printed, though Chandler was paid royalties through at least 1899.⁷⁰ The appearance of *Construction Details* in numerous contemporaneous library catalogues and inclusion in the curricula of schools beyond MIT do suggest a wide circulation. Public libraries in Boston and Pittsburgh note copies of *Construction Details* in their collections, and university libraries at Brown University, the Technical University of Munich, Rhode Island School of Design, Pratt Institute, and Cooper Union name *Construction Details*

⁶⁹ [Untitled advertisement], *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895): n.p. The same two-page advertisement appeared in vol. 2, no. 4 (April 1896). A full-page, unillustrated advertisement with essentially the same text ran in vol. 4, no. 11 (November 1898).

⁷⁰ Francis W. Chandler Diary, 1899, H. D. Chandler papers, box 4, folder 18.

among their holdings.⁷¹ Ownership was not limited to public libraries in major cities or large universities and technical institutes. Smaller cities around Massachusetts, such as Brockton and Somerville, for example, had copies of *Construction Details* in their collections.⁷² For the library in Wilkes-Barre, Pennsylvania, *Construction Details* was singled out as one of two “most valuable additions” out of over one hundred volumes added to the “Department of Useful Arts.”⁷³ Private ownership beyond MIT students and graduates is difficult to reconstruct, but one copy was owned by Daniel Smiley (1855–1930). Working in upstate New York and responsible for part of the design of Mohonk Mountain House, started by his older half-brother Albert, Smiley had no known connection to Chandler or MIT, but he certainly owned a personal copy of *Construction Details* in which he inscribed his name.⁷⁴

More than simply being added to library collections, *Construction Details* made its way onto recommended reading lists and into the curricula of other universities beyond MIT. It became a standard reference work and recommended reading in a variety of contexts. In a series of articles in *The Brickbuilder* on “Standard Architectural Books,”

⁷¹ *Catalogue of the Books Relating to Architecture Construction and Decoration in the Public Library of the City of Boston*, Subject Catalogue no. 10 (Boston, 1894), 102; “List of Additions to the Library, January 1st to March 1st, 1901, Arranged by Class,” *Monthly Bulletin of the Carnegie Library of Pittsburgh* 6, nos. 1–3 (January–March 1901): 39; “Brown University Library,” *Cooperative Bulletin of the Providence Libraries* 3, no. 4 (April 1902): 9; *Bericht über die Königliche Technische Hochschule zu München für das Studienjahr 1904–1905* (F. Straub, 1906), 69; “Gifts to the School and the Library,” *Catalogue of the Rhode Island School of Design, Twenty-Fifth Year, 1902–1903* (Providence, 1902), 40; “Accessions for May,” *Co-operative Bulletin, Pratt Free Library* 3, no. 9 (June 1904): 182A; and Cooper Union for the Advancement of Science and Art, *Forty-Eighth Annual Report* (De Vinne Press, 1907), 31.

⁷² “List of Newly Added Books,” *Brockton Public Library Quarterly Bulletin* 13, no. 2 (April–June 1911): 22; and “List of New Books,” *Library Bulletin, Somerville Public Library* 6, no. 2 (January 1903): 21.

⁷³ “Seventh Annual Report of the Librarian of the Osterhout Free Library,” *Library News-Letter, Osterhout Free Library* 6, no. 2 (May 1896): 10.

⁷⁴ This copy is in a private collection.

Construction Details was listed as one of the thirteen essential titles in the construction category: “This book gives in large scale plates all details of common building; framing, trim, bonds, etc., which are too often left to the mechanics employed. The measurements are given carefully, and the various materials presented in different colors.”⁷⁵ In Francis C. Moore’s 1897 *How to Build a Home*, Chandler’s *Construction Details* is listed among several recommended titles on “the best methods of construction” in the book’s preface, and singled out among the others as “worthy of careful study.”⁷⁶ The Council of Supervisors of the Manual Arts, organized in 1901, named *Construction Details* among three books on drawing in a recommended bibliography for their members.⁷⁷

In the decade after its publication, *Construction Details* appeared as a course textbook, often required, at multiple institutions. At the Rose Polytechnic Institute in Terra Haute, Indiana, *Construction Details* was a required textbook to accompany the second-year courses in “Details of Construction in Wood” and “Details of Construction in Masonry.”⁷⁸ Similarly, *Construction Details* was a recommended reference book for

⁷⁵ “Standard Architectural Books—VII,” *Brickbuilder* 18, no. 10 (October 1909): 214.

⁷⁶ Francis C. Moore, *How to Build A Home, Being Suggestions as to Safety from Fire, Safety to Health, Comfort, Convenience, Durability and Economy* (New York, 1897), n.p.

⁷⁷ Elizabeth H. Perry, “A Working Library for the Supervisor of the Manual Arts,” *Year Book of the Council of Supervisors of the Manual Arts*, Second Annual Meeting, New York, 5–6 December 1902 (Gilbert G. Davis, 1902), 84.

⁷⁸ Rose Polytechnic Institute, *Nineteenth Annual Catalogue of the Rose Polytechnic Institute, Terre Haute, Ind.* (Rose Polytechnic Institute, 1901), 81 and 83. The courses appeared in the curriculum through at least 1910, and Chandler’s *Construction Details* is still listed among the institute’s required textbooks. See Rose Polytechnic Institute, *Twenty-Fifth Annual Catalogue of the Rose Polytechnic Institute, Terre Haute, Ind.* (Rose Polytechnic Institute, 1910), 99.

second year students at McGill University in a required two-semester course sequence on carpentry, masonry, brickwork, joinery, and details of doors and windows.⁷⁹

If advertising allows for a glimpse into the aspirational utility of *Construction Details*, and library catalogues and course bulletins can convey where it was available, reviews can begin to reveal something of its actual reception and use. The most thorough review of *Construction Details* appeared in *American Architect and Building News* in June 1892.⁸⁰ Though unsigned, it is almost certainly by the journal's long-time editor William Rotch Ware, nephew of William Robert Ware and former architecture student at MIT and the École des Beaux-Arts. The tone of the review is positive, and the reviewer clearly agrees that these plates are extremely useful, necessary, and entirely unprecedented. Portions of the review warrant quotation at length:

When a student or a new draughtsman is set to making detail drawings, he has either to hunt through the office drawers for some similar detail he can follow, or pester those about him with questions as to what is the usual thickness of a sash, whether the rebate in a door-frame is 3/8" or 1/2" whether the outer casing of a window frame butts against or laps over the outer boarding, and so on; but, with these admirable plates to turn to, he can work out his own drawing with satisfaction to himself and to those about him. [. . .]

It is extraordinary, the number and kind of every-day practical matters a student fresh from school finds he does not know when he begins to do office-work. It is not a little humiliating for a youth who has been designing 'casinos,' 'picture-galleries' and 'little museums' to find that he doesn't know whether the putty should be indicated on the inside or the out of a sash, and finds the head of the office pointing out that his detail won't fit, because he has not allowed for the thickness of the

⁷⁹ McGill University, *Annual Calendar of McGill College and University, Montreal, Session 1904–1905* (McGill University, 1904), 167.

⁸⁰ Review of *Construction Details*, by Francis Ward Chandler, *American Architect and Building News* 36, no. 858 (4 June 1892): 153. Chandler retained a clipping of this review. F. W. Chandler correspondence, box 1, folder 3.

stripping for the ceiling laths, since he had always supposed the laths were nailed to the joists direct. [. . .]

To be sure, they deal largely with the commonplaces of every-day practice, but draughtsmen are fallible and peripatetic as well, and who knows what evil practices may be imported unannounced into his drawings by some one who has been working last for a careless or ignorant employer? A collection such as this, to which a new-comer can be referred, would form a desirable safeguard for every office library to contain.⁸¹

Interestingly, what is taken for granted from the start of the review is that these types of detail drawings are produced in an architect's office and not "left to the skill of the builder." This was certainly not the case in the majority of American construction, especially in wood, but to consolidate that type of work within the domain of an architect and his office was part of a mutual hegemonic mission. Ware's *American Architect and Building News*, for which he served as editor from 1880 to 1908, played a large role in the creation of a self-identified American architectural profession.⁸² Chandler's *Construction Details* worked towards establishing a profession of control that both MIT and the *American Architect and Building News* sought to promote. The reviewer's claim that young architects leaving school know very little of the practical day-to-day work of architectural offices was exactly Chandler's motivation in formally publishing the work. Furthermore, the review panders to an older crowd that did not train in any of the American architecture schools, all of which had been founded within the previous few decades and which had fairly low enrollment, by critiquing the young architects coming out of these programs. Ultimately, concerns about control are revealed throughout the

⁸¹ Review of *Construction Details*, *American Architect and Building News*, 153.

⁸² For this argument, see Mary N. Woods, "The First American Architectural Journals: The Profession's Voice," *Journal of the Society of Architectural Historians* 48, no. 2 (June 1989): 117–138.

review: control of design, control of drawing production, control of construction, and control over the work carried out in the architecture office.

In the plates themselves, the review finds some fault with Chandler's standard details, specifically their likely real-world performance in the prevention of water infiltration and fire. The reviewer is particularly critical of the fact that the plates do not refer at all to advances in slow-burning construction. *Construction Details*, the reviewer notes, instead focuses on "the ordinary methods of cellular building" likely because it is common "in country places everywhere, simply because its methods are generally understood, because the merchant sizes of materials are adapted to it, and because circumstances make it a cheaper method to use than one that is absolutely better and safer."⁸³ Chandler, of course, was familiar with advances in slow-burning construction, jotting notes about Charles J. H. Woodbury's *Fire Protection of Mills* in his 1888 diary, employing slow burning construction details such as a lack of furrings and an isolated fire stair in his 1889 design for MIT's new architecture and engineering building, and writing on the importance of slow-burning construction and fireproofing in the design and construction of schools.⁸⁴ Chandler's depiction of the older method of timber building in *Construction Details* does not reveal ignorance, but instead indicates his aim for the rapid and widespread adoption of the publication and, more importantly, its associated

⁸³ Review of *Construction Details*, *American Architect and Building News*, 153.

⁸⁴ F. W. Chandler Diary, 1888, H. D. Chandler papers, box 4, folder 5; Charles J. H. Woodbury, *Fire Protection of Mills and Construction of Mill Floors: Containing Tests of Full Size Wood Mill Columns* (New York, 1882); Francis W. Chandler et al., "The Engineering Building," *Abstract of the Proceedings of the Society of Arts, Massachusetts Institute of Technology* 28, meeting 404 (1889–1890): 129–155; Francis W. Chandler, "Schoolhouse Planning and Construction," in *Municipal Architecture in Boston, From Designs by Edmund M. Wheelwright, City Architect, 1891 to 1895*, ed. F. W. Chandler (Boston, 1898), 22.

implications for professional consolidation. A more traditional, more familiar, more standard method of building would pose a lower barrier of adoption by both the draftsmen drawing details and the workers and mechanics constructing them on a building site.

Another unsigned review from 1892, this time in *The Nation*, praises *Construction Details* for presenting information with “greater minuteness and completeness” than similar attempts that had come before. The review paraphrases and expands on the points in Chandler’s preface:

The general methods of building construction that are in use are not difficult to learn or to teach; but their details are multitudinous, and are in practice acquired, but slowly and tediously in the routine of office work, and often slighted in courses of instruction, in which, naturally, the chief attention is reserved for the more difficult branches of an architect’s training. It follows that a good many students get into practice without learning them thoroughly, and even, we suspect, a good many architects get to the end of it without finding out such small matters as how the furrings are set for lathing into the corners of a frame house, or how the nailing of the ends of floor-boards is provided for, or a window-sill is made wind tight and water-tight.⁸⁵

The reviewer easily identifies and aligns with Chandler’s aims for *Construction Details*. That these details are often passed over in academic training is acknowledged, and the utility of these plates to students and recent graduated as well as more experienced draftsmen and architects is noted. The review implies that responsibility for this knowledge, and for drawing the associated details, lies with the architect.

At least one letter confirms that *Construction Details* was used in architecture offices as Chandler expected. Boston-based architect and so-called father of the stick

⁸⁵ Review of *Construction Details*, by Francis Ward Chandler, *The Nation* 55, no. 1412 (21 July 1892): 57–58. Chandler retained a copy of this review. See F. W. Chandler correspondence, box 1, folder 5.

style John A. Fox wrote to Chandler about *Construction Details*, asserting that “It will be a great help in office routine, as there is nothing of the kind that so well sets forth the best American practice. The old forget small matters of detail and the young have them to learn so such a treatise helps at both ends of the line and saves much talk and time.”⁸⁶ The letter, coincidentally written on the same day that the lengthy review was published in *American Architect and Building News*, repeats some of the same concerns. “I hope you may continue the scheme to cover all ordinary details. It is handy to have the plates separate for some uses, but on the whole I think a bound and cloth backed edition would serve office wear and tear best. I should be glad to pay extra for such an edition.”⁸⁷

Fox was not the only reader with questions about the unusual format of *Construction Details*. In another letter to Chandler, a seemingly confused Ludwig Frank, head drawing teacher at the Manual Training High School in Providence, Rhode Island, wrote: “Have you a text book on Construction Details to go with your plates of that name?”⁸⁸ Frank’s question is logical given his appointment and reveals some of the quirks of *Construction Details*. The loose plates made for easy reference in a university classroom or in an office drafting room, but this format posed challenges for high schools. Furthermore, the text of the plates is patchy, only providing partial explanations of select details and would necessarily require further explanation by a more experienced draftsman or architect, as noted in the *American Architect and Building News* review and elsewhere. *Construction Details* was not suited to self-study or to technical high school

⁸⁶ John A. Fox to Francis W. Chanler, 4 June 1892, F. W. Chandler correspondence, box 1, folder 3.

⁸⁷ Fox to Chandler, 4 June 1892, F. W. Chandler correspondence.

⁸⁸ Ludwig Frank to Francis W. Chandler, 7 October 1892, F. W. Chandler correspondence, box 1, folder 4.

training and in that way was possibly intentionally exclusionary. It in neither introductory nor comprehensive but was rather meant for a class of experts and workers—architects and draftsmen—who already had a sufficient and common baseline training.

Circulation beyond *Construction Details*

Construction Details, in addition to remaining available in print for over a decade, was clearly used at MIT beyond the end of Chandler's tenure. One bound copy, now in the Rotch Library Limited Access Collection at MIT, was given by Chandler in 1903 and checked out regularly by students well into the nineteen-teens. Other copies have been donated to the MIT Libraries and MIT Museum by alumni of the architecture program who used the publication during their time at the institute and held onto it for their entire career or lifetime.⁸⁹ The latest of these belonged to a member of the class of 1907, suggesting that the published version of *Construction Details* was in use as part of the architecture curriculum at MIT at least until then.⁹⁰

An interesting copy of *Construction Details*, owned by architect Israel P. Lord, is also preserved in the collection of the MIT Museum.⁹¹ Lord probably first encountered the publication during his years as a special student in the Department of Architecture at MIT from 1902 to 1904, when it was a standard part of the curriculum and Chandler was

⁸⁹ There are five copies of *Construction Details* at MIT's Distinctive Collections: three in the Rotch Library Limited Access Collection and two in the Institute Archives Reference Collection. There are three complete copies and one partial copy at the MIT Museum.

⁹⁰ Chandler, *Construction Details*, MIT Museum, 1979.028.067, Maude Parlin Collection, gift of Mrs. Charles Davenport.

⁹¹ Plates from Chandler, *Construction Details*, MIT Museum, 2016.002.449–.473, Israel Pierre Lord Collection, gift of Mary Ann Howkins.

head of the department. After two years as the 1908 Rotch Travelling Scholar, Lord returned to Boston to work at the offices of Codman and Despradelle and teach at MIT, where he likely encountered *Construction Details* again in regular use. The copy in Lord's archive is made up of blueprinted reproductions of every plate of the folio. The importance of the coloring of the various materials to the legibility of the work is confirmed by the time-consuming hand-coloring on all of the reproduced plates (Fig. 1.15, compare to Fig. 1.5). The exact date of the blueprinted copies—and therefore whether Lord acquired these as a draftsman before starting at MIT, as a special student, as an instructor, or in another capacity—is not known, but their existence speaks to the desirability and usefulness of the publication either beyond its published lifespan or for less than the ten-dollar price (or both).

Illustrations from *Construction Details* circulated even more widely through the inclusion of plates and portions of plates, credited or not, in other publications. Charles L. Adams, longtime professor of drawing and descriptive geometry at MIT, reproduced plate 18 from *Construction Details* in multiple editions of his popular textbook on mechanical drawing (Fig. 1.16, compare to Fig. 1.4).⁹² For a reason likely unintended by Chandler, the plate depicting timber-frame construction was included not for its value as a description of architectural construction detail, but rather as a clear and legible example of isometric drawing.

The most significant dissemination of the content of Chandler's *Construction Details* occurred via an entirely separate publication. Frank E. Kidder's *Building*

⁹² Charles L. Adams, *Mechanical Drawing: Technique and Working Methods for Technical Students* (George H. Ellis, 1905), 163. The same illustration appears through the final, 6th (1913) edition.

Construction and Superintendence served as a key guide for a generation of architects and was undoubtedly more comprehensive and more widely circulated than Chandler's *Construction Details*. Kidder, in this multivolume work that appeared in several revised editions, aimed to show "the most approved methods of doing the various kinds of work" in masonry (volume 1), carpentry (volume 2), and roof trusses (volume 3).⁹³ Kidder's impetus for compiling and publishing such a work was similar to that of Chandler's in publishing *Construction Details*: "That there is demand for such a work has been evidenced to the author by numerous inquiries from Architects and instructors in our architectural schools, and also by the fact that exists no similar work describing American methods and materials."⁹⁴ Similar, too, were Kidder's intended audiences; his primary focus was on students of architecture and architectural instruction, but he also envisioned use by draftsmen, designers, and architects of all levels of experience.⁹⁵

Kidder drew upon his experience in architectural practice across the United States and acknowledged that "much assistance has been obtained from prominent Architects" and from their "various books and publications."⁹⁶ Though text dominates the volumes, Kidder inserts over one thousand illustrations, mostly excerpted and redrawn from earlier sources, including Chandler's *Construction Details*. Reflecting the focus of Chandler's

⁹³ Frank E. Kidder, *Building Construction and Superintendence, Part 1, Mason's Work* (New York, 1896); Frank E. Kidder, *Building Construction and Superintendence, Part 2, Carpenters' Work* (New York, 1898); Frank E. Kidder, *Building Construction and Superintendence, Part 3, Trussed Rooves and Roof Trusses* (William T. Comstock, 1906).

⁹⁴ Kidder, *Building Construction and Superintendence, Part 1, Mason's Work*, 2nd ed. (New York, 1897), n.p. (preface).

⁹⁵ Kidder, *Building Construction, Part 1* (1897), n.p. (preface).

⁹⁶ Kidder, *Building Construction, Part 1* (1897), n.p. (preface).

original publication, Kidder's reuse of Chandler's drawings can be found exclusively in the volume on carpentry. Kidder repurposed Chandler's illustrations on topics ranging from chimney flashing and gutters to cellar bulkheads, but most of the reproduced illustrations are those for details of wood framing, window construction, and interior finishes (Figs. 1.17 and 1.18, compare to Figs. 1.5 and 1.4). Eventually, by the ninth edition (1918), rewritten and enlarged by Thomas Nolan, a professor of architectural construction at the University of Pennsylvania, Chandler is directly credited for some illustrations.⁹⁷ Regardless of whether he was credited or whether the source was known to the reader, inclusion in Kidder's book ensured a much wider audience and broader dissemination than the original Heliotype Printing Company's plates could have afforded. By the 1906 edition of the second volume, six thousand copies had been printed, and by the 1911 printing of the first volume, the number of copies printed in the series was more than ten thousand.⁹⁸ Chandler's reactions to or opinions about this reuse are not known, but if Chandler's objectives in publishing *Construction Details* included disseminating both the specific methods of detailing and the general idea that this knowledge belonged in the domain of the architect, inclusion in Kidder's successful and widely used book cemented this aspiration.

⁹⁷ Kidder, *Building Construction and Superintendence, Part 2, Carpenters' Work*, 9th ed., ed. Thomas Nolan (William T. Comstock, 1918), 180n.

⁹⁸ See Frank E. Kidder, *Building Construction and Superintendence, Part 2, Carpenters' [sic] Work*, 6th ed. (William T. Comstock, 1906); and Frank E. Kidder, *Building Construction and Superintendence, Part 1, Mason's Work*, 9th ed., ed. Thomas Nolan (William T. Comstock, 1911). Chandler's illustrations appeared in the 1898, 1899, 1900, 1902, 1905, 1906, 1911, 1913, 1918, 1920, and 1926 printings and editions of the carpentry volume of *Building Construction and Superintendence*.

Precedents and Alternative Models

The adaptation, reproduction, and dissemination of Chandler's drawings via Kidder's book is evidence that, of the many choices of illustrated publications of construction details, Chandler's was one of the most legible and among the closest to contemporary ideals of construction practice. The accuracy and legibility of the drawings result from the specific emblematic zone they occupy, hovering between specific example and abstracted diagram. Later authors, most notably Charles Ramsey and Harold Sleeper in *Architectural Graphic Standards* (1932), would rise to prominence due to this very same sort of moderate abstraction. *Construction Details* was unlike most other architecture detail books, and it is worth looking at several examples to illustrate the point.

Some architectural details published before the end of the nineteenth century were specific buildings. Meant to serve as exemplars of work, the specificity of the designs as published was not seen as shortcoming but rather a benefit of the genre. More commonly, though, in pattern books or general treatises, the intricacies of construction were omitted, or at most treated schematically.⁹⁹ This lack of specificity is found in treatises and pattern books published in the United States, especially before the Civil War.¹⁰⁰ In Asher Benjamin's *The Architect, or Practical House Carpenter*, for example, some specific

⁹⁹ For an early example, see the plates on timber framing in Pierre Le Muet, *Manière de bien bastir pour toutes sortes de personnes* (Paris, 1681). For more on the conceptual history of the detail from a variety of disciplinary lenses, especially in the European context, see Eric Bellin, *Detailing Worlds: A Conceptual History of Architectural Detail* (Bloomsbury Visual Arts, 2025).

¹⁰⁰ For more on this context, see Dell Upton, "Pattern Books and Professionalism: Aspects of the Transformation of Domestic Architecture in America, 1800–1860," *Winterthur Portfolio* 19, no. 2/3 (Summer/Autumn 1984): 107–150. See also Michael Osman, "Specifying: The Generality of Clerical Labor," in *Design Technics: Archaeologies of Architectural Practice*, ed. Zeynep Çelik Alexander and John May (University of Minnesota Press, 2020).

information is given—such as the recommended rise and run of stair treads, or the loadbearing capacity of the various limited building materials then available—but the remainder of the details were left to the experience of the carpenter or builder, to be determined on site.¹⁰¹ Andrew Jackson Downing’s *Cottage Residences* (1842) and later, similar books were written with picturesque, late-Enlightenment goals in mind with the ultimate aim of improving taste and elevating beauty. Although Downing gives specific recommendations for materials and workmanship throughout the book, his preoccupation is with general arrangement, fitness, and effect and his explicitly stated goal is “to inspire all persons with a love of beautiful forms and a desire to assemble them around their daily walks of life,” rather than to produce an instruction manual or compendium of details.¹⁰² In an interesting addendum on building contracts and specifications, Downing presents, perhaps unknowingly, an inherent tension in American building practice: “it is highly necessary to have perfectly satisfactory plans, showing every portion of the house . . . before it is commenced or contracted for . . . and also to procure from some experienced and competent architect, or master-builder, very complete and full specifications for the whole work,” yet, at the same time, this type of work “requires a very accurate knowledge of every thing relating to building—a knowledge that neither the generality of proprietors, nor but few artisans among us will generally be found to

¹⁰¹ Asher Benjamin, *The Architect, or Practical House Carpenter* (Boston, 1843). First published in 1830 as *The Practical House Carpenter*. Most carpenters or builders had one or two books at most. One early nineteenth-century carpenter in Athol, Massachusetts had only two books, both by Benjamin. See Elbridge Boyden, *Reminiscences of Elbridge Boyden, Architect* (Worcester, 1890), 4.

¹⁰² Andrew Jackson Downing, *Cottage Residences: or, A Series of Designs for Rural Cottages and Cottage Villas, and their Gardens and Grounds Adapted to America* (New York, 1842), ii–iii.

possess thoroughly.”¹⁰³ Only at the end of the final addendum on the “Employment of architects or professional men” does Downing point to a possible future for the standard involvement of architects in American building. Downing notes that a group of “thoroughly informed and competent” architects is “a class yet very small,” but, quoting architect Alexander Jackson Davis, suggests that “the architect furnishes the design, including the elevations, sections and working drawings, a complete list of specifications, procures an estimate, and gives an occasional superintendence while the building is in progress” as part of their fee.¹⁰⁴

With adjacent goals and similar ends, Samuel Sloan’s *Model Architect* (1852) included plates of details, but, undimensioned and unlabeled, their main aim was to illustrate decorative features such as molding profiles rather than describe or prescribe construction (Fig. 1.19).¹⁰⁵ In books such as Benjamin’s, Downing’s, and Sloan’s, the descriptions and diagrams presented were so highly schematic as to only be useful for conveying general, high level principles or, only occasionally, the formal properties of details, with the specifics of actual construction left again to the experience of the builder. The context from which these sources come—both in general sociopolitical and

¹⁰³ Downing, *Cottage Residences*, 183–184.

¹⁰⁴ Downing, *Cottage Residences*, 185–186.

¹⁰⁵ Samuel Sloan, *The Model Architect: A Series of Original Designs for Cottages, Villas, Suburban Residences, etc., Accompanied by Explanations, Specifications, Estimates, and Elaborate Details* (Philadelphia, 1852). A similar series of kit-of-parts books of decorative details were popularized in the 1870s by Amos Jackson Bicknell. See, for example, A. J. Bicknell, *Detail, Cottage and Constructive Architecture* (New York, 1873); and A. J. Bicknell, *Specimen Book of One Hundred Architectural Designs* (New York, 1879). Similar books with additional details about wood framing were available from William T. Comstock. See, for example, William T. Comstock, *Modern Architectural Designs and Details* (New York, 1881). This was also later available as a monthly publication under the same title.

economic terms and in terms of the state of architectural professionalization and education—is distinct from that of Chandler’s *Construction Details*.

The closest, most similar precedent to *Construction Details* in terms of scope, content, audience, and format is Charles F. Mitchell’s *Forty Plates on Building Construction* (1891).¹⁰⁶ At the time of publication, Mitchell was a lecturer in construction at the Polytechnic Institute in London, founded in 1838 as the Royal Polytechnic Institution and today the University of Westminster. Like Chandler, Mitchell expected the primary audience to be students at his school, but also acknowledged that, in the absence of a similar general work, it may be useful to other students and practitioners. Unlike *Construction Details*, *Forty Plates on Building Construction* could be purchased either a full, bound set, or separately, as sections or individual plates. *Building Construction* contains twenty-one plates on timber construction and joinery, nine on brickwork and masonry, five on plumbing, five on ironwork, and a complete set of three working drawings for a small residence. The proportion of total plates dedicated to timber and masonry is quite similar to that of *Construction Details*, but in the case of *Building Construction*, each section was revised by a different instructor or professional after being initially compiled by Mitchell. Although similar in size to *Construction Details*, Mitchell’s publication contains varied information about construction more generally, including diagrams and text related to loads and statics (Fig. 1.20). Many of the illustrations show less specificity than those in Chandler’s *Construction Details*, although they contain more notes on dimensions and engineering than the latter. Despite this, the

¹⁰⁶ Charles F. Mitchell, *Forty Plates on Building Construction* (London, 1891). The copy at the MIT Libraries was entered 2 May 1892, one week before Chandler’s *Construction Details* was published.

illustrations in Mitchell's work provide a mix of general, overall hints on construction and engineering, whereas Chandler's focus is much more on the intricacies of detail.

As architecture curricula and the profession of architecture continued to evolve in the United States, more books like *Construction Details* became available. Advertised alongside *Construction Details* in the January 1900 issue of *Architectural Review* was Clarence Martin's 1899 *Details of Building Construction*. "One of the best books on construction ever published," according to the advertisement, the 10-inch by 12-inch bound volume consisted of thirty-three plates showing typical domestic construction.¹⁰⁷ Martin's book is focused exclusively on timber construction, but he also devotes a majority of plates to window and door details, like Chandler (Fig. 1.21). Martin's explanatory texts accompanying the drawings are both longer and more numerous than Chandler's, though he also acknowledges that the plates are meant to accompany instruction, not replace it.¹⁰⁸

Martin was Assistant Professor of Architecture at Cornell University at the time *Details of Building Construction* was published. Similar to the origins of *Construction Details* that can be inferred from Chandler and Ware's correspondence, Martin's plates began as informal sketches made for classroom instruction that were then circulated among students as blueprinted copies. Martin writes, in the volume's short preface, "The drawings, consisting originally of rough sketches on large sheets of wrapping-paper, were at first used for temporary illustration only; but the results proved so satisfactory that it

¹⁰⁷ "Publications of Bates & Guild Co., 13 Exchange St., Boston" [advertisement], *Architectural Review* 7, no. 1 (January 1900): xi. The book was published by Bates & Guild of Boston and available for \$2.

¹⁰⁸ Clarence A. Martin, *Details of Building Construction* (Boston, 1899), n.p. (preface).

seemed best to study the work more carefully and to put it into more permanent form for class-room use.”¹⁰⁹ Beyond that, though, Martin saw the potential that “they might prove useful to workers outside the college class-room.”¹¹⁰ After apologizing for inconsistency in style and format across plates, Martin reminds the reader that this is a book about details, not design, and is intended to show the best current practice in the United States, based on his professional experience and the consultation of Cornell’s library and collection of construction drawings from prominent firms. Martin’s aims in publishing these details were to record and present the best standard work in the country and, though less explicitly than Chandler, to subsume this knowledge and control under the architect via, as Martin puts it, the “workers” in the architectural office.¹¹¹

A consolidated review article in *The Brickbuilder* recommending books for a drafting room library drew a direct comparison between Martin and Chandler’s publications: “Professor Martin’s book omits the subject of framing, but otherwise covers essentially the same field as Professor Chandler’s work already noted. It is concerned simply with houses and minor public buildings. The plates are in line without color.”¹¹² The lack of color and smaller format, which at first might seem disadvantageous to clarity, probably account for *Details of Building Construction*’s extended availability and popularity when compared to Chandler’s *Construction Details*. After first being published in 1899, *Details of Building Construction* was available in a second, 1905

¹⁰⁹ Martin, *Details of Building Construction* (1899), n.p. (preface).

¹¹⁰ Martin, *Details of Building Construction* (1899), n.p. (preface).

¹¹¹ Martin, *Details of Building Construction* (1899), n.p. (preface).

¹¹² “Standard Architectural Books—VII,” *Brickbuilder* 18, no. 10 (October 1909): 214.

edition in at least three printings, bringing the total number of copies printed to nine thousand by 1914.¹¹³ In a mutually sustaining cycle, the two dollar book—one fifth of the cost of Chandler’s—became a required or recommended text in far more circumstances than Chandler’s, such as part of the curriculum of the Young Men’s Christian Association’s two-term courses on “Architectural Drawing” and “Building Construction.”¹¹⁴ Soon after publication, it was also one of the authorized text books required by the Boston School Committee to be present as a reference book in every evening drawing school, high school, and even grammar school in the city.¹¹⁵

Chandler in Practice: The Office of the Supervising Architect of the Treasury

It is clear from the aims and impacts of *Construction Details* and through his teaching that Chandler hoped to consolidate building authority among members of the American architectural profession. One short yet significant period from Chandler’s career, between working for Ware and Van Brunt and partnering with Edward Clark Cabot, elucidates the formation Chandler’s view of architecture as a profession of management and control. Working in the Office of the Supervising Architect of the Treasury of the United States (OSA) from 1871 to 1874, Chandler participated in novel techniques of management at a distance and early attempts at the bureaucratic rationalization of architectural work.

¹¹³ Clarence A. Martin, *Details of Building Construction* (Bates & Guild Company, 1914).

¹¹⁴ George B. Hodge, *Outlines of Courses of Study* (Young Men’s Christian Association Press, 1908), 40–43.

¹¹⁵ “Authorized Text-Books, Etc.” *Documents of the School Committee of the City of Boston*, School Document no. 8 (Municipal Printing Office, 1901).

The centralization of the design and execution of federal building projects of the United States formally began in 1852 with the establishment of the OSA within the United States Treasury Department. There were multiple reasons cited at the time for establishing the office, but all centered around improved efficiency with the goal of long-term financial savings.¹¹⁶ Most importantly here, the OSA pioneered methods of office practice that would come to serve as a model for decades to come. At one point the largest architecture office in the world, the OSA necessarily introduced new systems of management and administration to increase efficiency, streamline practice, and track an unprecedented number of architects, draftsmen, and projects spread thousands of miles apart. Some methods adopted by the 1870s included a strictly hierarchical managerial structure within the office, standardized paperwork and filing systems, and conventional forms, specifications, and contracts. Secondary scholarship on the OSA is sparse and dated and mostly focuses on particular architects or buildings rather than on this novel administrative structure.¹¹⁷

During Chandler's tenure, the OSA was under the direction of Alfred B. Mullett, who served as Supervising Architect from 1866 to 1874. In addition to numerous smaller projects, the OSA under Mullett was responsible for the design and construction of major

¹¹⁶ For accounts of the office published during its active years, see Rufus H. Taylor, *History, Organization, and Functions of the Office of the Supervising Architect of the Treasury Department* (Washington, 1886); and Darrell Hevenor Smith, *The Office of the Supervising Architect of the Treasury: Its History, Activities, and Organization*, Institute for Government Research Service Monographs of the United States Government 23 (Johns Hopkins Press, 1923).

¹¹⁷ See, for example, Lawrence Wodehouse "Alfred Mullett and his French Style Government Buildings," *JSAH* 31, no. 1 (March 1972): 22–37. Notable exceptions include Anna Vemer Andrzejewski, "Architecture and the Ideology of Surveillance in Modern America, 1850–1950" (PhD diss., University of Delaware, 2000); and Antoinette J. Lee, *Architects to the Nation: The Rise and Decline of the Supervising Architect's Office* (Oxford University Press, 2000).

works such as the State, War, and Navy Building (now the Eisenhower Executive Office Building) in Washington and the San Francisco Mint. These projects, in progress from 1871 to 1888 and 1869 to 1874 respectively, would have been a major part of Chandler's work at the OSA. Chandler was promoted to a management role within a year of joining the office. Mullett wrote to him on September 14, 1872, to confirm the appointment:

You will in addition to your present duties take charge of the Draughtsmens [sic] Division of this Office. Instructions and orders will be given to them through you in all cases where practicable. [. . .] You will be held responsible for the manner in which the drawings are prepared and finished, and for their correctness, as well as for the amount of work performed. I have noticed with regret that several of the draughtsmen in the Office are wasting a considerable portion of their time, and that others are working in a very inefficient manner.¹¹⁸

Chandler executed these duties to the high standards of the office. Within a month of the promotion, he was even temporarily appointed "Acting Supervising Architect during the absence of the Supervising Architect."¹¹⁹

If Chandler could take credit for any one project at the OSA it was a modest but important design for a series of small buildings for the United States Life-Saving Service (LSS). Like the OSA, the LSS was an administrative division within the Treasury Department. Charged with saving life and property from shipwrecks and other disasters along the coastlines of the United States, the formation of the LSS was precipitated by a series of naval disasters around 1853, and several fatal shipwrecks in the 1870–1871 season highlighted the severe shortcomings of the organization and administration of the service. Under the leadership of Sumner I. Kimball, the then-newly appointed

¹¹⁸ Alfred Mullett to Francis W. Chandler, 12 September 1872, Chandler Family papers, box 1, folder 1.

¹¹⁹ William A. Richardson to Francis W. Chandler, 3 October 1872, Chandler Family papers, box 1, folder 1.

superintendent of the LSS, a report was commissioned to survey of the existing life-saving stations, their operation, and their staff and apparatus.¹²⁰ Armed with the findings of the report, Kimball sought and eventually received Congressional approval to centralize the administration of the LSS, divide it into regional groups, professionalize the formerly volunteer job of stationmaster, and increase the size, number, and quality of life-saving stations. As a fellow Treasury Department branch, the OSA was placed in charge of planning and administering the construction of a series of new life saving stations along the Atlantic coast, and Chandler in particular was charged with their design. Unlike previous stations, which were essentially homely single-room boathouses, Chandler's design took into account both the expanded functional needs of the growing LSS as well as a desire for some aesthetic consideration. According to Kimball, "these new stations were built upon an enlarged and improved plan, some regard to architectural taste also being had."¹²¹

Consisting of two stories and multiple room divisions per story, Chandler's design combined the necessary requirements of the brief in a spartan yet thoughtful design that ultimately reflected the stick style popular at the time (Fig. 1.22). *Appleton's Annual Cyclopaedia* described Chandler's life-saving stations as

two-story houses, mainly built of tongued and grooved pine, with gabled roofs, covered with cypress or cedar shingles, and strong shutters to the

¹²⁰ For a general overview of the history of the Life-Saving Service up to 1876, see Sumner I. Kimball, *Annual Report of the Operations of the United States Life-Saving Service for the Fiscal Year Ending June 30, 1876* (Washington, 1876). For detailed articles from the contemporaneous popular press highlighting the history and work of the LSS, see "Service, United States Life-Saving," in *Appleton's Annual Cyclopaedia and Register of Important Events*, n.s., vol. 3 (New York, 1879): 749–766; George J. Hagar, "The United States Life-Saving Service: Its Origin, Progress and Present Condition," *Frank Leslie's Popular Monthly* 5, no. 2 (February 1878): 165–178; and "The United States Life-Saving Service," *Scribner's Monthly* 19, no. 3 (January 1880): 321–338.

¹²¹ Kimball, *Annual Report*, 53.

windows, and are securely bolted to a foundation of cedar or locust posts, sunk in trenches four feet deep. Their architecture is somewhat of the pointed order, somewhat of the chalet style, with heavy projecting eaves and a small open observatory or lookout deck, on the peak of the roof, from which spires a flagstaff.¹²²

Chandler's standard design was used for about a dozen buildings from Maine to North Carolina (Fig. 1.23) and he visited virtually none of the sites during their construction, relying mostly on a combination of his drawings and specifications plus a designated representative monitoring construction. While I want to highlight that this experience was significant to Chandler's development, his multi-use plans are entirely unremarkable within the history of the OSA, which had been increasing the efficiency of its operation for decades by standardizing plans and administering construction at a distance. Ammi Young, for example, administered most of his 1850s custom house projects from the office, sending out drawings of standard construction details and receiving photographs of works in progress.¹²³

After a brief leave in November 1874, Chandler formally resigned from the OSA in December to "accept a valuable partnership," as Mullett put it.¹²⁴ Chandler's timing was opportune, as Mullett was forced out of his position soon thereafter by the new Secretary of the Treasury Benjamin Bristow. Even though Chandler was no longer

¹²² "Service," *Appleton's Cyclopaedia*, 752.

¹²³ Numerous United States Custom Houses were built from the same plans furnished by Young. To take one example, the details of the U.S. Custom Houses designed for Gloucester, Massachusetts; Burlington, Vermont; Toledo, Ohio; and Sandusky, Ohio are identical. See Secretary of the Treasury, *Plans of Public Buildings in Course of Construction*, vols. 1–31 (Washington, 1855–1856), "American Architectural Books" microfilm, reel 113, no. 1456. See also Bates Lowry, *Building a National Image: Architectural Drawings for the American Democracy, 1789–1912* (National Building Museum, 1985), 51–55. For a reference to supervision via photography, see Lee, *Architects to the Nation*, 55–56.

¹²⁴ Alfred Mullett to Francis W. Chandler, 12 December 1874, Chandler Family papers, box 1, folder 2.

present and OSA leadership had changed, his design was carried out, exerting control across time and space from the drafting room. The dozen or so LSS buildings, “marked by architectural taste as well as fitness,” were completed according to Chandler’s plans and specifications in 1876 under Captains John McGowan and J. H. Merryman, new superintendents of construction for the LSS.¹²⁵ Although it only makes up three years of his long career, the period Chandler spent at the OSA afforded him the opportunity to work within a then-unique system of efficient architectural practice that was otherwise unparalleled in the country. Chandler took the specific lessons of the reuse of plans and details to his work at Cabot and Chandler for the next dozen years. Significantly, he also absorbed his experiences with OSA office practice and later recombined them into his ever-evolving curriculum at MIT, manifesting themselves in the publication of *Construction Details* and in the increasing focus on the business and bureaucratic aspects of the architectural profession.

Chandler and Manual Training

Chandler’s interest in industrial education and manual training is well-documented. In reviewing it here, I do not claim that the coursework in his MIT curriculum should be classified as industrial or manual (far from it), but I do hope to suggest that his familiarity with and involvement in the manual training landscape in Boston is significant to understanding his overall project for architecture professionalization as articulated at MIT. Kevin Block has suggested that William Robert Ware’s role in the passage of the 1870 Drawing Act, requiring drawing education in all

¹²⁵ Kimball, *Annual Report*, 72.

public schools in Massachusetts, was necessary for the framing of his work in architectural education at MIT. If Ware was promoting university education for a type of architect whose drawings would direct laborers, then those laborers would need to have a certain literacy in drawing.¹²⁶ Chandler's interest in manual training might have had similar motives.

Chandler was connected to manual training in Massachusetts at least by 1877, when he and Cabot designed a renovation and extension of the Lancaster Industrial School after carefully familiarizing themselves with the needs of such an enterprise.¹²⁷ More importantly, in the 1880s, Chandler was on the board of Boston's North Bennet Street Industrial School (NBSIS). The school, founded earlier in the decade by philanthropist, activist, and reformer Pauline Agassiz Shaw, was vocational in focus and promoted the manual arts. After decades of working to reform Boston's education system, including founding the city's first kindergartens, Shaw began financing Harriet Clark Caswell's North End Industrial Home in the 1870s. Shaw grew Caswell's facilities and program to include a library, printing press, cooking school, and carpentry workshop, and a new institution called the North Bennet Street Industrial School was formally established in 1885 "to give industrial training, with all its invigorating and educating influences."¹²⁸ In the first report after the school's formal incorporation, Francis Ward

¹²⁶ Block, "The Ware Course."

¹²⁷ Francis W. Chandler Diary, 1877, H. D. Chandler papers, box 3, folder 73.

¹²⁸ Managers and Advisory Board, "North Bennet Street Industrial School," pamphlet (April 1886), n.p., North Bennet Street Industrial School Records, 1880-1973, folder I2, Schlesinger Library, Radcliffe Institute, Harvard University (hereafter cited as "NBSIS Records"). The carpentry program was established in 1881. For a history of the school, see Christine Compston et al., *Rewarding Work: A History of Boston's North Bennet Street School* (North Bennet Street School, 2018).

Chandler is listed as one of eight managers, who served adjacent to the advisory board. His immediate social circle was heavily involved, with other members of these committees including his brother-in-law Tucker Daland (treasurer) and J. W. Wheelwright (manager and head of library committee), wife of Chandler's friend, colleague, and collaborator Edmund Wheelwright.¹²⁹

In the following two years, from 1887 to 1889, Chandler was responsible for introducing additional techniques, ideas, and personnel from MIT to the NBSIS. The methods of instruction in the carpentry program in 1887 were noted as being “substantially the same as those of the School of Mechanic Arts, in the Institute of Technology” (Fig. 1.24).¹³⁰ In 1887, the NBSIS board explained its “new but growing faith that ‘the whole boy should be sent to school and not a part of him;’ that it is not enough to train the intellect alone, by what have been well called ‘mental gymnastics,’ but that the eye and the hand are together the most trustworthy leaders of the brain; that ‘all the members’ must hereafter be trained together, so that the eye shall no longer say to the hand ‘we have no need of thee.’”¹³¹ A sentiment that, again, firmly aligns with MIT's founding principles and Chandler's core pedagogical beliefs. Following Chandler, other MIT affiliates joined the NBSIS board in 1888 including president Francis A. Walker and alumna and instructor Ellen Swallow Richards.¹³²

¹²⁹ Managers and Advisory Board, “North Bennet Street Industrial School,” NBSIS Records, folder I2. References to NBSIS meetings appear throughout Chandler's diaries. See, for example, F. W. Chandler Diary, 1886, H. D. Chandler papers, box 4, folder 3; and Chandler Diary, 1888, H. D. Chandler papers.

¹³⁰ *The Work of the North Bennet Street Industrial School from 1881 to 1887* (Boston, 1887), 8, NBSIS Records, folder I2.

¹³¹ *The work of the NBSIS*, 3, NBSIS Records.

¹³² *The work of the NBSIS*, 16, NBSIS Records.

Chandler's last academic year on the NBSIS board saw the introduction of the Sloyd system of woodworking. Sloyd, Swedish for *handiwork* or *handicraft*, was a philosophy of education that at its core advocated for manual training, especially in woodworking, to promote moral, mental, and physical development. Sloyd first emerged in the 1860s out of a general concern that ready-made industrial articles were leading to a general decline in Swedish society. In the 1870s, the theory and practice of Sloyd were developed, refined, and articulated by Otto Salomon, who started a school for teachers in Nääs, Sweden. Sloyd ideas circulated around Europe and beyond mainly through these teachers, but a much wider audience was reached in the second half of the 1880s when Solomon published an article in a German periodical that was almost immediately reprinted as a pamphlet. First translated into English in 1888 and sponsored by the Industrial Education Association of New York, *The Slöjd in the Service of the School* was the first introduction to Sloyd for many Americans. Solomon, working against percolating misconceptions, emphasizes that Sloyd is a universal reform in instruction and not merely a skill-focused means to employment and the production of goods. The objects produced are "incidental" whereas the development of the laborers themselves is "essential," not the other way around.¹³³ Even before Solomon's tract was translated into English, Marian Hovey, a wealthy Boston socialite, invited Carl Fallen, a Swedish Sloyd teacher, to give a lecture in her parlor, which immediately led to the establishment of a

¹³³ Otto Salomon, *The Slöjd in the Service of the School*, trans. William H. Carpenter, ed. Nicholas Murray Butler, Monographs of the Industrial Education Association 1, no. 6 (New York, 1888), 6. A full-page advertisement

temporary Sloyd instructional workshop in Brookline.¹³⁴ Sloyd at NBSIS was further formalized in 1889 with the hiring of Gustaf Larsson from the Nääs school, who was charged with establishing a similar training program in Boston. Larsson's school, the Sloyd Training School of Boston, operated out of the same quarters as NBSIS and remained under Larsson's direction until his death in 1919.

In February 1889, Chandler jotted in his diary "Sloyd system of industrial training."¹³⁵ The uncharacteristically unshortened entry suggests its relative novelty to Chandler, and it is unlikely he was familiar with Sloyd before its implementation at NBSIS in the 1888–1889 school year. Its immediate appeal to Chandler, though, is logical on two levels. First, there is a certain philosophical overlap between Sloyd and Chandler's approach to education. In Solomon's words:

The aim of education is, beyond question, to bring about a development as many-sided as possible. . . . Since, in consequence of the many-sidedness of the qualities and powers which the educator has to regard, no subject alone is capable of taking into consideration all sides of the formal education, such a choice of the different educational means must naturally be sought that they shall mutually supplement each other and together form a whole.¹³⁶

Among Sloyd's fourteen general principles can be found "It must exercise the thinking powers and not be purely mechanical."¹³⁷ That all being said, Sloyd was at its essence about handicraft and the practical manipulation of materials with tools. This brings us to the second layer of resonance with Chandler's MIT work. Although Sloyd deemphasized

¹³⁴ *The Work of the North Bennet Street Industrial School from 1888 to 1889* (Boston, 1889), 4. NBSIS Records, folder I2.

¹³⁵ Francis W. Chandler Diary, 1889, H. D. Chandler papers, box 4, folder 6.

¹³⁶ Solomon, *The Slöjd in the Service of the School*, 9.

¹³⁷ Solomon *The Slöjd in the Service of the School*, 27.

divisions of labor, its implementation at NBSIS, perhaps at Chandler's suggestion, was directly aimed at training young men to build. In the new version of the architecture profession Chandler was constructing from within MIT, an architect or well-trained draftsman would draw and specify timber construction details that would direct the work of a competent but subservient builder. NBSIS training was a perfect counterpoint to Chandler's MIT Training. Eventually, graduates of the former would carry out manual work as conceptually directed by graduates of the latter. Even the timber frame construction models built by NBSIS students (Fig. 1.25) can be viewed as companions to the timber frame model used for teaching alongside *Construction Details* at MIT which, of course, the MIT students did not themselves build as part of their intellectual training (see Fig. 1.11).

Toward a Chandlerian Philosophy of Practice and Pedagogy

Chandler published very little in his lifetime, and his diaries are mainly daybooks rather than journals. Through a close examination of *Construction Details* and its place in the curriculum Chandler championed at MIT, one can begin to piece together something resembling a philosophy of, or at least a general approach to, architectural education. Two short articles published by Chandler in 1906 and 1907 provide the most lucid descriptions of his views on architectural education and the profession more broadly. At this point in his tenure—nearly two decades into his role as a full-time professor and less than five years away from retirement—Chandler's major views on architectural education had permeated the MIT curriculum and were furthered engrained by his official promotion to head of the Department of Architecture in 1907.

In May 1906, Chandler wrote an intensely critical letter to the editors of *Inland Architect and News Record* in response to an article that had appeared in the journal that February. The February article was excerpted from a report of the Committee on Education of the Architecture League of America, chaired by Newton A. Wells with the assistance of Robert C. Spencer (MIT 1891) and John W. Case. The report team had attempted to tabulate how much time was spent and weight was placed on various subjects in architecture curricula, to collect anecdotal opinions on the value and effectiveness of the atelier system in the United States (which was then popular at Columbia), and, ultimately, to make recommendations about architectural education.¹³⁸

Individual opinions of architects as to which elements of architectural education were the most important varied within the report. Architect Bertram Goodhue ranks design the highest, followed by drawing in the middle, and with “building construction and mathematics” last. “Indeed,” he explained, “a mechanical mind cannot be expected to become a great architect.”¹³⁹ Perry Ash, the head of the Department of Architecture at George Washington University, stated, “I strongly believe that the function of the architectural college is to develop the taste and artistic faculties, and I consider the course most efficient, in the long run, where the maximum of drawing and design is given and the minimum of engineering is provided for.”¹⁴⁰ James Knox Taylor (MIT 1879), Supervising Architect of the Treasury, argued that “the architect nowadays does not need

¹³⁸ Newton A. Wells et al., “Architectural Education,” *Inland Architect and News Record* 47, no. 1 (February 1906): 3–6.

¹³⁹ Bertram Goodhue, quoted in Wells et al., “Architectural Education,” 5.

¹⁴⁰ Perry Ash, quoted in Wells et al., “Architectural Education,” 5.

an extensive mathematical and engineering education” and, as a result, recommends increasing the time in the curriculum allotted to “construction, design, free-hand drawing, and modeling.”¹⁴¹ In their synthesis, the authors of the report present the common view of the respondents that engineering and higher mathematics should be in the most subordinate position that and design should be of primary importance. They found “an almost absolute unanimity regarding the emphasis that should be laid on the aesthetic side of architectural education.”¹⁴²

In explaining the role of construction in the scheme of these two poles, engineering and aesthetics, the authors of the report quote in its entirety a letter from architect Hermann V. von Holst (MIT 1896) that complicates their claim. In the letter, von Holst explains:

I feel Design and Construction are taught too much as separate, independent subjects, the result being that the student acquires an education to become a good draughtsman in the narrower sense of the word. . . . The art of thinking broadly and correctly can be given the student only by constant mingling of the drawing-board work and in the work done in watching actual buildings, in the modeling room, out of doors, etc. No one can be honest in his design, without being thoroughly acquainted with the different materials, their possibilities and limitations, and without having acquired the ability to see correctly. This latter faculty is not developed in the drawing-room, but out of doors.

The tendency at specialization is carried too far nowadays, and is an imminent danger to the making of *broad men*. The designer and the construction man have been too much separated. The designer should be taught that he has to check himself by structural and practical considerations; and the one who says “I do not care about design” must be taught that no matter what he does he has to design.¹⁴³

¹⁴¹ James Knox Taylor, quoted in Wells et al., “Architectural Education,” 6.

¹⁴² Wells et al., “Architectural Education,” 6.

¹⁴³ Hermann V. von Holst, quoted in Wells et al., “Architectural Education,” 6

Like his peers quoted in the article, von Holst firmly believes that design should take a primary place in architectural training. However, he is less willing to divide this out as something wholly separate from engineering and construction training. His assertion that the best way to learn is a mix of drafting room work and real-world observation reflects his own architectural education and professional background. After attending the University of Chicago, von Holst trained at MIT under Chandler, earning his degree in 1896. He also trained in the Chicago branch offices of H. H. Richardson's successor firm Shepley, Rutan and Coolidge, and went on to run his own practice in the Rookery Building while teaching at the at the Art Institute's Chicago School of Architecture.

While the report writes a few sentences in agreement with von Holst's letter, the committee goes on to its other task of analyzing existing curricula. In tabulating how much time is dedicated to "the aesthetic side of educational training," the committee notes that this makes up slightly more than half of the time at Harvard, three-fifths at Columbia, slightly less than half at the University of Pennsylvania, slightly more than two-thirds at Cornell, and slightly less than one third at MIT and the University of Illinois. In the committee's conclusion, "This indicates that, while Columbia and Cornell are somewhat in advance and Pennsylvania a little behind, the Institute of Technology [MIT] and the University of Illinois are very much behind the present average professional opinion in this matter of aesthetic training."¹⁴⁴

Chandler's May 1906 letter to the editors takes issue with the report's analysis, conclusions, and recommendations. The root of Chandler's issue is with the method used in conducting the surveys that made up the findings of the report:

¹⁴⁴ Wells et al., "Architectural Education," 6.

Statistics are proverbially a snare, even to the most competent and veracious committees. . . . It [the report] is founded on a mechanical tabulation of the hours of instruction devoted to different subjects at the principal architectural schools of America. The conclusions are mechanically drawn from this tabulation, and it seems to be accepted as a fact that the subjects of study are easily divided into two groups: one relating to *Aesthetics*, and the other to *Construction and Mathematics*.¹⁴⁵

For Chandler, the rigid and total division of design and construction was an abomination in architectural training. Ware's initial conception for the MIT Curriculum, which Chandler shepherded into the twentieth century, saw that architectural education would blend teaching of the aesthetic and practical elements of architecture through a blend of theoretical instruction and a *knowledge* of the practical dimensions of building.

If Chandler's protestations were ostensibly about the research methods of the committee, he also took the opportunity in the published letter to explain and defend the curriculum at MIT and articulate his broader views on architecture and architectural education. His response, the most thorough of any of his statements on the subject, warrants quotation at length:

An analysis of architectural study made from this point of view seems to me not only worthless (speaking in an educational way), but positively harmful, because it leaves in the mind of the student the impression that Architecture, instead of being an Art based fundamentally on sound construction, is produced in the main by fine draftsmanship and by skill in decoration.

No curriculum can be dissected fairly in this mechanical manner; the subjects that compose it are too closely interwoven, and, moreover, educational subjects in the hands of capable teachers grow to have a broader meaning than the categories indicate, and have still wider meanings than their simple names imply, as they come to supplement each other more closely.

¹⁴⁵ F. W. Chandler, "Architectural Education—A Protest." *Inland Architect and News Record* 47, no. 4 (May 1906): 55. Emphasis in the original.

At all events, we at the Institute of Technology believe that no man can be a thoroughly trained practicing architect without some knowledge of engineering. We further believe that the most artistic student should have no excessive difficulty in absorbing the mathematics necessary to understand those structural necessities which are the basis of any worthy architectural design, and to fit him to confer intelligently with the engineer when the building operation needs his assistance.

I am perfectly aware that the architect can no longer be both architect and engineer, as were a few of the big men of the Italian Renaissance, but there is danger to the profession in the demand for less and less construction, as witness the growing complaints of the engineers that it is their brains that go to the building up of one of these great office structures, but that the architects get the credit. There are even instances where the tables have been turned and the engineer has employed the architect as a decorator to design a front to his steel construction.

The fact is, design and construction can not be separated. The most striking example of the results of its proper alliance was in mediaeval times, when construction and design went hand in hand from the building of the magnificent portal to the lofty nave of the French cathedral. This alliance is what gives architecture its reasonableness—the characteristic by which it should be judged. The designer who is sound in construction is an architect. It is he who is called upon to develop great schemes; he settles the constructional motive of the building, and his design is influenced by it; otherwise he is simply a decorator.¹⁴⁶

Despite an academic curriculum's fundamental premise to divide and systematize the transfer of knowledge—whether skill, information, or method—Chandler asserts that architectural education, much like the practice of architecture itself, cannot be fully partitioned and is ultimately indivisible. Not only did each class in the curriculum build on previous class work, but the work in various classes was interrelated and interconnected. This projected indivisibility of a curriculum supports the general goal of the profession to remain unified and relevant to a public where building and engineering specialists were becoming increasingly common and trusted. Just like architecture was a

¹⁴⁶ Chandler, "Architectural Education," 55.

total profession of both “Aesthetics” as well as “Construction and Mathematics,” to use Chandler’s words, he firmly believed education should inculcate this total professional integration of aesthetics and construction. The ultimate unclassifiability and ineffability of the work of the architect is an important part of the mystique of professionalization.

The next year, in 1907, Chandler wrote a general summary of the curriculum of the MIT Architecture Department for *Architectural Review*. Less impassioned and insistent than his letter to the editor of *Inland Architect*, the later article goes into more detail about the specifics of architectural instruction at MIT. Chandler writes, “Since the beginning the general plan of instruction has been changed only by developing the older courses and by adding others to meet the new conditions arising in modern practice.”¹⁴⁷ In rooting the department in tradition he is conveying stability and downplaying curricular change. At the same time, he is justifying those very changes as appropriate responses to the real, relevant, and evolving needs of professional architectural practice.

Chandler participated in massive changes in the Architecture Department while at MIT, including the addition of a specific, specialized undergraduate track in Architectural Engineering in the 1900–1901 academic year and a Master’s degree program beginning in 1903–1904.¹⁴⁸ Both of these significant additions are markers and results of changes in the profession. Masters-level education was possible now in the United States thanks to the increasingly elevated status of the profession; the efforts of the preceding decades

¹⁴⁷ F. W. Chandler, “Massachusetts Institute of Technology; Department of Architecture Course of Instruction,” *Architectural Record* 21, no. 6 (June 1907): 443.

¹⁴⁸ Massachusetts Institute of Technology, *Thirty-Sixth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1900–1901* (Cambridge, 1900), 38; and Massachusetts Institute of Technology, *Thirty-Ninth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1903–1904* (Boston, 1904), 79.

were resulting in the kind of delimited, trusted profession that many architects had hoped for, contributing to an increased demand for academically trained architects with degrees. A track in architectural engineering acknowledges the need for architectural workers who have some general design training, but who also know more than the rudiments of physics, materials, and statics. It reflects the hopeful expanded remit of architects at the turn of the twentieth century while also reflecting a perennial tension between architects and engineers in questions of control and expertise.

In the article, Chandler goes on to further make a case for the importance of knowledge of construction in all architectural education, writing, “Scientific construction is continually becoming a more necessary part of the architect’s profession. His knowledge must be broad and thorough, and the practice of to-day shows that an architect should not only be a skilled artist, but should also be scientifically trained as to control intelligently all constructive questions.”¹⁴⁹ Chandler’s general sentiment here is virtually unchanged from his earlier teaching and curricula, and he goes beyond some of Ware’s founding principles for architectural instruction at MIT. In fact, by having architects train more deeply in knowledge of construction, Chandler is contributing to the expanded public and professional remit of architecture as the control of building, not building itself. The claims that the MIT curriculum responded to the needs of modern practice is accurate, but the curriculum is not a one-way recipient of change; changes in the curriculum also changed the profession and were used as justification for its solidification as such.

¹⁴⁹ Chandler, “Massachusetts Institute of Technology,” 450.

Conclusions

Construction Details is but one manifestation of Chandler's influence on the MIT curriculum. The first new course Chandler introduced after joining as faculty was on managerial practice called "Business Relations, Contracts, etc." A later course description, from 1904, explains that it consisted of lectures "relating to contracts, competitions, the employment by the architect of engineers, clerks of the work, etc., the relations of architect to client, contractor, and draughtsman; special classes of building, and such related topics as may arise in current work"—in short, the realities of professional architecture.¹⁵⁰ A brief course description alone is not sufficient evidence of actual teaching, but we can indeed confirm from Chandler's diaries that he presented regularly on working drawings, building construction, specifications, and the hiring of contractors. It is also under Chandler's direction that the department created a dedicated drafting room for the study of office practice, which included a full-size mockup of a building section, sample window mechanisms, and display cases full of materials samples and construction maquettes, and a full copy of *Construction Details*.

To summarize, Chandler bolstered, refined, and expanded the coursework on administration and construction that had been a part of MIT's architectural instruction from its founding, foregrounding the knowledge of construction and business practices in the intellectual formation of young architects. In publishing *Construction Details* and through his other curricular adjustments, Chandler kept pace with the requirements of professional practice. *Construction Details* is emblematic of the curriculum at MIT and

¹⁵⁰ Massachusetts Institute of Technology, *Bulletin of the Massachusetts Institute of Technology, Catalogue of the Officers and Students with a Statement of the Requirements for Admission and a Description of the Courses of Instruction* 40, no. 1 (Massachusetts Institute of Technology, 1904), 185.

Chandler's continued mission to train competent architectural workers who would direct the work of subordinate laborers via drawings and specifications. When the portfolio was published, Chandler and MIT's hope was to educate a body of trained students for the age of ever-longer specifications, the proliferation of subcontracting, increasingly complex building codes and laws requiring documentation and paperwork, and a multiplication of new materials, construction techniques, and building systems.

With one foot in the academy and one in the profession, Chandler witnessed and participated in the transformation of architectural practice into an increasingly administrative and intellectual endeavor. He strengthened and augmented courses not only on the knowledge of the practical construction- and detail-related aspects of architecture, but also on the actual business of the day-to-day operations of an increasingly managerial profession. Chandler and MIT—and all architecture schools, for that matter—were not operating in isolation: to remain relevant and effective, and to further strengthen the profession, academic training in architecture was compelled to embrace the bureaucratic realities of architectural practice. This coursework and training in construction details, superintendence, and administration more broadly is hidden in the corners of the history of the MIT curriculum, but it was fundamental to the success of students and the applicability of their training, and in the general formation of architecture's professionalized expertise.

CHAPTER TWO

Duplicating Authority: Blueprinting and the Managerial Architect

On April 23, 1842, the English scientist Sir John Herschel recorded that day's experiment in his notebook: "When the paper is thrown into water the impression becomes stronger . . . & turns to a fine Prussian blue. . . . This paper will prove valuable."¹ Herschel was describing the chemical process that later became known to architects and engineers as the blueprint, with its characteristic Prussian blue background and white lines (Fig. 2.1). Herschel's discovery certainly did prove valuable, as he predicted, although not immediately. While discovered in 1842, the process was not widely used to duplicate drawings until the 1880s, at which point it went from a mostly unknown copying technology to one of the most ubiquitous processes in design practice. Even by 1921, after dozens of other duplication processes had been discovered, blueprinting was still by far the most popular, accounting for about three quarters of the copies of architectural drawings made in the United States.² These same decades, about 1880 through 1920, saw the formation and solidification of the modern American architectural profession and the organization of the modern building site, both of which

¹ Sir John F. W. Herschel, *Experimental Memoranda*, 1842, Manuscript Library, Harry Ransom Center, University of Texas at Austin, quoted in Mike Ware, "Cyanotype: A Blueprint for Visual Vandalism?" *Studies in Photography* (2013): 25.

² Benjamin James Hall, *Blue Printing and Modern Copying for the Engineer and Architect, Draughtsman and the Print Room Operative* (Sir Isaac Pitman & Sons, 1921), 9.

required numerous, identical copies of drawings. Of course, some copies of drawings were needed in practice before this, and copies have been made for millennia, but other available methods were expensive or unreliable and ultimately threatened to weaken the precarious authority of the architect. That the rise of the blueprint overlapped with the rise of the architectural profession and the expansion of building practice is no mere coincidence. Blueprinting technology accompanied and even facilitated the transformation of architecture into a legitimate profession and helped to secure the emerging authority of the architect.

The significance of blueprinting in the transformation of the architectural profession is noted by several architectural historians, but often only in passing. Michael Lewis's survey of architectural education in America from 1860 to 1920 comes closest to crediting blueprinting with its essential role in the professionalization of architecture in the period. Lewis writes that the "growing complexity of the design process" was a large factor in these changes, but "even more consequential was the introduction of blueprint technology," though he does not offer more detail.³ Carolin Lange and Hetty Berens have recently published the results of a survey of the blueprints in the collection of the Nieuwe Instituut in Rotterdam. They make excellent points, relating that "blueprinting emerged at a time when many parties were involved in complex design and construction processes," and noting that "reliable copies were essential for effective communication," though these claims are not theorized or fully historicized and are made in a specifically Dutch

³ Michael J. Lewis, "The Battle between Polytechnic and Beaux-Arts in the American University," in *Architecture School: Three Centuries of Educating Architects in North America*, ed. Joan Ockman (MIT Press, 2012), 76.

context.⁴ In her history of the profession in nineteenth-century America, Mary Woods acknowledges that architecture firms readily began making blueprints because they were “inexpensive, accurate, and easy to produce,” especially when compared to earlier reproduction technologies like photolithography. She notes that with blueprinting, architecture offices could dismiss their tracers, but she does not elaborate further or go into detail on the technology or its full implications for architectural practice.⁵

The possible historical significance of blueprinting in the history of cartography has been noted in an article by Jeffry S. Murray, though his main purpose in writing was to convince archivists and historians not to discount blueprints in favor of originals.⁶ In his dissertation on visual tools used by the American mining engineers, Eric Nystrom includes a chapter on blueprints, tracing their technological development and suggesting their place in organizational structures.⁷ Frances Robertson, writing on the history of Scottish industrial design, notes that blueprints “stood for the commercial and intellectual control of large organizations,” but her main aim is to situate blueprinting in the history of photomechanical printing in industry.⁸ Fortunately, technical publications by

⁴ Carolin Lange and Hetty Berens, “Blueprint Experiments,” in *Approaches to Drawing in Architectural and Urban Design*, ed. Fabio Colonnese et al. (Cambridge Scholars Publishing, 2024), 521–522.

⁵ Mary N. Woods, *From Craft to Profession: The Practice of Architecture in Nineteenth-Century America* (University of California Press, 1999), 140.

⁶ Jeffrey S. Murray, “Blueprinting in the History of Cartography,” *Cartographic Journal* 56, no. 3 (August 2009): 257–261.

⁷ Eric Charles Nystrom, “Learning to See: Visual Tools in American Mining Engineering, 1860–1920” (PhD diss., Johns Hopkins University, 2008), 70–131. The chapter on blueprints is eliminated in the book version; see Eric C. Nystrom, *Seeing Underground: Maps, Models, and Mining Engineering in America* (University of Nevada Press, 2014).

⁸ Frances Robertson, “Blueprints as Master Plans: Photomechanical Reproduction, Industrial Duplication and the Machine Aesthetic,” *Studies in Photography* (2013): 45–51.

conservation scientists offer some valuable, though often scant, historical information on blueprinting in architectural contexts.⁹

Researching blueprints as a medium is not a straightforward task. They are rarely catalogued accurately as such in databases and finding aids, and there is no one archive or even type of traditional archive that can be relied upon. Confusing matters further is the fact that blueprints go by many names in primary sources. In English alone, a blueprint can be referred to as a cyanotype, negative cyanotype, blue-print, negative ferrotype, ferro-prussiate print, or a cyanofer process print, not to mention more general terms like heliography, sun printing, actinic copying, and sun tracing, which may refer to blueprinting or to another type of photochemical process. Blueprints were working documents, regularly folded, creased, annotated, rolled, and exposed to all types of weather and debris.¹⁰ They were considered ephemeral, and copies were often discarded as soon as construction was complete. The difficulty is exacerbated by the former practice of discarding blueprints from archival collections when the original drawings exist. Of course, many blueprints survive in architectural archives, though not in the same numbers as original drawings, not in numbers that reflect their former ubiquity, and certainly not in any clear and consistent way that can be studied reliably. Taken together, the combination of misidentification and uneven retention means that alternatives to

⁹ See Belinda Fireman, "The Technology and Conservation of Blueprints," *Paper Conservation News* 81 (March 1997): 3–6; Eléanore Kissel and Erin Vigneau, *Architectural Photoreproductions: A Manual for Identification and Care*, 2nd ed. (Oak Knoll Press, 2009); Lois Olcott Price, "The History and Identification of Photo-Reproductive Processes Used for Architectural Drawing Prior to 1930," *Topics in Photographic Preservation* 6 (1995): 41–49; and Lois Olcott Price, *Line, Shade and Shadow: The Fabrication and Preservation of Architectural Drawings* (Oak Knoll Press, 2010).

¹⁰ Lange and Berens illustrate examples of some of these markings and correctly observe that "the additional layers and traces on blueprints show how they functioned and circulated." Lange and Berens, "Blueprint Experiments," 521.

traditional archives of plans and papers are required to write a history of an object type that has in many ways been considered disposable. Discussions of blueprinting in the late nineteenth- and early twentieth-century architectural press are key references in an array of primary sources, as are product and trade catalogues from manufacturers and suppliers, instruction manuals about blueprinting and photoduplication, patent records, documentation about court cases related to blueprints, and other contemporaneous published sources.

Historian Ben Kafka has observed that generations of scholars had “discovered all sorts of interesting and important things by looking *through* paperwork, but seldom paused to look *at* it.”¹¹ Most architectural historians conducting archival research on topics covering the period from the 1880s through even the 1940s have encountered cyanotype blueprints. Yet the former omnipresence of the blueprint in architectural practice is not generally reflected in the work of historians considering these decades. Perhaps blinded by their ubiquity, we have only examined them, if at all, for their content. As a specific type of object with unique material properties and socially constructed associations, blueprints are more than carriers of content for historians (or builders) to use. Blueprints are material traces, objects in themselves worthy of careful consideration and questioning—objects to be looked *at* rather than *through*.

In this chapter, I recover some of the history of the role of blueprints in a material, medium-specific, and sociological sense rather than as an inconsequential intermediary between architect and structure. Blueprints are not simply neutral carriers in the web of

¹¹ Ben Kafka, “Paperwork: The State of the Discipline,” *Book History* 12 (2009): 341. Emphasis in the original.

architectural practice, bureaucracy, and authority. They are, rather, a key class of document that forms that very bureaucracy and authority.¹² Blueprinting technology and architectural practice are inextricably intertwined, and the former can be traced to sketch a history of the latter.

In approaching blueprints in this chapter, I draw on the concept of sociotechnology, which treats technology and society as two interrelated parts of a larger whole. These categories do not exist as such with clear boundaries, and ideally the distinction between the two blurs the more one realizes they are to some degree mutually constituted. Though this non-constructivist, non-determinist approach might be critiqued as noncommittal, it offers in return explanations and analyses that reveal more fully the rich texture of an underlying tangle of connections. Architects could have adapted to the requirements of modern practice without blueprinting, and other professionals (like engineers) used blueprinting, but in bringing histories of blueprints and architectural practice together I hope to reveal a productive, mutually supporting relationship.

My goal in this chapter is to address several questions: Why did the architectural profession make extensive use of blueprinting specifically when other methods of copying drawings were available? Why did the use of blueprinting become widespread when it did, forty years after the discovery of the process? What was assumed to be special about blueprints, and how were they thought of as instruments of control? In my answers to these questions, I show how the use of blueprints was predicated on their capacity to be exactly repeatable, as well as on their special connection with the original

¹² Matthew Hull makes a similar claim broadly for all documents and bureaucracies. See Matthew S. Hull, "Documents and Bureaucracy," *Annual Review of Anthropology* 41 (2012): 251–267.

drawing and the authority of the architect. Yes, blueprints were cheap and quick to make, but reducing an explanation of their adoption to one of simple material convenience misses their theoretical, rhetorical, and legal significance in the formation of the architectural profession in the United States. The use of blueprints was both practical and idealist, and I aim to reconstruct that context.

Copying Before Blueprinting

Drawings in general are necessary to convey information, especially information that cannot be further simplified or reduced into another form. A technical architectural drawing does not resemble a retinal image, like a realist painting, nor can it be expressed otherwise by any sort of mnemonic or phoneme, like written or spoken language.

Orthographic architectural drawing, like any type of mechanical, engineering, or design drawing, takes on the fundamental problem of representing a three-dimensional design in the two-dimensional plane of a paper or other substrate. Drawings are necessary to communicate and record these architectural ideas, especially across time and space, and copies of drawings multiply and extend this potential. There are a wide variety of methods for producing copies of drawings, some of which have been in use for centuries, long before the discovery and eventual use of the cyanotype process for this purpose.

Before undertaking an analysis of the advantages of the blueprint, it is important to enumerate some historical copying methods and their characteristics. One method, especially popular for copying or transferring full-sized details, was pouncing. In pouncing, a pin or other sharp tool was used to puncture the surface of a drawing, simultaneously pricking a blank paper below and thereby transferring the general outline

of the original drawing. Often, graphite powder or another marking material was dusted over the original, falling through the pinholes onto the blank sheet below, further emphasizing the outline. Special tools existed to assist with this work, most notably the pounce wheel, which could be rolled along a straightedge or drafting curve or manipulated freehand to trace an original. The copy made via pouncing would be merely an approximation of the original, with all the lines of the copy being manually drawn to connect the dots. The original drawing would be irreversibly altered as part of the process.

Another method called for powdered graphite or lampblack to be spread on the back of an original drawing which was then transferred onto another paper by the pressure of a blunt stylus. This method was notoriously messy, left traces of the process on the back of the original, and often resulted in indistinct lines on the copy that would have to be drawn over again. These problems were only partly remedied by the introduction of commercial carbon black copy paper in the mid nineteenth century.

Another method in use since at least the Renaissance involved ruling a light grid over the drawing to be copied, replicating the grid on a blank paper, and redrawing the content, square by square, to make the copy. If both drawings were made in ink and the grid in graphite, it was possible to erase the grid after copying and thus remove most traces of the process. The copy made by this method would resemble the original, but it would certainly not be an exact duplicate. Despite this, it was considered by one 1852

manual on industrial drawing to be the “most simple” and “most accurate and speedy” of the copying methods available.¹³

Optical and mechanical devices, like the camera lucida or the pantograph, could also be employed, but they too had serious disadvantages. High-quality, lens-based optical instruments like the camera lucida were expensive, and copies made with their aid often resulted in a change of scale from the original—a impossible concession for an architectural drawing drawn to a particular scale. The pantograph, a version of which was patented by English architect Sir Christopher Wren in the seventeenth century, allowed for the copying of drawings through a series of mechanical connections. When the outline of one shape was traced, that motion would be repeated by a writing instrument at the opposite corner of a parallelogram made of wood sticks pinned at particular points. The position of the connection points determined the scale of the reproduced drawing, and pantographs were most often used to increase or reduce the scale of the original. Pantographs without a scale change from original to copy were sometimes called multigraphs, polygraphers, or digraphs, and were often used to write two copies of a document at a time, perhaps most famously used by Thomas Jefferson.¹⁴ The device was plagued with mechanical problems, and the need to continually dip quills or pen nibs in ink made this process largely impractical. In general, pantographs were prone to faulty mechanics and inhibited the natural motions necessary for drawing. Furthermore, in

¹³ Dennis H. Mahan, *Industrial Drawing, Comprising, the Description and Uses of Drawing Instruments, the Construction of Plane Figures, the Projections and Sections of Geometrical Solids, Architectural Elements, Mechanism, and Topographical Drawing* (New York, 1863), 156.

¹⁴ See Silvio A. Bedini, *Thomas Jefferson and His Copying Machines* (University of Virginia Press, 1984). Jefferson’s polygraph was patented by John Isaac Hawkins in 1803, who then assigned American patent rights to painter and inventor Charles Wilson Peale. Jefferson corresponded at length with Peale to suggest improvements to the machine.

architectural applications, each draftsman using a pantograph copying at full scale would require a work area at least twice the size as normal.¹⁵

Tracing was the most common method of copying, where a translucent sheet of material was placed over an original drawing and redrawn onto the former with a pencil, pen, or other tool. Tracing media, whether thin parchment rendered translucent with linseed oil or a film made of fish glue dried on a smooth marble slab and peeled off, have been in use since at least 1400.¹⁶ More reliable and less malodorous tracing paper was commercially available by the beginning of the nineteenth century and could be overlaid on an original drawing and traced to make a copy.¹⁷ The thinness necessary for the tracing paper's high translucency, though, also meant that it was a weak support for drawing and prone to tearing, having "too slight a texture to bear much handling," according to one contemporary source.¹⁸ This, of course, was unsuitable for drawings that needed to be used regularly in the present or again in the future. This issue was partly

¹⁵ I use the term *draftsman* since the overwhelming majority of drafting room workers were men. Furthermore, women working in architectural drafting, even well into the twentieth century, referred to themselves as *draftsmen* or *draughtsmen*. The employment of women draftsmen in English offices was reported at least twice in *American Architect and Building News*. Tracing was presented a job appropriate to women, as it allowed them to "be protected from the rather disagreeable contact to which much of the architect's work would expose them." [Untitled editorial note], *American Architect and Building News* 1 (2 December 1876): 386. At the English firm Clarke, Chapman & Gurney at Gateshead, near Newcastle upon Tyne, women draftsmen worked in a separate building so they "need never meet or even see the other employees of the firm." "Draughtswomen in England," *American Architect and Building News* 13, no. 384 (5 May 1883): 214. In the United States, the offices of architect Grosvenor Atterbury included "half a dozen skilled and efficient women draftsmen." D. Everett Waid, "How Architects Work," *The Brickbuilder* 21, no. 1 (January 1912): 10.

¹⁶ Franz Maria Feldhaus, *Geschichte des technischen Zeichnens* (Franz Kuhlmann, 1967), 55.

¹⁷ For an overview of tracing paper, see Claude Laroque, "History and Analysis of Transparent Papers," *Paper Conservator* 28 (2004): 17–32. For the use of tracing paper in early modern Europe, see Anna Bortolozzi, "Transparent Paper as a Medium of Copying and Design in the Early Modern Architectural Workshop," *RIHA Journal* (2024).

¹⁸ W. E. Worthen, ed., *Appleton's Cyclopaedia of Drawing, Designed as a Text-Book for the Mechanic, Architect, Engineer, and Surveyor* (New York, 1857), 386.

solved in the mid nineteenth century by the introduction of tracing cloth or drafting linen, which was thin enough to be translucent but strong and flexible enough to be handled regularly.

Tracing defined the work of architectural offices for much of the nineteenth century. In 1907, architect George C. Mason looked back on the working conditions in American offices immediately after the Civil War. Due to differences in materials, instruments, and office methods, he recalls, “office work was consequently much more laborious and uninteresting; this largely from the monotony of tracing and duplicating drawings and sets of specifications. [. . .] Duplication and reduplication was a labor, but not one of love.”¹⁹ The tedium of tracing is a common feature of first-hand accounts of nineteenth-century architecture offices.

Tracing certainly had an advantage over earlier copying methods in that it did not alter the original drawing in any way, but it still had its share of problems. Copies made by any of the above processes are manual, mediated by a draftsman or other operator and thus involve the always costly and often unreliable factor of human labor. Tracing was time consuming and required a labor force that had to be paid and supervised. In an 1890 article on the operation of the offices of Burnham & Root in Chicago, the author writes that tracing “necessitated the employment of a large number of cheap draughtsmen who . . . were in the aggregate very expensive, and their work required much oversight to

¹⁹ George Champlin Mason, *Architects and Their Environment, 1850–1907; Together with Notes and Reminiscences of the Fathers of the Profession, Their Clients and Assistants* (Rubblestone, 1907), 46 and 48.

make it at all reliable.”²⁰ Sometimes, problems with the fidelity of tracings had to do with the skill or attention of the tracer, the position being one of the lowest paid in the office and often filled by teenage boys. Furthermore, each of the tracings would have to be examined and verified by a chief draftsman, adding even more time to the process. We will soon see how concerns about the fallibility of draftsmen played a crucial role in the rise of blueprinting.

A mechanical technology could in theory alleviate the problem of direct human mediation, and one was available, though it was of limited use in architectural drawing applications. Wet letterpress copying was invented by Scottish engineer James Watt around 1780 and was used into the 1950s. The process involved taking a moistened paper and pressing it in a screw press against a freshly written letter. Some of the water-soluble ink of the original would transfer to the damp paper. The copy would be in reverse, and so would be read through the back of the extremely thin copy paper.²¹ The benefits of this technology were acknowledged immediately. Of the new “wooden Clerk,” Gilbert Hamilton wrote to Watt: “Your new method intended for the utter extirpation of all Clerks, as [it] is much exacter than the best of them.”²² Two common problems were the smearing of the ink of the original and the tearing of the extremely fragile copy paper,

²⁰ “The Organization of an Architect’s Office, No. I,” *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 6 (11 January 1890): 84.

²¹ For more on the history and technology of wet press copying, see Barbara Rhodes and Wells Streeter, *Before Photocopying: The Art and History of Mechanical Copying, 1870–1938* (Oak Knoll Press, 1999); Sonja Titus et al., “The Copying Press Process: History and Technology, Part 1,” *Restaurator* 27 (2006): 90–102; and Michael Cook, “Towards a History of Recording Technologies: The Damp-press Copying Book,” *Journal of the Society of Archivists* 32, no. 1 (April 2011): 35–49.

²² Gilbert Hamilton to James Watt, 9 May 1779, quoted in Cook, “Towards a History of Recording Technologies,” 36. See also Richard Hills, “James Watt and His Copying Machine,” in *The Oxford Papers, Studies in British Paper History* 1, ed. Peter Bower (British Association of Paper Historians, 1996), 81–88.

especially when damp. The size of the required press and copy book for architectural drawings would have been prohibitively cumbersome, and the likelihood of tearing the copy paper would have increased with the large sheet size. Some special inks for copying architectural drawings were produced, but the resulting image would still be reversed.²³ Most importantly, though, this method of wet press copying generally needed to be done within one day of the inking of the original. Large architectural drawings took days or even weeks to execute, and there was often the need to edit or copy a drawing months or even years later. Although Michael Cook and others claim that Watt was motivated by a need to copy large technical drawings, it seems that his device was marketed exclusively as a “Machine for Copying Letters and Other Writings,” not drawings.²⁴

A photographic process could promise fidelity to the original and reduce the time necessary to make a reproduction. By the end of the nineteenth century, photography was beginning to become widely accepted as a dependable method of making images, even if culturally constructed and not an inherent property of the medium. In *Appleton's Cyclopaedia of Drawing* of 1857, it is noted that “duplicates of drawings are now very neatly executed, and of course accurately copied, by the Photographic Process.”²⁵ At a paper read before the Royal Institute of British Architects in 1877, the young architect Maurice Bingham Adams praised photography, “which for truthfulness and beauty must

²³ For a brief exploration of architectural copying inks, see Rhodes and Streeter, *Before Photocopying*, 37–38. They explain that, typically, “words and numbers were added to the drawings only after they had been copied.” Drawings could be viewed in their original, un-reversed state via transmitted light against a window or light table.

²⁴ See Cook, “Towards a History of Recording Technologies”; and James Watt and Company, *Directions for Using the Machine for Copying Letters and Other Writings* (Birmingham, 1780).

²⁵ Worthen, *Appleton's Cyclopaedia of Drawing*, 368.

ever remain unsurpassed,” and, beyond this, could serve “as a corrective in error in sketching, keeping the draughtsman up to the mark.”²⁶ Despite the promise of the medium’s fidelity in copying, its use remained impractical primarily due to the exorbitant cost of photographic reproductions and to the specialized nature of the required skills and equipment. Furthermore, many architectural drawings were larger than the largest commercially available photographic plate (mammoth plate, 18 by 21 inches), necessitating a reduction in scale, a difficult compromise to make when copying a drawing made to a very specific graphic scale. Making enlarged photographic prints from negatives added time and expense to the overall process, required specialized skill and additional equipment like a heliostat, and, moreover, was not widely practiced until the improvement of electric light and the later development of non-glass substrates for negatives. Despite these issues, photography was used occasionally to copy architectural and engineering drawings and maps, but typically only in urgent circumstances, such as the duplication of battle maps during the American Civil War.

Pouncing, gridding, pantographing, tracing, and photographing were, of course, not the only ways to make reproductions. Traditional printmaking techniques were sometimes used to reproduce and disseminate architectural drawings, but this was reserved for special purposes given the time required and costs involved.²⁷ Furthermore, especially before the application of photography to printmaking, the production of a printing plate also involved an intermediate draftsman or delineator. Even the use of

²⁶ “Architectural Illustrations—II, from a paper read by Mr. Maurice B. Adams before the R.I.B.A.,” *American Architect and Building News* 2, no. 60 (17 February 1877): 53.

²⁷ Some adapted lithographic processes were used for general office copying, See Rhodes and Streeter, *Before Photocopying*, 145–152.

simpler, more direct, and more recent inventions like lithography (1796) and hectography (1869) made little economic sense for the short print runs necessary for working architectural drawings.²⁸

Cyanotype and the Rise of the Blueprint

The cyanotype process, named for the distinctive cyan blue color of the resulting print, is incredibly simple, requiring few materials and little specialized skill. In some of his early cyanotype tests, Sir John Herschel used light-reactive chemicals to copy engravings (Fig. 2.2). He was impressed by the speed and accuracy of the process, and recorded in his notebook that it does the copying “very beautifully,” but also noted one curious feature: “the copies are negative.”²⁹ Herschel presented his discovery, which he named *cyanotype*, two months later at a meeting of the Royal Society of London on June 16, 1842.³⁰ The process was famously used by Anna Atkins soon thereafter to copy botanical samples by laying them directly onto sensitized paper and exposing them to light. Atkins is best known for her *Photographs of British Algae*, which was printed in

²⁸ Hectography was briefly used for the copying of drawings in the offices of Burnham & Root. See “The Organization of an Architect’s Office,” 84. An 1891 source notes: “The hektograph is not accurate enough for the framing plans, so the old blue-print process helps out here. Figures are never caught on top of a bubble, and one knows that everything that was on the tracing is sure to be on the blue print.” H. E. Perkins, “System in Architects’ Offices,” *Inland Architect and News Record* 17, no. 1 (February 1891): 3. For more on the history and process of hectography, see Robyn Tait, “Hectographs—Their History, Technology and Conservation Treatment,” *AICCM Bulletin* 22, no. 1. (1997): 65–67; and Rhodes and Streeter, *Before Photocopying*, 137–145.

²⁹ Herschel, *Experimental Memoranda*, quoted in Ware, “Cyanotype,” 25. Emphasis in the original.

³⁰ John F. W. Herschel, “On the Action of the Rays of the Solar Spectrum on Vegetable Colours, and on Some New Photographic Processes,” *Philosophical Transactions of the Royal Society of London* (1842): 81–114. See Mike Ware, “Herschel’s Cyanotype: Invention or Discovery?” *History of Photography* 22, no. 4 (1998): 371–379.

multiple installments beginning in October 1843 and considered the first photographically illustrated book (Fig. 2.3).³¹

The principle described by Herschel and used by Atkins is the same as the blueprinting process used by architects. First, the paper for the print must be sensitized in a solution of two chemicals: potassium ferricyanide (red prussiate of potash) and ferric ammonium citrate.³² On top of this paper is laid the object or drawing to be copied, having been made on a translucent or transparent substrate. The two stacked sheets are exposed to light and then the sensitized sheet is rinsed in water to develop and fix the print. A Prussian blue precipitate forms where light came into contact with the sensitized paper and rinses away in areas where lines on the original drawing prevented the penetration of light. Thus, a negative of the drawing or object is produced, whereby the black lines and white background of the original translate into the white lines and blue background of the negative duplicate (Fig. 2.4). A blueprint is a direct photographic image, meaning that there is no intermediate negative. It can also be classified as what photographers might call a photogram, an image made without a lens or camera where an object, in this case a drawing, is placed directly on a light-sensitive surface.

The cyanotype is notably simple among photographic processes. Robert Hunt remarked in 1857 that it “answers quite well for taking drawings from dried plants, or for copying prints” and praised “its cheapness, and the facility with which it can be

³¹ See Larry J. Schaaf and Hans P. Krauss Jr., *Sun Gardens: Victorian Photograms by Anna Atkins* (Aperture, 1985); and Larry J. Schaaf, *Out of the Shadows: Herschel, Talbot and the Invention of Photography* (Yale University Press, 1992).

³² The latter chemical can be replaced with any compound that allows for an iron(III) salt to be reduced to an iron(II) salt, which then reacts photochemically with potassium ferricyanide to produce Prussian blue pigment (hydrated iron hexacyano ferrate complex). See Dusan C. Stulik and Art Kaplan, *The Atlas of Analytical Signatures of Photographic Processes: The Cyanotype* (Getty Conservation Institute, 2013).

prepared.”³³ It achieved a level of simplicity in one respect that remains unrivaled to this day among photographic processes: the only chemical compound necessary to develop and fix the photographic image is water. Unlike other, more sensitive photographic processes, making cyanotypes did not require a formal darkroom. Instead, a slightly dimmed room shaded from direct light would be sufficient. Furthermore, sensitized paper could be kept for weeks or even months if stored in a light-tight container. For these reasons, blueprinting could be easily incorporated into the layout of existing architecture offices.³⁴

Among practicing photographers in the nineteenth century, the cyanotype was generally looked down upon as an inferior medium, in part because of the amateurish simplicity of the process and in part because of an artistic prejudice against its unapologetic blue color. Marcus Aurelius Root, in his lengthy survey of photographic processes published in 1864, dismisses the cyanotype process as “hardly worth the while to introduce.”³⁵ Beaumont Newhall makes no mention of cyanotypes in his *History of Photography*, a standard and representative survey in the field for decades.³⁶ Nearly all photographers and critics argued that the characteristic blue color of cyanotypes made

³³ Robert Hunt, *Manual of Photography*, 5th ed. (London and Glasgow, 1857), 152.

³⁴ This point is made by Lange and Berens. See Lange and Berens, “Blueprint Experiments,” 509. For a nineteenth-century description of room darkening strategies, see Benjamin H. Thwaite, “Heliography, or the Actinic Copying of Engineering Drawings,” *Scientific American Supplement* 23, no. 584 (12 March 1887): 9320. For a contemporaneous commentary on preparing and storing photosensitive papers, see Massachusetts Institute of Technology, *Notes on Mechanical Engineering and The Blue Process* (Boston, 1890).

³⁵ Marcus Aurelius Root, *The Camera and the Pencil* (New York, 1864), 402.

³⁶ Beaumont Newhall, *The History of Photography from 1839 to the Present*, rev. ed. (Museum of Modern Art, 1982). Newhall does mention cyanotype in *Latent Image*, but only in passing; see Beaumont Newhall, *Latent Image: The Discovery of Photography* (Doubleday, 1967), 61.

them ineligible to be considered artistic, with a few exceptions.³⁷ Historians of photography inherited this prejudice and have only recently begun to recognize cyanotype as a photographic process worth studying and exhibiting.³⁸ Interestingly, the same photographic process that was viewed as amateurish among one group became the photoduplication process that helped secure the professionalism of another.

Herschel's process seems to have been little used for copying between Anna Atkins's project and the 1870s, but it did not, as some scholars have suggested, go entirely unused. Herschel himself, as well as his son, Alexander Herschel, made cyanotype copies of calculations, tables, and astronomical charts as was widely reported in the nineteenth century.³⁹ In addition to Herschel's copies, there is a fascinating example from France in a short essay by H. Bischoff. In "Reproduction photographique en bleu de Prusse," published in March 1858, Bischoff admits that "for a long time I had been searching for a simple and easy means of obtaining a reproduction by light of an engraving or lithograph [or] drawing of machines and apparatuses, such as one finds in books or journals. Silver chloride is too expensive, bichromate of potash is not sensitive

³⁷ Adelaide Skeel, "Blues," in *American Annual of Photography and Photographic Times Almanac*, ed. C. W. Canfield (New York, 1889), 48–50; and John A. Tennant, "The 'Blue Print' and Its Variations," *Photo-Miniature* 1, no. 10 (January 1900): 481.

³⁸ In the United States, the first major survey exhibition of cyanotypes was held in 2016. See Nancy Kathryn Burns and Kristina Wilson, eds., *Cyanotypes: Photography's Blue Period* (Worcester Art Museum, 2016). The only general and notable exception to this rule is the work of Anna Atkins, which began attracting attention in the 1970s with the rise of second-wave feminism and a growing interest in the histories of photography and scientific illustration.

³⁹ See "The Cyanotype Copying Process," *Photographic Times* 7, no. 80 (August 1877): 175–176; and Ernst Lietze, *Modern Heliographic Processes: A Manual of Instruction in the Art of Reproducing Drawings, Engravings, Manuscripts, Etc., by the Action of Light; For the Use of Engineers, Architects, Draughtsmen, Artists and Scientists* (New York, 1888), 51. John Herschel also made a cyanotype copy of a Schiller poem he translated from German into Latin in 1867. See Ware, "Cyanotype," 31.

enough, and the later discoveries of Niepce are not easy to put in practice.”⁴⁰ Bischoff describes a solution to this problem that consists of placing a drawing made on translucent paper over a sheet of sensitized paper, exposing this to full sunlight, and using red prussiate of potash (potassium ferricyanide) to develop the image. The result: a reproduction of white lines on a blue ground.⁴¹ Bischoff’s copy is, without a doubt, a true blueprint—a negative cyanotype copy of a positive original.

The Herschel and Bischoff examples are exceptional, not representative; the use of the cyanotype process to make copies in the middle decades of the nineteenth century could be described generously as sporadic. The first commercially available paper, produced by Auguste Marion et Cie of Paris, went on the market in the 1860s, though was not widely recognized until 1872.⁴² This should not be viewed so much as a singular

⁴⁰ H. Bischoff, “Reproduction photographique in bleu de Prusse,” *Bulletin de la Société Vaudoise des Sciences Naturelles* 5, no. 42 (March 1858): 403–404.

⁴¹ Bischoff, “Reproduction photographique,” 403.

⁴² Marion described the large scale, mechanical production of blueprint paper for copying drawings of “furniture, machines, tools and other industrial products” in 1865. See A. Marion et Cie, *Procédés nouveaux de photographie: ou, notes photographiques* (Paris, 1865), “History of Photography,” microfilm, reel 120, no. 1299. Marion’s prepared blueprint paper was described again in 1870. See A. Marion, *Initiation aux procédés anciens et nouveaux, sels d’argent, ferro-prussiate et charbon* (Paris, 1870), “History of Photography,” microfilm, reel 120, no. 1294. The prepared paper does not seem to have been widely noticed until 1872. See C. Tronquoy, *Reproductions photographiques par le papier au ferro-prussiate de M. Marion* (Paris, 1872); “Séance de 2 Août 1872,” *Mémoires et compte rendu des travaux de la Société des Ingénieurs Civils* (Paris, 1872): 432–439; “Séance du 26 Juillet 1872,” *Bulletin de La Société d’Encouragement pour l’Industrie Nationale* 71, 2nd series, 19 (1872): 670–672; and Advertisement, *Year-Book of Photography and Photographic News Almanac* (London, 1875), n.p. Most secondary sources incorrectly give 1872 as the date Marion’s paper was first available. See, for example, Louis Nadeau, *Encyclopedia of Printing, Photographic, and Photomechanical Processes* (Atelier Louis Nadeau, 1994), 48; and Stulik and Kaplan, *The Cyanotype*, 5. Others have claimed 1876 as the year blueprint paper was first available commercially. See, for example, Kissel and Vigneau, *Architectural Photoreproductions*, 31. They might be repeating errors of early chroniclers of the process like Lietze; see Lietze, *Modern Heliographic Processes*, 55. James Andrew gives the date as 1881; James H. Andrew, “The Copying of Engineering Drawings and Documents,” *Transactions of the Newcomen Society for the Study of History of Engineering and Technology* 53 (1981–1982): 7. Marion became so closely associated with blueprinting that the process was called *Mariotype* in some contemporaneous French sources. See, for example, Charles Derosne, *La Photographie pour tous: traité élémentaire des nouveaux procédés* (Paris, 1882), 58.

initiator or sole enabler, but rather as an indication of a perceived market opportunity based on a general commercial need. At most it was a catalyst and facilitator, but a very important one. In the United States, the first major public demonstration of Marion's paper was conducted by P. Barnes at the February 1878 meeting of the American Institute of Mining Engineers in Philadelphia.⁴³ One contemporary commentator in *Scientific American* notes that the process had been in use for several years in France but that "American engineers have but recently begin to appreciate its value."⁴⁴ The fact that prepared paper was not readily available or widely known about, though, should not be taken as an indication that the blueprint process was never used. The April 1877 issue of the New York-based *Builder and Wood-Worker* referred in passing to "the well-known blue-process familiar to engineers and others."⁴⁵

Blueprinting was neither universally nor immediately adopted by engineers and architects in the United States, and architects in general adopted blueprinting later than

⁴³ P. Barnes, "Note Upon the 'Blue' Process of Copying Tracings, etc.," *Transactions of the American Institute of Mining Engineers* 6 (1877–1878): 197–198. In a footnote Barnes notes the significance of A. L. Holley and Ogden White in introducing the process to the United States. Ogden White read a paper "On Ferro-Prussiate Paper for copying drawings" at the February meeting of the institute in New York; "New York Meeting, February 1877," *Transactions of the American Institute of Mining Engineers* 5 (1876–1877): 27–50. Reflecting on the previous decade in 1882, MIT professor Channing Whitaker claimed that the process had been taught at MIT since 1876, two years before Barnes's demonstration; see Channing Whitaker, "Apparatus for Printing by the Blue Process," *Association of Engineering Societies* 1, no. 10 (August 1882): 358. Instruction in blueprinting is referenced in the 1878–1879 course catalog for MIT; Massachusetts Institute of Technology, *Fourteenth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, 1878–1879* (Boston, 1878), 39. Other authors claim that the process was introduced to the American public at the Centennial Exposition in Philadelphia in 1876. See, for example, W. W. Sturtevant, *How to Make Blue Prints* (Bruce Publishing Company, 1921), 14.

⁴⁴ "The Blue Process of Copying Tracings," *Scientific American* 39, no. 22 (30 November 1878): 340. The process was reported earlier in *American Architect and Building News*; see "The 'Blue' Copying Process," *American Architect and Building News* 4, no. 136 (13 July 1878): 44.

⁴⁵ "The Black Process," *Builder and Wood Worker* 23, no. 268 (April 1877): 53. Bill Addis claims that blueprinting was "commonly used" by the late 1850s but cites no sources to prove this assertion. See Bill Addis, *Building: 3000 Years of Design Engineering and Construction* (Phaidon, 2007), 379.

members of the engineering professions. But by 1884, less than a decade after its first major presentation in the United States, one author indicated the blueprinting was “The process in general use to-day in large manufacturing establishments, architects’ offices, &c.”⁴⁶ Another author in the same year noted that “of all these [copying] processes the ordinary blue negative system is most used, as being the cheapest, the easiest to work, and as yielding results which fulfill all necessary requirements.”⁴⁷ Despite its relative popularity, correspondents to professional periodicals were still asking for instruction in the fundamentals of blueprint making as late as 1896, serving as a reminder that blueprinting was by no means universally or simultaneously adopted.⁴⁸ Manual copying was still practiced, especially in smaller firms working on simple projects and in more traditional firms who continued to copy by older methods. Regardless, the rapid uptake of the technology within the span of one decade by much of the profession warrants close examination.

Advantages, Disadvantages, and Adaptations

Blueprints were the best option for reproducing architectural drawings because of the simplicity of the process, the comparatively low cost, and the durability of the result. Without a doubt, the chief selling-point of blueprinting was its simplicity. In a pamphlet about Marion’s prepared blueprinting papers, C. Tronquoy notes that the process is so

⁴⁶ James Sumner Pettit, *Modern Reproductive Graphic Processes* (New York, 1884), 8–9.

⁴⁷ “Processes for Copying Drawings and Tracings,” *American Architect and Building News* 16, no. 455 (13 September 1884): 125.

⁴⁸ “Trouble in Making Blue Prints,” *Carpentry and Building* 18 (October 1896): 231.

simple that it “can be used by everyone.”⁴⁹ In American periodicals and professional journals, readers were reminded that “any person of average intelligence can do the work in such a way as to meet ordinary requirements.”⁵⁰ In books and pamphlets on photography and modern reprographics, readers were told that blueprinting was a process “entailing a minimum of photographic knowledge and skill.”⁵¹ Additional contemporary sources describe blueprinting as “absurdly inexpensive,”⁵² and noted that “for simplicity and permanency it is second to none.”⁵³ Its simplicity even led to a long-lasting trope first introduced by Barnes in his 1878 presentation of blueprinting and carried on for decades in the professional press and in blueprint industry advertising. Barnes said, “The manipulations required are of the simplest possible kind, and are entirely within the skill and comprehension of any office boy who can be trusted to copy a letter in an ordinary press.”⁵⁴ Thirty-five years later, Keuffel & Esser still promised that their blueprinting machines were “so simple that they can be operated by a boy.”⁵⁵

Unlike other photographic processes, the chemicals needed for blueprinting were cheap and readily available from local suppliers. There was also a particularly forgiving

⁴⁹ Tronquoy, *Reproductions photographiques*, 7.

⁵⁰ “Making Blue Prints,” *Carpentry and Building* 16 (March 1894): 60.

⁵¹ Hall, *Blue Printing*, 2.

⁵² Tennant, “The ‘Blue Print’ and Its Variations,” 482.

⁵³ George Edward Brown, *Ferric and Heliographic Processes: A Handbook for Photographers, Draughtsmen, and Sun Printers* (New York, circa 1904), 7.

⁵⁴ Barnes, “‘Blue’ Process,” 197. This passage was paraphrased in what is possibly the earliest American article on blueprinting; see “The ‘Blue’ Copying Process,” 44.

⁵⁵ Keuffel & Esser Co., *Catalogue of Keuffel & Esser Co., Manufacturers and Importers, Drawing Materials, Surveying Instruments, Measuring Tapes*, 34th ed. (Keuffel & Esser, 1913), 230.

range of proportions of the two chemicals involved that would still yield an acceptable print, and no darkroom was required. Once properly rinsed, blueprints “possess a great power of duration,”⁵⁶ especially when compared to handmade copies on thin tracing paper or prints made by other photographic processes. The 1885 catalog of the New York-based drafting supplies company E. G. Soltmann included a section on “The ‘Blue Process,’” printed in blue ink to catch the reader’s attention and invoke the process’ distinctive Prussian blue color. Soltmann’s advertisement, which informed shopper-professionals who may not have been familiar with the process, is representative of the rhetoric surrounding blueprinting and warrants consideration in full:

Within the past few years the use of “Blue Prints” (copies of tracings by the Blue Process) has steadily increased. The *Low Price, the Rapidity with which they can be Produced*, and the *positive knowledge of having a facsimile of the original* are but a few of the many advantages gained by using these *copies*. Iron Workers, Bridge Builders, Machinists, etc., use them extensively. At a comparatively small outlay copies of every part of the work can be freely distributed among the men, thus overcoming the disadvantage of compelling a number of persons to work and measure from one drawing. Architects acknowledge it to be economical and convenient to furnish sets of “Blue Print” copies to the Builder, Mason, Carpenter, Stone Cutter and others who desire estimating on structures. The necessity of calling at the Architect’s office to examine the drawings or to await their turn in taking away the tracings is hereby obviated, and the contractors are enabled to estimate at their leisure.

The tracings are not injured or defaced, and can at any time be used for producing additional copies.⁵⁷

Low cost, high speed, great accuracy, and the streamlining of work in the increasingly complex building industry are the essential qualities of the process Soltmann advertises to

⁵⁶ Jerome Léon Vidal, *Cours de reproductions industrielles: exposé des principaux procédés de reproduction graphiques, héliographiques, plastiques, hélioplastiques et galvanoplastiques*, vol. 1 (Paris, 1882), 30.

⁵⁷ E. G. Soltmann, *Price List of Drawing Materials, Architects and Engineers’ Supplies, Blue Process Papers, Etc.* (New York, 1885), 23. Emphases in the original.

his perhaps-uninitiated customers. As far as the building industry was concerned, blueprinting was clearly far superior to any of the other methods of copying available at the time.

The commendations of simplicity and economy given to the photochemical process could also be given to the apparatus necessary for producing blueprints. A simple photographer's printing frame is all that was needed. To produce the best print possible, a blanket, cushion, or rubber or felt pad was placed beneath the sensitized paper and original drawing and a sheet of plate glass was placed on top. The glass, drawing, sensitized paper, and cushion were held in complete contact by springs and battens, and pressure bars pushed up from below (Fig. 2.5). Any gap between the drawing and the sensitized paper might allow light to bleed around the lines, resulting in a fuzzy or indistinct copy. The larger the drawing to be copied, the higher the chances for uneven contact and resulting imperfections. The number of United States patents for improvements to blueprint frames is astounding, with a variety of solutions ranging from simple clips to complex vacuum apparatuses.

One possible disadvantage of the blueprint, in addition to the potential for the optical and chemical imperfections noted above, is that it reverses the contrast of the original. That is, the resulting cyanotype is a negative of the positive drawing. This reversal was acceptable for many uses, especially for drawings to be used at construction sites, but it was noted as a "serious disadvantage" by some contemporary sources.⁵⁸ A

⁵⁸ Vidal, *Cours de reproductions industrielles*, 109. Lange and Berens have gone so far as to suggest that this reversal be viewed as a *benefit* of the blueprinting process: "In reversing the image, the blueprint not only created a reliable copy of an architecture drawing but also highlighted its complex information and made it stand out on the deep blue surface." Lange and Berens, "Blueprint Experiments," 510.

related concern at the time was that the Prussian blue background “fatigues the eye in some cases.”⁵⁹ Some architects worked around the reversal by blueprinting the drawing to be copied on a thin sheet of sensitized paper to create a negative, and then blueprinting that negative again to create a positive. This at least doubled the amount of time and materials required to make a copy and therefore remained an uncommon practice. The next simplest photoduplication process, the positive cyanotype (Pellet process), involved four chemicals as opposed to the two used in traditional cyanotypes. Despite this added complexity, the Pellet process was chosen by some architects, especially when white space might be needed on the copy for adding hand-applied color overdrawing or extensive annotation.⁶⁰ Another potential problem is that blueprints were difficult to photograph because their color did not register well on traditional photographic plates. One might need to photograph blueprints to reduce them in scale or to disseminate them in publications, and workarounds were found that made use of panchromatic photographic plates and deep-red filters.⁶¹

According to those advocating for the use of blueprints, these were, at most, minor inconveniences. George C. Mason, quoted above, recalled the tedious task of tracing drawings and the frustration at having to produce even more copy sets when one of the drawings that had left the office with a contractor was lost or damaged. It stands in stark contrast to the architects working at the time he was writing, in 1907: “Drawings

⁵⁹ “Methods of Chemically Reproducing Drawings,” *American Architect and Building News* 11, no. 322 (25 February 1882): 94.

⁶⁰ “A Simple Positive Blue Print Process,” *Carpentry and Building* 20 (October 1898): 255–256.

⁶¹ “Notes and Comments,” *Engineering Record* 53, no. 3 (20 January 1906), 63; and “Photographing Blueprints,” *Engineering Record* 70, no. 8 (22 August 1914), 216.

can be roughed out and then drawn directly on the linen; duplicated ad-infinitum with little labor and absolute accuracy; . . . Verily, the paths of the architects of the present time are strewn with flowers compared with the rougher experience of their predecessors.”⁶²

The most straightforward option for exposing sensitized blueprint paper was to take advantage of freely available sunlight. A common type of blueprinting frame was devised that was mounted on small wheels and rested on two parallel tracks that extended out of a window (Fig. 2.6). An early 1885 version was available in the United States for \$35.⁶³ These window-mounted solar printing frames, once a common feature of the American cityscape at the turn of the twentieth century, are all but forgotten today. No artificial light available in the nineteenth century was strong enough to expose the sensitized paper. In the first years of architectural blueprinting, even sunlight required long exposure times. An architect working at the end of the 1870s in a northern city on a cloudy winter afternoon might expect an exposure time of an hour or more—an excuse architects readily added to their roster of reasons for project delays.⁶⁴ By 1900, chemical improvements reduced the exposure time for a blueprint to as little as one minute.⁶⁵ Other

⁶² Mason, *Architects and Their Environment*, 49.

⁶³ Soltmann, *Price List* (1885), 29.

⁶⁴ See “A Blue Printing Process,” *Scientific American* 38, no. 3 (19 January 1878): 40. A later article in *Scientific American* notes that the exposure time could be several hours; see “Methods of Chemically Reproducing Drawings,” *Scientific American* 46, no. 12 (25 March 1882): 185.

⁶⁵ “Blue Printing,” *Carpentry and Building* 22 (June 1900): 156–157.

improvements led to a reduction in the cost of prepared blueprint paper; a 10-yard, 42-inch wide roll that cost \$4 in 1885 cost only 85 cents in 1916.⁶⁶

The blueprint process could not be surpassed for its combined low cost, rapidity, and simplicity, not even by the other photoduplication processes developed later in the nineteenth century, such as the blue-line (Pellet), brown-line, Van Dyke, and red-line processes. A commentator in 1905 noted that “almost every architect has made his own experiments in the use of different devices for duplicating drawings. All have tried the hectograph process, the moonstone process, and various other processes, but all have sooner or later returned to the blue printing process as the most correct, durable, cheapest and most convenient means of duplicating drawings.”⁶⁷

Historically, the volume of blueprints produced by architecture offices is astounding. By 1920, the Department of Architecture of the State of New York, for example, produced an average of eight thousand feet of blueprints per day.⁶⁸ The industry seems to have been fairly resilient, but they did face a notable crisis during the First World War, when potassium ferrocyanide from Germany was difficult to obtain and, when available, was more than thirty-fives times the pre-war cost.⁶⁹ The industry survived, and blueprints were still in “universal use” in 1921, despite advances in other

⁶⁶ Soltmann, *Price List* (1885), 25; and Defiance Manufacturing Company, *Drawing Materials, Architects and Engineers' Supplies, Blue and Black Prints, Lithographic Reproductions* (Defiance Manufacturing Company, 1916), 25. For an overview of blueprint paper production, see F. B. Hayes, “Blue Print Paper: Its Manufacture and Some of Its Characteristics,” *Scientific American Supplement* 75, no. 1933 (18 January 1913): 45–46.

⁶⁷ “Office Equipment of the Up-To-Date Architect,” *Carpentry and Building* 27 (July 1905): 198.

⁶⁸ “State Departments of Architecture,” *American Architect* 117, no. 2299 (14 January 1920): 45.

⁶⁹ “Advance in Cost of Blue Prints,” *Building Age* 38 (March 1916): 62; and “Coating for Blueprint Paper can be Produced by Simple Method,” *Engineering Record* 73, no. 18 (29 April 1916): 585.

inexpensive photoreprographic techniques and improvements in Pellet printing devices.⁷⁰ The same year, Benjamin James Hall explained to the readers of his *Blue Printing and Modern Copying for the Engineer and Architect* that the ferro-prussiate process was the “first in the field” and, “by reason of its simplicity and economy, still retains its popularity.”⁷¹ In 1930, one of the few statistical surveys of commercial blueprinting establishments was conducted in the United States. According to the report, which surveyed the 138 largest blueprinting companies in the country, the total aggregated business volume for 1930 was an astonishing \$12,615,733.⁷² Cyanotype blueprinting, in fact, remained the preferred method up to the 1950s, at which point the diazotype process and electrostatic photocopying surpassed it in efficiency of time and cost.

Complexity and Control

If the above confirms the popularity and advantages of blueprinting and provides a partial rationale for its adoption at a material-, medium- and process-specific level, it might be appropriate to ask next why blueprinting was adopted only in the 1880s, especially considering that the chemical process had long been available, technically having been discovered forty years earlier. Any attempt to answer to this question is necessarily multidimensional, consisting of a complex constellation of factors. The range of factors—from the increasing complexity of buildings and building, to the formation of the

⁷⁰ “Office Equipment,” *American Architect* 120, no. 2372 (20 July 1921): 52.

⁷¹ Hall, *Blue Printing*, 1.

⁷² Donald K. Wallace and U.S. Bureau of Foreign and Domestic Commerce, *A Nation-wide Survey of the Blue Print and Allied Industries. A Study of Production and Distribution Factors Including Costs, Profit and Loss* (International Association of Blue Print and Allied Industries, 1933), 1.

architect as an authoritative figure, to the changes in office arrangement and practice, to solidifying legal standards—will be the focus of the remainder of this chapter.

In situating the rise of blueprinting historically, it is necessary to consider the architectural profession and construction practice. Blueprints were made necessary in part by increasingly complicated buildings and building projects, as well as an increase in the amount of new construction overall, in part fueled by economic growth and capital investment between the financial panic of 1873 and instability of the 1890s. New and improved materials, construction technologies, and building systems were major factors in the exponential growth of architectural complexity toward the end of the nineteenth century. Furthermore, larger and more complicated buildings were made possible and necessary by increasing populations, rising land values, and growing practices of speculation. A larger building with modern amenities would bring in more sales and rental income than a smaller, older building on the same site. Larger corporations and more centralized and expansive government services necessitated more and larger buildings. For the first time in American history building, fire, and life safety codes were being passed and enforced. In order to carry out these complicated projects, and adhere to new requirements, far more drawings, and copies of drawings, were being produced for a single project than ever before.⁷³ According to an 1891 report, the New York office of the architect George B. Post, for example, produced between 3,500 and 5,000 drawings,

⁷³ For a discussion of blueprints in English engineering in this so-called Second Industrial Revolution, see Robertson, “Blueprints as Master Plans.”

tracings, and blueprints for a single building project.⁷⁴ These complex endeavors would have been unrecognizable to American architects of the preceding generation.

The increasing complexity of architectural projects coincided with telling signals of the rise of an architectural profession, and the height of blueprinting in the United States coincides exactly with the period in which the boundaries of the architectural profession were being delineated from the outside and from within. Increasingly, the architect was viewed as a designer whose work was intellectual, creative, organizational, and immaterial rather than manual or practical, in the strictest sense of the word, which was becoming more the domain of subcontracted workers for complex projects, or a local carpenter with craft knowledge for simpler ones.⁷⁵ The architect secured additional authority in this period through new legal and professional credentials. Illinois became the first state to formally require architects to be licensed in 1897, with others soon to follow. Twenty years before the Illinois licensure law was passed, architects were already concerned about the deleterious effects of un- or under-trained architects. The trespassers threatened to unsettle the status quo of the unofficial guild system. “The field of architecture in the United States, open as it is, with no barrier at which anybody’s right to enter it can be disputed, seems to be peculiarly tempting to adventurers; and there is no

⁷⁴ “The Organization of an Architect’s Office. No. VII,” *Engineering Record, Building Record and The Sanitary Engineer* 24, no. 23 (7 November 1891): 362.

⁷⁵ The concept of “immaterial labor” has been used recently by scholars considering late-twentieth-century and contemporary architectural practice. See Peggy Deamer, “Architectural Work: Immaterial Labour,” in *Industries of Architecture*, ed. Katie Lloyd Thomas et al. (Routledge, 2016), 137–147. See also Peggy Deamer and Phillip G. Bernstein, eds., *Building (in) the Future: Recasting Labor in Architecture* (Yale School of Architecture, 2010); and Peggy Deamer, ed., *The Architect as Worker: Immaterial Labor, the Creative Class, and the Politics of Design* (Bloomsbury Academic, 2015).

end to the confusion they make in it.”⁷⁶ Small measures were taken between this 1877 statement and the 1897 law, such as the unenforceable 1888 rule that draftsmen were not permitted to do work on their own outside of their paid position in a firm and sign that work as an architect.⁷⁷ Rules such as this one provided a sense of security to architects who feared being undercut in an unregulated system, and they argued that it was in the best interest of the general public to be sure that those designing their buildings met some minimum standard of training. It was this latter reason, public safety, that ultimately provoked the Illinois State Legislature to pass the licensure law.⁷⁸ The license was to be awarded after the successful completion of an examination which sought to prove knowledge of materials, building practice, laws, construction management, and the “practical application of such knowledge in the ordinary professional work of an architect.”⁷⁹ With licensure came the license stamp, allowing the architect to literally mark their drawn work with proof of their vetted expertise.

In addition to the symbolic, professional, and intellectual power that came with these new credentials and the expanded roster of services expected from an architect, the architect acquired more managerial and administrative power over two workforces: that of the office and that of the building site. In the office, a major firm could have over one hundred draftsmen on staff, and on a building site, the architect—via his blueprints,

⁷⁶ “Professional Etiquette,” *American Architect and Building News* 2, no. 95 (20 October 1877): 335.

⁷⁷ “Independent Work done by Draughtsmen Out of Hours,” *American Architect and Building News* 23, no. 651 (16 June 1888): 277.

⁷⁸ “Chicago,” *American Architect and Building News* 57, no. 1128 (7 August 1897): 49.

⁷⁹ Harvey B. Hurd, ed., *The Revised Statutes of the State of Illinois* (Chicago, 1897), chapter 10a, section 4, 169.

specifications, and designated superintendent(s)—ultimately ostensibly controlled the action of contractors, managers, and laborers. Timothy Hyde’s recent notes on historical building sites can be read in this light. He has suggested that we understand a building site as “a space of contingency . . . in a profound sense . . . as the mutual and continuous influence of human and non-human agencies.”⁸⁰ Blueprints, as exact copies of an architect’s original instructions, can be key non-human actors that extend human action and are loci of structures of authority. As the architect’s work became more abstracted from the increasingly complicated worksite, drawings became more necessary. Multiple copies of the same drawing enabled action at a distance, allowing an architect to maintain control over a project and give instructions to multiple workers in different places simultaneously and over time.⁸¹ Blueprints facilitated the transformation of architecture into a legitimate profession by physically extending the authority of the architect to be in many places at once while simultaneously facilitating the complex building projects that made necessary those very professional architects.

It is also in the last third of the nineteenth century that the concept of the general contractor emerges in the American construction industry, quickly becoming the predominant way to coordinate large projects.⁸² With the rise of the general contractor

⁸⁰ Timothy Hyde, “The Building Site, Redux,” *Journal of Architectural Education* 75, no. 1 (2021): 92.

⁸¹ In that they retain a stable meaning and authority across various contexts, blueprints fit Bruno Latour’s concept of immutable mobiles. See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Harvard University Press, 1988); and Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford University Press, 2005).

⁸² Norcross Brothers of Worcester, Massachusetts, considered to be the first general contracting firm, was founded in 1869. See James F. O’Gorman, “Builder: Orlando Whitney Norcross (Norcross Brothers),” in *The Makers of Trinity Church in the City of Boston*, ed. James F. O’Gorman (University of Massachusetts Press, 2004). This arrangement was practiced earlier, in England. See H. M. Port, “The Office of Works and Building Contracts in Early Nineteenth-Century England,” *The Economic History Review* 20, no. 1 (April 1967): 94–110.

and competitive bidding, architects had the option of inviting contractors to their office for them to take quantities for estimating, or to provide them with a cheap set of blueprints for themselves. Although architects designing their own offices in the 1880s often included a specific room for contractors to examine plans and specifications, a scrupulous contractor could need hours or days with the full set of drawings and specifications.⁸³ Architects and contractors alike, therefore, preferred a copy that could leave the office to be studied and then retained for future reference and record keeping.

In addition to having duplicate copies for contract estimating, multiple copies would be needed to provide to subcontractors and select workers. Writing his manual *Blueprinting* in 1919, John Friese provided vividly contrasting descriptions of a typical building site before and after the adoption of blueprints. Looking back on the old system, he notes that there would have been a single copy set of drawings kept on the building site in a small shack. Managers and workers would go to the shack whenever they needed to verify a detail or refresh their memories on other aspects of the project. Friese observes that, “Needless to say such procedure was very expensive in time wasted.”⁸⁴ Standing in contrast to the crowded chaos of the worksite in the time before blueprinting is the worksite of Friese’s contemporary world: “The value of the relatively cheap blueprint has become so recognized that at the present time it frequently happens that each worker on a given job will be given a blueprint or set of blueprints.”⁸⁵ With the ostensible freedom

⁸³ See Chelsea Ann Spencer, “The Contract, The Contractor, and The Capitalization of American Building” (PhD diss., Massachusetts Institute of Technology, 2024), 180.

⁸⁴ John F. Friese, *Blueprinting* (Manual Arts Press, 1919), 7.

⁸⁵ Friese, *Blueprinting*, 8

newly afforded by personal copies came an increased level of control by the architect-cum-manager. We can confirm Friese's claims by comparing them to the words of the contemporary architect and writer Harold Van Buren Magonigle. He explains that in his own working method he has a set of drawings blueprinted for the contractor, more for each of the trades represented by the general contractor, and a copy for his own employees on the site. This last copy is the one Magonigle would consult when he was required on site on site. He wrote, "I can control the way my own man keeps his drawings and thus be reasonably sure that when I want a drawing on the job it can be found; it is useless to expect a contractor to maintain order in the shanty and I have given up trying."⁸⁶

The Organization of the Architect's Office

If the network of connections and communication necessary to complete a building project were thought of diagrammatically, it is the architect's office we would find at the nexus. Blueprinting and unprecedentedly complex projects necessarily required new forms of office organization in terms of both space and labor. Spatially, the physical arrangement of the office would shift to accommodate changes. In terms of labor, blueprinting altered and redefined the positions necessary in architecture offices, the typical demographics of employees hired to fill those roles, and the overall workflow and office method. To accommodate growing complexity in an efficient way, the tasks of the large, corporate architectural office were fragmented. The duties formerly done by

⁸⁶ Harold Van Buren Magonigle, "Some Suggestions as to the Making of Working Drawings," *Brickbuilder* 22, no. 7 (July 1913): 148.

one individual were separated into a series of specialized tasks to be repeated by a trained worker or entire department, closely paralleling the contemporary rise of mechanized production with interchangeable parts. Frederick Winslow Taylor's work, culminating in his 1911 *Principles of Scientific Management*, and Frank and Lillian Gilbreth's more architecture-specific *Bricklaying System* (1909), could serve as models for the efficient organization of tasks.⁸⁷ Furthermore, much of the decision-making work formerly done at the building site, to be determined by a skilled builder, housewright, or artisan, was now done in the architect's office. By the beginning of the twentieth century, an architect's office was a complex, hierarchical network of individuals and teams (Fig. 2.7).

The increasing complexity of organizations is, of course, not unique to the architectural profession. In fact, it is in some ways an apparent and defining feature of the Great Merger Movement of American corporations in the ten years around the turn of the twentieth century. One British commentator marveled at the "subdivision and the specialization" of the American architectural system and commended the speed at which work could be carried out, but he called into question the detrimental effects such a system might have on drafting technique.⁸⁸ The space of the office itself also became larger and more fragmented. Rather than the gentleman-architect working in his library, or even a small team working in a drafting room atelier, architects' offices gained the subdivided complexity of a Victorian domestic interior, with dedicated rooms for design,

⁸⁷ Frederick Winslow Taylor, *Principles of Scientific Management* (Harper & Brothers, 1911); and Frank B. Gilbreth [and Lillian M. Gilbreth], *Brick-Laying System* (Myron C. Clark, 1909).

⁸⁸ "The Complete Organization of American Architects' Offices," *American Architect* 114, no. 2228 (4 September 1918): 294.

drafting, specification writing, photography, and blueprinting, plus individual offices for principals and managers.

Accommodating an increasing volume of documents for increasingly complex architectural projects necessitated changes in the makeup and workflows of architecture offices. The amount of space dedicated to articles describing workflows and office arrangements in American architecture and engineering periodicals is testament both to the general interest in the topic and to the variety of practicable solutions. Wilson Brothers & Co. of Philadelphia, the firm responsible for the design of train shed at Philadelphia's Broad Street Station (1881) and the main building at Drexel University (1888–1891), had a typical working method in their drafting department. Drawings were made in pencil on paper and permanent tracings in ink were taken from these drawings. The tracings were then blueprinted and retained for the firm's records, while the initial pencil drawings on paper, having served their purpose, were destroyed. The blueprinting was carried out by a boy whose sole job it was to make blueprints.⁸⁹ In this arrangement, the original pencil drawings were probably worked up and revised before being traced in ink on drafting linen, the latter becoming the master from which to make prints and, in some ways, becoming the new original. The practice of destroying the pencil original was not universal; a roughly contemporaneous textbook, the twelfth edition of Tuthill's *Practical Lessons in Architectural Drawing*, states that in a modern office "the originals

⁸⁹ The firm had three large blueprinting apparatuses on the roof of their offices, which could be accessed by stairs (for workers) or a dumbwaiter (for drawings). "The Organization of an Architect's Office, No. III," *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 12 (22 February 1890): 181.

are kept, as are also the tracings from which new blue-prints may be made as occasion demands.”⁹⁰

A reorganized workforce was required to carry out this new type of copying task. In earlier decades, tracings were made by junior draftsman. One of William Robert Ware’s motivations in establishing the architecture program at MIT in the 1860s was to produce a cadre of reliable junior draftsmen who could carry out routine office tasks like tracing and making working drawings. As Ware noted in 1865, “Any prosperous architect must leave nine drawings out of ten to be made entirely by his subordinates under supervision of course more or less minute.”⁹¹ Blueprinting allowed junior draftsmen, many of whom now had better, more uniform training, to focus on the work of drafting as opposed to the tedious work of copying. As an 1890 trade catalogue noted, blueprinting “saves not only much labor and expense, but a great deal of weariness to the junior draftsman, to whose lot it usually falls to make copies or tracings of drawings.”⁹² Tracing required skill and attention on the part of the junior draftsmen, but blueprinting, in the category of photochemical copying, required no drafting skill. At a smaller office, a junior draftsman would operate a blueprinting frame or machine, but at larger offices, individuals were hired with the sole charge of making of blueprint copies. In the hierarchy of the office, this new type of worker was below the rank of junior draftsman.

⁹⁰ William Burnet Tuthill, *Practical Lessons in Architectural Drawing*, 11th ed. (William T. Comstock, 1902), 12. The reference to blueprints in this section does not appear in the 10th (1897) edition; see William Burnet Tuthill, *Practical Lessons in Architectural Drawing*, 10th ed. (New York, 1897).

⁹¹ William Robert Ware to John Runkle, 27 April 1865, William R. Ware Papers (MC-0014), box 1, folder 2, Massachusetts Institute of Technology, Department of Distinctive Collections, Cambridge, Massachusetts.

⁹² F. W. McAllister, *Catalogue of Mathematical Instruments, Drawing Paper, Surveying Instruments, Levels, Paints and Drawing Materials* (Baltimore, 1890), 1.

In fact, it was often the general office errand boy who would have the slight promotion to blueprinter. At Wilson Brother & Co. of Philadelphia, for example, the position was “usually filled by one of the office boys who has served his term and been promoted.”⁹³ Work as a blueprinter was an appealing entry-level position because it could be a means to higher, more interesting, better-paying positions. It was also mostly isolated work, appealing to the individualism of young Americans who believed in the myth of the self-made man.⁹⁴ According to an article about the Drafting Department at the Union Iron Works, “nearly all of the blue-print work is done by boys, one or two of whom are taken from the store-room apprentices and worked in the blue-print department for a few months before entering the shops. These boys get to do their work very well in a short time.”⁹⁵ The promise of promotion from blueprinter was surely not always fulfilled. Photographs of printing rooms and catalog illustrations of blueprinting machines much more often feature older men than younger ones. Blueprinting was repetitive, physically demanding work that likely involved discomfort from exposure to chemicals and constant hunching and stretching; it was one of the most physically taxing tasks in an architecture office.⁹⁶

It should be made clear that junior draftsmen did not cease making tracings after the advent of blueprint copying in offices. Sometimes a junior draftsman would make a

⁹³ “The Organization of an Architect’s Office. No. III,” 181.

⁹⁴ For an exploration of the concepts of office fatigue and the self-made man, see Michael Zakim, *Accounting for Capitalism: The World the Clerk Made* (University of Chicago Press, 2018).

⁹⁵ “Draughting Department, Union Iron Works,” *Engineering Record* 41, no. 10 (10 March 1900): 228.

⁹⁶ This topic has not yet been explored by architectural historians. For chemical exposure in photographic practice in the nineteenth century, see Jennifer Tucker, “‘Diseases in the Darkroom’: Morality and Mortality in Nineteenth-century Photographic Chemical Work,” *PhotoResearcher* 41 (2024): 17–31.

tracing from a drawing on thick paper or an incomplete drawing by a more senior architect, and then the tracing would be blueprinted. Though this did involve tracing, the tracing would only have to be made, checked, and approved one time, and the blueprints would require virtually no oversight or verification beyond ensuring that the drawing was exposed and developed in a way that resulted in a legible document. Because tracing became less of a task of repetitive copying, it was increasingly viewed as more than a rote chore. The author of a 1917 textbook on machine drawing notes that, “while tracing is the first step of an apprentice draftsman in his profession, the student in mechanical drawing will find that considerable care, practice, and skill are required to make a satisfactory tracing.”⁹⁷ At Burnham & Root’s office, as noted earlier, copying in large numbers “necessitated the employment of a large number of cheap draughtsmen who [were a] very undesirable addition to the office force.”⁹⁸ Undesirable, perhaps, because they were laborers who had to share a drafting room and office with employees of higher status—increasingly, newly-minted graduates and aspiring professional from school of architecture. After the introduction of photoduplication in the offices of Burnham & Root, it was observed that “the host of cheap draughtsmen has gone, and those who remain are picked men, carefully sifted, ready to respond heartily to any call and well able to do good work at short notice.”⁹⁹

⁹⁷ Ralph Winchester Hills, *Machine Drawing, Prepared in the Extension Division of the University of Wisconsin* (McGraw-Hill, 1917): 71.

⁹⁸ “The Organization of an Architect’s Office, No. I,” 84.

⁹⁹ “The Organization of an Architect’s Office, No. I,” 84.

Written descriptions and plans of architecture offices were frequently published alongside commentary on office personnel and workflows. Blueprinting was so important that architecture and engineering firms altered the spatial arrangements of their offices to better suit the technology, giving valuable roof and window space over to blueprinting. Adler & Sullivan, for example, had their offices on the top two stories of their Auditorium Building in Chicago (see Fig. 2.10). Directly above the consultation room that separated Dankmar Adler and Louis Sullivan's offices, was the "Printers Room," with easy access by stairs to the "Blue Print Wash Room."¹⁰⁰ The Philadelphia offices of Samuel Hannaford & Sons included a dark room and print frame apparatus.¹⁰¹ The examples are seemingly endless, and most include substantial dedicated space for the now important task of blueprinting. Many firms in cities did not have the luxury of easily accessible roof space and instead made use of the window printing frame described earlier (see Fig. 2.6). The published plan of the offices of the Draughting Department of the Union Iron Works in San Francisco shows tracks for eight such solar printing frames projecting from the windows (Fig. 2.11).¹⁰² For offices that did not get sufficient direct sunlight or have roof access, one engineer in 1887 even suggested a system of pulleys for hoisting a printing frame to a higher position on the outside of a building.¹⁰³

¹⁰⁰ "New Office of Adler and Sullivan, Architects, Chicago," *Engineering and Building Record* 22, no. 1 (7 June 1890): 5.

¹⁰¹ "New Offices of Samuel Hannaford & Sons, Architects, Cincinnati," *Engineering Record, Building Record and The Sanitary Engineer* 22, no. 12 (23 August 1890): 180.

¹⁰² "Draughting Department, Union Iron Works," 227.

¹⁰³ Benjamin H. Thwaite, "Heliography, or the Actinic Copying of Engineering Drawings," *Scientific American Supplement* 23, no. 584 (12 March 1887): 9320–9321.

Whether due to city ordinance or rental agreement, some architecture firms in congested neighborhoods were not permitted to build permanent constructions from a window. The offices of George B. Post made use of a retractable framework that was interesting enough to illustrate in an 1891 edition of *Engineering Record* (Fig. 2.12).¹⁰⁴ The engineering office of the Boston Elevated Railroad Company included a specially constructed, timber-frame room on top of the office building they occupied: “This room is covered with copper plate, is heated by steam, fitted with incandescent lamps, and contains the usual apparatus for washing and drying blue prints. A large printing frame is mounted on a track which passes through a window in the easterly end of the room out on to the roof. This frame is so attached to the car as to allow of its being placed in any position to receive the rays of the sun. A telephone connects the blue print room with that of the chief draftsman below.”¹⁰⁵ At MIT’s campus, professor of mechanical engineering Channing Whitaker designed a custom blueprinting frame around 1881 that included a vacuum apparatus and could be adjusted on any of three perpendicular axes to directly face the sun (Fig. 2.13).¹⁰⁶

Not all architect’s offices made their blueprints in house. The number of commercial blueprinters listed in city directories in the decades covered by this study attests to this fact. Outsourcing was especially appealing to firms who did not have space

¹⁰⁴ “The Organization of an Architect’s Office, No. VII,” 363.

¹⁰⁵ “Office System, Engineering Department of Elevated Lines, Boston Elevated Railway Company,” *Engineering Record* 39, no. 8 (21 January 1899): 166.

¹⁰⁶ Whitaker described the device in a public presentation on 21 June 1882. See Whitaker, “Apparatus for Printing by the Blue Process.” The illustration of the apparatus on page 355 of the article was based on a photograph by Baldwin Coolidge (see Figure 2.14). For additional sources on blueprinting at MIT, see this chapter, note 43.

for blueprinting in their quarters or who did not typically work on the types of large projects with contractors that would require the production of blueprints. We know, for example, that around 1890 the Philadelphia office of architect Theophilus F. Chandler Jr. outsourced all of its blueprinting.¹⁰⁷ A mail-in service was even advertised in the 1880s to architects from “any part of the country, who have no facilities for making ‘Blue Prints.’”¹⁰⁸

In the first two decades of the twentieth century, many of the larger architecture and engineering firms began purchasing their own electric blueprint machines, leaving commercial blueprinters to cater to smaller firms or offer different services. These new electric blueprinting machines fell into several categories. The earliest and simplest versions, used in the last decade of the nineteenth century and often custom built, essentially consisted of an electric arc-light placed above a traditional solar printing frame. Although exposures by this method could take several hours, it freed architects from the constraints of making blueprints only during daylight hours.¹⁰⁹ Printing by electric light, even in this rudimentary method, could save time in other ways, as rapidity of exposure is only one part of the total time required to make a blueprint. Samuel L. G. Knox reminisced in 1901 that, “the limit of our blue-print production was in the ability and strength of the boys to handle these [solar window] frames. It took only thirty seconds to make a blue-print, but it took seven or eight minutes’ time to get the frame out

¹⁰⁷ “The Organization of an Architect’s Office, No. IV,” *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 13 (1 March 1890): 195.

¹⁰⁸ Soltmann, *Price List* (1885), 24.

¹⁰⁹ See H. G. Reist, “Bue-Printing by Electric Light,” *Transactions of the American Society of Mechanical Engineers* 22, no. 904 (1901): 888–898; and George J. Jones, “Electric Blue-Print Making,” *Scientific American* 89, no. 3 (18 July 1903): 45–46.

in place, back again, and ready for another exposure.”¹¹⁰ With an electric light setup, one drawing could be exposed while the next drawing and frame were set up nearby. Once the first drawing was fully exposed, the light could then be swung to the second drawing, and so on, virtually eliminating time lost to frame movement, setup, and transition.

Another development in electric printing, originally invented in England and then patented in the United States in 1901, consisted of a vertical glass cylinder around which a drawing and sensitized paper were wrapped and secured. An electric arc-light inside the hollow center was then turned on for the duration of the required exposure (Fig. 2.14).¹¹¹ Later, a high-thruput version of the drum machine was also developed, typically horizontal in orientation, in which the sensitized paper and drawing were fed around a rotating cylinder and exposed to a stationary row of arc-lights directed at it from outside the cylinder (Fig. 2.15).¹¹² After years of development and market competition, fully automated blueprinting machines appeared on the market that were able to expose, develop, fix, wash, and dry a blueprint in the span of two minutes (Fig. 2.16). One such machine, whose drum and lights were electrically powered, was available for \$279 in 1916.¹¹³ Despite the availability of these automatic machines, new manual window frame

¹¹⁰ Knox, quoted as discussant in Reist, “Bue-Printing by Electric Light,” 896.

¹¹¹ See, for example, Edward Schildhauer for Eugene Dietzgen Company, “Apparatus for Blue-Printing,” US Patent 687,272, filed 11 March 1901, issued 26 November 1901; and Samuel Brent Whinery for Pittsburgh Blue Print Company, “Blue-Printing Apparatus,” US Patent 699,355, filed 23 January 1902, issued 6 May 1902. One cylindrical machine that made use of sunlight did precede these; see “Apparatus for Making Very Large Blue Prints,” *Engineering Record, Construction Record and The Sanitary Engineer* 35, no. 22 (1 May 1897): 469–470. An example of a cylindrical blueprinting machine survives at the Frederic Law Olmstead National Historic Site in Brookline, Massachusetts.

¹¹² See, for example, Charles Spaulding, “Blue-Printing Machine,” US Patent 702,252, filed 10 December 1901, issued 10 June 1902.

¹¹³ Defiance Manufacturing Company, *Drawing Materials*, 37. The version that operated on alternating current was \$15 more. See also C. F. Pease, *Catalog B: Blue Print Machinery and Drafting Room Supplies*,

models continued to be available until at least 1917, and a floor plan showing the recommended layout for a printing room relying mainly on daylight was published as late as 1922.¹¹⁴ It would be wrong to suggest that all firms totally abandon one method for another. Frederick Law Olmstead, for example, continued to maintain a window frame on tracks even though he owned a vertical drum machine. Sun on a clear day had an intensity that had not yet been matched by artificial means.

Properties of the blueprint process necessitated changes in drawing techniques and conventions. Prior to the rise of blueprints, it was not uncommon to see color in construction drawings in the United States. Color often corresponded to specific materials, and the correspondence was conventional: red for brick, bluish gray for stone, light blue for iron, yellow for wood, and so on.¹¹⁵ Although cyanotypes can reproduce some degree of tone, blueprints are relatively bad at expressing gradient and certainly cannot reproduce color. This was noted early on by Herschel and again later by the earliest architects and engineers to adopt the process. Since color could neither be used in its traditional form nor reproduced easily, architects needed to adapt their methods. Some architects in the 1880s adopted a hybrid, transitional method, making blueprints and then applying color by hand to each copy (Fig. 2.8). In 1887, the English engineer Benjamin

2nd ed. (C. F. Pease, 1918). For a detailed overview on the technological development of blueprinting machines and related apparatuses, see Nystrom, “Learning to See,” 77–88.

¹¹⁴ Kolesch & Co., *Illustrated Catalogue and Price-list of Drawing and Tracing Papers, Sun Print Papers and Equipments, Drawing Instruments and Materials, Surveying Instruments, Accessories, etc.* (Kolesch & Co., 1917), 22; and Hall, *Blue Printing*, 73–74.

¹¹⁵ See, for example, S. Edward Warren, *A Manual of Drafting Instruments and Operations* (New York, 1872), 58–63; and Mahan, *Industrial Drawing*, especially Chapter 5, “Conventional Modes of Representing Different Materials,” 75–78. See also Basile Baudez, *Inessential Colors: Architecture on Paper in Early Modern Europe* (Princeton University Press, 2021).

H. Thwaite offered two options, recommending that “the sectional parts of the figure should be cross-hatched, or the sectional parts should be colored with shades slightly less opaque than the linear portions . . . and as these sectional parts of the print are reproduced almost white, they can be colored with the usual conventional colors, which could hardly be done on a blue ground.”¹¹⁶ At this phase, in what we can call the decade of the rise of blueprinting, Thwaite suggests either a workaround that produces a white area on which conventional color can be applied or the adoption of crosshatching conventions. Interestingly, just a decade later, Thwaite suggested the complete rejection of the former in favor of the full adoption of the latter (Fig. 2.9).¹¹⁷ By the turn of the twentieth century, the extra effort of adding color to construction drawings was altogether abandoned, and, in order to accommodate blueprinting, linear hatched conventions to represent materials became the norm.¹¹⁸

¹¹⁶ Benjamin H. Thwaite, “Heliography, or the Actinic Copying of Engineering Drawings,” *Scientific American Supplement* 23, no. 584 (12 March 1887): 9320.

¹¹⁷ Benjamin H. Thwaite, “Engineering Heliography, Or the Sun-Print Copying of Engineering Drawings,” *Transactions of the Federated Institution of Mining Engineers* 10 (1895): 69–88. In addition to noting the limited capacities of reprographic technologies, Jeffrey Brooker suggests that the increasing number of alloys used in engineering and manufacturing contributed to the abandonment of color on design drawings. Peter Jeffrey Booker, *A History of Engineering Drawing* (Northgate, 1979), 174.

¹¹⁸ See, for example, contemporary textbooks such as Charles Reinhardt, *The Technic of Mechanical Drafting: A Practical Guide to Neat, Correct and Legible Drawing* (Engineering News Publishing Company, 1904), plates 1–4. Drawings made in black ink only had been strictly required by the United States Patent Office as early as 1880 because reproductions were made for publication “by the photolithographic or other analogous process.” See United States Patent Office, *Rules of Practice in the United States Patent Office* (Washington, 1880), 10–13. The Patent Office published its own hatching conventions in 1899. See United States Patent Office, *Rules of Practice in the United States Patent Office* (Washington, 1899), 86. Eric Nystrom discusses the importance of color in mining maps and the effect of blueprinting on drafting practice; see Nystrom, “Learning to See,” 95–98. See also Paul Emmons, *Drawing Imagining Building: Embodiment in Architectural Design Practices* (Routledge, 2019), 143–144. For a history of early modern conventional signs, see Basile Baudez, “Conventional Signs in Early Modern Architectural Plans,” in *Approaches to Drawing in Architectural and Urban Design*. For a theoretical exploration of these conventional lines and symbols in a mostly twentieth-century context, especially those representing glass and insulation, see Paul Emmons, “Demiurgic Lines: Line-making and the Architectural Imagination,” *Journal of Architecture* 19, no. 4 (2014): 536–559.

The lines of a drawing also needed to take on a different character. The effect of the optical properties of certain inks and papers on the human eye does not necessarily reflect their optical properties when part of a blueprinting process. For example, although dark blue ink lines or pencil lines may be satisfactorily legible on an original drawing, those lines could be indistinct in a blueprinted copy. Architects adapted, beginning to almost exclusively use dark India ink, to which they sometimes added additional warm-colored pigments to reduce light transmission and thus improve blueprint line clarity. Some architects even added sugar to their ink, producing sticky lines they would dust with fine metal powder to render them completely opaque for the blueprinting process.¹¹⁹ Although blueprinting was adopted as a generally efficient, technological means of copying, its full implementation in day-to-day work required significant adaptations to traditional drafting techniques, materials, and practices.

Blueprinting not only changed the office workflow and drafting technique, but also the architectural design process itself and the resulting buildings. The medium facilitated the reuse of drawings and therefore promoted the standardization of details. This was possible (and practiced) before blueprinting, but new drawings would need to be traced for each successive purpose.¹²⁰ Using the same detail drawing from one building for another saved the time and expense of making drawings and writing specifications unique to each project, and it reduced the risk of errors resulting from the production of custom details on site. The working method of the architects of the Boston

¹¹⁹ Lange and Berens, "Blueprint Experiments," 513. For a comprehensive nineteenth century source on ink, see Sigmund Lehner, *The Manufacture of Ink* (Philadelphia, 1892).

¹²⁰ See the example of Ammi Young's Custom Houses for the United States Treasury Department in Chapter 1, note 122.

School Department is revealed in a 1919 article from *American Architect*. A drawing for a standard detail of “every possible feature of the building from column base to the flagpole on the roof” was made on tracing cloth. This drawing would be retained by the architects and “can be used for any number of buildings without further drafting, by striking off the necessary number of blue prints.”¹²¹ A related formal reproducibility was becoming the norm in architectural ornament with rise of mass-manufactured architectural terra cotta. Certain building types that became more prevalent at the end of the nineteenth century—namely steel-frame skyscrapers—lent themselves to this type of duplication in plan. Unlike most buildings, even a masonry high-rise building, the floor plans of skeleton-frame skyscrapers could be exactly repeated. It was a literal interchangeable part, and blueprinting as a duplicating technology lent itself to this kind of repeatable architecture.

The Power Ascribed to Blueprints

The professionalization of architecture, the growing complexity of building projects, and the increasingly managerial role of the architect required a new type of document, something other than a hand-made copy. Blueprints, the copies of drawings produced by the cyanotype process, did not have to come into common use when they did, if at all. Blueprinting was the process of choice because it was the most efficient method of repeatable, photochemical duplication. The most significant feature of photochemical processes like blueprinting and photography was their perceived

¹²¹ Clarence E. Dobbin, “Public School Buildings—Methods, Economies and Standardization in the Preparation of Plans,” *American Architect* 115, no. 2270 (25 June 1919): 894.

objectivity. That is, the idea that there was an exact, reliable, undeniable correspondence between original and copy.¹²² Humans, and drawings and copies made by humans, are variable and fallible. A hand-drawn copy can never be exact. At the conclusion of a practice problem on copying molding profiles, the author of an 1863 instruction manual notes that “the curve drawn through the points thus set off will be a copy of the given one; the accuracy of the copy depending on the skill of the draftsman.”¹²³ A photochemical process could eliminate the variability of a human draftsman prone to fatigue, a shaky hand, laziness, inconsistency, and, at worst, self-interest or malevolence. Thanks to its “strictly photographic” nature, according to an author in *Building and Wood Worker* in 1881, it could be trusted that, in a blueprint, “all details are closely reproduced, even to the texture or threads of the tracing-cloth.”¹²⁴ James Waterhouse, Assistant Surveyor-General of British India, articulated clearly the reasons to choose blueprinting over a human copyist: “The most skilful [sic] and careful draughtsman is liable to make errors in copying, and never can attain the same accuracy of delineation, especially of

¹²² The assumption that photographic processes are wholly mechanical or objective did not emerge until later in the nineteenth century. See Douglas R. Nickel, “‘Impressed by Nature’s Hand’: Photography and Authorship,” in *Using Visual Evidence*, ed. Richard Howells and Robert W. Matson (Open University Press, 2009), 42–54. See also Laura Saltz, “Natural/Mechanical: Keywords in the Conception of Early Photography,” in *Photography and Its Origins*, ed. Tanya Sheehan and Andrés Mario Zervigón (Routledge, 2015), 195–207; and Douglas R. Nickel, “Nature’s Supernaturalism: William Henry Fox Talbot and Botanical Illustration,” in *Intersections: Lithography, Photography, and the Traditions of Printmaking*, ed. Kathleen S. Howe (University of New Mexico Press, 1998), 15–23.

¹²³ Mahan, *Industrial Drawing*, 55. The problems of copying engineering drawings by hand, which “inevitably incorporated errors and changes,” is addressed in Eugene S. Ferguson, *Engineering and the Mind’s Eye* (MIT Press, 1992), 75. In the same book, see also “Appendix: The Hazards of Copying Technical Drawings,” 107–113.

¹²⁴ “Blue Process of Copying Drawings,” *Builder and Wood Worker* 17, no. 170 (November 1881): 193.

minute objects, as is obtained with the camera.”¹²⁵ In a commentary on the process of reproducing drawings in the offices of Burnham & Root, an author in *American Architect and Building News* notes that “the value of this ingenious invention to architects engaged in important work can be best appreciated by those who have had most experience of the stupidity and carelessness of tracing-boys, and who have had to foot the bills incurred through their mistakes.”¹²⁶ With blueprinting, the failings of the draftsman could be overcome, and the architect, armed with a professional degree and a license, could maintain direct authority over his or her projects.

Photographic and photomechanical objectivity, which early adaptors of blueprinting clearly had in mind as key features of the process, have been explicated and theorized by scholars for decades. William Ivins, in his groundbreaking *Prints and Visual Communication*, argued that technological progress itself was dependent on the ability to produce an “exactly repeatable pictorial statement” to facilitate communication. Ivins’s argument moves chronologically through the history of printmaking toward what he views as the apogee of visual communication: photography, or, more specifically, the halftone reproduction. Photography, Ivins says, is “not subject to the omissions, the distortions, and the subjective difficulties that are inherent in all pictures in which draughtsmanship plays a part.”¹²⁷ If a human copyist might be unreliable, and the presence of the human copyist is ostensibly absent from a photographic image, then the

¹²⁵ James Waterhouse, *Practical Notes on the Preparation of Drawings for Photographic Reproduction, with a Sketch of the Principal Photomechanical Printing Processes* (London, 1890), 2.

¹²⁶ “The Organization of an American Architect’s Office,” *American Architect and Building News* 27, no. 735 (25 January 1890): 50.

¹²⁷ William M. Ivins Jr., *Prints and Visual Communication* (Harvard University Press, 1953), 122.

understanding of photographic images as objective is possible, if not entirely accurate. Lorraine Daston and Peter Galison make a similar argument in the context of scientific illustrations, showing that what was desired in the nineteenth century was a specifically mechanical objectivity, one in which a “patient, indefatigable, ever alert” machine could be trusted over the potentially faltering or dishonest human.¹²⁸ In Daston and Galison’s scheme, the reason machines were preferred was “not simply that these devices saved the labor of human observers; they surpassed human observers in the laboring virtues.”¹²⁹

Made without a camera or lens, blueprints were exempt from contemporary debates about the distortions of camera-made, lens-based photographic images. Although the blueprint may overcome the concern of distortions produced by lenses and the problem of errors made by human copyists, it does not remove humans completely. The subject of a blueprint is not a piece of seaweed or another preexisting natural entity; rather, it is a drawing made by a human. There is no natural order of things to preserve in an architectural drawing as there is in a scientific illustration. Instead, what is at stake is the authority of the architect as expert, and any deviation from the original would undermine that authority. The only hand present in a blueprint is the hand of the architect or draftsman of the original drawing. The intermediary—whether that be a human copyist, a human-made lens, or both—is removed from the equation and thus the blueprint is imbued with the authenticity and authority of the original, the only intermediate factors being the sun and iron salts.

¹²⁸ Lorraine Daston and Peter Galison, “The Image of Objectivity,” *Representations* 40 (Autumn 1992): 119.

¹²⁹ Daston and Galison, “Image of Objectivity,” 83.

The blueprint copy possesses a special relationship with the original drawing. It is a rare hybrid that could simultaneously exploit the assumptions about photographs and architect-made drawings and yet not be only one or the other. A blueprint is stamped with both the objectivity of a photochemical process and the expertise of an architectural drawing. In the context of cyanotypes by Anna Atkins and others, David LaRocca has suggested that even the photographic term contact print “emphasizes the radical proximity, the adjacency” of the original object and its image.¹³⁰ Although he misunderstands the precise definition of a contact print, which is necessarily made from a photographic negative, his general point about proximity holds. In blueprints, the former physical adjacency of the original, as evidence even by the printed threads of the tracing cloth, takes on the metaphysical and even intimate adjacency of the architect and his or her corresponding expertise. The cultural associations with photography combined with the moral, virtuous tone that Ivins and Daston and Galison identify around objectivity also appear in much of the discourse around blueprinting. One leading manual by Ernst Lietze from 1888 says in its preface that blueprinting is “adapted to the special use of the Engineer, the Architect, and the Draughtsman, who may wish to employ the heavenly light as a copying clerk.”¹³¹ The heavenly light—a light that can be trusted.

¹³⁰ David LaRocca, “Object Lessons: What Cyanotypes Teach Us About Digital Media,” in *Photography’s Materialities: Transatlantic Photographic Practices over the Long Nineteenth Century*, ed. Geoff Bender and Rasmus R. Simonsen (Leuven University Press, 2021), 207.

¹³¹ Lietze, *Modern Heliographic Processes*, iii.

Blueprints and the Law

The American legal system had a similar estimation of the verisimilitude and resulting interchangeability of blueprints. A case in Nebraska in 1898 determined that “blueprints furnished by the architect, instead of the original drawings prepared by him, are ‘plans’ within the meaning of a contract requiring him to furnish the plans of a building and entitle him to compensation for [the] same.”¹³² Legally, in this case, there was no distinction between the original and the blueprint. Caselaw on the subject was convoluted and contradictory. In some contexts, unlike the Nebraska case, an original drawing and a blueprint were treated differently, such as with postage rates and customs duties.¹³³

The importance of drawings and blueprints for reasons of authority and accountability were widely understood. John Cassan Wait’s 1898 book *Engineering and Architectural Jurisprudence* is a collection of clauses from contracts and Wait’s commentary on them. In the section on architectural drawings, he reproduces a sample contract clause that calls for the contractor to retain architectural drawings during construction and then return them all to the engineer or architect at the completion of the project. Wait’s ensuing analysis reveals some of the concerns of the profession and the possible benefits of blueprinting: “The latter part of this stipulation is unsatisfactory to a contractor, as it takes evidence away from the contractor, unless he goes to the expense of

¹³² *School District v. Fiske* (Neb.), 84 N. W. Rep. 40 (1898), reported in “Law in the Building Trades,” *Carpentry and Building* 23 (May 1901): 125.

¹³³ “Postal-Rates on Drawings,” *American Architect and Building News* 16, no. 446 (12 July 1884): 22; and “Customs Duty on Architectural Plans,” *American Architect and Building News* 47, no. 1005 (3 March 1895): 140.

making copies of all plans and drawings. Nowadays specification and plans are usually printed or duplicated by photographic processes, so that contractor is provided with a copy which he is permitted to keep.”¹³⁴ The desire to retain drawings was due in part to their possible future use as evidence, revealing an anxiety, or at least an awareness, of the possibility of legal action. Wait immediately goes on to tout the benefits of photographic processes for the duplication of contract drawings, which allow each interested party to retain a copy. Wait does not consider the option of a handmade copy, perhaps because of the general knowledge that such copies are costly and unreliable, and that they bear an unverified relationship to the original.

Why the concern with evidence? As one late-nineteenth-century architect put it, “where there is no accountability there is no security.”¹³⁵ The idea of a drawing as a representation of the original intent of the architect is essential to any scheme of professionalization and any claim of expertise. Architectural authority was contingent upon the legal and professional accountability of architects. One author in *American Architect and Building News*, probably the journal’s editor William Rotch Ware, summarized the issue effectively at the end of the 1870s:

When plans and drawings have served their primary purpose as tools which the architect uses for carrying out his work, the value which remains to them is as records of it. These records may be of use to settle questions and disputes, if any arise afterwards, concerning the character of the work or the incidents of its execution, or as means of study, if alterations become necessary, or of reproducing it if it is destroyed. For all these uses the public is better served on the whole by the rule that the

¹³⁴ John Cassan Wait, *Engineering and Architectural Jurisprudence* (New York, 1898), 226.

¹³⁵ “Responsibility of Architects,” *American Architect and Building News* 1 (25 November 1876): 377.

drawings should remain in the keeping of the architect. In most cases they are safer so, and more accessible.¹³⁶

In this scheme, the drawing would hold more power and trustworthiness than even the architect's testimony. The precious drawings are ideally to be kept in the possession of the architect. These were related to concerns about intellectual property, as expressed by Arthur Gilman in his closing address at the 1867 convention of the AIA, in which he complained about builders who keep an architect's drawings after construction is complete and then profit off of the documents by using them again and again.¹³⁷

The significance of the use of blueprints, or any other visual material, as evidence should not be taken for granted. The increasing number of technical drawings produced and entered into evidence over the course of the eighteenth and nineteenth centuries was a result of significant shifts in jurisprudence. More specifically, the increased number of technical drawings was in part a direct result of the establishment and codification of patent law and the proliferation of patent offices.¹³⁸ As Jennifer Moonkin explains, it was only in the second half of the nineteenth century that evidence in American courts began to consist regularly of more than only spoken or written words. Photographic and machine-made images were at one time considered purely hearsay evidence. It was only as late as the 1880s, the same decade when most architects and engineers were adopted blueprinting, that photographic evidence became more common in the American courtroom. By the end of the century, visual evidence was given a privileged status as

¹³⁶ "The Custody of an Architect's Drawings," *American Architect and Building News* 3, no. 129 (15 June 1878): 207.

¹³⁷ Arthur Gilman, "Closing Address," in *Proceedings of the Annual Convention of the AIA*, 26–30.

¹³⁸ Alois Nedoluha, *Kulturgeschichte des technischen Zeichnens* (Springer, 1960), 69–70.

demonstrative evidence, a shift fundamentally tied to the introduction of photographs in the courtroom.¹³⁹ Visual evidence produced by photographic processes was not able to stand alone as definitive proof, but it was certainly understood as more than a tangential illustration used only to aid in witness testimony. Blueprints were one such photographically produced record and thus were more than supplemental illustrations to claims: they could serve as their own form of evidence.

Blueprints, like all paperwork, are not only a form of communication; they are simultaneously a record of that communication.¹⁴⁰ Spoken instructions—though generally acceptable in earlier periods when projects were smaller, material and building technologies were simpler, fire and life safety codes were nonexistent, and legal action was less common—were no longer sufficient. The author of an 1891 article on “The Management of an Architect’s Office” warns: “Do not trust to verbal messages; they are nearly always improperly delivered. Write whatever you cannot say personally.”¹⁴¹ This also explains the increased frequency and detail of contracts. The architect’s control over the worksite and building were confirmed legally in contracts, which gave the architect and his or her drawings the most privileged position in the system.

¹³⁹ Jennifer L. Moonkin, “The Image of Truth: Photographic Evidence and the Power of Analogy,” *Yale Journal of Law and the Humanities* 10, no. 1 (1998): 1–74. Joel Snyder echoes the argument that photographs gained meaning in the American legal system through analogy with writing; see Joel Snyder, “Res Ipsa Loquitur,” in *Things that Talk: Object Lessons from Art and Science*, ed. Lorraine Daston (Zone Books, 2004), 195–221. For the general building of trust in photographic evidence in the nineteenth century, see Jennifer Tucker, *Nature Exposed: Photography as Eyewitness in Victorian Science* (Johns Hopkins University Press, 2005).

¹⁴⁰ See Lisa Gitelman, *Paper Knowledge: Toward a Media History of Documents* (Duke University Press, 2014). For Gitelman, any object becomes a document the moment it is mobilized as evidence. For paperwork as evidence, see Zakim, *Accounting for Capitalism*, 12.

¹⁴¹ “The Management of an Architect’s Office—II,” *American Architect and Building News* 33, no. 819 (5 September 1891): 148.

The professional and legal power of blueprints explains the seemingly endless, heated debates in the period around the custody of architectural drawings. Architects believed that they had a right to their drawings and their relationship with them was “in a manner paternal.” The suggestion of their transfer to an individual or intuitional client was “an outrage to [the architect’s] self-esteem”¹⁴² Even in the American context, the historical event that stoked the debate was the seizure of Charles Barry’s drawings for the Houses of Parliament at Westminster by the Commissioner of Public Works from the architect’s heirs. The Commissioner’s action was upheld by the English courts. One American responding to the controversies of drawing custody explained that a client may ask to obtain copies of drawings for their own records, but “not because he has in justice or in usage any claim of ownership in the original drawings.”¹⁴³ This statement was made in 1879, well before the widespread use of blueprinting, and the anonymous author goes on to stipulate that “the architect should be paid the cost of making these copies” especially because of the “considerable amount of additional work” making copies would entail.¹⁴⁴ What is significant about original drawings is that they can be blueprinted to make additional copies, but a blueprint cannot—at least not easily. In the context of the organization of mining companies, Eric Nystrom has argued that the irreproducibility and destructibility of a blueprints actually worked to “reinforce the authority of the

¹⁴² Robert Kerr, *The Consulting Architect: Practical Notes on Administrative Difficulties and Disputes* (London, 1886), 293–294.

¹⁴³ “Custody of an Architect’s Drawings,” 208.

¹⁴⁴ “Custody of an Architect’s Drawings,” 208.

original.”¹⁴⁵ If an architect’s relationship with a drawing was “paternal,” so, too, was the relationship of an original drawing and its derivative blueprints.

Detailed drawings, specifications, and contracts became in themselves evidence of architectural professionalism. Arthur Gilman, again in his closing remarks at the 1867 AIA convention, verbally painted a thoroughly contrasting picture of a builder-amateur and an architect-professional, decades before these were more formally divided in practice, training, and law:

Instead of plans and elevations neatly drawn and carefully figured; instead of stone and framing plans drawn in the most thorough manner, and every detail drawn out at full size, so that sometimes, as we all know, the drawings for a single large building are counted by hundreds; instead of matured specifications of pages in length, whose items describe in the fullest and most exact manner all the work to be done; instead of all the plans, specifications, and contracts being signed and identified by the contracting parties before the work is commenced,—the ‘practical architect’ palms off upon his employer a dozen hasty drawings in pencil, to a small scale,—a specification, as I have often seen them, not fairly covering a single sheet of fool’s cap, *and often no contract at all*,—relying merely on verbal agreements with the mechanics, with a perfectly well understood bonus to himself, of from 5 to 10 per cent as the fundamental consideration. I have known such men never to make a detail drawing until the workmen have waited for it a week or more, and then to roughly scratch it out on a board on the spot, handing it to the men with a muttered curse for their presumed stupidity in not being able to get on with their work without a word of explanation. Is it any wonder that such an ‘artist’ alters, re-alter and alters back again nearly the whole of his meagre ideas during the progress of the work, or that he almost invariably, by these means, makes his buildings cost almost double the sum first placed at his disposal for their erection.¹⁴⁶

Like licensure was framed as a matter of public safety, professionalization in architecture and its guild-system monopoly was framed as a matter of consumer protection. The way

¹⁴⁵ Nystrom, “Learning to See,” 93.

¹⁴⁶ Gilman, “Closing Address,” *Proceedings of the Annual Convention of the AIA*, 30. Emphasis in the original.

for architects to prove their work and expertise, from a drafting room at a remove, was through the production of documents.

In addition to serving as records and evidence, exact duplicates of drawings were essential in order for the contractor bidding process to be fair. In fact, this was one of the few points made in the first article ever published on blueprinting in *American Architect and Building News*.¹⁴⁷ Discrepancies between copies could lead to annoyance at best and financial ruin at worst. One notorious case was *Sexton v. Chicago*—a legal battle widely known at the end of the nineteenth century. On March 30, 1878, the City of Chicago solicited bids from contractors for the construction of its newly designed City Hall. The new building was a masonry structure supplemented with iron supports and an iron beam roof. Separate bids were solicited for excavation, foundations, cut stone, masonry, and iron. Of the bids submitted for the iron work, the City contracted with Patrick J. Sexton for just over \$100,000. In preparing their bids, some contractors were presented the original drawings, whereas Sexton and others had examined traced copies of the originals. But the tracings he was shown differed in important ways from the originals. Sexton's bid was based on drawings that showed iron beams that were seven pounds per linear foot and an upper floor that contained simple skylights. Revisions had been made to the original drawings and not updated on the tracings. The updated version included iron beams were ten pounds per linear foot, rather than seven, and skylights with elaborate iron superstructures. In total, the seemingly small discrepancies would have amounted to a 10 percent increase in expenses. The City attempted to hold Sexton to his contract, based on the incorrect drawings, and argued that Sexton should be responsible

¹⁴⁷ "The 'Blue' Copying Process," 44.

for the difference in cost. It was reported that the City claimed they were not liable, arguing that “Sexton might have seen [the original plans], if he had asked to do so.”¹⁴⁸ Upon appeal, the City further argued that “It is the original plan, and not a tracing, to which the contract refers, and which must be consulted in every case of difference or dispute between the parties.”¹⁴⁹

The decision of the Superior Court of Cook County, upheld by the Appellate Court of the First District of Illinois, ruled in favor of the City of Chicago. The case was finally appealed the Supreme Court of the State of Illinois in 1883, which reversed the decision of the lower courts. In ruling in favor of Sexton, justice John Mulkey noted that a Mr. Jordan, the city architect’s draftsmen, had “through inadvertence or neglect . . . failed to make the corresponding correction in the tracing copies” and that the City was responsible. In a related case three years later about forfeiture of the contract, the Supreme Court upheld that the City “owed the duty to prepare and furnish him [Sexton] with accurate plans and tracings,” which it neglected to do.¹⁵⁰

While the legal battle in *Sexton v. Chicago* was ostensibly over which party should pay for iron beams, it was the status of handmade copies of architectural drawings that was ultimately in question. Regardless of the outcome, this case proved that using original drawings as legal documents posed an unnecessary risk. Original drawings are mutable, both over time—through honest or fraudulent revision—as well as from original

¹⁴⁸ Theodore Minot Clark, *Architect, Owner and Builder before the Law* (New York, 1894), 154.

¹⁴⁹ Norman L. Freeman, “Patrick J. Sexton v. The City of Chicago,” in *Reports of Cases at Law and in Chancery Argued and Determined in The Supreme Court of Illinois* 107 (Springfield, 1884), 325. See also Clark, *Architect, Owner and Builder before the Law*, 153–154.

¹⁵⁰ Norman L. Freeman, “The City of Chicago v. Patrick J. Sexton,” in *Reports of Cases at Law and in Chancery Argued and Determined in The Supreme Court of Illinois* 115 (Springfield, 1884), 230–245.

to handmade copy, through the mediation of a draftsman. In an article on the management of architectural offices, D. Everett Waid offers suggestions to his readers for mitigating these issues: “The specifications and the drawings also should be identified by the signatures of the contractor. A set of blue prints as being less susceptible of alteration is set aside for the signed office copy.”¹⁵¹ A blueprinted record like this would eliminate the possibility of an erased line or a changed number. Coincidentally, the year Sexton submitted his bid (1878) was also the year in which blueprinting was first brought to the attention of a wide audience of American architects and engineers.

Blueprinted copies also added additional security. Significant loss from fire was not uncommon at the end of the nineteenth century. A letter to the editors of *American Architect and Building News* from 1880 describes a situation in which a set of drawings were loaned to an iron foundry that subsequently burned down. According to the architect, “the great hurry to get out the work prevented us from making tracings, therefore I gave the contractors the original drawings.”¹⁵² No copies had been made because of a rush, but blueprinting could solve this problem in only a few minutes. The offices of Shepley, Rutan & Coolidge of Boston, the successor firm to H. H. Richardson’s practice, had installed “a large fireproof vault, reserved for drawings of which duplicates do not exist.”¹⁵³ The success, importance, and ease of blueprinting, combined with the serious risk of loss by fire or other disasters, even led some firms to go back and make

¹⁵¹ D. Everett Waid, “The Business Side of an Architect’s Office IV,” *Brickbuilder* 11, no. 9 (September 1902): 191.

¹⁵² “Responsibility for the Accidental Destruction of Drawings,” *American Architect and Building News* 9, no. 263 (8 January 1881): 22.

¹⁵³ “The Organization of an Architect’s Office, No. II,” *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 11 (15 February 1890): 165.

blueprints of drawings that had not been otherwise copied for whatever reason. American periodicals eagerly republished a discovery noted in *Deutsches Baugewerbes Blatt* that saturating drawings in benzene would render them translucent enough to blueprint and would not irreversibly alter the original.¹⁵⁴ The lines on these blueprints were not as crisp as those made from drawings on tracing paper or cloth, but they did allow for the copying of a firm's archive. With a blueprinted copy, the architect could be assured of both accountability and security.

Managing Records, Managing Evidence

These objective records would be useless if they could not be found, and there is another kind of virtue present in disciplined organization. Clinton Blake, in his 1924 manual of legal advice for architects, admits that he is “heretical enough to believe that an architect may be a great artist in the truest sense of that term and at the same time a man possessed of sound business sense and judgment, and that he may organize his office on business principles and conduct it on a basis of business efficiency.”¹⁵⁵ It was not only virtuous to keep records but also to organize them in a rigorous and orderly way. As was commonly noted in contemporary sources, the entire success of a business could be “greatly aided or seriously jeopardized” by the efficiency of their filing system.¹⁵⁶ In his

¹⁵⁴ “Copying Drawings,” *American Architect and Building News* 26, no. 721 (19 October 1889): 188. See also “Rendering Paper Transparent,” *Carpentry and Building* 5, no. 11 (November 1883): 225.

¹⁵⁵ Clinton Hamlin Blake, *The Architect's Law Manual* (Pencil Points Press, 1924), 18.

¹⁵⁶ Walter Desborough, *Office Machines, Appliances and Methods* (Sir Isaac Pittman & Sons, 1921), 105. The last chapter of Michael Osman's book *Modernism's Visible Hand* describes similar regulatory and organizational roles of paperwork in American architectural practice; see Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America* (University of Minnesota Press, 2018). For a history

1928 book on drafting room practice, aimed at architects, architectural author and editor Eugene Clute recommended blank forms and rubber stamps to facilitate office organization and reproduced twenty five samples.¹⁵⁷ Clute also insisted on a triple-entry form of record keeping in relation to drawings; when a copy of a drawing is made, it should be noted separately on the original, the copy, and on a form to be kept and filed by project number.¹⁵⁸ A similar filing system was used at the Metropolitan Water Works in Boston, where anyone in the office requiring a print would fill out standardized cards to request and track copies (Fig. 2.17).¹⁵⁹ In many offices, notations were also made on the original drawings, often in title blocks, any time a change was made or a blueprint copy was produced.¹⁶⁰

The amount of paperwork in a single office became unwieldy, and clerical roles specifically for filing and record keeping were created. A description of the Union Iron Works from 1900 is enlightening: “All the records of blueprints are kept by the ladies who have the classification and storage of drawings. Orders from the shop or draughting room for blueprints pass first through the hands of the ladies, who keep accurate records of all prints issued. Their office is in telephonic, voice tube and dumb waiter communication with the blue-print room, directly above, another interesting adjunct to

of analog office information storage via the technology of filing and the filing cabinet, see Craig Robertson, *The Filing Cabinet: A Vertical History of Information* (University of Minnesota Press, 2021).

¹⁵⁷ Eugene Clute, *Drafting Room Practice* (Pencil Points Press, 1928), 18.

¹⁵⁸ Clute, *Drafting Room Practice*, 297.

¹⁵⁹ “Office Furniture, Engineering Department, Metropolitan Water-Works,” *Engineering Record, Building Record and The Sanitary Engineer* 38, no. 16 (17 September 1898): 336.

¹⁶⁰ Ralph E. Flanders et al., *Drafting-Room Practice*, 2nd ed., Machinery’s Reference Series 2 (Industrial Press, 1909), 5.

the draughting room.”¹⁶¹ Furthermore, only blueprinted copies—never original drawings—were permitted on the shop floor.¹⁶² In a series of articles on “The Management of an Architects’ Office” in *American Architect and Building News*, the author sternly reminds the readers: “Never let an original go out of the office without either a receipt or a voucher in the shape of a letter of transmission which should state the general contents and all prices quoted.”¹⁶³ The language of a 1917 textbook for an extension school program given through the University of Wisconsin is even stronger: “In all up-to-date drafting offices the pencil drawings are never allowed to be taken out of the office, but are traced on transparent cloth, and from this blue prints are made.”¹⁶⁴ This is not simply an issue of trust and cautiousness, but one of authority and management of knowledge and evidence. According to J. J. Harmon, writing in 1907, “in order for a working drawing properly to fulfill its mission, it must not only furnish instructions to the workman, but it must also be capable of easy duplication, and be so made that it can be indexed and filed away according to some convenient system.”¹⁶⁵ The value of a drawing is in its role as communicator, offering a retrievable, reproducible, incontrovertible record of an architect’s instruction, authority, and control. For Harmon, the ability to be

¹⁶¹ “Draughting Department, Union Iron Works,” 228. For an overview on office furniture and arrangement in the context of mining engineering, see Nystrom, “Learning to See,” 107–124. For an early description of tracking and filing drawings in an architecture office, see Perkins, “System in Architects’ Offices.”

¹⁶² “Draughting Department, Union Iron Works,” 228.

¹⁶³ “The Management of an Architect’s Office—II,” 149.

¹⁶⁴ Hills, *Machine Drawing*, 71.

¹⁶⁵ J. J. Harmon, “The Making, Indexing and Filing of Drawings,” *Engineering Record* 55, no. 7 (16 February 1907): 189.

blueprinted is vital and requisite for any document that is to be considered an architectural drawing.

Conclusion

Blueprints were instrumental in the transformation of architecture into a legitimate profession. This is especially true in the United States where, unlike in Europe, a strong national professional identity had yet to form before the time blueprinting was widely used. Blueprints physically extended the authority of the architect and facilitated increasingly complex building projects. Architects became managers, capable of the carrying out their role at a distance thanks to blueprinted copies of their schemes. The power of the blueprint ultimately lies in its status as an ostensibly objective, photochemical copy of the architect's original drawing, something especially important in the formative years of the modern profession. It is thus a document imbued with authority, and this feature of blueprints explains in part their crucial role in the establishment and crystallization of the architectural profession in the United States. These inexpensive documents stand at the center of accountability, authenticity, trust, evidence, and control.

This chapter not only provides an overview and analysis of the prevalence of blueprints over certain decades but also demonstrates more broadly how the careful study of a ubiquitous technology and its associated discourse can lead to a fuller understanding and better contextualization of the history and assumptions of a profession. In the case of architects, blueprinting is connected with the reorganization of working methods and office practice, the distancing of the professional architect from both builder and building

site, and even the duplication of architectural features, from details to entire floor plans. Concerns for speed and cost, two of the same factors that made blueprints favorable to manual copying, were the reasons that blueprinting was more or less abandoned in the 1950s for the more efficient diazotype process and electrostatic photocopying. The change went almost unremarked on in the professional press probably because the transition from one ostensibly accurate photochemical copying method to another was far less transformational or even existentially relevant than being freed from the inaccuracies of hand copying in the first place. Regardless of the photochemical or photostatic method of reproduction, notions of authority and control were and are still linked to copies of architectural plans.

One of the factors that makes researching blueprints so frustrating ultimately helps make a strong case for their power, ubiquity, and deep ties to authority in the American architectural profession: today, the word *blueprint* is used to describe almost anything except a cyanotype copy of a drawing, with white lines on a blue ground. It was still defined in this narrow, accurate sense in a 1941 edition of *Webster's Dictionary*, where a blueprint is described as “a positive print obtained from a ferricyanic process from a transparent negative.”¹⁶⁶ Among architects, *blueprint* has often stood in for the word *plan*, and the professional and popular press as well as the general public have parroted the analogical, metaphorical slippage.¹⁶⁷ More significantly, *blueprint* has come

¹⁶⁶ Noah Webster et al., *The Modern Webster Dictionary for Home and School, Self-Pronouncing* (World Publishing Company, 1941), 68.

¹⁶⁷ See, for example, Shane Reiner-Roth, “Original blueprints for World Trade Center towers found in trash, sold for \$250,000,” *The Architects Newspaper* (11 March 2020). The plans in question, one of which is illustrated in the article, are very clearly diazotypes, not blueprints.

to mean *master plan*, or any sort of top-down, carefully coordinated scheme meant to be followed exactly. Today, the online edition of the same dictionary quoted above includes a second definition of “blueprint” as “something or someone . . . serving as a model or providing guidance” and “*especially*: a detailed plan or program of action.”¹⁶⁸ Recent uses in this vein abound in news headlines: “In South Korea, a Blueprint for Resisting Autocracy”; “MIT has a blueprint to get its campus off fossil fuels”; “A blueprint for a successful second half for the San Francisco Giants.”¹⁶⁹ Academics and other writers continue to publish books with titles like *A New Blueprint for a Green Economy* and *Addressing Sickle Cell Disease: A Strategic Plan and Blueprint for Action*.¹⁷⁰ Even lawyers and judges use the term blueprint to connote something clearly and completely enumerated, in contrast with a sketch and its comparative nebulousness.¹⁷¹ A conceptual blueprint, in the sense of an objective source of guidance, can even be used as basis on which to construct a legal test.¹⁷² Although the word is today almost entirely divorced from the medium to which it originally referred and from the profession it initially

¹⁶⁸ “blueprint,” Merriam-Webster Dictionary, www.merriam-webster.com/dictionary/blueprint, accessed 8 May 2025. Emphasis in the original.

¹⁶⁹ E. Tammy Kim, “In South Korea, a Blueprint for Resisting Autocracy,” *New Yorker* (14 December 2024); Phil McKenna, “MIT has a blueprint to get its campus off fossil fuels. Some students and alums say they have a better (cheaper) plan,” *Boston Globe* (18 February 2025); and Grant Brisbee, “A blueprint for a successful second half for the San Francisco Giants,” *New York Times* (23 July 2024).

¹⁷⁰ See, for example, Edward B. Barbier and Anil Markandya, *A New Blueprint for a Green Economy* (Routledge, 2013); and Rose Marie Martinez, Henrietta Awo Osei-Anto, and Marie McCormick, eds., *Addressing Sickle Cell Disease: A Strategic Plan and Blueprint for Action* (National Academies Press, 2020).

¹⁷¹ See *Gutierrez v. Board of Managers of Flagship Wharf Condominium*, 100 Mass. App. Ct. 678, 182 N.E. 3d 993, 2022 Mass. App. LEXIS 11.

¹⁷² Such as in the case of “adherence to a neutrally devised, preplanned blueprint in order to eliminate arbitrariness and discretion.” *Commonwealth v. Anderson*, 547 N.E. 2d 1134, 406 Mass. 343, 1989 Mass. LEXIS 424.

bolstered, *blueprint* has become a metaphor and remains inextricable from notions of managerial authority.

CHAPTER THREE

Lettering and Architectural Identity

In 1895, Henry S. Jacoby published *A Text-Book on Plain Lettering*. As a professor of civil engineering at Cornell University, he aimed to create a resource for students seeking advice and instruction in various styles of letters “suitable for engineering and architectural drawings.”¹ A clear division between architectural and engineering lettering was maintained throughout the book’s text and plates. Standard Gothic letters were presented and described as “the most useful style for any engineer” (Fig. 3.1),² while entirely different styles were recommended for architectural drawings, “where the artistic element prevails” (Fig. 3.2).³ There is an obvious difference in the style, form, and overall impression of the lettering presented on each of these plates. The reasons for and interpretations of that difference, though, form a richly textured landscape. In this chapter, I uncover and theorize architectural lettering, which at the end of the nineteenth and beginning of the twentieth centuries was both a backdrop and a stage for debates about professions, differentiation, drawing, and expertise.

In the first chapter of this dissertation, I argue that architects, through the content of their drawings, brought into their professional domain a type of work that had

¹ Henry S. Jacoby, *A Text-Book on Plain Lettering* (New York, 1895), [iii].

² Jacoby, *Plain Lettering* (1895), 60.

³ Jacoby, *Plain Lettering* (1895), 59.

previously been left to the knowledge and skill of the builder. In the second chapter, I argue that, through the perceived photochemical certainty of blueprints, architects were able to extend and cement their emerging authority and expertise. Neither construction details nor blueprints are exclusively architectural; a contractor or builder could draw highly refined details, and an engineer's drawings could be blueprinted. Where, then, might a drawing be visibly and uniquely architectural? As one way to answer this question, I look to lettering on architectural drawings. Through lettering, architects self-consciously differentiated themselves from engineering professionals, conveying at a glance that their work was not only technical, but also artistic, creative, individual, and marked by a unique freedom and flexibility.

The overall period under consideration in this project, roughly 1880 to 1920, was also a period of significant change in the style and conception of lettering on drawings. What I aim to highlight is that it was in this period that architectural lettering emerged as something distinctive and distinguishable. To do this, I will look to an array of drafting and lettering manuals as well as a body of original drawings. Although the form and style of architects' letters were part of the internal construction of a professional community, outside audiences like engineers and the general public were also in mind. To this end, I will also draw from sources that elucidate a contemporaneous cultural interest in handwriting in general and graphology in particular, for which the American public had a feverish appetite in this exact period. While one could simply state that architects' lettering on drawings is more "artistic" than that of engineers and leave it at that, I seek to examine this apparent trend as a site of profession delimitation, self-image construction,

and the claiming of unique expertise. Discourse about lettering can even be read as a stand-in for discourse on the nature and delimitation of the architectural profession.

Architect, Engineer, and Imagination

Andrew Saint has argued that it was tasks and hierarchies, as opposed to new building technologies, that ultimately differentiated architects from engineers in nineteenth century England and France.⁴ What exactly, though, were these tasks and hierarchies? Saint began to address this more broadly, including in the American context, in *The Image of the Architect*. He identifies “one strain of architectural ideology” that has been most prevalent over the past two centuries: “artistic individualism, which ascribes both merit in particular buildings and general progress in architecture according to a personal conception, usually of style, embodied in buildings.”⁵ Saint quotes from dozens of architects and theorists in reconstructing the historical view of architecture’s perceived essence. He summarizes the multi-century consensus he identifies, writing that, historically, “architecture is only special when it is the product or the object of ‘imagination’.”⁶ Saint traces the intellectual history of imagination in architecture to the Enlightenment, and more specifically to the writings of the Earl of Shaftesbury and to

⁴ Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (Yale University Press, 2007), 486. In looking at the tasks performed, Saint is, probably unconsciously, following the method of studying professions that Andrew Abbott recommends. Andrew Abbott, *The System of Professions: An Essay on the Division of Expert Labor* (University of Chicago Press, 1988).

⁵ Andrew Saint, *The Image of the Architect* (Yale University Press, 1983), 6.

⁶ Saint, *Image of the Architect*, 162.

artists like Joshua Reynolds, and follows that thread through its Romantic extreme with John Ruskin.⁷

Saint confines himself to the writings of architects and intellectuals in making his argument about imagination but assures his reader that there is a universality about this perception of the architect's essential differentiating quality. At the very least, his claim can be supported and extended at least to the early twentieth century American context by examining vocational guides, important interfaces between specialists and professionals and the general public and aspirants. One guide from 1917 summarized the definition of architects and engineers rather coarsely, if tellingly: "The engineer who is also an artist is an architect."⁸ Franklin Stewart Harris's roughly contemporaneous book *The Young Man and His Vocation*, published in Boston, presented to American teenagers information on fifteen professions and advice on how to choose one. Architecture, he stated succinctly, "is the combination of an art, a science, and a business."⁹ By contrast, in a third vocational guide, an engineer is described simply as "a compound of common sense and mathematics."¹⁰ Benjamin S. Hubbell, architect of the Cleveland Museum of Art, gave the following interpretation to prospective architects and engineers in summarizing the differences between the two: "Considered from an engineering point of view, a building is entirely successful when it meets the practical needs for which it has been erected, but if a building only meets these needs and does not appeal to the imagination and to our

⁷ See Saint, *Image of the Architect*, 161–163.

⁸ Edwin Tenney Brewster, *Vocational Guidance for the Professions* (Rand McNally, 1917), 142.

⁹ Franklin Stewart Harris, *The Young Man and His Vocation* (Richard G. Badger, 1916), 73.

¹⁰ Ernest McCullough, *Engineering as a Vocation* (David Williams, 1911), 17.

love of the beautiful, it fails from an architectural point of view.”¹¹ Echoing Enlightenment and Romantic views of architects as imaginative artists, American conceptions of the architect before the First World War similarly emphasized a unique combination of artistry and imagination in tandem with a general knowledge of sound construction and building. I will return to the idea of imagination throughout this chapter through the lens of architectural lettering. First, though, some contextual background on architectural lettering, especially before about 1890, is necessary.

Drawing and Lettering / Lettering as Drawing

Drawing is understood as a form of graphic communication especially used for recording or transmitting ideas that cannot otherwise be conveyed verbally or textually. That the main substrates for drawing and writing have been the same throughout most of the history of both means that drawing and writing, or lines and letters, often appear on the same surface. Most architectural drawings have on them lettering in one form or another, from simple titles or dates to complicated textual explanations. The content of the lettering—the mental, linguistic representations recalled by the marks on the sheet—is, of course, important, and constitutes the primary motivation for lettering drawings in the first place. In this chapter, however, I look instead to another layer of meaning conveyed by the marks on the page: not necessarily by their letterforms, but by their style and associations.

¹¹ Benjamin S. Hubbell, “Architecture,” in *Engineering as a Career: A Series of Papers by Eminent Engineers*, ed. Frederick Haynes Newell and C. E. Drayer (D. Van Nostrand, 1916), 142.

When I refer to architectural lettering in this chapter, I mean letterforms made on drawings used to title, caption, explicate, or otherwise compliment or supplement a drawn design, as well as the manual process of making those letters. In many historic treatises, this is referred to as *office lettering*. I am not referring to the other category often called *design lettering*, where the letter being drawn was a depiction of a design to be carried out, such as a chiseled inscription on a memorial.¹² Lettering design in this sense is a field with a rich history. In fact, most of the limited secondary scholarship ostensibly about architectural lettering is about this type of design lettering, perhaps more accurately called environmental lettering.¹³ Similarly, there is a significant body of scholarship, primarily design research, on map and cartographic lettering.¹⁴ Although cartographic lettering work, as written communication, shares the goal of legibility with

¹² This distinction between office lettering and design lettering appears in numerous contemporary sources. See, for example, Thomas E. French and Robert Meiklejohn, *The Essentials of Lettering: A Manual for Students and Designers*, 2nd ed. (Varsity Supply Company, 1910).

¹³ For the best examples of work on this type of lettering, see the publications of Nicolette Gray: Nicolette Gray, *Lettering on Buildings* (Reinhold, 1960); Nicolette Gray, *Lettering as Drawing* (Oxford University Press, 1971); Nicolette Gray, "Lettering and Society," *Visible Language* 8, no. 3 (Summer 1974): 247–260; Nicolette Gray, "Lettering: Craft, Art, or Technology," *Crafts* 8, no. 42 (January/February 1980): 22–25; and Nicolette Gray, *A History of Lettering: Creative Experiment and Letter Identity* (Phaidon, 1986). Gray also published a series of articles on alphabets and lettering in *Architectural Review* (London) between 1953 and 1963. See also Milner Gray and Ronald Armstrong, *Lettering for Architects and Designers* (Reinhold, 1962). For a more current example of scholarship on this subject, see Jose Roberto D'Elboux, "Architectural Lettering: From Information to Identity; A Study on Gregori Warchavchik's *Condominio Cícero Prado*," in *Design Frontiers: Territories, Concepts, Technologies*, 8th Conference of the International Committee for Design History and Design Studies (2012). I am also clearly not discussing architectural lettering in the sense of fonts that have an architectural quality or that were designed by architects. Although this is an interesting category—one need look no further than Peter Behrens, who was both a skilled architect and respected font and lettering designer—it is far outside the scope of this chapter. For an example of this type of work, see Chris Burke, "Peter Behrens and the German Letter: Type Design and Architectural Lettering," *Journal of Design History* 5, no. 1 (1992): 19–37.

¹⁴ See, for example, E. L. Alkhotany, "Nature and Function of Lettering: A Study in Cartographic Design Based on Cultural Factors" (master's thesis, Carleton University, 1985); Barbara Gilma Shortridge, "Map Lettering as Quantitative Symbol: A Preliminary Investigation" (PhD diss., University of Kansas, 1977); and Alex Tait, "Typography and Map Design," in *Cartography in the Twentieth Century*, vol. 6 of *The History of Cartography*, ed. Mark Monmonier (University of Chicago Press, 2015).

engineering and architectural lettering, map lettering is colored by the specter of publication in a way that architecture and engineering lettering are not.

Lettering, as it has been understood for centuries, can be both drawing and writing. Even some of the earliest instructional authors on the subject in the United States based their work on this supposition. Rembrandt Peale, for example, in his 1835 *Graphics: A Manual of Drawing and Writing*, grounded his work on the premise that there was an inherent affinity and overlap between the two elements of his subtitle. “Writing is nothing else than drawing the forms of letters,” he says.¹⁵ Michael Fried has argued that drawn writing is foregrounded in works of painting and literature in the United States at the end of the nineteenth century in ways that were both direct and figurative.¹⁶ Later-nineteenth and early-twentieth century teachers writing for an audience of architects continued and extended the proposed connection between writing and drawing. By the 1910s, some authors were reminding their readers that “lettering . . . is drawn and not written,” or that lettering “is drawing, not writing.”¹⁷ Lettering was not

¹⁵ Rembrandt Peale, *Graphics: A Manual of Drawing and Writing, for the Use of Schools and Families* (New York, 1835), 6. Contemporary publication in Europe and other American publications agreed with this writing–drawing connection. See, for example, Benjamin P. Wilme, *A Manual of Writing and Printing Characters, Both Ancient and Modern, for the Use of Architects, Engineers and Surveyors, Engravers, Printers, Decorators and Draughtsmen* (London, 1845); Benjamin P. Wilme, *A Hand-book for Mapping, Engineering, and Architectural Drawing* (London, 1846); John Gadsby Chapman, *The American Drawing-Book: A Manual for the Amateur, and Basis of Study for the Professional Artist, Especially Adapted to the Use of Public and Private Schools, as Well as Home Instruction* (New York, 1847); and George J. Becker, *Ornamental Penmanship: A Series of Analytical and Finished Alphabets* (Philadelphia, 1854).

¹⁶ Michael Fried, *Realism, Writing, Disfiguration: On Thomas Eakins and Stephen Crane* (University of Chicago Press, 1987). Fried looks to painter Thomas Eakins and author Stephen Crane to make his points about writing. Fried roots Eakins’s interest in perspective and realism in the latter’s understanding of writing as drawing, a claim made stronger by that facts that Eakins’s father was a noted writing instructor and that writing and drawing were taught as part of a single skill in nineteenth-century Philadelphia schools.

¹⁷ Ben J. Lubschez, *Over the Drawing Board: A Draftsmen’s Hand Book* (Journal of the American Institute of Architects, 1918), 55; and Thomas E. French, *A Manual of Engineering Drawing for Students and Draftsmen* (McGraw-Hill, 1911), 59.

only done on drawings, but it was also considered a species of the latter. For our purposes, then, lettering can be considered wholly within the practice of drawing.

The Importance of Lettering

The vital significance of lettering on drawings cannot be taken for granted. The sheer volume of publications dedicated to lettering in the period under consideration begins to convey the importance of the subject to contemporary authors, practitioners, and students. Legibility and efficiency were important factors in lettering, as we will see, but the overall visual impact of a drawing due to its lettering was also known to be consequential. One drafting manual from the 1890s noted, “The general appearance of a drawing is very much affected by the lettering, and too much care cannot be taken to have all letters and titles well constructed.”¹⁸ In a textbook on mechanical drawing, Alpha Pierce Jamison provided an analogy helpful to understanding the importance of lettering in drawing: “Lettering is to a drawing what clothes are to a man—it makes the appearance, and appearance is of much importance to a drawing.”¹⁹ The general consensus was that good lettering could improve a bad or mediocre drawing, and bad lettering would mar a good one.²⁰ Care was taken in lettering because it could even confirm (or betray) one’s identity as a professional (or not). One author wrote to an

¹⁸ Wilbur F. Decker, *Manual of Industrial Drawing for Carpenters and Other Wood-Workers* (New York, 1892), 26.

¹⁹ Alpha Pierce Jamison, *Elements of Mechanical Drawing, their Application and a Course in Mechanical Drawing for Engineering Students* (John Wiley & Sons, 1904), 26.

²⁰ Frank Chouteau Brown wrote that “the final result of any drawing remains to be made or marred by the lettering.” Frank Chouteau Brown, “Office Lettering, Part I,” *Architectural Review* 8, no. 7 (July 1901): 87. For similar statements, see French, *Manual of Engineering Drawing*, 58; and Wooster Bard Field, *Architectural Drawing* (McGraw-Hill, 1922), 131.

audience of carpenters with architectural aspirations that “A few words must be devoted to the subject of printing or writing on drawings. This is usually the worst feature of unprofessional work, and not often the best in that.”²¹

That lettering could have an impact on the reception and legibility of a drawing was not a new realization. Writing in 1837 in the context of mapping and civil engineering, U.S. Army Lieutenant S. Eastman noted that, “The formation of letters is not entirely unimportant, in a topographical drawing. When well or ill made, they increase or diminish the effect and beauty of the piece.”²² Bad overall effect and the general inconsistency of lettering on architectural, engineering, and topographical drawings was noted by other practitioners and commentators. In the 1840s, Benjamin P. Wilme observed that “Any competent and impartial judge would (on an examination of the writing on the majority of our plans) declare that we are sadly deficient in this branch of the surveyor’s art.”²³ Although written in an English context and specifically about topographical drawing, Wilme’s statement would hold even more true in the United States, where surveying, engineering, and architecture were drastically less consistent or professionalized.

Words written on drawings before the end of the nineteenth century were often indistinguishable from other forms of daily lettering, either standard cursive hand or some form of calligraphic or otherwise ornamental script. Representative examples from

²¹ Fred T. Hodgson, *Architectural Drawing Lessons for Carpenters and Builders* (National Builder, 1915), 18.

²² Seth Eastman, *Treatise on Topographical Drawing* (New York, 1837), 63.

²³ Wilme, *Manual of Writing*, n.p. (preface).

both categories can be found in mid nineteenth-century drawings by Boston-based architect Nathaniel J. Bradlee. In his 1855 competition drawing for the first Boston Public Library building (Fig. 3.3), the title, caption, date, and scale are all written in a similar, though internally inconsistent, calligraphic script. Although it might seem relatively simple at first glance, numerous features of the writing on the drawing classify it as ornamental penmanship by nineteenth century standards. For example, the bottom of the long stroke of the P in “Public” and in “Plan” have a decorative flourish, as do the terminal strokes of the N in “Nathaniel.” The serifs and lines at the top and bottom of each letter in the “Front Elevation” label, too, are extended in an ornamental, embellished mode.²⁴ In another drawing by Bradlee made a few months earlier, we see him make extensive use of his standard cursive (Fig. 3.4). Here, the words explain details and label various elements of the building. Although there is regional and individual variety among draftsmen, most writing on architectural drawings in the United States up to the last quarter of the nineteenth century, whether ornamental calligraphy or standard cursive, was written in this type of flowing, connected hand.

Handwriting achieved new cultural relevance over the course of the nineteenth century in the United States as mechanical print took over most domains of American reading.²⁵ Handwriting style and instruction at the time was dominated by the work of

²⁴ The calligraphy on the drawings is distinctly different from Bradlee’s regular script hand, presented at length in the prefatory sheet to this drawing. The title and date on the preface sheet resemble the text on the illustrated elevation drawing, but the extensive body of the text is a much more natural, non-calligraphic, Spencerian script. Interestingly, this drawing also provides an example of design lettering in the form of the block, non-script writing Bradlee proposes for the building’s façade. Boston Atheneum, Bradlee Architectural Collection, 1937.4, Volume 3.

²⁵ Handwritten correspondence remained an important exception, but the mass-production of typewriters (1873) and the invention of teleprinters (1887) incurred on even this territory by the end of the century. For

Platt R. Spencer. Spencer advanced a method of teaching handwriting that was widely adopted in America's developing public schools and used extensively in burgeoning businesses by a growing urban army of clerks and other office workers. Based in part on the earlier work of English writing instructor Joseph Carstairs, Spencer's script was constructed on the pedagogical rule of subdividing the motions of writing letters into their minute, constituent muscular actions.²⁶ Although there was a motor, technical root to Spencer's method, it was organized around strong moralistic overtones, a consistent parallel being drawn between good handwriting and good character. For Spencer, according to critic and theorist Johanna Drucker, "the development of good habits for writing was tantamount to a course in moral righteousness, and the rhetoric which wove through his manuals made clear that slovenliness of handwriting was no less a sin than any other major fault of character."²⁷ This idea was shared by most handwriting instructors and educated American society as a whole. Developing good handwriting was proof of honest self-improvement and the disciplined mastery of one's mind over one's body.²⁸ Along with the moral valence of handwriting quality and skill, there was also a creative opportunity via calligraphic flourishing. Once the basics of a neat, disciplined hand had been established, penmen were encouraged to deploy the basic strokes to creative

an exploration of the role of print in earlier manuscript practices, see Rachael Scarborough King, ed., *After Print: Eighteenth-Century Manuscript Cultures* (University of Virginia Press, 2020).

²⁶ For an early American promotion of Carstairs, see Benjamin Franklin Foster, *Practical Penmanship, Being a Development of the Carstairian System* (Albany, 1832).

²⁷ Johanna Drucker, *The Alphabetic Labyrinth: The Letters in History and Imagination* (Thames and Hudson, 1995), 246.

²⁸ See Tamara Plakins Thornton, *Handwriting in America: A Cultural History* (Yale University Press, 1996), especially chapter 2. See also Karen Sánchez-Eppler, "Copybooks and the Rescripting of Cultural Values", in *Handwriting in Early America: A Media History*, ed. Mark Alan Mattes (University of Massachusetts Press, 2023).

ends, from ornamenting a paragraph's initial letter all the way to constructing elaborate scenes of flora and fauna.

An American ornamental hand, even one as sober-seeming as Bradlee's, was an object of critique from European commentators and later American writers. In the English edition of his *Methodical Textbook to Round-Writing*, German inventor and author Friedrich Soennecken begins by noting that, "However great the importance may be which Americans and Englishmen . . . attach to a simple and neat mode of penmanship, . . . they are still deficient in the art of simple, neat and well executed ornamental writing."²⁹ His new invention, called Round Writing—essentially a type of calligraphy executed with proprietary pens—was meant to solve this problem. Although ornate to modern eyes, Soennecken's system was meant to simplify and improve inscription for the broad user base he had in mind (including "Engineers, Architects, Lithographers, Merchants and others").³⁰ He did specifically illustrate an architectural plan in the book (Fig. 3.5), and in the forward by professor Franz Reuleaux, Director of the Berlin Royal Technology Academy, we are told that Round Writing in Germany was almost exclusively used for "inscribing plans."³¹ Some of the exercises presented in the book, meant to be copied out by the student on the mostly blank pages, were moral

²⁹ Friedrich Soennecken, *Methodical Text Book to Round Writing for Self-Instruction and for Use in Schools*, 17th ed. (New York, 1887), v.

³⁰ Franz Reuleaux, "Preface," in *Methodical Text Book to Round Writing*, n.p.

³¹ Reuleaux, "Preface," vi. Additionally, in a version of the 1878 edition, an advertisement on the back cover states: "By decree of the German Government, all Surveyors are bound to letter all maps etc. etc., after the method of Round Writing introduced by F. Soennecken." See copy of Frederick Soennecken, *Methodical Text Book to Round Writing for Self-Instruction and for Use in Schools*, 6th ed. (New York, 1878), Historical Textbooks Collection, Gutman Library, Harvard Graduate School of Education.

incantations of a Spencerian variety: “Use your time for improvement,” and “Manners, with learning, make a gentleman.”³²

Round Writing, even in Soennecken’s own description of it, was ornamental. Ornamental *writing* was almost universally replaced by *lettering* on engineering and architectural drawings in the United States within about a decade of the English translation of Soennecken’s book. That the turn of the century was a period of dramatic change and improvement in lettering on drawing was recognized and noted by contemporary authors. In 1912, engineer and scientific management proponent Oscar E. Perrigo reflected on the change:

In former years the lettering on mechanical drawings was frequently remarkable for its ornamental design and execution, and there was little effort made to standardize it or to simplify its design. In recent years this has been greatly changed, and the question of utility, that is, the absolute certainty of the meaning of every figure, sign, symbol and letter is deemed most essential.³³

In one of the most widely circulated treatises on lettering, Thomas French and Robert Meiklejohn assert the point a bit more bluntly: “The day of the wild letter on which the architects allowed their fancy free rein is passed. There is an individuality in lettering often as marked as in handwriting, but there must be no grossness of exaggeration, nor riot of flourishes, nor wandering of free lines.”³⁴ That this was a huge transformation cannot be overstated. Two generations earlier, a similar, non-script print hand, one with separated, upright letterforms, was viewed as a method of writing used exclusively by

³² Soennecken, *Methodical Text Book to Round Writing* (1878), 24 and 25. The same exercises appeared in the 1887 edition.

³³ Oscar E. Perrigo, *Mechanical Drawing, Part 1: Instruments—Geometrical Problems*, Machinery’s Reference Series, no. 85 (The Industrial Press, 1912), 33.

³⁴ French and Meiklejohn, *Essentials of Lettering*, 35–36.

poor, uneducated, and illiterate individuals.³⁵ By 1887, though, even Spencer's relatively conservative textbooks included a section on print lettering, indicating it was gaining currency as an acceptable form of written communication at exactly the moment when American architects and engineers began turning their attention to lettering in ways that they never had before.³⁶

Mechanical versus Freehand Lettering

Despite the recommendation of avoiding unnecessary ornament in lettering at the turn of the twentieth century, it was still a time-consuming task. "Very frequently," one writer observed in 1908, "more time is spent in lettering a drawing than in inking in the objects represented."³⁷ How this often-time-consuming lettering ought to be done was a matter of lengthy debate, both in architectural and engineering circles. Regardless of one's training or profession (or professional aspirations), one point of agreement, different from a generation earlier, is that lettering on drawings was something distinct from regular handwriting or calligraphy. "Ordinary script writing is not permissible," one

³⁵ See Patricia Jane Roylance, "Print Hand: Class, Literacy, and the Mechanization of Writing," in *Handwriting in Early America*.

³⁶ P. R. Spencer's Sons, *New Spencerian Compendium of Penmanship: A Comprehensive Work upon the Art and its Various Departments; Practical Writing, Calligraphy, Text and Lettering, Flourishing, Pen-Drawing* (New York and Chicago, 1887).

³⁷ International Textbook Company, "Geometrical Drawing," in *International Library of Technology: A Series of Textbooks for Persons Engaged in the Engineering Professions and Trades, or for Those who Desire Information Concerning Them* (International Textbook Company, 1908), 21. The idea was repeated in other correspondence school textbooks in the period: "more time is required to make well-executed letters than to make well-executed drawings of objects." International Correspondence Schools, *A Textbook on Architectural Drawing: Geometrical Drawing, Architectural Drawing, Ornamental Drawing, Advanced Architectural Drawing* (International Correspondence Schools, 1901), 19.

textbook declared definitively.³⁸ Lettering was now seen as a task more careful and deliberate than writing: “It takes an experienced draftsman considerable time to do good lettering, and no draftsman can perform this work as quickly as he can ordinary writing.”³⁹

This non-writing lettering was most often divided by authors and instructors into two categories: freehand and mechanical. In general, freehand lettering was done without the aid of drafting tools beyond the pencil or pen required to make the letters themselves, although a T-square or other rule could be used to draw guide lines. Mechanical lettering, on the other hand, refers to a wide variety of lettering techniques that share the feature of being drawn or constructed with a physical aid, whether stencil, template, scribe, or special triangle or rule.

On the point that freehand lettering is preferred to mechanical lettering, architects and engineers agreed. “The first principle to remember,” according to *Radford’s Architectural Drawing*, “is that good lettering comes from freehand work, and not a mechanical product.”⁴⁰ Although written in 1912, Radford’s statement reverberates across decades. As early as 1852, Dennis Hart Mahan wrote that “The draftsman should be able to sketch in by the eye letters of every character and size without resorting to rulers or dividers; until he can do this, whatever pains he may take, his lettering will be stiff and

³⁸ International Correspondence Schools, *Textbook on Architectural Drawing*, 19.

³⁹ International Textbook Company, “Geometrical Drawing,” 21.

⁴⁰ William A. Radford, *Radford’s Architectural Drawing: Complete Guide to Work of Architect’s Office; Drawing to Scale, Tracing, Detailing, Lettering, Rendering, Designing, Classic Orders of Architecture* (Radford Architectural Company, 1912), 326.

ungainly.”⁴¹ Leaving no room for misinterpretation, Thomas French writes, “Lettering is **not** mechanical drawing.”⁴² Interestingly and significantly, the drawings being lettered that Mahan, French, Radford, and other authors on lettering refer to are almost always mechanical drawings. The drawings themselves—made with T-squares, compasses, triangles, and rules—are made with an entirely different set tools and techniques than the letters drawn on them.

The proliferation of mechanical lettering devices available at the time belies the general conviction that freehand lettering was the preferred option. One of the simplest and earliest of these devices was the set lettering square (Fig. 3.6). The fixed device included four inclined edges, each labelled with the several letters whose strokes could be drawn with that corresponding angle. Willaim Ford Stanley claims to have invented the device “to give the oblique angles which occur in the alphabet” for use when stencils were too expensive or otherwise inconvenient.⁴³ Hard rubber versions of these lettering triangles were sold in the United States by 1877, a set of three available for \$1.25.⁴⁴ Writing in 1904, one commentator noted that they are “used to some extent” in

⁴¹ Dennis Hart Mahan, *Industrial Drawing: Comprising, the Description and Uses of Drawing Instruments, the Construction of Plane Figures, the Projections and Sections of Geometrical Solids, Architectural Elements, Mechanism, and Topographical Drawing*, 2nd ed. (New York, 1863), 152

⁴² French, *Manual of Engineering Drawing*, 58. Emphasis in the original.

⁴³ William Ford Stanley, *A Descriptive Treatise on Mathematical Drawing Instruments, Their Construction, Uses, Qualities, Selection, Preservation, and Suggestions for Improvements; with Hints upon Drawing and Colouring*, 3rd ed. (London, 1868), chapter 24. The device does not seem to have been widely known in the United States by the late 1870s. See “Instruments for Mechanical Drawing,” *Manufacturer and Builder* 9, no. 2 (February 1877): 29.

⁴⁴ James W. Queen & Co, *Priced and Illustrated Catalogue of Mathematical Instruments and Materials for Drawing, Surveying and Civil Engineering* (Philadelphia, 1877), 48. They were also available from Keuffel & Esser (beginning around 1883), W. & L. E. Gurley (1884), E. G. Soltmann (1885), F. W. McAllister (1890), and Theodore Alteneder & Sons (1892).

engineering offices,⁴⁵ while another author states that “encouragement should not be given to these aids.”⁴⁶ One major disadvantage of the traditional set lettering triangle is that the T-square had to be repositioned to properly align each of the angles as they were needed to guide individual pen strokes. A “sawtooth” version of a lettering device, invented by Henry S. Jacoby, with whom we began this chapter, eliminated the need to adjust the position of the T-square for each letter stroke, but this updated form still required the horizontal repositioning of the tool for each stroke. Stencils, though common in nineteenth-century Europe, especially for repeated words on plans like “bedroom” or “elevation,” were not equally popular in the United States.⁴⁷

The proliferation of patents for extremely complicated, seemingly expensive and cumbersome devices for putting letters on drawings can at least be interpreted as evidence of lettering’s importance and the difficulty of learning to do it well. One device, patented in 1888 and based on the same principal as Stanley’s lettering triangle, included more than a dozen differently angled surfaces against which to draw a letter stroke (Fig. 3.7). A decade later, in 1897, Lucian Rust patented a “simple and efficient lettering device” that consisted of a movable straight-edge arm, the angle and position of which

⁴⁵ Christopher E. Sherman, *The Theory and Practice of Lettering, Designed for the Use of Engineers and Draftsmen Generally but Especially for the Use of Students in Engineering*, 6th ed. (Midland Publishing Company, 1904), 10.

⁴⁶ Victor T. Wilson, *Free-Hand Lettering: Being a Treatise on Plain Lettering from the Practical Standpoint for Use in Engineering Schools and Colleges* (John Wiley & Sons, 1905), 95.

⁴⁷ See Eric Kindel, “Fit to be Seen: Stencils for Architects, Engineers and Surveyors,” *AA Files* 61 (2010): 108. Even the illustrations used in American publications showing the use of stencils were adaptations of English examples. See, for example, Frederick S. Copley, *A Set of Alphabets of All the Various Hands in Modern Use with Examples in Each Style* (New York, 1870), 47, which is a version of the plate “Stainfoil (or stencil) Plates, Shewing the Method of using them,” from Wilme, *Hand-Book*, n.p. A major exception is Wilfred Lineham, who stated that “the stencil is probably the most useful mechanical aid for the draughtsman.” Wilfred J. Lineham, *A Treatise on Hand Lettering for Engineers, Architects, Surveyors and Students of Mechanical Drawing* (Chapman and Hall, 1915), 3.

was determined by a system of grooves and notches marked around the edge of the movable disc that would adjust to the different strokes of the corresponding letter (Fig. 3.8). Despite numerous patents for these and other similarly elaborate devices, there is no surviving evidence of their commercial production or availability, perhaps indicating that the demand for mechanical aids to lettering at the end of the nineteenth century was low among architect and engineers.

The only extra-alphabetic assistance sometimes permitted was a T-square edge or a lightly drawn guide line. “By using the square as a guide to the eye only, and stopping the letters while free from and above it, it is quite possible to make very plain and distinct lettering. But it is simpler and better still to make one or two light guide lines for the letters.”⁴⁸ Although the guide lines would be drawn in with a mechanical device, the lettering itself would remain freehand, and thus fall in the preferred category.

The most frequently stated reason for preferring freehand to mechanical lettering was to save time. It was, therefore, partly matter of cost efficiency. One need not look further than Stanley or Rust’s devices to detect a fundamental unwieldiness and inefficiency. “Ruled letters are seldom found on any working drawings, as the element of time involved is so great that few shops are willing to pay for it,” notes a textbook from the Armour Institute of Technology’s correspondence school.⁴⁹ In one treatise on mechanical drawing, the ideal letter was not described by its form per se, but rather by the ease and efficiency of its construction and its overall legibility: “The best form of

⁴⁸ Frank Chouteau Brown, “Office Lettering, Part II,” *Architectural Review* 8, no. 10 (October 1901): 124.

⁴⁹ Charles L. Griffin, “Working Drawings,” in *Compendium of Drawing* (American School of Correspondence at Armour Institute of Technology, 1904), 25.

letter for practical use is that which gives the neatest appearance with a maximum of legibility and requires the least amount of time and labor in its construction.”⁵⁰

Efficiency, though, is not the only factor. The visual quality of the result even beyond simple legibility is important, too. According to many architects and engineers, at the core of freehand lettering was that idea that it was essentially a design problem that any good architect or engineer ought to be able to solve, the construction of a letter being somehow akin to the construction of a machine or a building. Victor T. Wilson provides an excellent summary of this view in his 1905 *Free-Hand Lettering*, writing, “The beginner is apt to approach the subject with the misconception that lettering is a form of mechanical drawing, that the use of the straight-edge is in order, that the various letter forms and the spaces between them can be figured out by measurement.”⁵¹ This, however is not true: “Fundamentally **good lettering will be good design**.”⁵²

Legibility and efficiency, though, do not necessarily require uniformity. Neither does good design. Alton Smith, a professor of machine design at Worcester Polytechnic Institute, wrote advice to his engineering students to this effect: “From an artistic standpoint, a mechanical letter is often objectionable on account of its extreme precision and exact duplication, just as a piece of machine carving is less pleasing than that done by hand. With free-hand letters, this lack of flexibility does not exist because slight

⁵⁰ John S. Reid, *A Course in Mechanical Drawing* (New York, 1898), 64.

⁵¹ Wilson, *Free-Hand Lettering*, 1-2.

⁵² Wilson, *Free-Hand Lettering*, 2. Emphasis in the original. See also French and Meiklejohn, *Essentials of Lettering*, 58.

variations are unavoidable and no two As or Bs or Cs will be exactly alike.”⁵³ It is the slight variation in freehand letters, made without the rigid aids of mechanical devices, that is valued in many cases.

Rebukes of mechanical devices were not entirely universal. Exceptions to the rule, surprisingly, were often in the name of efficiency. In an engineering context, Frederick Willson notes that, in making letters, “the beginner should . . . do without mechanical aids in their construction” in the name of efficiency. Willson, though, leaves room for the use of mechanical lettering aids for engineering draftsmen: “When under great pressure as to time it is, however, perfectly legitimate to employ some of the mechanical expedients used in large establishments as ‘short cuts’ and labor-savers.”⁵⁴

Through the variety of voices quoted above, I hope to convey both that freehand lettering was almost universally preferred to mechanical lettering even if the reasoning for this preference was not necessarily consistent or held with an equal level of conviction among authors. Furthermore, there was a general shift in practice where, by 1890, handwriting as such did not appear on most drawings. Returning to the opening question of this chapter, then, it is not a mechanical versus freehand divide that explains the difference between architects’ and engineers’ lettering. On the contrary, it is the opportunity for careful design and expressive, subtle variability that steers both groups to freehand lettering.

⁵³ Alton L. Smith, *Notes on Technical Sketching and Free Hand Lettering for Engineering Students* (pub. by author, 1909), 109.

⁵⁴ Frederick Newton Willson, *Practical Engineering Drawing and Third Angle Projection* (Princeton: 1897), 88.

Character and Style

What, then, should these freehand letters look like? There was consensus among drafting professionals at the turn of the century that earlier, nineteenth-century ornamental hands or even Spencerian script were not appropriate to the task at hand. Some architects, engineers, teachers, and authors were extremely prescriptive about what style of lettering ought to be used on any particular drawing, while others were more flexible. Even in the domain of engineering, according to one observer, “No rigid rules can be laid down as to choice of alphabets for the various possible cases. Common-sense, custom and a natural regard for the ‘fitness of things’ are the determining factors.”⁵⁵ While statements and convictions about an exact style vary in degree, there was a general consensus that, in the words of one textbook author, “the style of the letters should be in harmony with the character of the drawing.”⁵⁶ In his preface to his 1894 book *Lettering on Working Drawings*, John C. L. Fish shared this view of fitness and also provides space for possible professional differentiation: “The different purposes for which drawings are made control the character of the lettering, the different professions having their own characteristics in this as well as in that of the treatment of the drawing.”⁵⁷

What character or style of lettering, then, was viewed as appropriate for architectural drawings? Necessarily, given the strong link between lettering style and drawing style, this is also a question about the character of architectural drawings

⁵⁵ Willson, *Practical Engineering Drawing*, 88.

⁵⁶ Henry S. Jacoby, *A Text-Book on Plain Lettering* (Engineering News Publishing, 1901), 59. Or, according to a roughly contemporary treatise, “the letters used should agree with the character of the drawing; they should be in accord with the general effect of the drawing on which they are placed.” Sherman, *Theory and Practice of Lettering*, 15

⁵⁷ Wilson, *Free-Hand Lettering*, 66.

themselves and, ultimately, a question about architecture, architectural work, and the architectural profession. To begin to answer this question, I will look again to several contemporary claims and, significantly, highlight representative examples of lettering specifically recommended for architectural drawing.

Fish's *Lettering of Working Drawings*, quoted above, was assumed by its author to be "the first presentation of a collection of styles of lettering made up directly from working drawings."⁵⁸ Fish collected samples from fellow faculty and instructors at Stanford University and corresponded with architects and engineers across the United States in the making of his volume. In his book, architectural drawings are treated in their own section, clearly signaled as divergent from engineering drawings in the book's organization. This separation confirms that, by the mid 1890s, there was something distinctive about architects' lettering on drawings. The standard of treating architectural lettering as a separate topic within general treatises was a trend that persisted. Jacoby had the following to say about lettering on architectural drawings: "As a rule, the lettering on architectural drawings is somewhat lighter in weight than that on engineering drawings, and is not so severely simple in form. Where the artistic element enters prominently into a drawing the letters are modified in form as well as weight so as to harmonize with their surroundings."⁵⁹ In Jacoby's statement, we begin to see associations and divisions that persist across the entire period in question: engineering lettering is simple and severe, whereas architectural lettering is artistic and flexible. Although artistic and imbued with a sense of freedom and liberty, architectural lettering was not without important

⁵⁸ John C. L. Fish, *Lettering of Working Drawings* (New York, 1894), n.p. (preface).

⁵⁹ Jacoby, *Text-Book on Plain Lettering* (1901), 64.

constraints. According to *Radford's Architectural Drawing*, one should always “choose a style of letter that will be clear and simple. While the architect has more liberty in the choice and spacing of letters than the engineer, yet the fundamental principle is clearness.”⁶⁰

Although faint elements of this architect–engineer lettering division can be detected before and after the period I am interrogating, the drastic change in lettering at the turn of the century was noted by at least one contemporary commentator. Writing in 1915, Wilfred Lineham reflected:

We now arrive at that quaint kind of hand lettering so much used by architects and others at the end of the 19th, and the beginning of the 20th centuries. It is meant to combine a somewhat easy formation with artistic appearance, and is derived from both Roman and Medieval manuscripts. If kept between reasonable limits of taste it is exceedingly charming. As there is, however, great freedom of canon, the forms of the letters are found to change on different architects' drawings.⁶¹

Echoing Radford's statement quoted above, Lineham reminds his reader that the artistic appearance, freedom, and charm in architectural lettering should be within reasonable limits.

“Artistic” does not always have positive associations. The unique character of architectural lettering was taken by some as ammunition for claims of inconsistency, slovenliness, whimsy, and lack of discipline on the part of architects. In a textbook on lettering specifically prepared for engineering college students, Victor Wilson offers a backhanded compliment: “The lettering usual on architectural drawings is of a very free and sometimes artistic sort, [and] is quite likely also to be of the careless rapidly executed

⁶⁰ Radford, *Radford's Architectural Drawing*, 332.

⁶¹ Lineham, *Treatise on Hand Lettering*, 216.

styles.”⁶² Even the opinions of architects writing for an audience of their peers could be tinged with accusations of indolence: “It is much easier to make a slanting line than a vertical line. Irregularities show less in slanting letters than in vertical letters, and for this reason some architects use a slanting letter entirely. The vertical letter, however, is much more dignified, and, when well done, is more satisfactory.”⁶³

Sample architect’s alphabets or example plates provide a helpful visual companion to the claims above. In the mid-1890s, Fish’s *Lettering of Working Drawings* and Jacoby’s *Text-Book on Plain Lettering* each provide plates of architectural lettering (Fig. 3.9, see Fig. 3.2). When compared to the same author’s examples of lettering on engineering working drawings, the unique character of the architectural lettering becomes apparent (see Fig. 3.1). There are similarities between the architectural working drawing lettering and engineering working drawing lettering—they are both legible and recognizable as Latin script letterforms, both are single stroke (i.e. not filled-in or block letters), both are made freehand, and both are upright as opposed to slanted—but their general look and impression is fundamentally different. The architectural letters are freer in construction and spacing. There is also more internal variety than in the engineering examples. The strokes in architectural lettering can be described as loose, resulting in a slightly wavy effect. Architectural lettering not only fell on the freehand side of the freehand–mechanical divide, but it also over-emphasized its freehandedness, or perhaps more accurately, visibly announced its non-mechanical production.

⁶² Wilson, *Free-Hand Lettering*, 68.

⁶³ Radford, *Radford’s Architectural Drawing*, 341.

This non-mechanical look and feel of architectural lettering in Fish and Jocoby's examples appears in other textbooks and guides at the time. There are, quite literally, hundreds of architect's alphabets to choose from, but I highlight a few here to convey their ubiquity and relative general consistency in effect. In 1906, Frank Chouteau Brown, to whom we will return shortly, offered a neat and concise sample alphabet for lettering architectural drawings (Fig. 3.10).⁶⁴ Frederick Giesecke's 1908 textbook, devoted to mechanical drawing, calls out several lettering designs as particularly "suitable for architectural drawings" (Fig. 3.11).⁶⁵ The next year, Alton Smith, writing for students at the Worcester Polytechnic Institute, presented a variety of freehand alphabets that are "free in style, easily made and, as such, well adapted to architectural drawings" (Fig. 3.12).⁶⁶ Similarly, Radford presents many versions of alphabets for architectural drawing in his 1912 *Architectural Drawing*, including varieties described as "easily-made" and "dignified" (Fig. 3.13).⁶⁷ Even in his 1919 *Progressive Steps in Architectural Drawing*, the lettering George Seamen promotes echoes Fish's presented a quarter century earlier (Fig. 3.14).⁶⁸

In addition to the typical artistic quality explanation, there were other justifications for the freer style of architectural lettering. An architectural working or

⁶⁴ Frank Chouteau Brown, *Architectural Lettering* (American School of Correspondence, 1906).

⁶⁵ Frederick E. Giesecke, *Mechanical Drawing, Part 1: Use of Instruments, Lettering, Geometrical Problems, and Projections*, 2nd ed. (Eugene Dietzgen, 1908), 32.

⁶⁶ Smith, *Notes on Technical Sketching* (1909), 116. In the 1909 edition, the quote corresponds to figure 59, page 115. In the 1912 edition, it is figure 63, page 123 (see Fig. 3.12).

⁶⁷ Radford, *Radford's Architectural Drawing*, 328–341.

⁶⁸ George W. Seaman, *Progressive Steps in Architectural Drawing* (Manual Arts Press, 1919).

construction drawing has a fundamentally different relationship to text than a typical engineering drawing in that the architectural working drawing is often accompanied by a lengthy written specification, whereas this is less of a certainty in engineering drawing, which would, in general, have more lettering on it. This difference was noted in the context of lettering on drawing by at least one early twentieth century author, though writing from the English context: “Architects’ drawings are treated more simply, the specification being responsible for a large amount of detail such as the engineer puts upon the drawing.”⁶⁹ By this logic, the burden of design communication in an architecture drawing is lower than the burden of design communication in an engineering drawing, the latter sheet containing all graphical and textual marks required for describing an object, at least in this period. Since the text on an architectural drawing is supplemented by the specification—or the drawing is perhaps itself supplemental to the specification—it can risk clarity and regularity and take on a more expressive timbre.

In his 1897 *Theory and Practice of Lettering*, Christopher Sherman notes that “In architectural drawings lighter and more artistic styles of letters are allowable than in the more technical classes of work.” This is partly explained by the author by the fact that “Architectural drawings are, to a greater extent than other drawings, made for public display or inspection, and on this account more elaborate or fanciful styles may be used.”⁷⁰ Although on its surface a logical argument, it does not account for the reality that engineering drawings made for public display, whether in exhibition or, especially,

⁶⁹ Lineham, *Treatise on Hand Lettering*, viii.

⁷⁰ Christopher E. Sherman, *The Theory and Practice of Lettering: Designed for the Use of Engineers and Draftsmen Generally but Especially for the Use of Students in Engineering* (Columbus, 1897), 24.

publication, use plainer, more regular letters, and architectural drawings for office and contractor use still made use of architectural freehand lettering.

Frank Chouteau Brown

Frank Chouteau Brown's 1902 *Letters and Lettering* and associated articles and reprints are a landmark in the history of architectural lettering. Born in Minnesota, Brown received part of his training at the Boston Art Club and practiced architecture in the city for most of his career. Brown was extremely attuned to architectural discourse and contemporary trends, as editor of *Architectural Review* from 1907 to 1919, and to the related goals of education, as head of art and architecture at Boston University. If a unique and detectable style of architectural lettering was a graphic shorthand for a professional community, then periodicals like *Architectural Review* were a primary means of circulation of these very same ideas and elements. In Brown's own drawings and those he chose to publish in *Architectural Review*, he proposed and promoted the types architectural lettering described in the previous section.

Brown's 1902 *Letters and Lettering* was preceded by a pair of articles in *Architectural Review* and reprinted in full or in part many times in the next two decades.⁷¹ Brown's interest in lettering was motivated at least in part by a professional

⁷¹ Brown, "Office Lettering, Part I"; Brown, "Office Lettering, Part II"; Frank Chouteau Brown, *Letters and Lettering: A Treatise with 200 Examples* (Bates & Guild, 1902), also published 1906, 1914, and 1921; Frank Chouteau Brown, "Architectural Lettering," in *Cyclopedia of Drawing*, ed. Alfred E. Zapf (American School of Correspondence at Armour Institute of Technology, 1905), also published American Technical Society in 1907; Frank Chouteau Brown, *Architectural Lettering* (American School of Correspondence, 1906), also published in 1914, 1916, 1917, and 1921 and as a separate instructional paper in 1906 and 1914; Frank Chouteau Brown, "Architectural Lettering," in *Architectural Drawing and Lettering* (Technical World Magazine, 1908), also published in 1910, published by American Technical Society in 1913, 1914, 1917, 1919, and 1920.

self-interest in furthering the conception of the architect as a locus of control. This primarily meant control over the “mechanic” who often made errors when interpreting direction from architects, which “must be,” according to Brown, “the inevitable result of any inexact or misunderstood drawing.”⁷² In cases where the misunderstanding is the fault of the architect, Brown contends that it is most often due to bad or illegible lettering on the drawing. In one of his 1901 articles, Brown critiques schools of architecture for mostly ignoring the topic of lettering, leaving it to be self-taught and determined by trial and error by the student. Priming his audience for the necessity of his own forthcoming book, he criticizes the existing guides available at the time, in which “no endeavor is made to supply a good selection of models for reference. Certainly the few plates and books prepared for the students are relics of a former century, and such that even the engineer (who views lettering with a mechanical eye) might well cavil at them.”⁷³

In preparing *Letters and Lettering*, Brown heard from other architects a similar dissatisfaction with the lack of clear and effective lettering books. Although Fish and Jacoby’s books had been in print for more than five years and were still available at the time, there was not an architecture-specific book on lettering or, rather, a book on lettering that was primarily for a group other than engineers. Artist and illustrator Orson Lowell wrote to Brown, in anticipation of the latter’s book, “I am very anxious to see it. The books of letters I’ve so far been able to get don’t satisfy me at all.”⁷⁴ Brown began

⁷² Brown, “Office Lettering, Part I,” 87.

⁷³ Brown, “Office Lettering, Part I,” 87.

⁷⁴ Orson Lowell to Frank Chouteau Brown, 14 September [1901], Frank Chouteau Brown Correspondence (Ms. 3278), Boston Public Library (hereafter cited as “Brown Correspondence”).

corresponding about a lettering project as early as 1895, but the bulk of his work on the book took place in 1901, when his *Architectural Review* articles were published. In an attempt to make his book as comprehensive and representative as possible, Brown wrote to dozens of American architects, many of whom he did not know, to collect lettering samples.⁷⁵ In preparing *Letters and Lettering*, Brown corresponded with architect Claude Bragdon, illustrator Edward Penfield, and artist Orson Lowell, and received lettering examples from additional architects like Harold Van Buren Magonigle, Alois Ludwig, Addison B. Le Boutillier, and Bertram Goodhue.⁷⁶

The book's approximately two hundred illustrations include typographic specimens, historical examples, photographs of carved inscriptions, bookplates, and poster designs in addition to architects' lettering on drawings. From the last category, Brown presents an architectural lettering alphabet of his own design, "Free and yet Classic in effect and feeling" (Fig. 3.15, see Fig. 3.10).⁷⁷ Presented on the next page is a very different but equally acceptable alphabet for architectural lettering, designed by Claude Bragdon (Fig. 3.16). Brown's overall aim in including this variety was to provide a wide array of acceptable examples of lettering for architects. From this assortment, each architect or draftsman should aim to design their own personal style. "The student will soon find that he unconsciously varies and individualizes the letters that he constantly employs, until they become most natural and easy for him to form. This insures his

⁷⁵ See, for example, correspondence with Cincinnati-based designer Harry L. Bridwell. Bridwell to Brown, 25 January 1901 and 18 April [1901], Brown Correspondence.

⁷⁶ For Bragdon, Penfield, and Lowell, see Brown Correspondence. For all architects and designers mentioned above, see Brown, *Letters and Lettering* (1902).

⁷⁷ Brown, *Letters and Lettering* (1902), 124.

developing a characteristic letter of his own.”⁷⁸ Brown concludes *Letters and Lettering* by reminding his readers that lettering is a design problem for them to solve as creative individuals:

Finally, the draughtsman’s first aim should be to make his lettering readable: after this has been accomplished he should strive to give it beauty. Art in lettering is only to be attained by solving the problem of legibility in the way most pleasing to the eye. Good lettering should appeal both to the eye and to the mind. Only when it combines legibility with beauty can it be excellent.⁷⁹

Overall, Brown conveys a certain ineffability or even mystical quality around architects’ lettering. “Composition in lettering is almost too intangible to define by any rule,” he writes.⁸⁰ He also makes sure to acknowledge that architectural lettering is different from engineering lettering: “Architectural office lettering has nothing in common with the usual Engineering letter.” Possibly as a corrective to earlier lettering treatises that singled out Architectural lettering, he continues: “to be more exact, the reverse is true: Engineering lettering has nothing in common with anything else.”⁸¹ Of engineering lettering, he writes that “the engineer seems to have developed it solely with an idea to its plainness of form and with an utter disregard of any artistic possibilities.”⁸² Furthering his case for the superiority of architectural lettering, Brown explains that the essential artistic freedom was also a chance to exhibit the companion quality of restraint: “Nothing is so senseless and injurious to the effect of lettering as the addition of a lot of quirks and

⁷⁸ Brown, *Architectural Lettering* (1906), 25.

⁷⁹ Brown, *Letters and Lettering* (1902), 207.

⁸⁰ Brown, *Architectural Lettering* (1906), 21.

⁸¹ Brown, *Architectural Lettering* (1906), 3.

⁸² Brown, “Office Lettering, Part II,” 126.

quavers with no structural or artistic significance.”⁸³ According to Brown, good architectural lettering must be artistic and not plain, yet still tasteful. While Brown designed numerous new alphabets drawn specifically for publication (see Fig. 3.15), he also illustrated examples of his own lettering work in practice, such as quickly executed lettering on detail working drawings (Fig. 3.17).

It is important to show, with at least one example, that this free, artistic form of architectural lettering was not limited to architects in major cities or to those who had similar kinds of academic training or experience in large offices. In examining an archive of drawings made by George Perkins Bissell Alderman from about 1895 to 1905, one consistently finds the free and artistic architectural type of lettering being discussed here (Fig. 3.18).⁸⁴ Alderman worked in the small city of Holyoke, Massachusetts, intellectually distant from the metropolitan architectural centers of Boston and New York. He began his working life as a carpenter and never went to architecture or trade school, though he was by the standards of the day an architect. Despite this geographic and academic remoteness, Alderman lettered, for lack of a better phrase, like an architect.

Lettering: Individuality, Freedom, and the Art of Architecture

If ultimately ineffable, Brown did have recommendations for the young, aspiring architect learning to letter: “I am not sure but that the best and quickest way to acquire ability in lettering is to draw from the life in as artistic an atmosphere as possible.”⁸⁵ It is

⁸³ Brown, “Office Lettering, Part II,” 127.

⁸⁴ George P. B. Alderman Collection, 2025.010, MIT Museum.

⁸⁵ Brown, “Office Lettering, Part I,” 88.

only after copying and study that one can develop their own lettering. According to Brown, “Lettering must be *designed*. Each form must be drawn as exactly and beautifully as possible.”⁸⁶ Beauty and artistry, as indicated above, are distinguishing characteristics of architectural lettering. Individuality, whether as an architect or draftsman or as a firm, could be intuited from architectural lettering. “The general influence of an office style remains so marked,” writes Brown, “that despite the fact that all the good forms of lettering are derived from one type of alphabet, it is often easy to determine by a glance at the lettering only, in what office a drawing was made.”⁸⁷ Identity, or identification, comes through lettering: both globally within the profession and personally as a designer.

Other authors also suggested innovation, originality, creativity, and individuality in architectural lettering. In the 1907 edition of Frank Daniels’s *Text-Book of Free-Hand Lettering*, the author notes that lettering, if understood as design, “is a means of expressing individuality.”⁸⁸ In architectural lettering, the freedom—or “liberty”, as one author put it—was also a chance to show taste, discipline, and care via restraint in design: “The natural, reasonable crudeness, if you please, of hand work, gives artistic value to such character of lettering. Crudeness does not, neither should it, typify carelessness or slovenness [sic].”⁸⁹ And in a book made for architects and engineers alike, one author describes the lettering of the former in these terms:

⁸⁶ Brown, “Office Lettering, Part I,” 88. Emphasis in the original.

⁸⁷ Brown, “Office Lettering, Part I,” 88.

⁸⁸ Frank T. Daniels, *A Text-Book of Free-Hand Lettering*, rev. ed. (D. C. Heath, 1909), iii.

⁸⁹ Oscar S. Teale, *How to do Architectural Drawing: A Text Book and Practical Guide for Students in Architectural Draftsmanship* (pub. by author, 1914), 213. For “liberty” in architectural lettering, see Ralph F. Windoes and Harvey B. Campbell, *Architectural Drawing for Secondary Schools* (Webb Publishing, 1917), plate 1.

A certain freedom and uniqueness is noticeable; the architect is largely an artist, and because of this abhors the rigidity of the common type form of letter; letters, for him, must mould themselves to suit his fancy, spreading out, exceeding their limiting lines and changing shape, the same freedom that is allowed in the use of other decorative forms. [. . .] The requisites for a good practical architectural letter like those in common use may be described as extreme lightness of body, legibility, and an artistic freedom in shape and proportion.⁹⁰

These qualities are exactly what made architectural lettering so unlike engineering lettering: “It is not necessary, neither is it desirable that lettering should be done in the stiff, mechanical and painfully exact way so prevalent with engineers.”⁹¹ Mechanical, in this case, refers not only to lettering produced with mechanical aids, which we know was not preferred by most engineers, but also to lettering that followed a strict pattern. “Avoid mechanical lettering & technique on architectural drawings,” one author wrote, “which should display the individual technique & freedom of the architectural draughtsman” (see Fig. 3.14).⁹² Even engineers recognized the points of the authors I have laid out above. In his *Manual of Engineering Drawing*, French writes that “Architecture is one of the fine arts, and in the make-up of an architect’s drawings there is an evidence of artistic feeling, produced in part by the freehand work and lettering upon them that gives them an entirely different appearance from a set of machine drawings.”⁹³ This artistic feeling is apparent not through the subject of the drawing or in design drawing as a genre, but is instead announced by the style of and approach to lettering.

⁹⁰ Wilson, *Free-Hand Lettering*, 68–69.

⁹¹ Teale, *How to do Architectural Drawing*, 209.

⁹² Seaman, *Progressive Steps in Architectural Drawing*, plate 35.

⁹³ Thomas E. French, *A Manual of Engineering Drawing for Students and Draftsmen*, 2nd ed. (McGraw-Hill, 1919), 244.

Graphology: Origins and American Popularity

The concept that handwriting might reveal something about its writer was noted in the early seventeenth century and expanded more fully in the eighteenth. From there, in the words of historian Tamara Plakins Thornton, “the association between script and self took hold.”⁹⁴ A popular, analytical approach to handwriting as revelatory of character received sustained interest in the last quarter of the nineteenth century, first in Europe and soon after in the United States.⁹⁵ Although today there is a contemporary bias against and general rejection of the pseudoscience of graphology, its basic tenets merit examination given graphology’s perceived validity at the end of the nineteenth and beginning of the twentieth century, and thus its cultural relevance in the period of focus of this study.

Graphology, the specific practice of attempting to determine character, personality, or temperament from handwriting, was first developed in France in the early 1870s by Jean-Hippolyte Michon, considered the founder of modern graphology, and further refined by his follower Jules Crépieux-Jamin. Michon saw graphology as a logical science akin to the then-popular practices of physiognomy and phrenology, which he regarded as “certainly very interesting,” but ultimately too difficult or impractical in

⁹⁴ Thornton, *Handwriting in America*, xiii.

⁹⁵ See Émilie de Vars, *Histoire de la graphologie* 2nd ed. (Paris and Orleans, 1877); and Joe Nickell, “A Brief History of Graphology,” in *The Write Stuff: Evaluations of Graphology—The Study of Handwriting Analysis*, ed. Barry L. Beyerstein and Dale F. Beyerstein (Promethius Books, 1992). Italian philosopher Camillo Baldi is said to have published the first book on handwriting analysis. See Camillo Baldi, *Trattato come da una lettera missiva si conoscano la natura, e qualità dello scrittore* (Carpi, 1622). Ancient and early modern writers, from Plato to Shakespeare, have noted the connection between handwriting and individuality. See David Ganz, “‘Mind in Character’: Ancient and Medieval Ideas about the Status of the Autograph as an Expression of Personality,” in *Of the Making of Books: Medieval Manuscripts, their Scribes and Readers*, ed. P. R. Robinson and Rivkah Zim (Scolar Press, 1997). For Edgar Allan Poe’s connection to handwriting, see Meredith L. McGill, “The Duplicity of the Pen,” in *Language Machines: Technologies of Literary and Cultural Production*, ed. Jeffrey Masten et al. (Routledge, 1997).

application. What was needed was, in his words, “a more positive science, more practical, and easier to apply. This science, recently formulated, is called Graphology,” a word Michon himself invented.⁹⁶ Interest in graphology quickly spread to England, and numerous authors attempted to codify the practice into something more rigorous and scientific. In 1880, Rosa Baughan wrote of this contemporary transformation: “That the hand-writing reflects, to a certain extent, the intelligence and character of the writer many great thinkers have acknowledged, but the study of these indications has hitherto been looked upon rather as a matter of sentiment and fancy than as a serious science.”⁹⁷ Simultaneously, the center of rigorous graphological research shifted to Germany, where researchers like William T. Preyer and, slightly later, Ludwig Klages added to the personality-reading practice of graphology a dimension of psychological and physiological diagnostics.⁹⁸ Simultaneously, forensic graphology—a set of practices used for verifying authenticity or detecting fraud—played a role on the international stage, serving as a key tool in the trials of the sensational Dreyfus affair.⁹⁹ This branch of graphology that analyzed documents and signatures in legal contexts was also gaining

⁹⁶ Jean-Hippolyte Michon, *Système de graphologie: l'art de connaitre les hommes d'après leur écriture*, 7th ed. (Paris, 1884), 14.

⁹⁷ Rosa Baughan, *Character Indicated by Handwriting* (London, 1880), 3.

⁹⁸ For more on this period, see Armin Schäfer, “Graphology in German psychiatry (1870–1930),” *History of Psychiatry* 27, no. 3 (2016): 307–319; Markus Schiegg and Deborah Thorpe, “Historical Analyses of Disordered Handwriting: Perspectives on Early 20th-Century Material From a German Psychiatric Hospital,” *Written Communication* 34, no. 1 (2017): 30–53; and Laurens Schlicht, “Graphology in Germany in the 1920s and 1930s: Amateurs, Psychologists, and the Police on the Scientific Nature of Graphology,” *NTM Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin* 28 (2020): 149–179.

⁹⁹ For an overview of graphology in the case, see Serge Nicolas et al., “Alfred Binet and Crépieux-Jamin: Can Intelligence be Measured Scientifically by Graphology?” *L'année psychologique* 115, no. 1 (2015): 3–52, especially part 1. See also Caspar Hirschi, “Dreyfus, Zola und die Graphologen: Vom Expertenversagen zum Intellektuellensieg?” *Historische Zeitschrift* 303, no. 3 (2016): 705–747.

currency in American jurisprudence at the turn of the century, partly facilitated by improvements to microphotography and chemical analysis.¹⁰⁰

What we recognize today as a pseudoscience was viewed by contemporary practitioners and audiences as “both a science and an art.”¹⁰¹ Graphology as a means of determining character was often compared to medicine; both, it was thought, involved an expert with skill, talent, and creative intuition and were legitimated by scientific principles and regular methods. Both, too, were open to contemporary concerns and skepticism. John Holt Schooling, an early English translator of Crépieux-Jamin, wrote in his introduction to the work of the latter: “This art, like that of medicine, is open to abuse and quackery, but that is no reason why it should not be rationally pursued, and if stripped of guess-work, and confined to its legitimate field as a branch of practical psychology.”¹⁰²

In part thanks to publications from England, graphology became extremely popular in the United States. The periodical *Illustrated American* had a “Graphology” section beginning in August 1892, in which the anonymous graphologist “L’Inconnu” would provide analyses of reader-submitted handwriting. The program was so popular that by October the journal was already “eleven months behind in publishing delineations

¹⁰⁰ Persifor Frazier referred to this branch of graphology as “Bibliotics.” See Persifor Frazier, *A Manual of the Study of Documents to Establish the Individual Character of Handwriting and to Detect Fraud and Forgery* (Philadelphia, 1894). For a slightly later example of graphology as a legal tool, see George W. Wood, *Scientific Handwriting Testimony: Higher Art of Handwriting and Typewriting Investigation Explained and Illustrated* (Cramer, 1922).

¹⁰¹ Grapho [pseud.], *Character Reading from Handwriting: A Simple Guide with Numerous Examples* (Philadelphia, 1915), 10. Graphology is still taken seriously by an enthusiastic community of practitioners. See, for example, the work of the American Association of Handwriting Analysts and the British Institute of Graphologists.

¹⁰² John Holt Schooling, “Introduction,” in Jules Crépieux-Jamin, *Handwriting and Expression*, trans. John Holt Schooling (London, 1892), xi.

of character.”¹⁰³ Possibly the first book on graphology from the United States was published the same year. Printed in Boston, *Talks on Graphology: The Art of Knowing Character Through Handwriting* explained to its American readers that “The philosophy of Graphology, as a manifestation of the soul by means of written signs, rests on the great fact of the intimate relation existing between every sign that emanates from the personality and the soul itself, which is the substance of this personality.”¹⁰⁴

Graphology was part of an intertwined cultural backdrop of new scientific and psychological assertions about the self and the mind. The handwriting–personality connection proposed in *Talks on Graphology*, for example, was contemporaneously mirrored in the less metaphysical but still enigmatic mind–body, or brain–physiology connection proposed in the most serious psychological literature of the day, such as that by William James. The premise of James’s entire system of psychology is that, in his words, “**All mental states . . . are followed by bodily activity of some sort.** . . . Not only certain particular states of mind, then (such as those called volitions, for example), but states of mind as such, *all* states of mind, even mere thoughts and feelings, are *motor* in their consequences.”¹⁰⁵ James warned that many of these changes were “inconspicuous.” and his studies and observations are what we would classify today as research in perception, mostly separate from the study of physical movement. Nevertheless, in contemporaneous popular interpretations of his new science,

¹⁰³ L’Inconnue [pseud.], “Graphology,” *The Illustrated American* 12 (29 October 1892): 408. The section appeared in all issues of vol. 12.

¹⁰⁴ Helen Lamson Robinson and M. L. Robinson, *Talks on Graphology: The Art of Knowing Character Through Handwriting* (Boston, 1892), 16.

¹⁰⁵ William James, *Psychology* (Henry Holt, 1909), 6. Emphases in the original. This book was an abridged, more general public-facing version of William James, *Principles of Psychology*, 2 vols. (New York, 1890).

handwriting might be considered a “motor consequence,” or at least a record thereof. Furthermore, James synthesized and expanded on a view of the unconscious for his American audience decades before Sigmund Freud’s theories of the unconscious in connection with psychoanalysis were popularly known in the United States.¹⁰⁶ James even published a short article addressing aspects of handwriting in 1889, and was interested in automatic writing and related actions for “the questions they awaken as to the boundaries of our individuality.”¹⁰⁷

Even the American Medical Association was compelled to address graphology in their *Journal* by the mid-1890s, especially given that, in their view, it was “likely to attract popular attention and become more or less a fashionable fad of the day.”¹⁰⁸ Although the pathological, diagnostic utility of handwriting analysis is acknowledged by the unnamed author, the article goes on to warn that handwriting as “an indication of character it is a dangerous guide,” and recommends that it “ought, at best, to be only used by especially skilled observers.”¹⁰⁹ The short article on graphology was prompted by German psychologist William T. Preyer’s recently published *Zur Psychologie des Schreibens* (1895). The reviewer, it seems, feared a possible coming legitimization of

¹⁰⁶ See James, *Principles of Psychology*, especially chapter 6.

¹⁰⁷ William James, “Automatic Writing,” *Proceedings of the American Society for Psychical Research* 1, no. 4 (1889): 555. Also quoted in Thornton, *Handwriting in America*, 143.

¹⁰⁸ “Graphology,” *Journal of the American Medical Association* 24 (19 June 1895): 1019.

¹⁰⁹ “Graphology,” *JAMA*, 1020. For an early example of the use of graphology as a diagnostic tool, see Albrecht Erlenmeyer, *Die Schrift: Grundzüge ihrer Physiologie und Pathologie* (Stuttgart, 1879).

graphology by “high authorities like Preyer,” who seem to be riding “the germ of truth that exists in the popular graphology of the day.”¹¹⁰

Graphology, Character, and Professions

If lettering on a drawing, whether architectural lettering or engineering lettering, is a matter of design and careful intention, then it is not the type of “natural” handwriting specimen typically required for graphological analysis. Writers on both graphology and lettering, though, leave room for an interrelationship. Henry Frith, an Irish engineer, wrote in his 1886 *Guide to the Study of Graphology* that while “you cannot expect to tell a man’s profession by his handwriting,” you can still ultimately reveal the “tendency of the mind, and thus find out the prevailing passions and habits as directed by the soul and the brain.”¹¹¹ Even when a writer adopted a “new” style of writing, whether it be an ornamental affectation, a disguise, or copying a calligraphic hand from a textbook, graphology claimed to be able to access some inner temperament or root essence.

Clifford Howard, writing under the pseudonym Simon Arke in *Graphology: Or How to Read Character from Handwriting*, makes an effective analogy: “When a man attempts to change his style of handwriting [. . .] he resembles the actor, who, while he may assume all the outward characteristics of another individual, still retains certain personal

¹¹⁰ “Graphology,” *JAMA*, 1020.

¹¹¹ Henry Frith, *A Guide to the Study of Graphology, with an Explanation of the Mysteries of Handwriting* (London, 1886), 20.

peculiarities of which he is himself unaware and which render it impossible for him to completely disguise his own individuality.”¹¹²

In his 1919 *Manual of Engineering Drawing*, French noted that “There is an individuality in lettering often nearly as marked as in handwriting.”¹¹³ This assertion is one of many that allows us to consider lettering on drawing alongside contemporaneous graphological practices and assumptions. Features in “natural” handwriting that were interpreted by graphologists as indicative of architectural proclivities also describe architectural lettering, as distinctive from engineering and other lettering. To take a few examples from graphology guides: “*Architecture*. Graceful, angular capitals”; “In some instances we may discover a blending of the firm, angular style and some of the graceful, artistic curves where the business man is say an architect, or possesses certain refined and artistic tastes”; “Simple, graceful and print-like capitals; neat margins; original style of letters and joining.”¹¹⁴ And, more generally, the idea that imagination, originality, and artistic inclination could be detected in handwriting was also widespread: “Every movement of the pen outside of quiet, simple, and regular forms of letters shows an exalted state of the soul. It may be enthusiasm, it may be imagination”; “The conventionality, originality, or eccentricity of a person is indicated by the conventionality, originality, or eccentricity of his or her writing”; “Those who possess the artistic

¹¹² Simon Arke [Clifford Howard], *Graphology: Or How to Read Character from Handwriting* (American Institute of Graphology, 1903), 8–9.

¹¹³ French, *Manual of Engineering Drawing* (1919), 57.

¹¹⁴ R. Dimsdale Stocker, *Clues to Character: Being a Complete Text-Book of the Law of Scientific Physiognomy and Graphology*, (Modern Medical Publishing Company, 1903), 93; Graphique [pseud.], *Graphology for All: A Key to the Character Reading of Handwriting*, (Frank Hollings, 1916), 11; and Albert J. Smith, *Applied Graphology: A Textbook on Character Analysis from Handwriting* (Gregg Publishing, 1920), 130. Emphasis in the original.

temperament, with its outreach of imagination, and sympathy with the larger issues of life, will show this to be so in their handwriting.”¹¹⁵ A related feature of architects’ lettering, as raised by Brown and repeated by others, is a fundamental ineffability, opacity, and inscrutability, setting architectural lettering (and the architect) apart from the more transparent work of the engineer—work that is precisely describable and comprehensible.¹¹⁶ Boston-based architect Isreal P. Lord received a “Personal, Typewritten Analysis” of a handwriting sample he submitted to a commercial graphologist who confirmed Lord’s writing had “signs of cultivation, refinement, poetic feeling and artistic sense.”¹¹⁷ My point here is not to reapply antiquated graphological analysis to architectural lettering, but rather to highlight that writing as a locus of interpreting something about its maker had a particularly marked cultural currency in the very same historical moment that architectural lettering was a locus of professional differentiation.

Conclusion

Cultural interest in handwriting in general and graphology in particular emerged after the popularization of typewriters in the United States over the course of the 1880s

¹¹⁵ Robinson and Robinson, *Talks on Graphology*, 68; John Rexford, *What Handwriting Indicates: An Analytical Graphology* (G. P. Putnam’s Sons, 1904), 9; and Grapho, *Character Reading from Handwriting*, 13.

¹¹⁶ For more on the art/science objective/subjective divide and its Kantian origins, see Lorraine Daston, “Scientific Objectivity with and Without Words,” in *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*, ed. Peter Becker and William Clark (University of Michigan Press, 2001), especially 265–269.

¹¹⁷ De Witt B. Lucas to Isreal P. Lord, 13 February 1929, Israel P. Lord Collection (2016.002), MIT Museum.

and 1890s. These machines, increasingly common in American offices, were beginning to replace the Spencerian hand that had defined office work for most of the century. The rapid change that came with this efficient method and its standardized, mechanical letterforms fostered a fear lost individuality.¹¹⁸ As print, especially print produced by hot metal typesetting, extended its dominance over textual communication, from daily newspapers to government documents to correspondence, a metaphor from the world of print technology gained currency to evoke a fear of homogeneity and overconformity: stereotyped. In Tamara Thornton's history of handwriting in the United States, she argues that handwriting "was capable of serving distinct cultural purposes and carrying distinct cultural messages . . . precisely because . . . print saturated American society and consciousness."¹¹⁹ Practically, words on architectural and engineering drawings were mostly exempted from the print or typewriter trend because of their large size, too big even for the 26-inch typewriter carriage offered by Underwood beginning in 1903. Other mechanical methods of applying or creating letters were available, but, in the end, architects, engineers, and other draftsmen generally preferred and recommended freehand lettering.

We must look beyond the typewriter, or another solely technologically determined argument, to understand the newly emerged interest, perhaps obsession, with lettering on architectural drawing around the 1890s. Architecture and, more precisely, architects, were

¹¹⁸ Francesca Fatta makes a similar argument situated earlier, claiming that the concept of handwriting as expressive of individuality could only arise after the invention of printing. See Francesca Fatta, "Lettering and Expressiveness: When Characters Tell a Story," in *Proceedings of the 2nd International and Interdisciplinary Conference on Image and Imagination*, ed. Enrico Cicalò (Springer, 2020). See also Thornton, *Handwriting in America*; and King, *After Print*.

¹¹⁹ Thornton, *Handwriting in America*, xii. See King, *After Print*.

solidifying as a profession and discipline beginning in this era. Since writing is a “culturally and historically contingent experience,” as Lisa Gitelman has argued, it is only through their contextualization that practices around writing can be understood.¹²⁰ Part of the development of a profession, as I have argued throughout this and the preceding chapters, is a process of delimitation and differentiation from similar professions. In the case of architecture, the most adjacent profession is engineering. Although reductive, Andrew Saint maps the concerns of the architectural profession onto the presidency of the American Institute of Architects. With the election of Richard Morris Hunt in 1888, AIA members revealed an interest in raising the profile and perception of architecture as an artistic profession, their leader having been the first American to study architecture at the École des Beaux-Arts. In short, with Hunt, architects aimed to “advance the cause of art” in architecture. With the election of Daniel Burnham as president in 1894, though, according to Saint, members of the AIA were promoting a view of architecture as a modern business. “The American architect,” Saint concludes, “had finally organized himself into becoming a businessman.”¹²¹ The shift to Burnham was a partial acknowledgement that the intra- and interprofessional (and public) perception of the modern American architect as part fine artist, unlike an engineer, had been at least partially achieved.

In order to do the work of a practicing architect, especially one that was now a businessman, technical working drawings were required. Furthermore, despite the

¹²⁰ Lisa Gitelman, *Scripts, Grooves, and Writing Machines: Representing Technology in the Edison Era* (Stanford University Press, 1999).

¹²¹ Saint, *Image of the Architect*, 94.

growing importance of specifications, the amount of lettering on drawings—and the number of drawings for a single project—reached a new peak. Ultimately, little distinguished the drawings by an architecture firm from those of a building engineering firm, so the subtle practice of lettering became a key site of demarcation. Lettering, according to a pocket-sized guide published in 1920, “often makes a more important impression than the drawing itself.”¹²² This impression was significant as the drawing moved through its various audiences: from a draftsman to a senior architect to the contractor to the construction worker. Freehand lettering, done on mechanical or working drawings, provided a space for architects to express their artistic difference from engineers and for that unique expertise to be on display for any user of the drawing. It was a vehicle for expressing some of the intangible abilities (creative, artistic design) that architects were trying to claim, secure, and convey in professionalization in the same historical moment, and thus was a subject of intense interest. That this expressive work was carried out on otherwise mechanical drawings made the case stronger through juxtaposition. Interestingly, it was rarely the professional architect—the individual of a certain class with specialist knowledge and expertise attained through training and experience—who was making the letters on working drawings. Although there was sometimes room for deviation, a draftsman or other office employee would become habituated to the profession’s consensual style of lettering.

Burnham’s presidency and the shift of focus to business does not, as Saint implies, suggest an abandonment of the artistic, imaginative dimensions of architecture.

¹²² George G. Greene, *Exercises in Lettering: Architectural and Other Alphabets*, Vest Pocket Series (Bruce Publishing, 1920), 4.

One of the first brochures for the then-new architecture program at the University of Pennsylvania stated in 1892 that, “For it is only by the combination of the scientific and aesthetic factors of his art that the true architect can be equipped.”¹²³ Francis Ward Chandler at MIT argued the same until his retirement in 1911. The lettering on drawings was a visible expression and representation of the creative work of architects. Additionally, lettering was a small but potentially powerful means of artistic expression in increasingly bureaucratic firms employing growing armies of draftsmen. Most architects and draftsmen worked in large, growing urban centers, where the associated flattening of personality and individuality was a major focus of the emerging field of urban psychology.¹²⁴

As I have suggested throughout this chapter, the lettering landscape changed after 1920. Although further research is required to provide a satisfactory explanation of changes to lettering into the twentieth century, a variety of contributing factors include the introduction of new lettering devices, new hierarchies of labor, and national and international standardization. New mechanical aids like the Ames Lettering Guide (patented in 1917) and what became known as the Leroy Lettering Guide (a version of which was first patented in 1919), became extremely popular in firm drafting rooms, where paraprofessional employees could be hired at a low rate and still produce a

¹²³ School of Architecture, University of Pennsylvania, *School Training in Architecture. A Statement Explanatory of the Course of Instruction in the School of Architecture, University of Pennsylvania, Philadelphia* (Philadelphia, 1892), 6.

¹²⁴ “The deepest problems of modern life,” according to Georg Simmel, “flow from the attempt of the individual to maintain the independence and individuality of his existence against the sovereign powers of society, against the weight of the historical heritage and the external culture and technique of life.” Georg Simmel, “The Metropolis and Mental Life,” in *The Blackwell City Reader*, ed. Gary Bridge and Sophie Watson (Blackwell, 2002), 11. Simmel’s essay was originally published in 1903 as “Die Großstädte und das Geistesleben.”

uniform letter.¹²⁵ As standardization and uniformity became a more important value broadly in business and engineering, signaled nationally by the founding of American National Standards Institute (ANSI) in 1918, standardization and uniformity became more expected in engineering drawing, whereas several decades before there had been more freehand flexibility. The increased use of guides and templates was even partially spurred by contemporaneous European standardization, which engineers in the United States working international would need to adopt. In DIN-16, for example, the Deutsches Institut für Normung (German Institute for Standardization) required the use of particular plain lettering styles in technical drawing beginning in 1919.¹²⁶ Freehand lettering in architectural and engineering drawing was becoming less of an obvious choice, and possibly even impermissible, but the sociohistorical context of professionalization was different around 1920 than it had been several decades earlier.

The National Council of Architecture Registration Boards (NCARB) was established in the United States in 1919. Although licensure was not a requirement in all states until the 1950s, the establishment of an organization like NCARB can be interpreted as a sign of a profession on the rise, approaching, or at least aspiring to, security and relative stability. Forcefully and forcedly artistic lettering by an imaginative practitioner of a creative profession became less necessary and less vital. The stamp of an architecture license carried with it the verification of architectural expertise that was both

¹²⁵ See Karen Severud Cook, “Labeling Techniques,” in *Cartography in the Twentieth Century*, The History of Cartography 6, ed. Mark Monmonier (University of Chicago Press, 2015). Later, beginning in the 1950s, dry-transfer lettering (often known by the brand name Letraset), became a normal, standardized way of applying uniform letters to architecture and engineering drawings.

¹²⁶ See Florian Hardwig and Thomas Maier, “From Lettering Guides to CNC Plotters—A Brief History of Technical Lettering Tools,” 15 January 2017, accessed 30 May 2017, www.typotheque.com.

technically sound and artistically imaginative, the latter having previously been conveyed through lettering. One symbolic mark was replaced with another. The striking waves and wobbles that defined the architectural lettering of the early 1900s were no longer present in part because they were no longer required; the case for creative expertise did not need to be made as loudly or as visibly.

CONCLUSION

In the preceding chapters, I have followed the agency of an individual, a technology, and a practice in the sociological process of professionalization in architecture. Their involvement in that process was not inevitable, but their capacities contributed to changes in architectural practice during a period of drastic transformation in American society. In each of the examples, the relationship between architectural drawings and their makers is distinctly different. In the first chapter, I looked to a particular type of drawing promoted by an instructor who sought to locate in the architect and his drawings a certain kind of technical knowledge and control. In the second chapter, I highlighted a technology that completely divorced the architect from the task of copying drawings, but in doing so brought his authority closer to the resulting blueprinted reproduction. In the third chapter, I traced a practice within drawing that architects linked closely to individuality and artistic agency. The lettering they valued for its self-expressive capacity to convey their position as creative individuals was executed on otherwise highly mechanical drawings. While the three chapters may seem disparate, they are neither arbitrary nor unconnected. Though certainly incomplete, taken together they become points in a cloud around which one can plot out a diagram of certain kinds of intellectual work and knowledge production in architecture. Other agents, media, technologies, or practices could have been examined. One could scrutinize documents like specifications, which require a specific kind of knowledge and work to produce; or

turn to architectural testimony that puts expertise to the test; or study information technology practices like microfilming that frame the evidentiary function of drawings; or even conduct a quantitative historical sociological study of the demographics of these self-described architects.¹ Professionalization is the creation of a community through exclusion, and one might even find compelling subjects and objects outside the realm of architecture altogether.

The skills employed and tasks done by architects in the “mundane” work of drawing details, making blueprints, and lettering drawings are not at all unlike the skills and tasks engineers, builders, and others use in doing virtually the same work. What is different, and what is central to this project, is the architect’s conception of their relationship to that skill or task. While architects most readily showed their professionalism by other means in other areas—the desire to get published in national architecture magazines, the production of elaborate perspective renderings, or their creative self-presentation in the professional setting of their office—construction drawings are still a fruitful class of artifact through which to consider what architects said and thought they did that made their work uniquely professional. In fact, because of how little there is that differentiates the work that goes into details, blueprints, and lettering by an architect and non-architect, and because the audience of these drawings was rarely

¹ For work on specifications, see Michael Osman, “Specifying: The Generality of Clerical Labor,” in *Design Technics: Archaeologies of Architectural Practice*, ed. Zeynep Çelik Alexander and John May (University of Minnesota Press, 2020); and Katie Lloyd Thomas, *Building Materials: Material Theory and the Architectural Specification* (Bloomsbury Visual Arts, 2021). For legal testimony and expertise, see Erik Carver, “‘This Whole Maze of Evidence’: Revisiting Professionalism and Property through *Hunt v. Parmlly*,” in *Writing Architectural History: Evidence and Narrative in the Twenty-First Century*, ed. Aggregate (University of Pittsburgh Press, 2021). For the connections between microfilming and bureaucracy, see Estelle Blaschke, “‘Installed For Your Protection’: Mikrofilm als Medium der Bürokratie,” in *Medien der Bürokratie*, ed. Friedrich Balke et al. (Wilhelm Fink, 2016).

public, it is in these very areas that the profession's discursive construction and architects' self-conceptions can become particularly visible.

Conceptions of the self at the turn of the twentieth century varied widely and might offer a place to begin to make sense of professionalization in a field that is deeply connected to both art and capitalism. Max Weber and George Herbert Mead's writing and teaching in social psychology at the time presented some of the earliest relational theories of the self. For Weber, no independent self as such existed, but was produced in relation to sociocultural habitus. A Weberian theory where the self, although embedded in sociohistorical context, was still an individual actor, would have appealed to architects who wanted to view themselves as creative individuals with agency. Weber's view of personality—something subjective that the individual controlled, as opposed to the figure of the impersonal, hyperrational, modern bureaucrat often associated with engineers—would have been attractive to architects who saw themselves as artist-designers, and especially to those who might wish to be viewed as charismatic authorities.² Similarly for Mead, working in the United States, the self did not exist except as constructed by context. Mead's concept of the self consisted not only of an external, socialized “Me”, but also an internal, spontaneous “I”, leaving room for creativity, agency, and individuality.³ Weber and Mead were working in academic contexts, but ideas of the self as an entity to be considered in its own right were widespread in literary and popular

² Max Weber, *From Max Weber: Essays in Sociology*, ed. and trans. H. H. Gerth and C. Wright Mills (Routledge, 2009); and Edith Hanke et al., eds., *The Oxford Handbook of Max Weber* (Oxford Academic, 2019).

³ See George Herbert Mead, *Mind, Self and Society from the Standpoint of a Social Behaviorist*, ed. Charles W. Morris (University of Chicago Press, 1934).

culture. A Whitmanesque idea of the self that was both individual and universally connected had immense currency in the United States in this cultural moment that straddled the Romantic and the Modern. Architect Claude Bragdon, whose lettering design we saw earlier (see Fig. 3.16), expressed a parallel idea in 1910, declaring that “everything is an expression of the Self.”⁴ It is in this contemporaneous socio-intellectual context that we might begin to better understand the architect’s self-conception and the subsequent importance of that characterization in the projects and processes of professionalization—especially in how architects imagined they related to the work of drawing.

What the sum of these chapters presents, I hope, is a mode of doing architectural history that is a sociology of knowledge and a social psychology of a certain genre of labor rooted in a category of material artifact. It highlights that certain sociological processes, such as professionalization, can only be contextualized and reconstituted at a variety of scales in a multitude of registers. Ultimately, architects did not distinguish themselves most strongly from engineers, builders, and contractors through construction drawings, but rather through the ways they understood and positioned themselves as individuals in relation to those drawings.

⁴ Claude Fayette Bragdon, *The Beautiful Necessity: Seven Essays on Theosophy and Architecture* (Manas Press, 1910), 9.

FIGURES

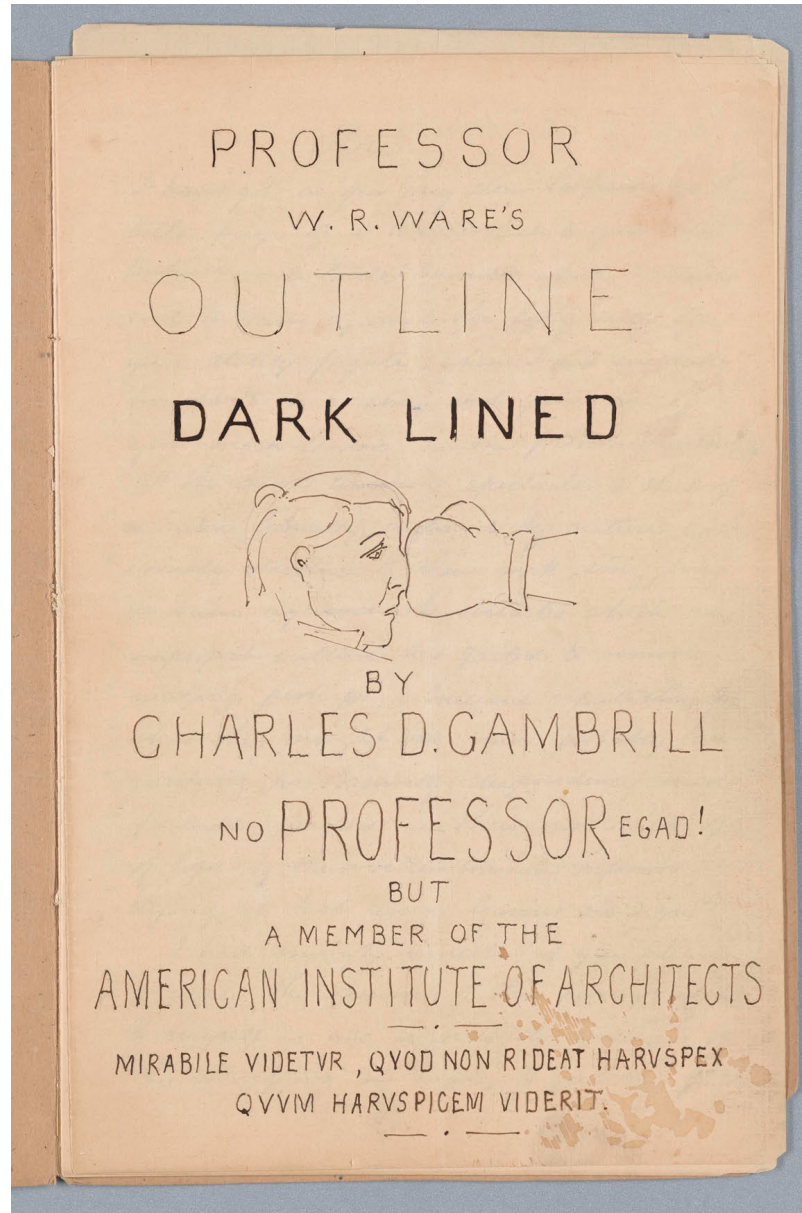


Figure 1.1. Charles D. Gambrill to William Robert Ware, 19 March 1866. William R. Ware Papers, MC-0014, Massachusetts Institute of Technology, Department of Distinctive Collections, Cambridge, Massachusetts.

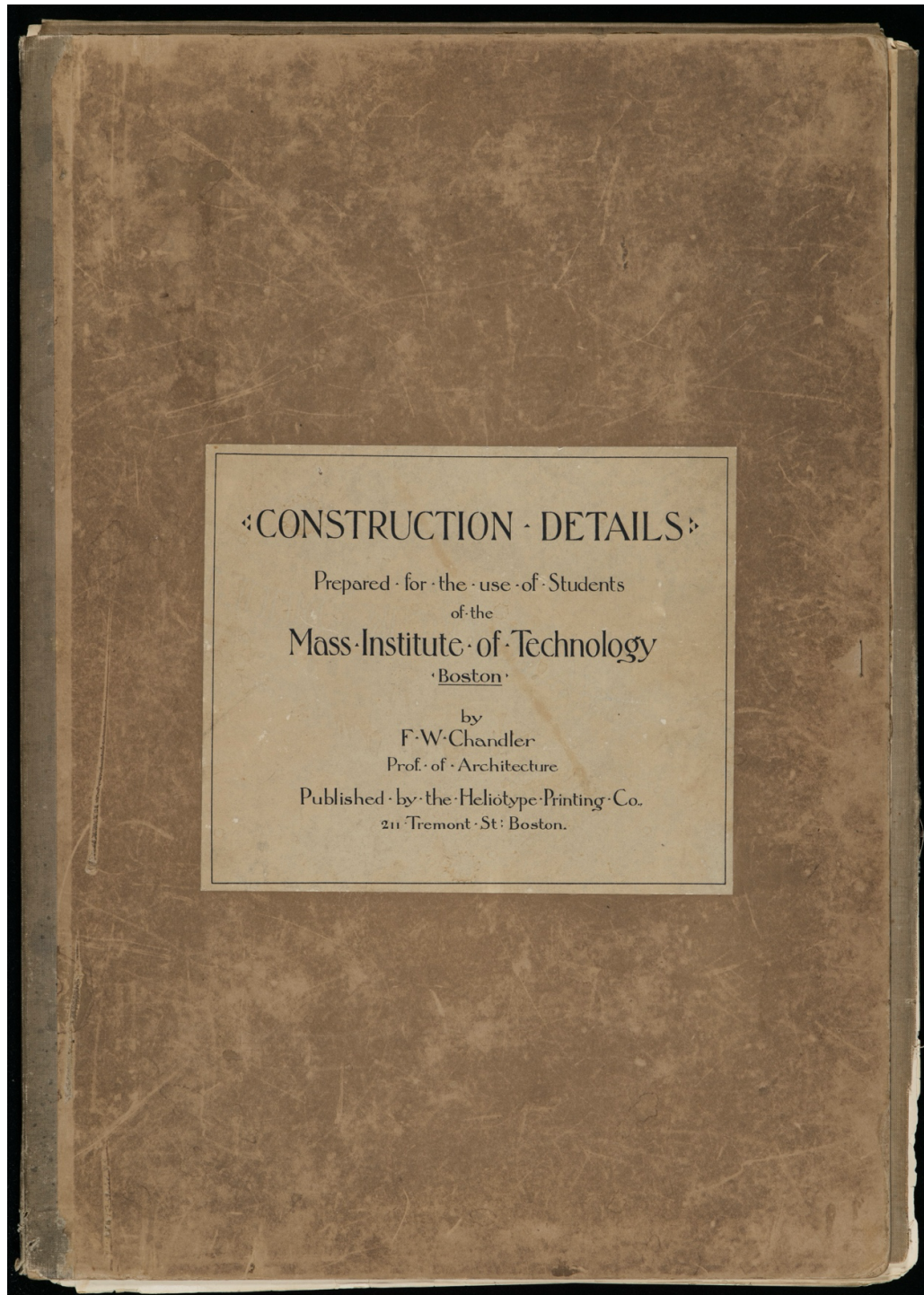


Figure 1.2. Francis Ward Chandler, cover of *Construction Details, Prepared for the Use of Students of the Mass. Institute of Technology, Boston* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.

Details of Window Frames Wooden Building PI. I
1/2 Scale

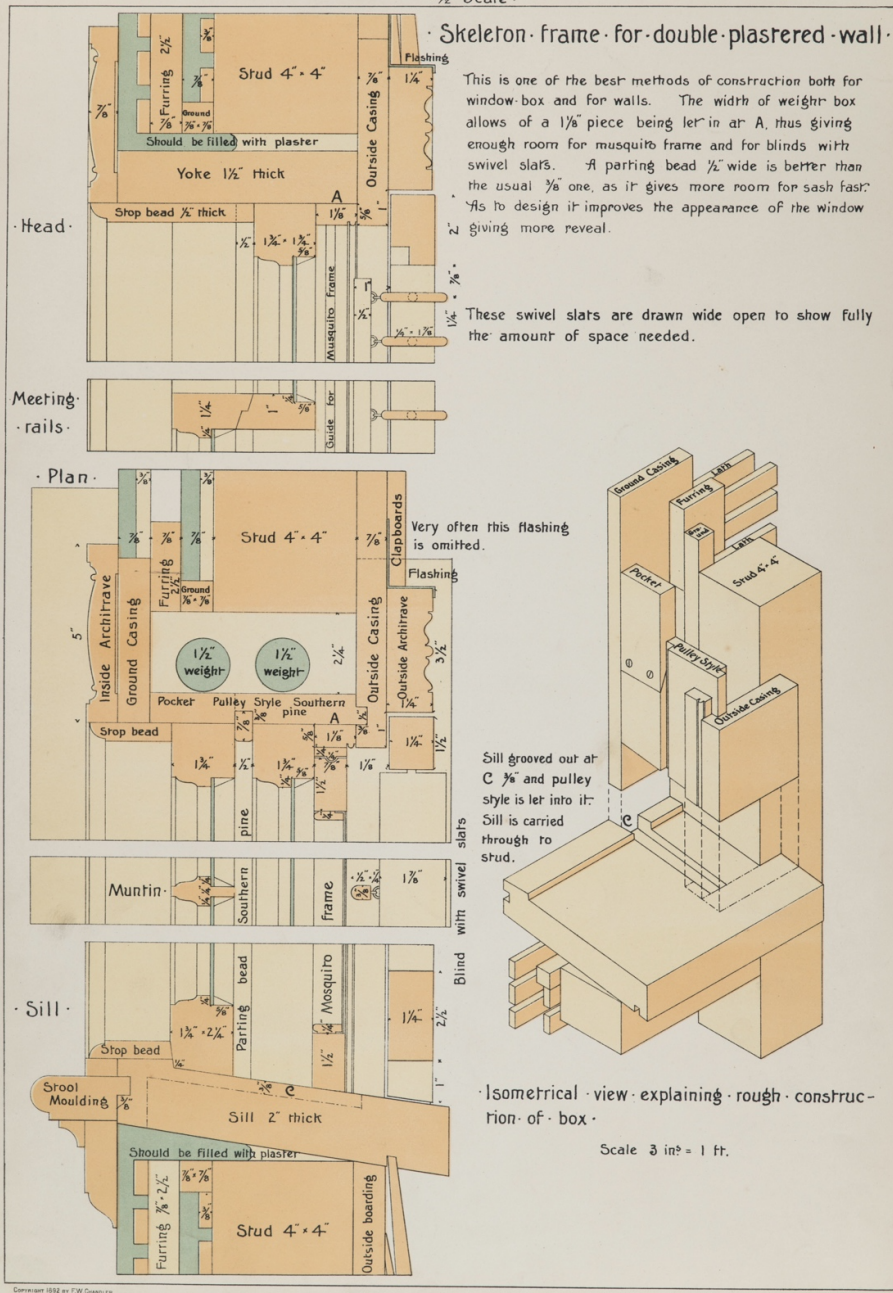


Figure 1.3. Francis Ward Chandler, "Details of Window Frames, Wooden Building," plate 1, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.

Details of Framing Pl. 14

Scale $\frac{3}{4}$ inch = 1 foot.

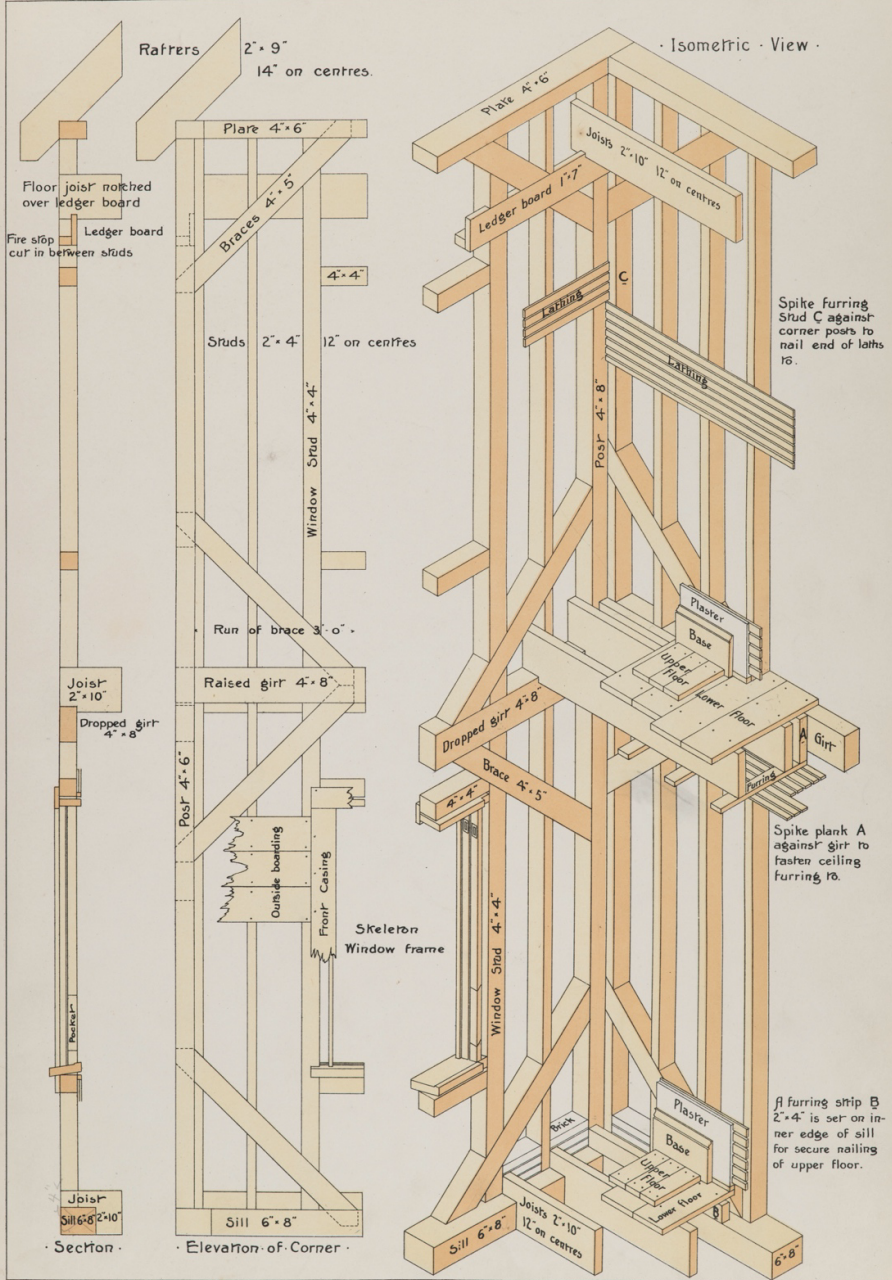


Figure 1.4. Francis Ward Chandler, “Details of Framing,” plate 14, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.

Details of Framing and Flashing P117.

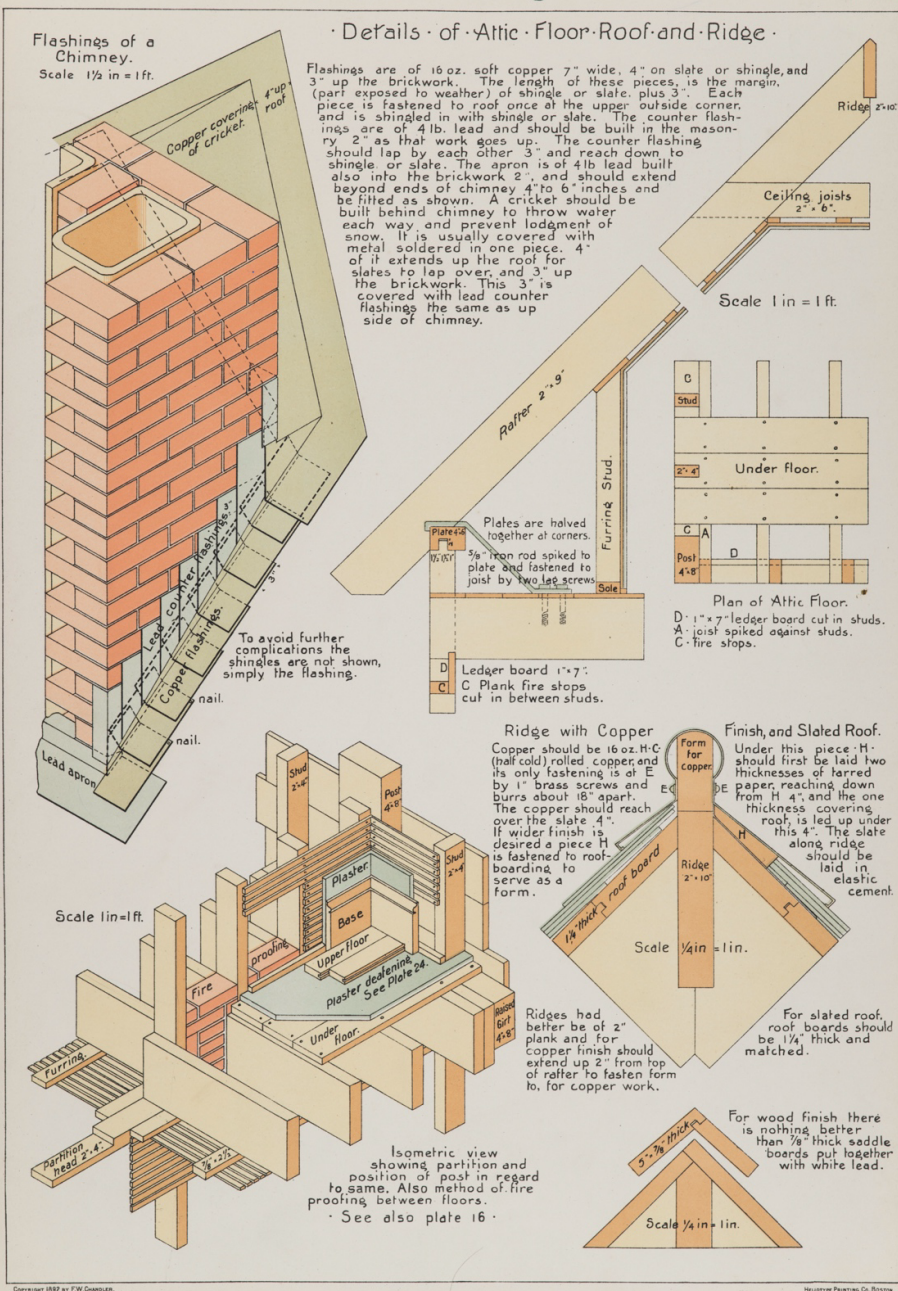


Figure 1.5. Francis Ward Chandler, “Details of Framing and Flashing,” plate 17, from *Construction Details* (Boston, 1892). MIT Museum, Maude Parlin Collection, 1979.028.067, gift of Mrs. Charles Davenport. Courtesy MIT Museum.

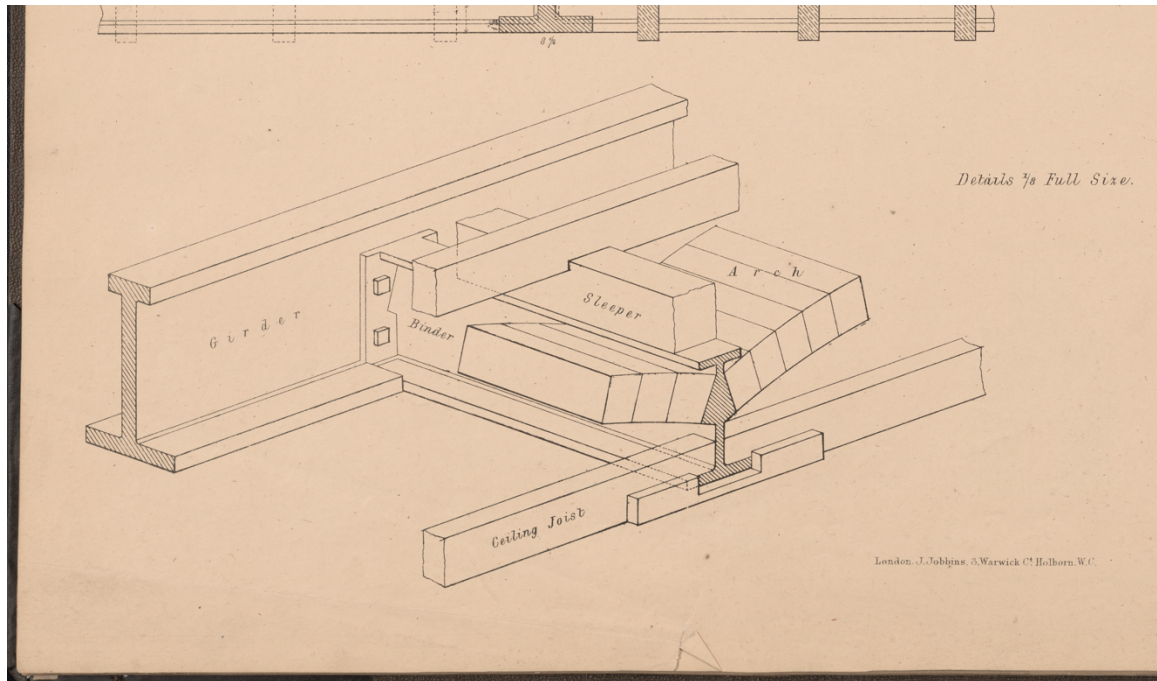


Figure 1.6. Henry Laxton, detail of “Fire Proof Floors, Wynyard Hall, Durham, The Late Phillip W. Wyatt Archt.,” plate 18, from *Examples of Building Construction*, vol. 1 (London, circa 1860). Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.

EXAMPLES OF BUILDING CONSTRUCTION.

Part I. Plans, Elevations and Outside Finish of a Wooden House.

12 Plates.



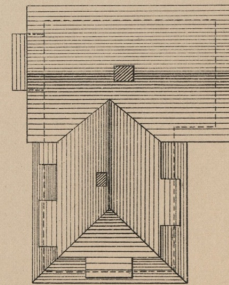
North Front.

Scale... 8 ft. to the inch.



East Front.

Scale... 8 ft. to the inch.



Plan of Roof.

Scale... 16 ft. to the inch.

PLATE Nº 6.

PART I. PLATE 6.

Figure 1.7. William Robert Ware, plate 6 (part 1, plate 6), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.

12 Plates.

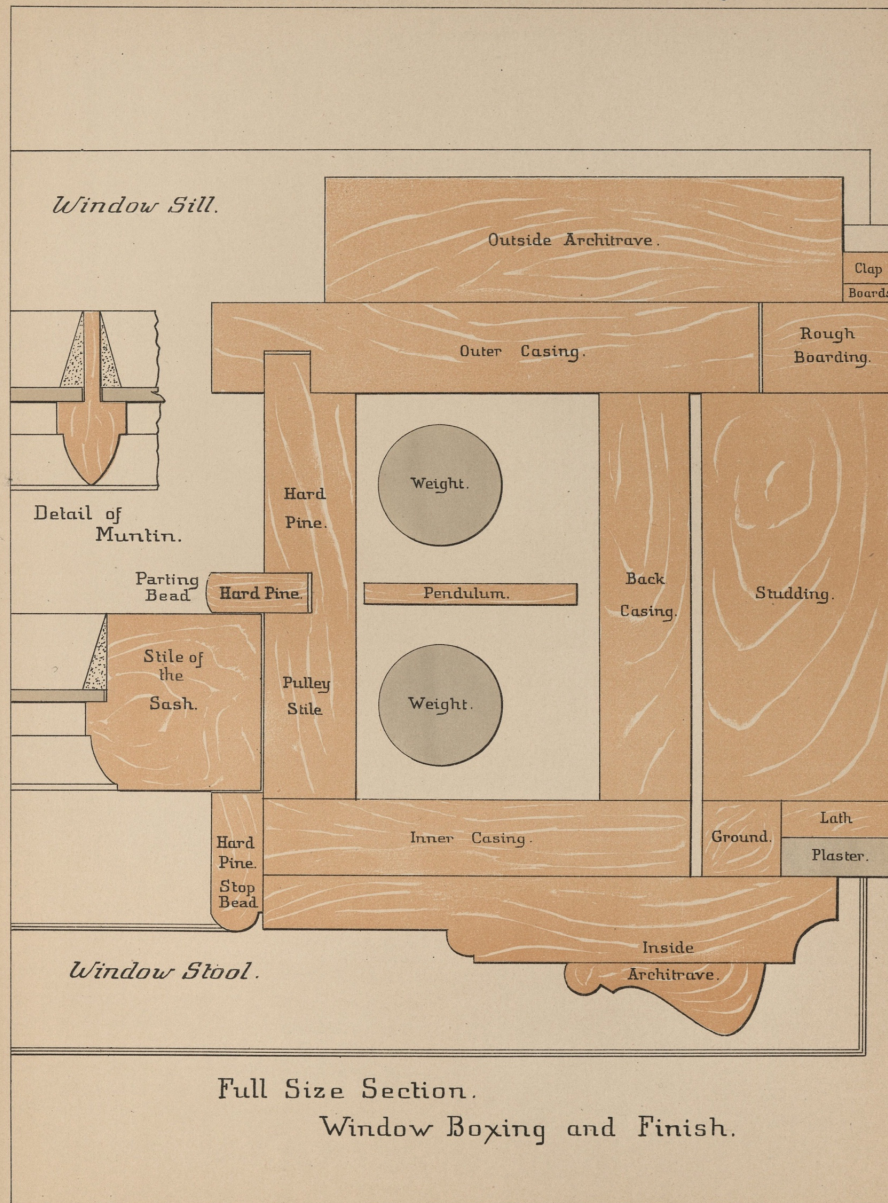


PLATE N^o 25.

PART III. PLATE 1.

Figure 1.8. William Robert Ware, plate 25 (part 3, plate 1), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.

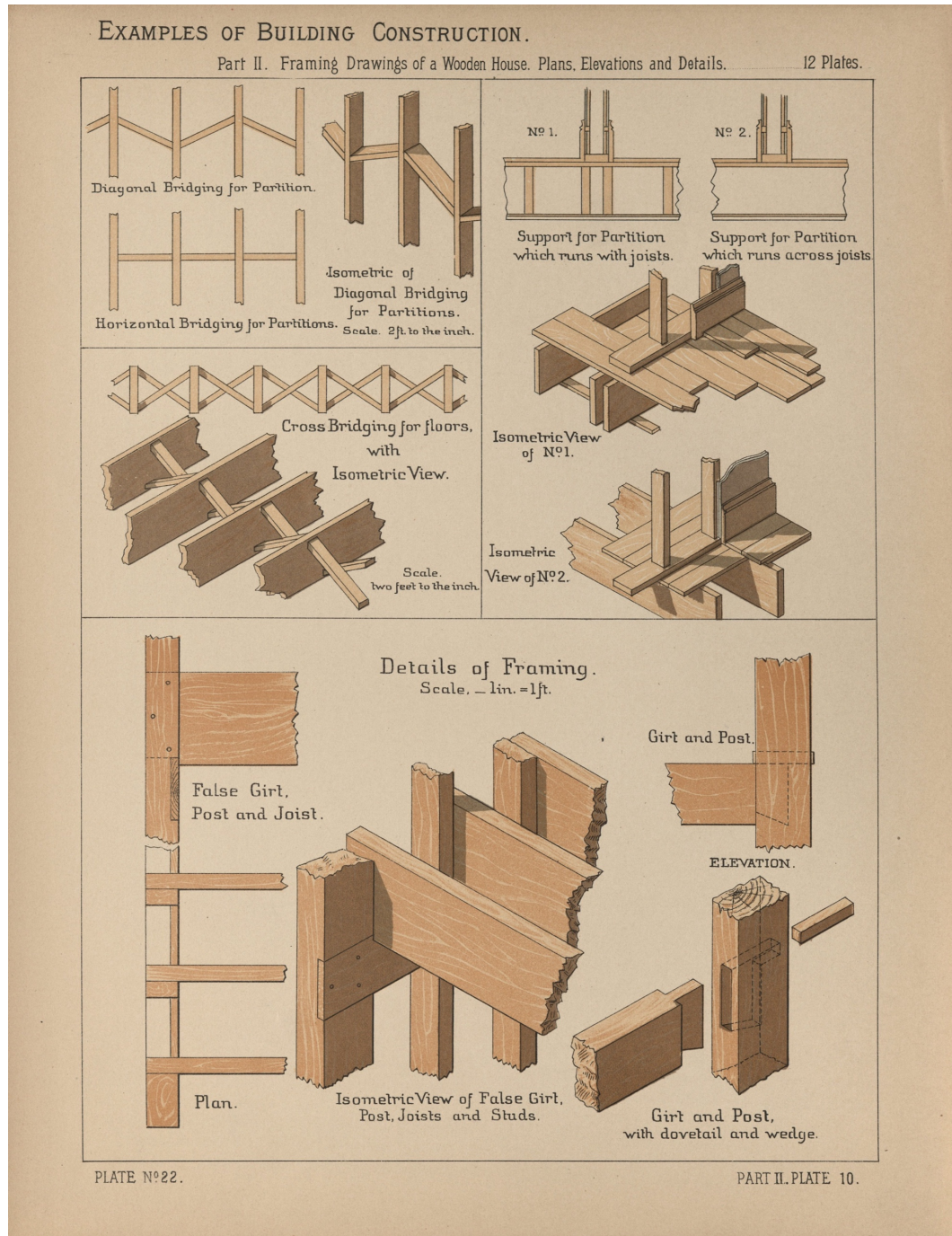


Figure 1.9. William Robert Ware, plate 22 (part 2, plate 10), from *Examples of Building Construction* (Boston, 1876). Harvard Graduate School of Design, Frances Loeb Library Special Collections, Cambridge, Massachusetts.



Figure 1.10. Photographer unknown, “MIT Libraries, Boston, Pierce Building, Architecture Library,” 1890s. MIT Museum, GCP-00081898, Biographical/Subject Files Collection. Courtesy MIT Museum.

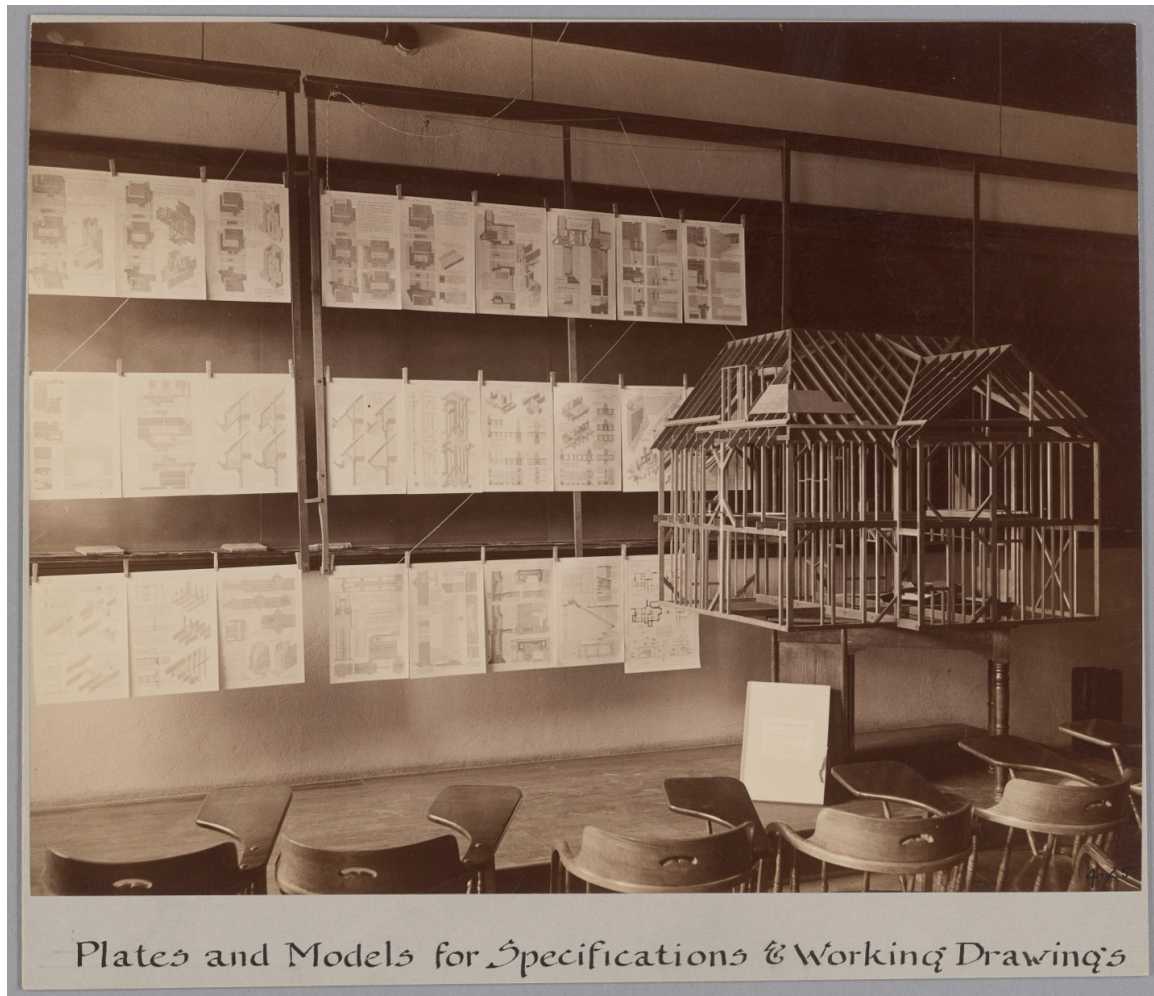


Figure 1.11. Photographer unknown, "Plates and Models for Specifications & Working Drawings," Massachusetts Institute of Technology, Boston, 1890s. MIT Museum, GCP-00040570, Biographical/Subject Files Collection. Courtesy MIT Museum.



Figure 1.12. Photographer unknown, “Office Practice Drawing Room,” Massachusetts Institute of Technology, Boston, 1890s. MIT Museum, GCP-00040558, Biographical/Subject Files Collection. Courtesy MIT Museum.

SMITH & ANTHONY STOVE CO., MFRS. OF SANITAS APPLIANCES.
 BOSTON. NEW YORK. CHICAGO.

For Students,
 Mechanics, Practitioners.

FOR ONE AS MUCH AS FOR THE OTHER.

"CONSTRUCTION DETAILS."

\$10. —  — \$10.

FULL-SIZE, HALF-SIZE, QUARTER-SIZE AND INCH SCALE.

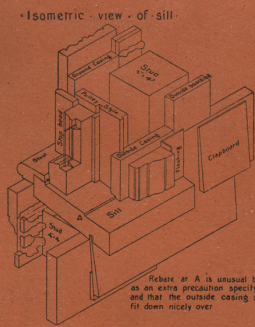
Twenty-five Folio Plates, showing in full, explicit and figured detail the best methods of every-day construction in American practice.

Prepared by FRANK W. CHANDLER, Professor of Architecture, at the Massachusetts Institute of Technology.

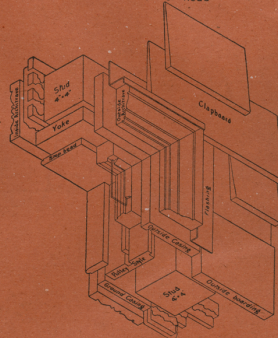
PRINTED IN COLOR, AND FOR SALE BY

**THE HELIOTYPE PRINTING COMPANY, - - 211 Tremont St., BOSTON, MASS.
 26 University Place, NEW YORK.**

And by LITTLE, BROWN & CO., 254 Washington Street, Boston.



Isometric view of sill.

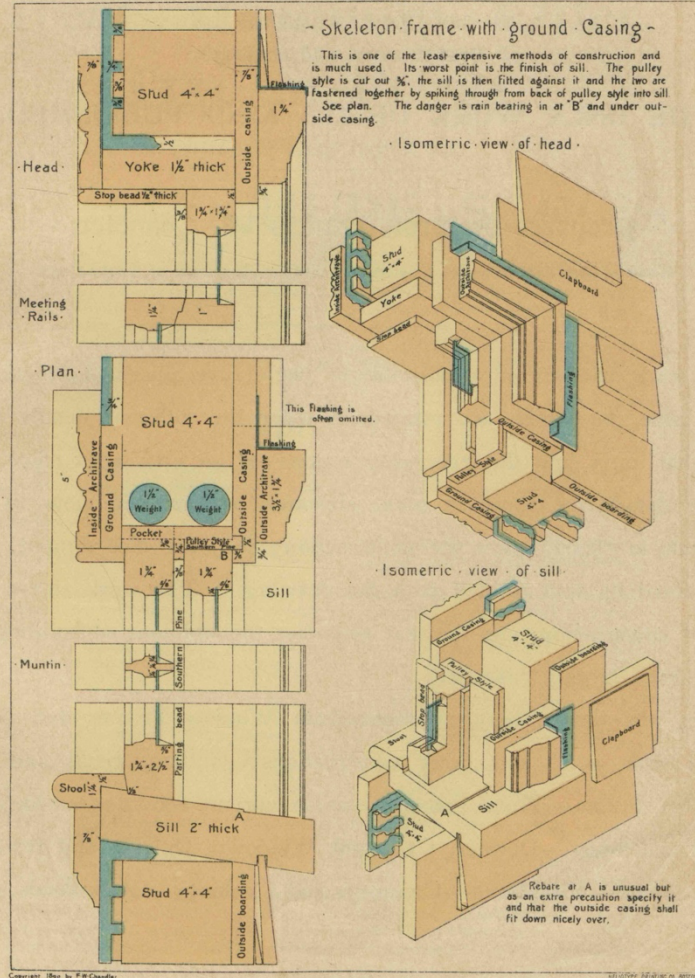


Isometric view of head.

Figure at A is unusual but as an extra precaution specify it and that the outside casing shall fit down nicely over.

Figure 1.13. Advertisement for *Construction Details*, from *American Architect and Building News* 36, no. 856 (21 May 1892). Francis Ward Chandler correspondence, Ms. N-2009, Massachusetts Historical Society, Boston, Massachusetts. Collection of the Massachusetts Historical Society.

Details of Window Frames Wooden Building Pl 2



MINIATURE PLATE
FROM

CHANDLER'S CONSTRUCTION DETAILS.

This most important work is the only collection of plates of its kind devoted to American methods of building construction, showing the best modern usages. Twenty-five plates, 14 by 20 inches, printed in colors; price prepaid, \$10.00.

FOR MORE DETAILED DESCRIPTION, SEE NEXT PAGE.

BATES & GUILD, 6 BEACON ST., BOSTON, MASS.

Figure 1.14a. Advertisement for *Construction Details*, from *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895). Environmental Design Library, University of California, Berkeley.

THE BROCHURE SERIES.

CONSTRUCTION DETAILS.

For Office Reference and the Use
of Draughtsmen and Students.

THE ONLY WORK OF ITS KIND PUBLISHED.

Prepared by Prof. Francis W. Chandler,

Head of the Architectural Department., Mass. Institute of Technology.

This work consists of a portfolio of twenty-five plates, 14 inches by 20 inches in size, on which are printed in color the different details of house building that enter into the every-day routine of an architect's office.

These details are drawn in plan, elevation or isometric view, to a large enough scale to clearly show the construction; they are also figured, and further explained by text printed with the drawing. The work shows the best methods of construction, and the text embodies the opinions of building experts who have been largely consulted.

Among the details may be mentioned: Window Frames and Boxes, in connection with wood and brick constructions—Gutters, metal and wood—Eaves—Girt Frame—Floor Framing, under various conditions, with details of joints and fastenings—Dormer, Casement Windows, Outside and Inside Doors—Sliding Doors—Fireplaces—Chimneys and Flashings—Bulk-heads, etc.

PRICE, \$10.00, EXPRESS PAID.

BATES & GUILD, 6 Beacon St., Boston, Mass.

For miniature specimen plate, see preceding page.

Figure 1.14b. Advertisement for *Construction Details*, from *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895). Environmental Design Library, University of California, Berkeley.



Figure 1.15. Isreal P. Lord, drawing over blueprint copy of “Details of Framing and Flashing,” plate 17, from Francis Ward Chandler, *Construction Details* (Boston, 1892). MIT Museum, Israel P. Lord Collection, 2016.002.465, gift of Mary Ann Howkins. Courtesy MIT Museum.

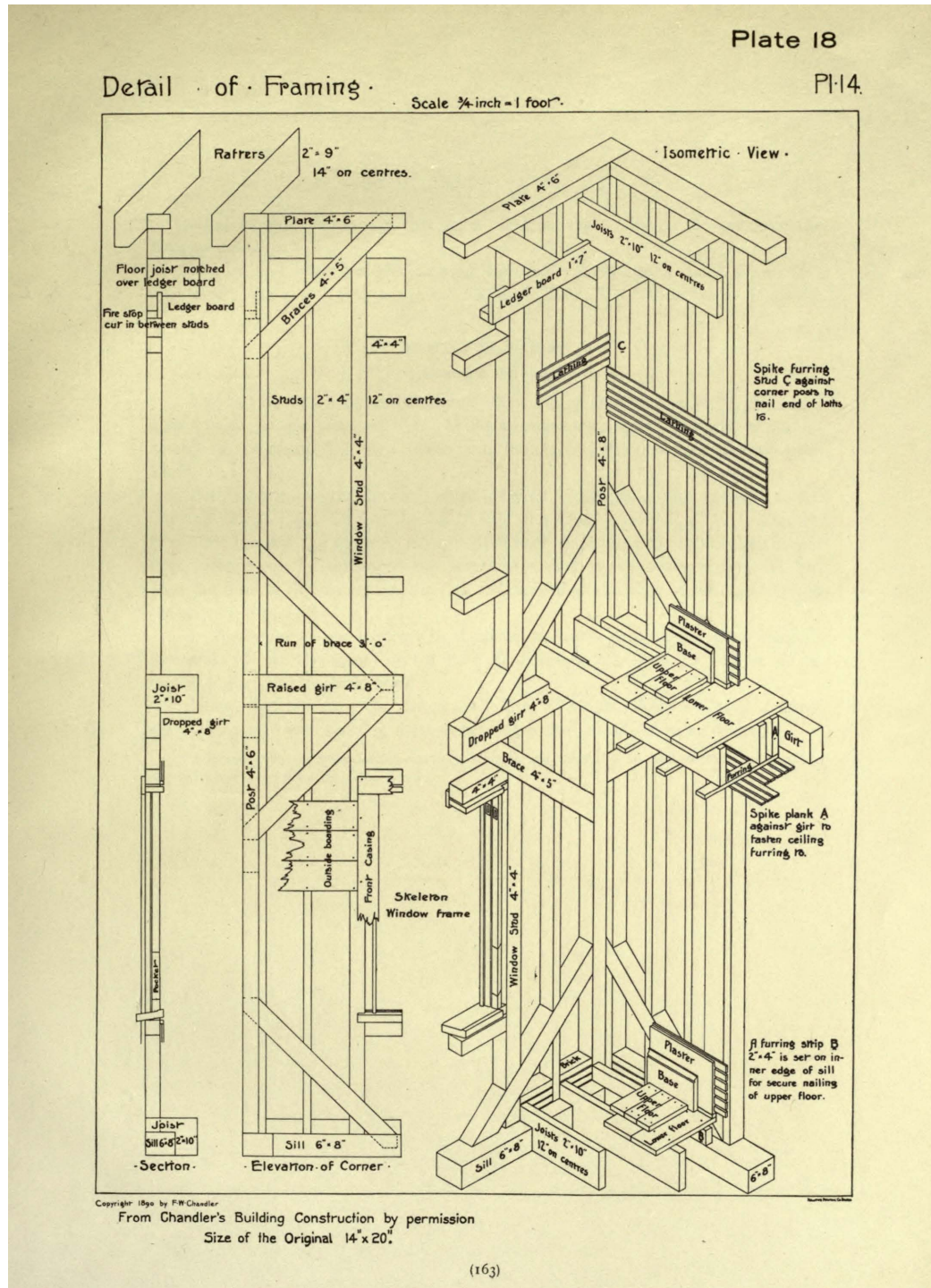


Figure 1.16. Francis Ward Chandler, "Detail of Framing," plate 18, from Charles L. Adams, *Mechanical Drawing: Technique and Working Methods for Technical Students* (George H. Ellis, 1905), 163. Originally published as plate 14, from Francis Ward Chandler, *Construction Details* (Boston, 1892). MIT Museum, Reference Collection. Courtesy MIT Museum.

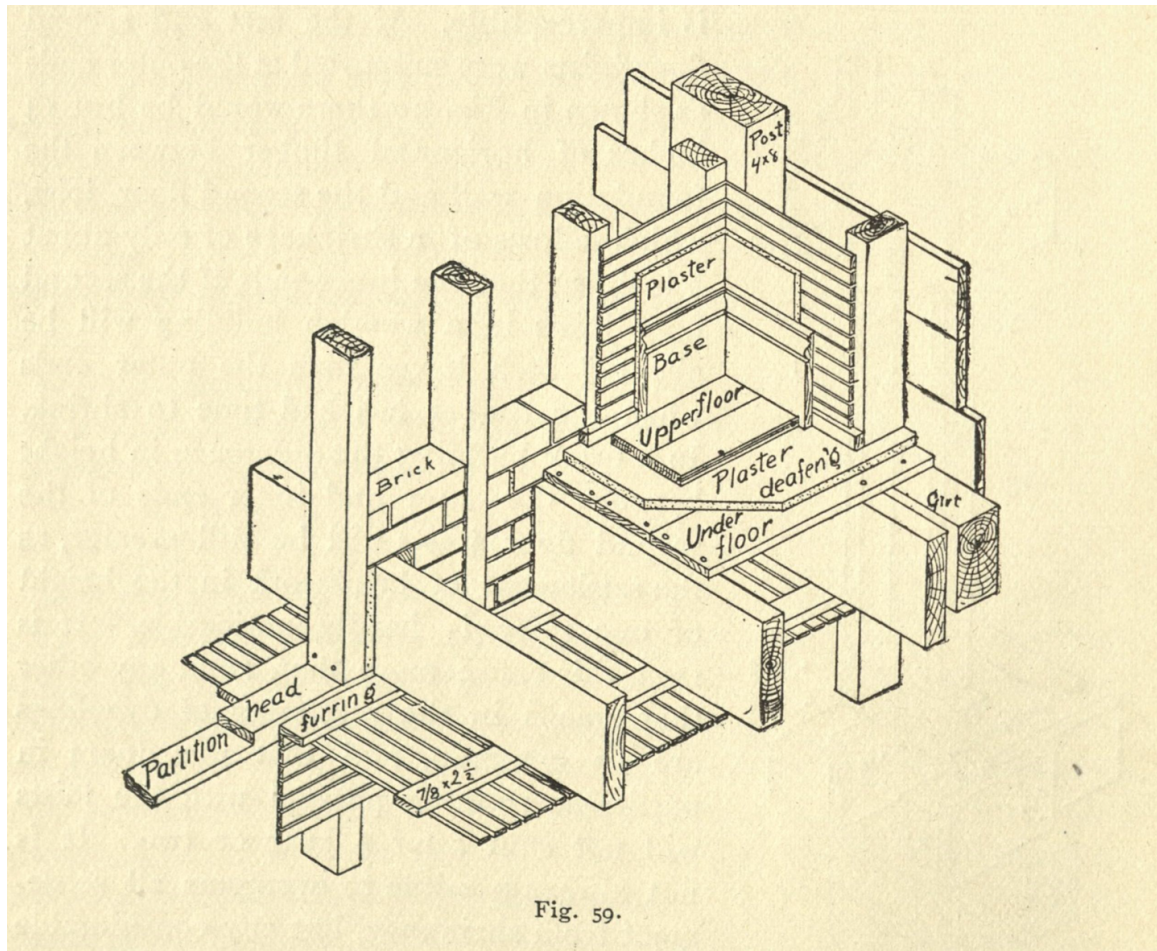


Figure 1.17. Frank E. Kidder, figure 59, from *Building Construction and Superintendence, Part 2, Carpenters' Work* (William T. Comstock, 1902), 79. MIT Libraries.

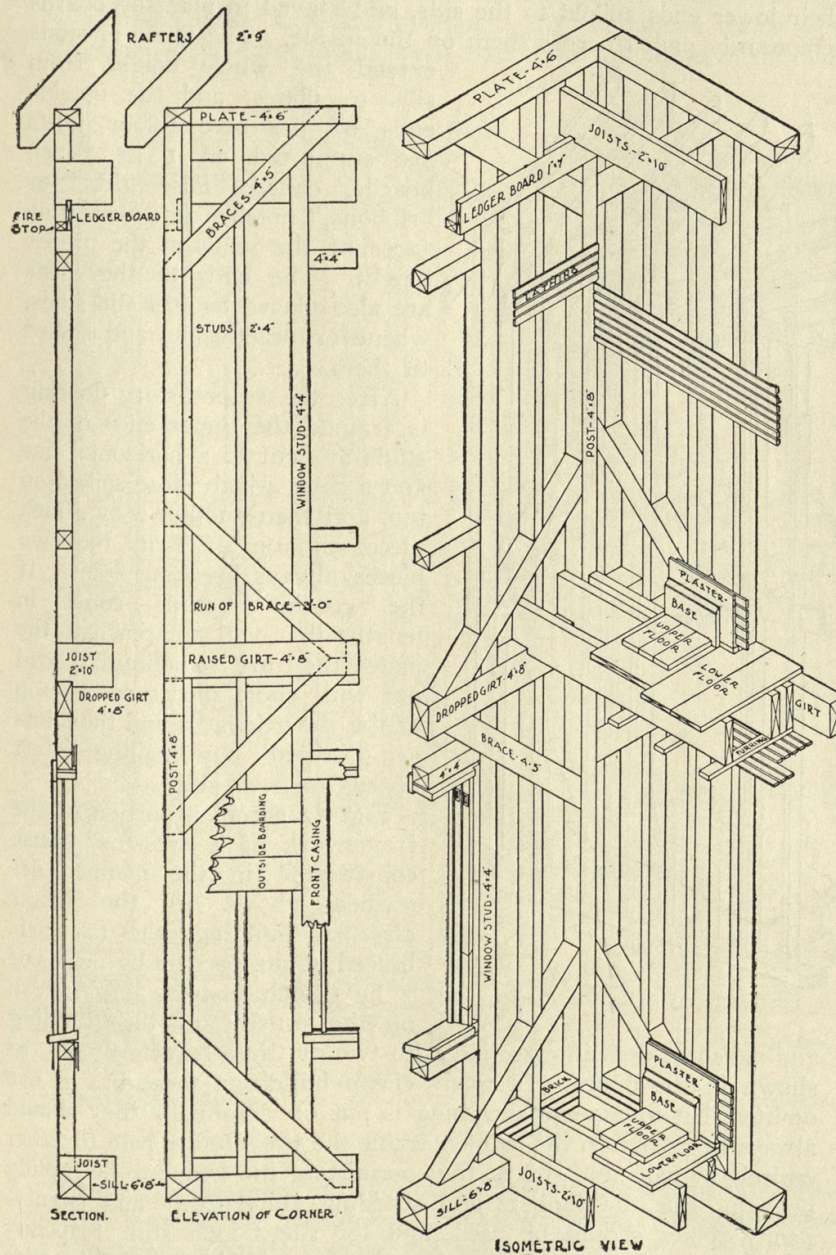


Fig. 30. Braced Frame.

Figure 1.18. Frank E. Kidder, “Braced Frame,” figure 30, from *Building Construction and Superintendence, Part 2, Carpenters’ Work* (William T. Comstock, 1913), 93. MIT Libraries.

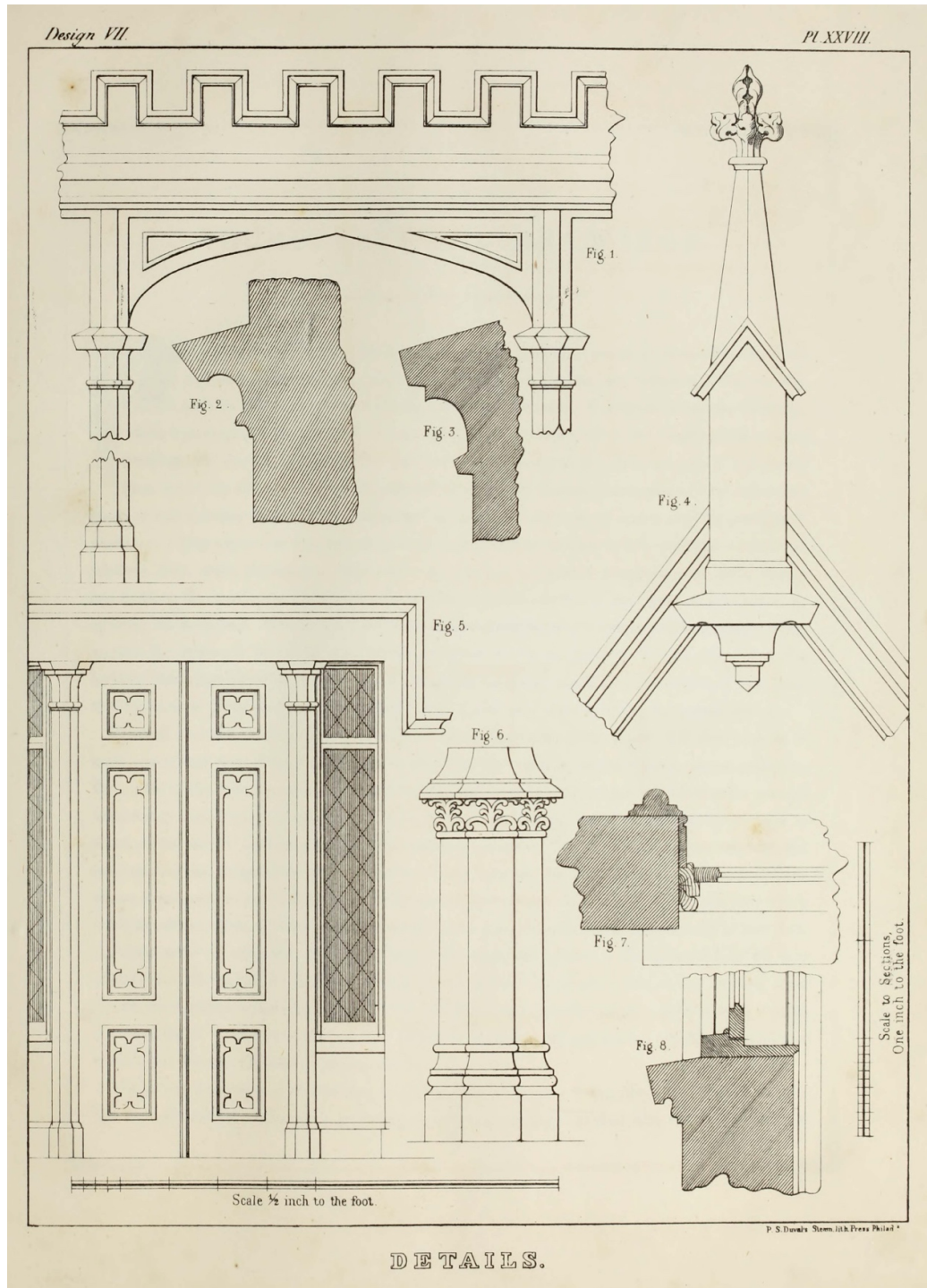


Figure 1.19. Samuel Sloan (author) and P. S. Duval (lithographer), “Details,” design 7, plate 28, from *The Model Architect* (Philadelphia, 1852). HathiTrust/Getty Research Institute.

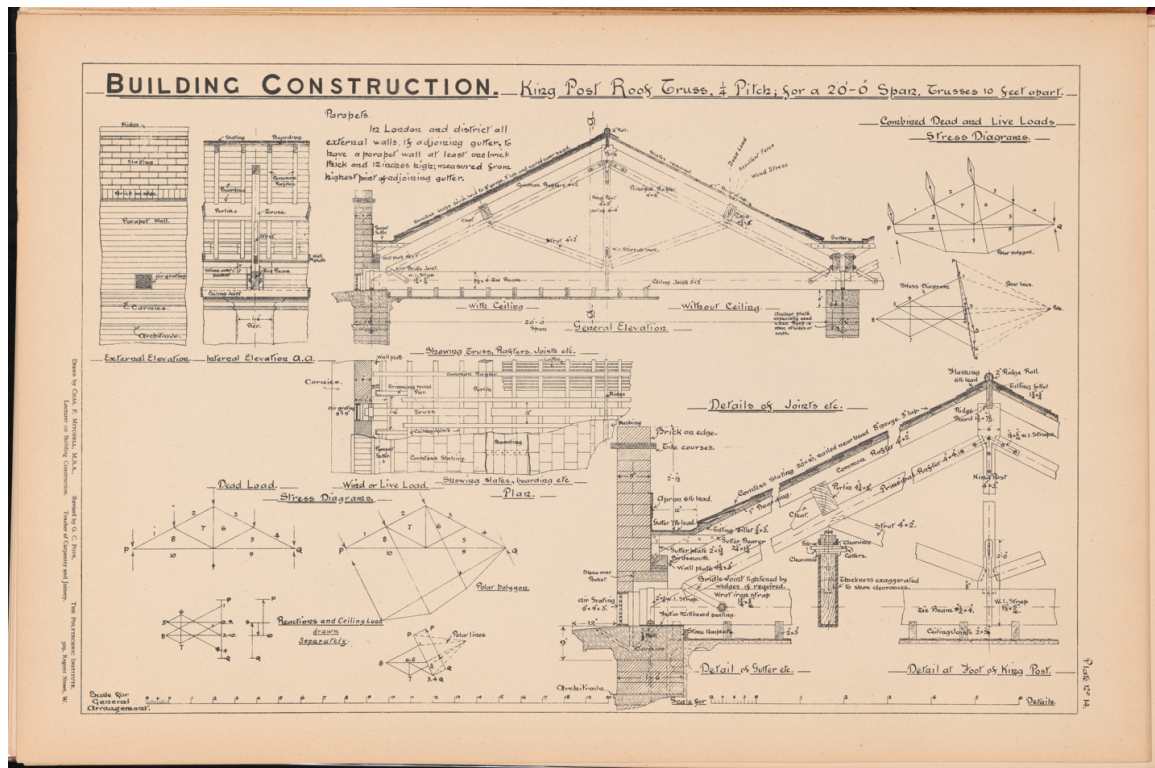


Figure 1.20. C. G. Pope, "King Post Roof Truss," plate 12, from Charles F. Mitchell, *Forty Plates on Building Construction* (London, 1891). Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.

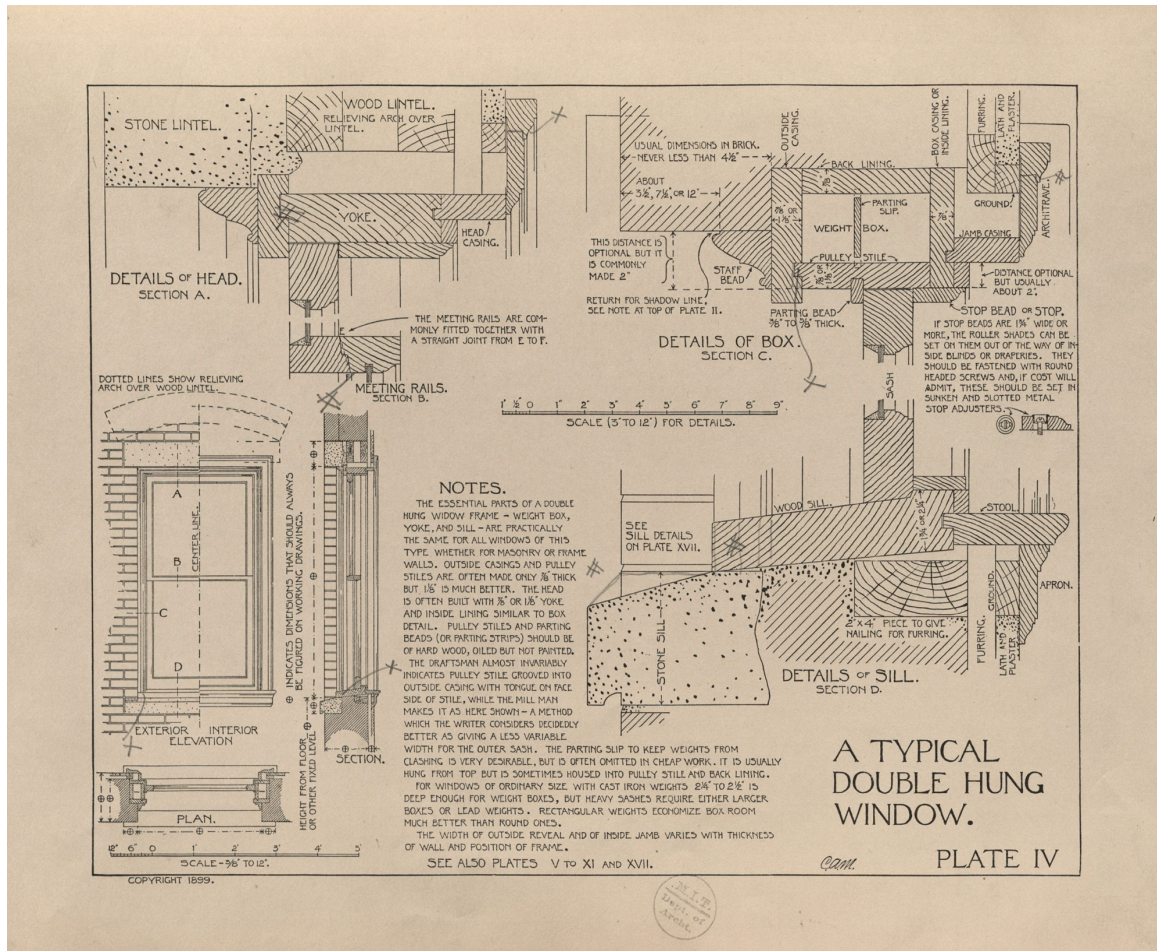


Figure 1.21. Clarence Martin, "A Typical Double Hung Window," plate 4, from *Details of Building Construction* (Boston, 1899). MIT Libraries.



Figure 1.22. Baldwin Coolidge (photographer), Exterior view of the Fletcher's Neck Life-Saving Station, Biddeford Pool, Maine, circa 1887. Historic New England, General photographic collection, PC001.02.01.USME.0210.0020.003.

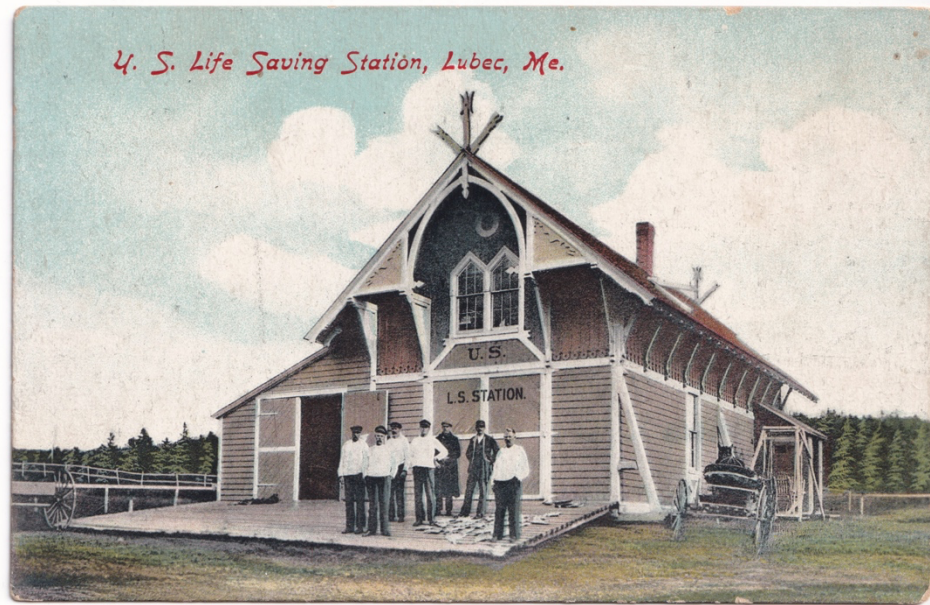


Figure 1.23. Postcards depicting Life-Saving Stations, Francis Ward Chandler (architect), Lubec and White Head, Maine, circa 1880s. Author's collection.



Figure 1.24. Photographer unknown, “Boys in a house-framing class building small structures,” North Bennet Street Industrial School, Boston, circa 1890–1900. North Bennet Street Industrial School Records, MC269-VI-40-1, Schlesinger Library on the History of Women in America, Radcliffe Institute.



A PRACTICAL KIND OF WOODWORKING HAVING
AN INTIMATE RELATIONSHIP TO INDUSTRY.

Figure 1.25. Photographer unknown, “A practical kind of woodworking having an intimate relationship to industry,” from *North Bennet Street Industrial School, 1881–1915* (Boston, 1915). North Bennet Street Industrial School Records, MC269, folder I10, Schlesinger Library on the History of Women in America, Radcliffe Institute.

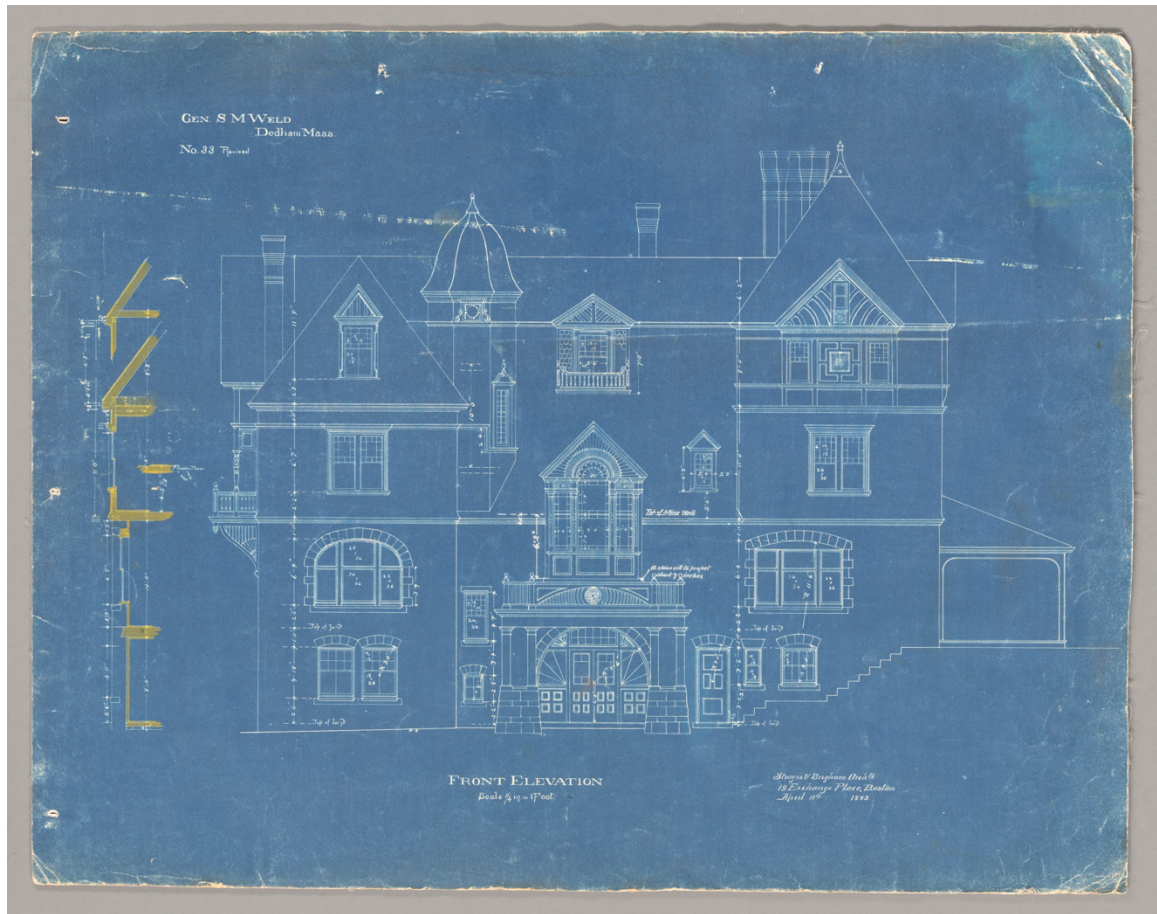


Figure 2.1. Sturgis & Brigham, “Front Elevation,” General S. M. Weld House, Dedham, Massachusetts, 1883. MIT Museum, 1992.012.001, transfer of Institute property (Institute Archives and Special Collections). Courtesy MIT Museum.



Figure 2.2. Sir John Frederick William Herschel, *Engraved Portrait of a Young Woman*, from The Brewster Album, about 1842. The J. Paul Getty Museum, Los Angeles, 84.XZ.574.84.



Figure 2.3. Anna Atkins, “*Cystoseira granulata*,” from *Photographs of British Algae: Cyanotype Impressions, Part I*, October 1843. Spencer Collection, b11861683, The New York Public Library.

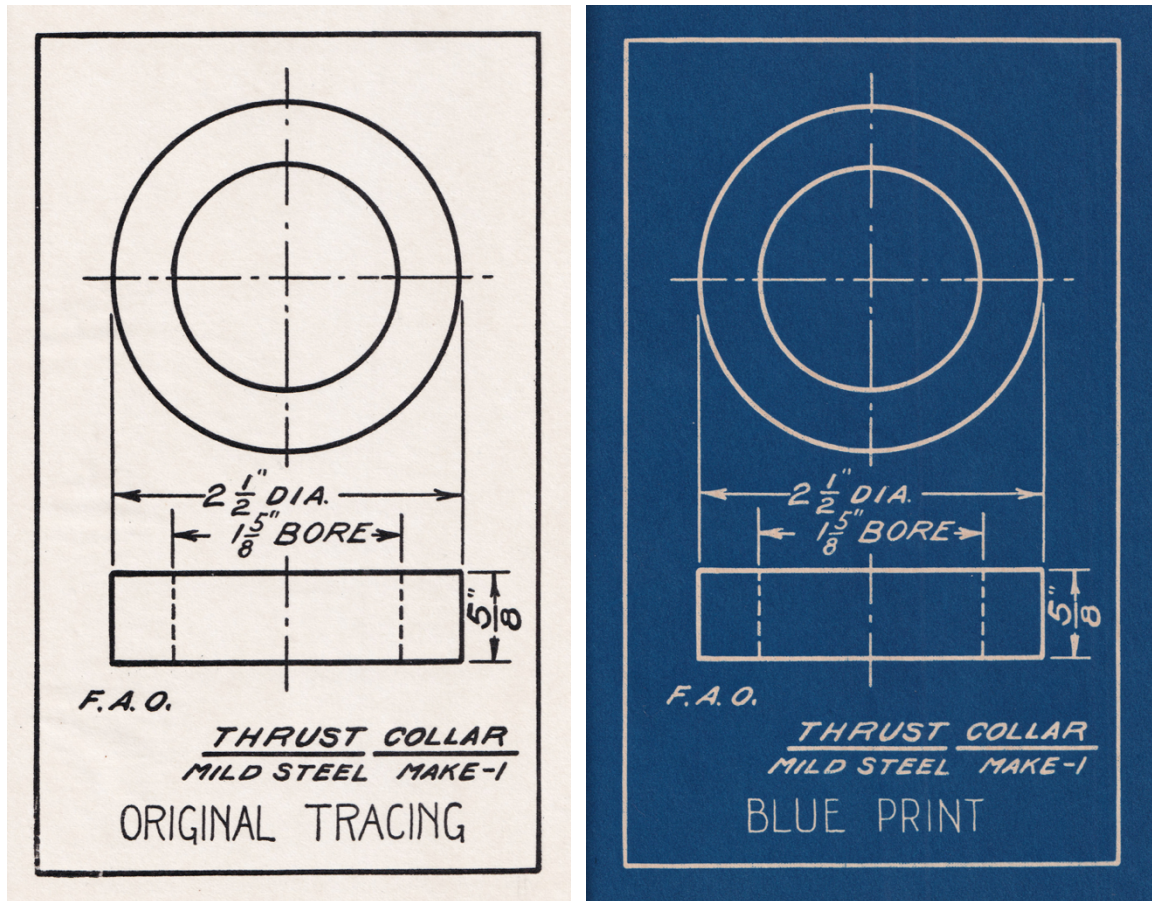


Figure 2.4. Walter W. Sturtevant, “Original Tracing” (left) and “Blue Print” (right), from *How to Make Blue Prints* (Bruce Publishing Company, 1929). Author’s collection.

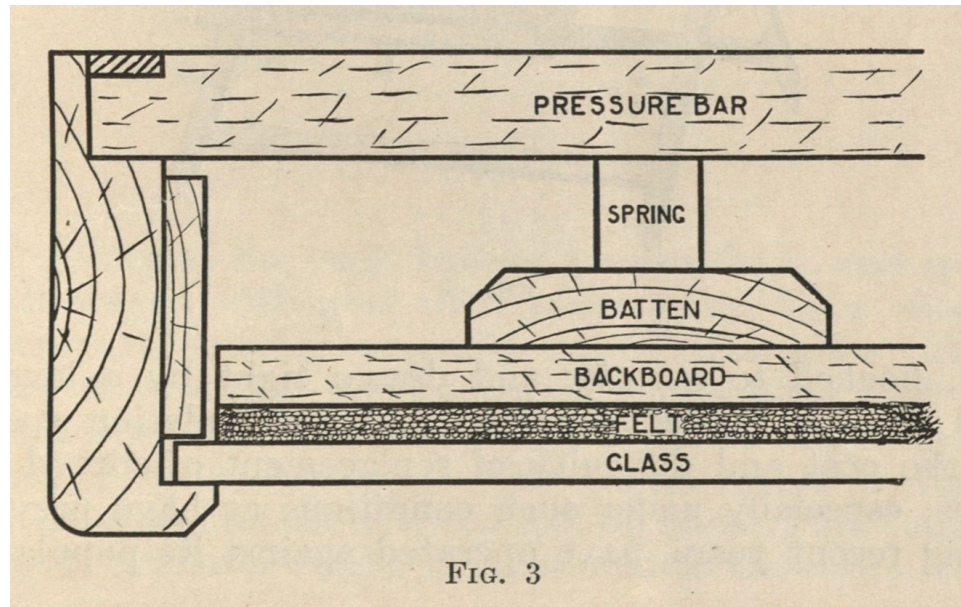


Figure 2.5. Benjamin James Hall, figure 3, from *Blue Printing and Modern Plan Copying for the Engineer and Architect, the Draughtsman and the Print Room Operative* (Sir Isaac Pitman & Sons, 1921), 21. MIT Libraries.

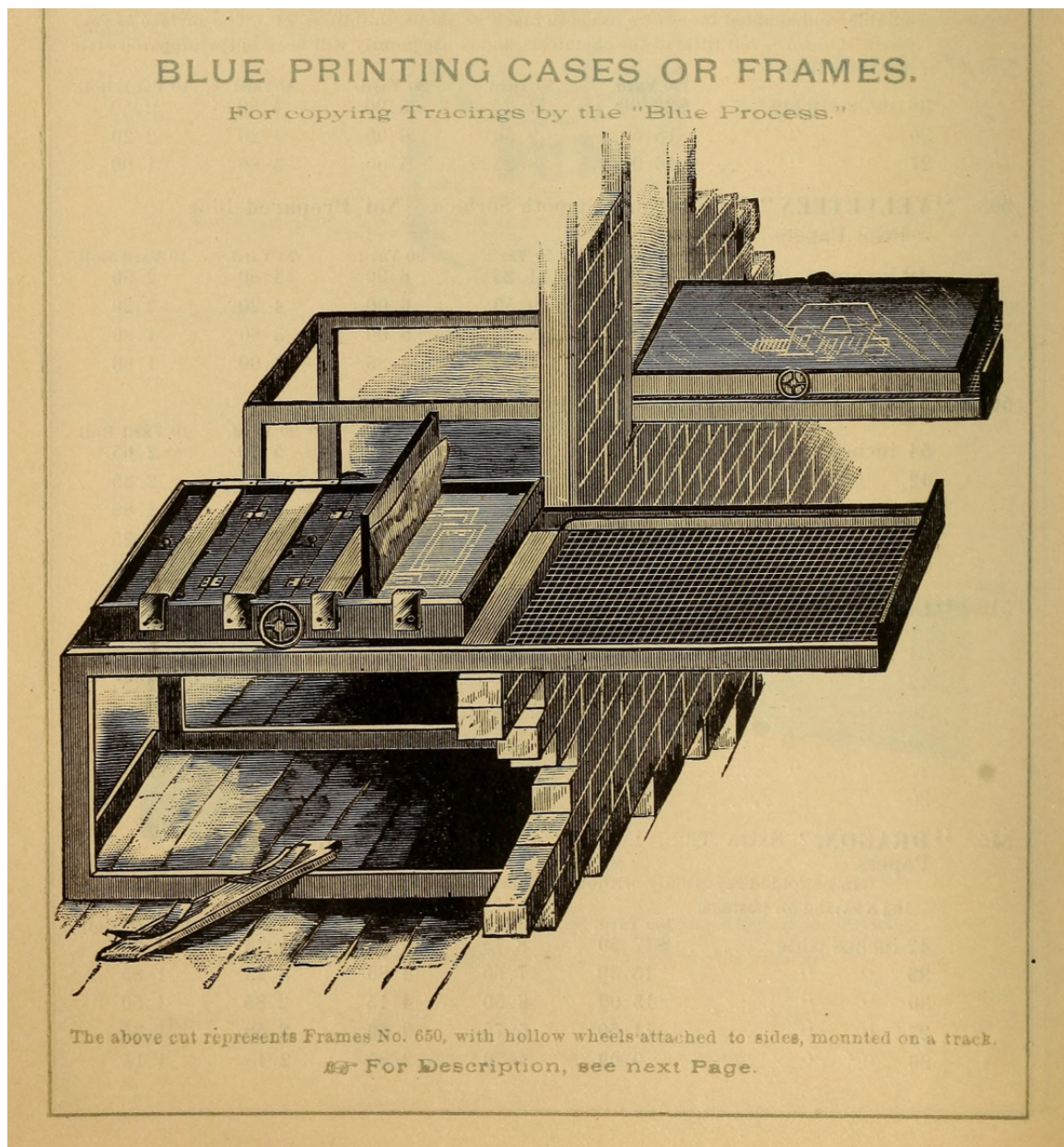


Figure 2.6. E. G. Soltmann, "Blue Printing Cases or Frames," from *Price List of Drawing Materials, Architects and Engineers' Supplies* (New York, 1885), 28. Library of Congress, ca07002818.

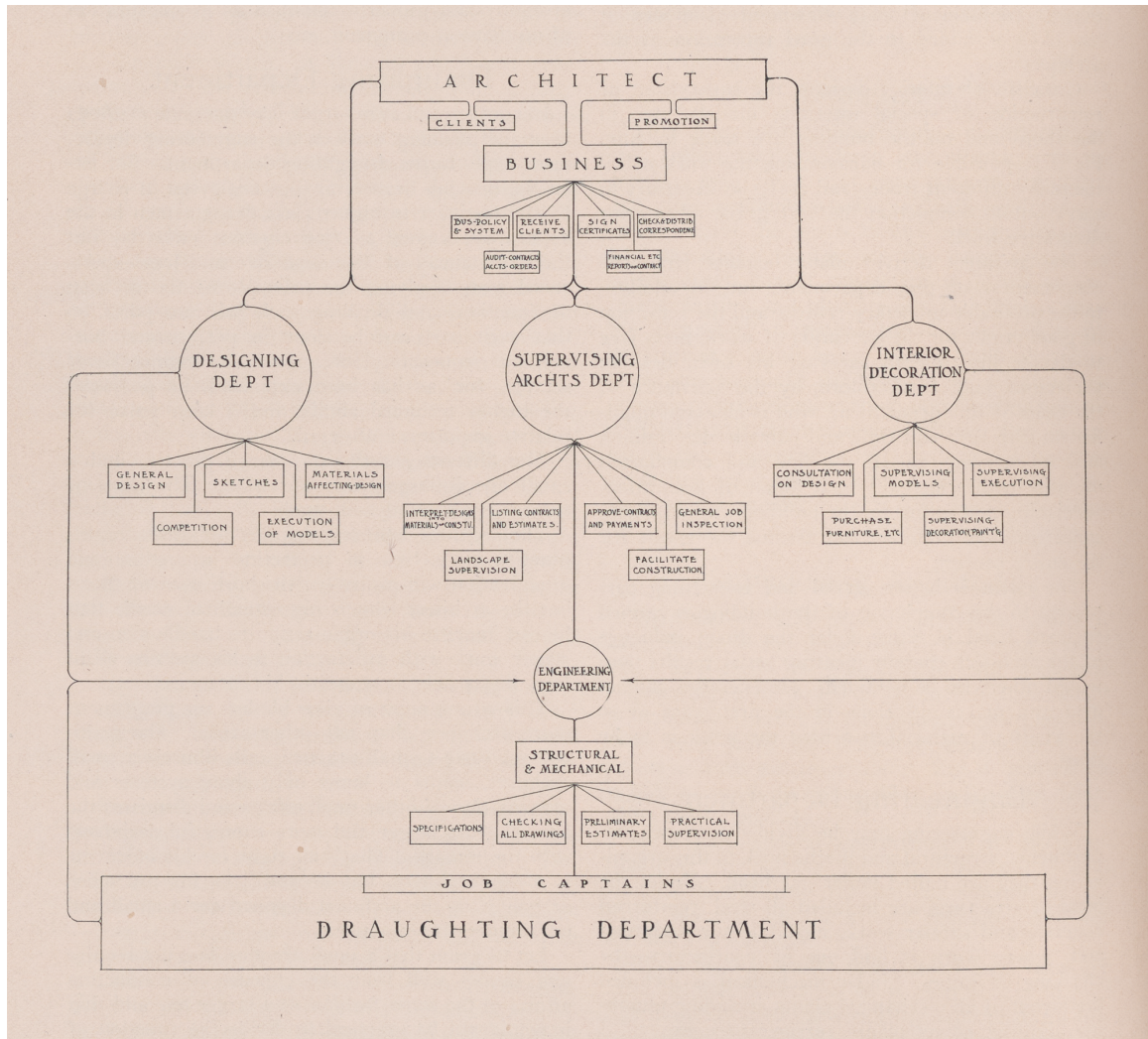


Figure 2.7. Daniel Paul Higgins, architectural office organization chart, from *American Architect* 115, no. 2246 (8 January 1919), 64. Massachusetts Institute of Technology, Rotch Library Limited Access Collection, Cambridge, Massachusetts.

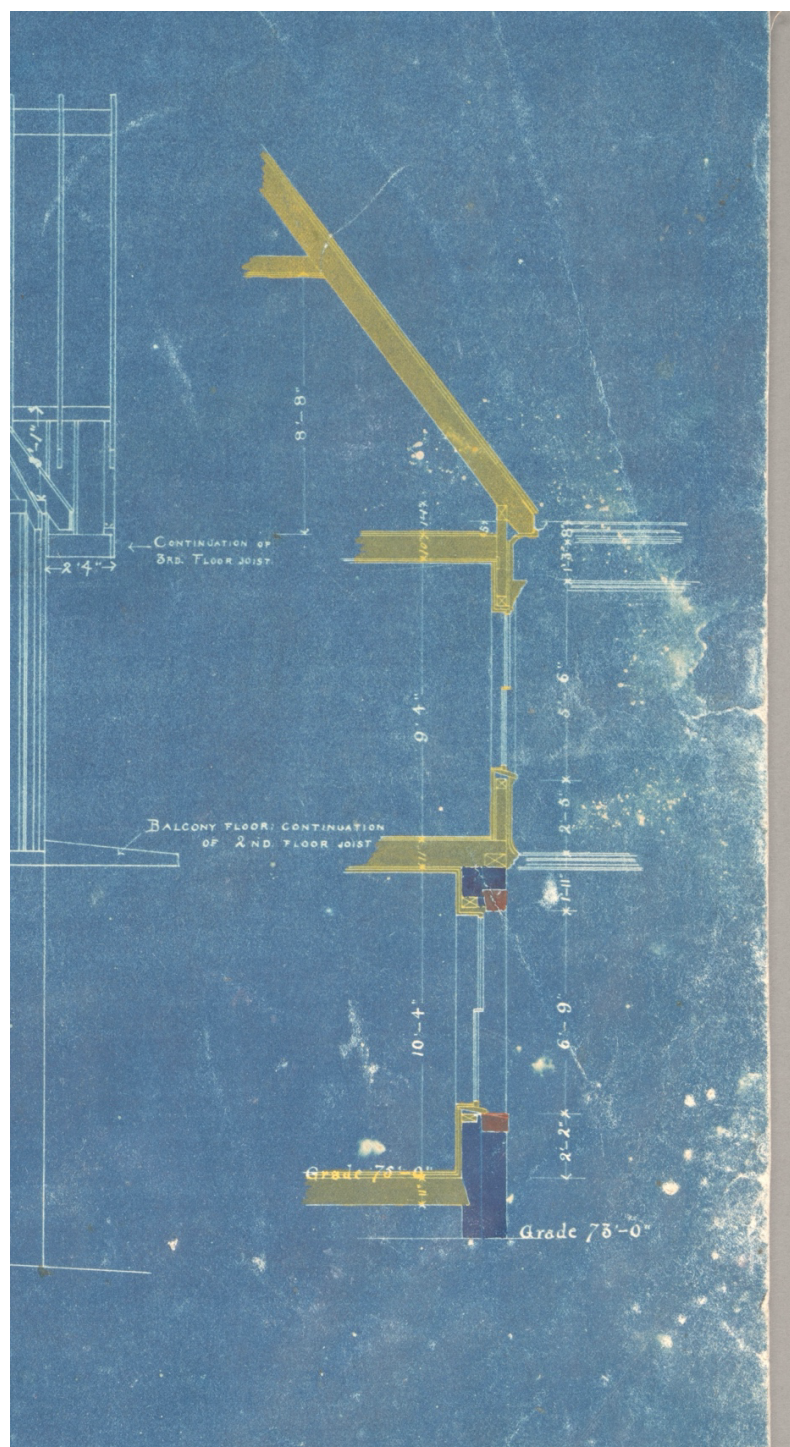


Figure 2.8. Sturgis & Brigham, detail of “South Elevation Frame,” General S. M. Weld House, Dedham, Massachusetts, 1883. MIT Museum, 1992.012.010, transfer of Institute property (Institute Archives and Special Collections). Courtesy MIT Museum.

FIG. 12.—CHARACTERISTIC HATCHINGS FOR
HELIOGRAPHIC PURPOSES.

DIMENSION LINE			
CENTRE LINE			
SECTION LINE			
WROUGHT IRON		WATER	
CAST IRON		GLASS	
STEEL		INDIA-RUBBER	
COPPER		RUBBLE	
BRASS		LEAD	
WOOD		PUDDLE	
BRICKWORK		MARBLE	
STONWORK		GRANITE	
CONCRETE		DEPOSITED EARTH	
CLAY		LOOSE STONES	
HARD EARTH		COAL	

Figure 2.9. Benjamin H. Thwaite, “Characteristic Hatchings for Heliographic Purposes,” figure 12, from *Transactions of the Federated Institution of Mining Engineers* 9 (London, 1895). MIT Libraries.

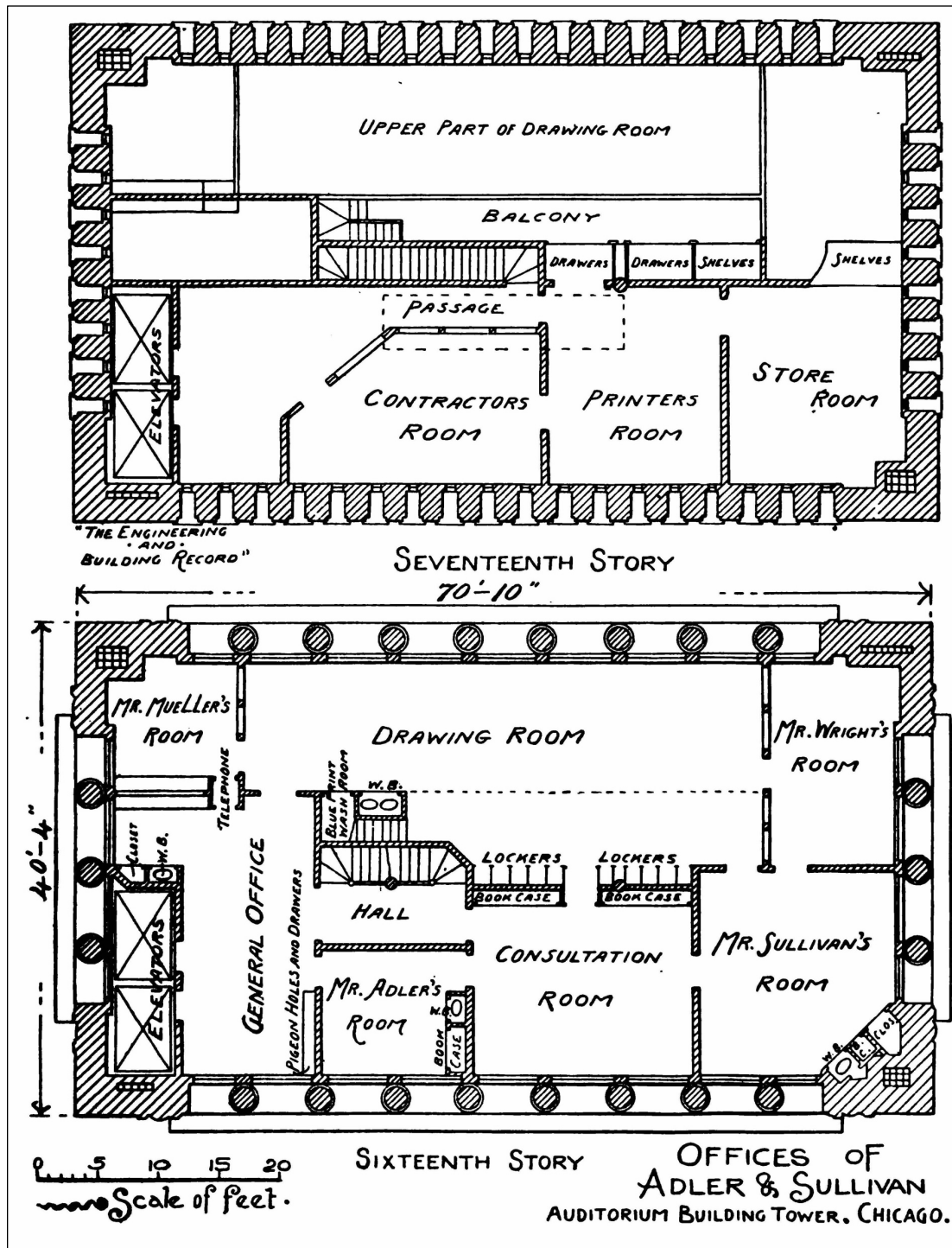


Figure 2.10. "Offices of Adler & Sullivan, Auditorium Building, Chicago," from *Engineering and Building Record* 22, no. 1 (7 June 1890), 5. University of Michigan/HathiTrust.

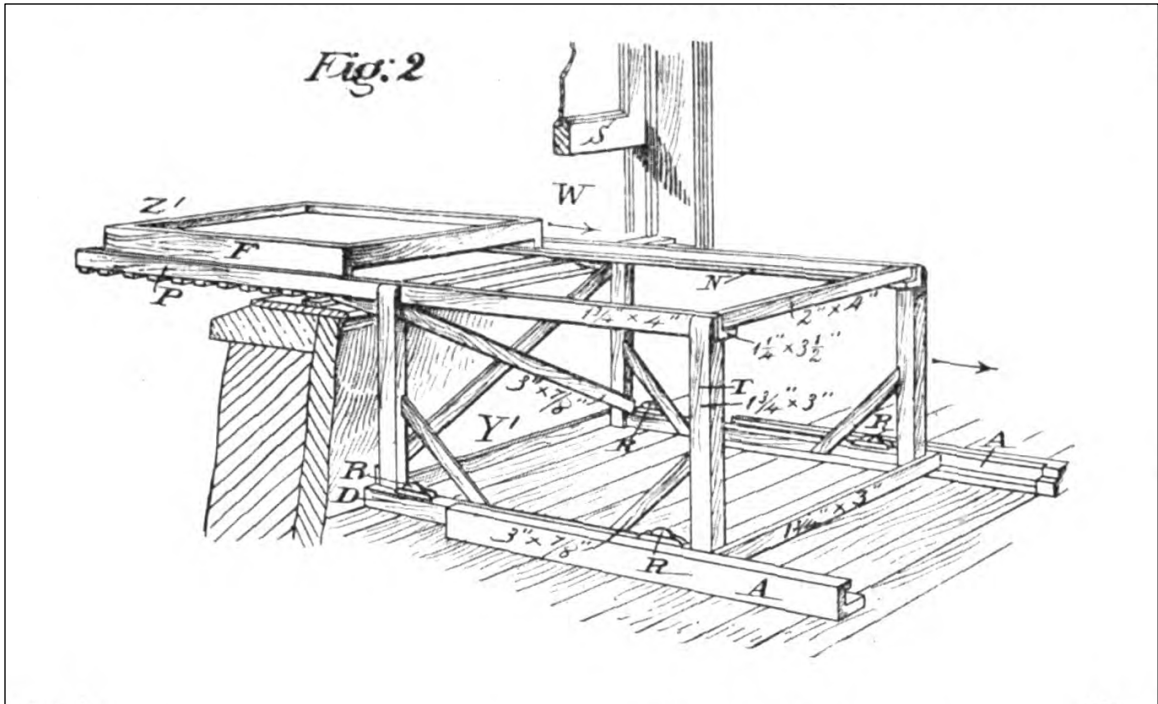


Figure 2.12. “Details of George B. Post’s Office, New York,” figure 2, from *Engineering Record, Building Record & Sanitary Engineer* 24, no. 23 (7 November 1891), 363. University of Chicago/HathiTrust.

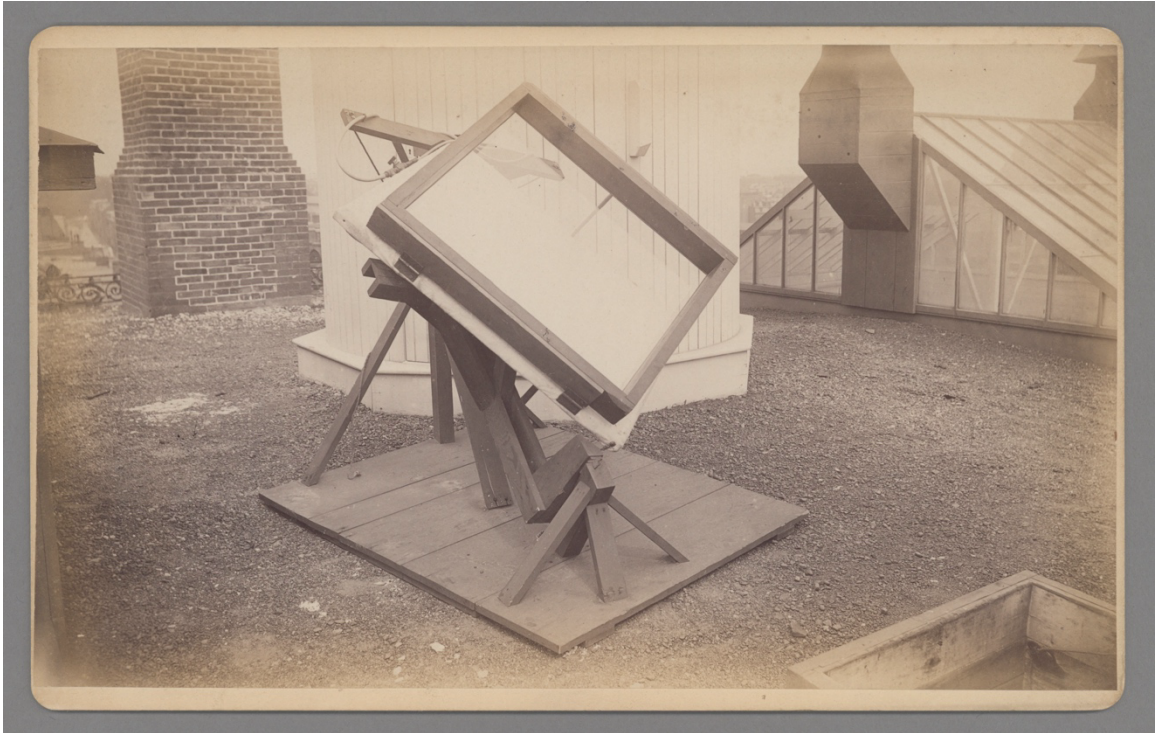
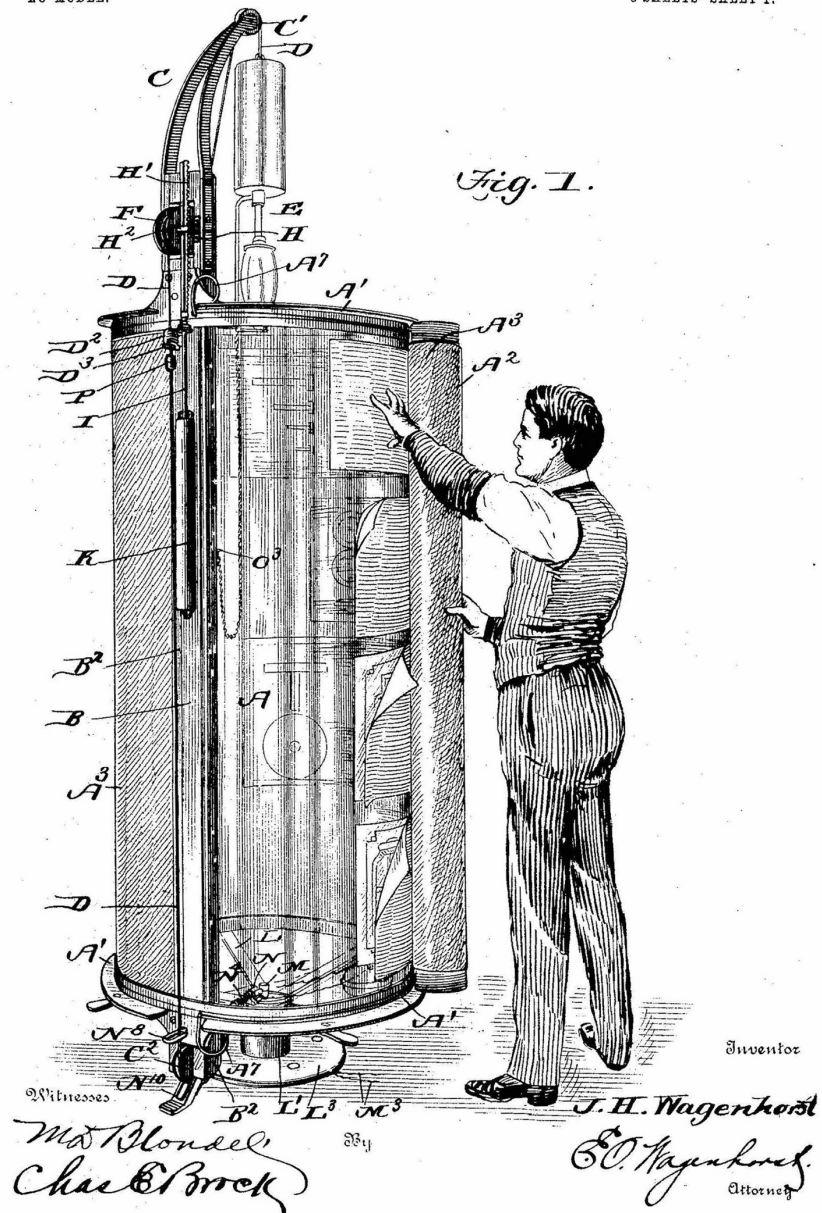


Figure 2.13. Baldwin Coolidge (photographer) and Channing Whitaker (designer), blueprinting apparatus, Massachusetts Institute of Technology, Boston, circa 1882. MIT Museum, Biographical/Subject Files Collection. Courtesy MIT Museum.

PATENTED JULY 19, 1904.

NO MODEL.

6 SHEETS—SHEET 1.



261

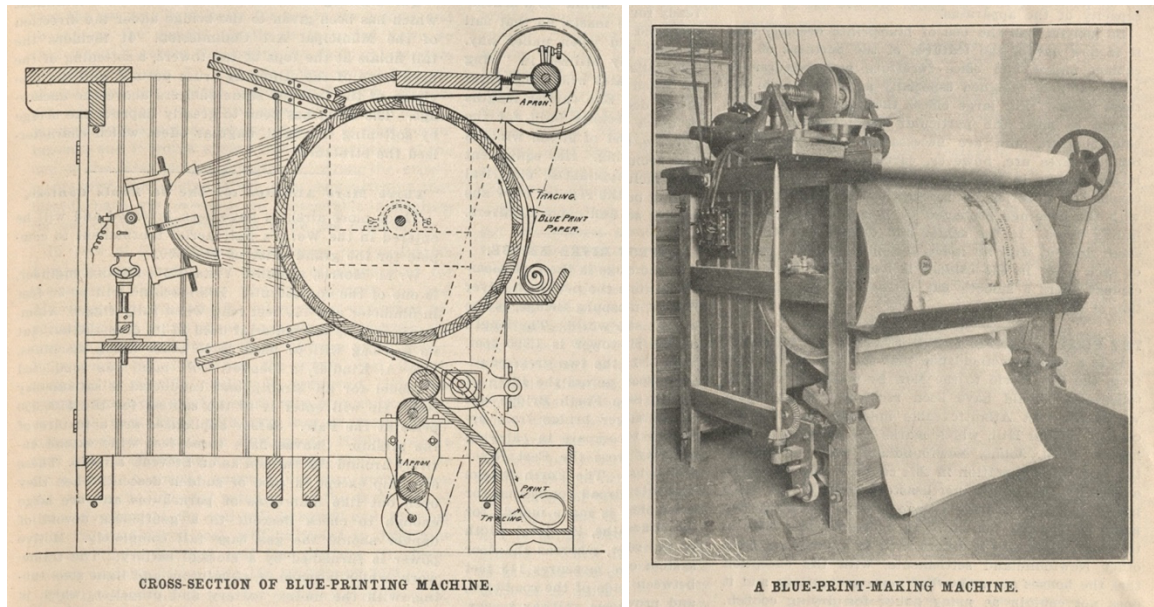
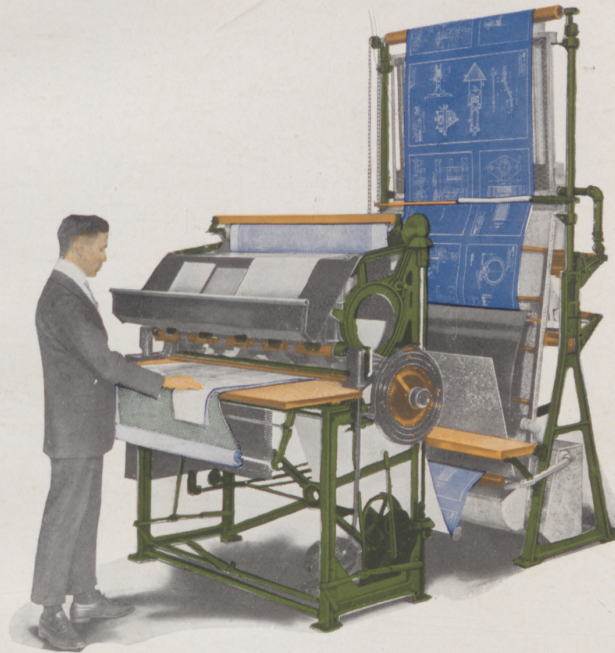


Figure 2.15. “Cross-Section of Blue-Printing Machine” (left) and “A Blue-Print-Making Machine” (right), from *Scientific American* 89, no. 3 (18 July 1903), 45. MIT Libraries.

Peerless Blue Printing, Washing and
Drying Equipment in
Operation



For full description see following pages

Figure 2.16. C. F. Pease Company, “Peerless Blue Printing, Washing, and Drying Equipment in Operation,” from *Catalog B* (C. F. Pease, 1918). Gorham Manufacturing Company Archive, John Hay Library, Brown University.

Order No.	Paper, Roll No.	Date, 189 .
No. of Tracing, No. of Drawer, No. of Case, Size,		
Title,		
{ Blue } { Print of { each } tracing { is } wanted. Ordered by { White } { this } { these } { are }		
When completed and trimmed { send } { deliver }		
to by (state time)		
of		
by { mail } { estimate } Taken by, { express } { construction } { messenger } { reference } Sent by,		
Date of Printing, 189 . Date of Delivery, 189 .		
..... yds., Roll No. Paper, opened 189 .		

Figure 2.17. Sample blueprint tracking card, from *Engineering Record, Building Record and Sanitary Engineer* 38, no. 16 (17 September 1898), 336. University of Michigan/HathiTrust.

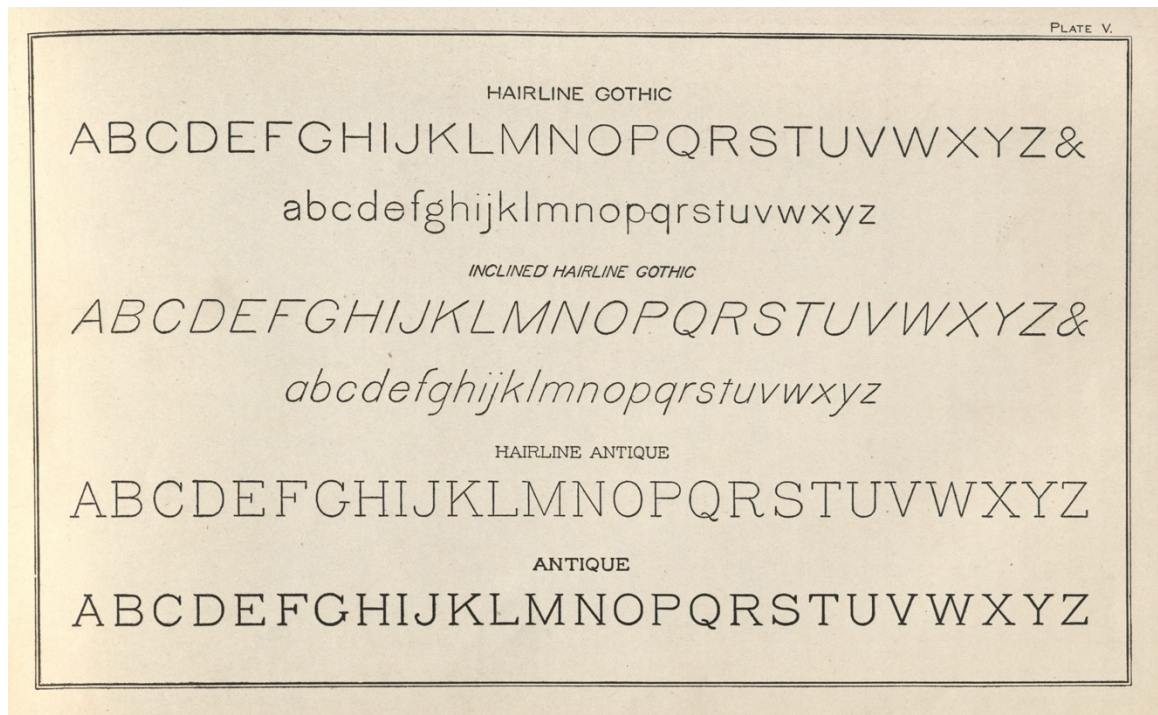


Figure 3.1. Henry S. Jacoby, plate 5, from *A Text-Book on Plain Lettering* (New York, 1895). MIT Libraries.

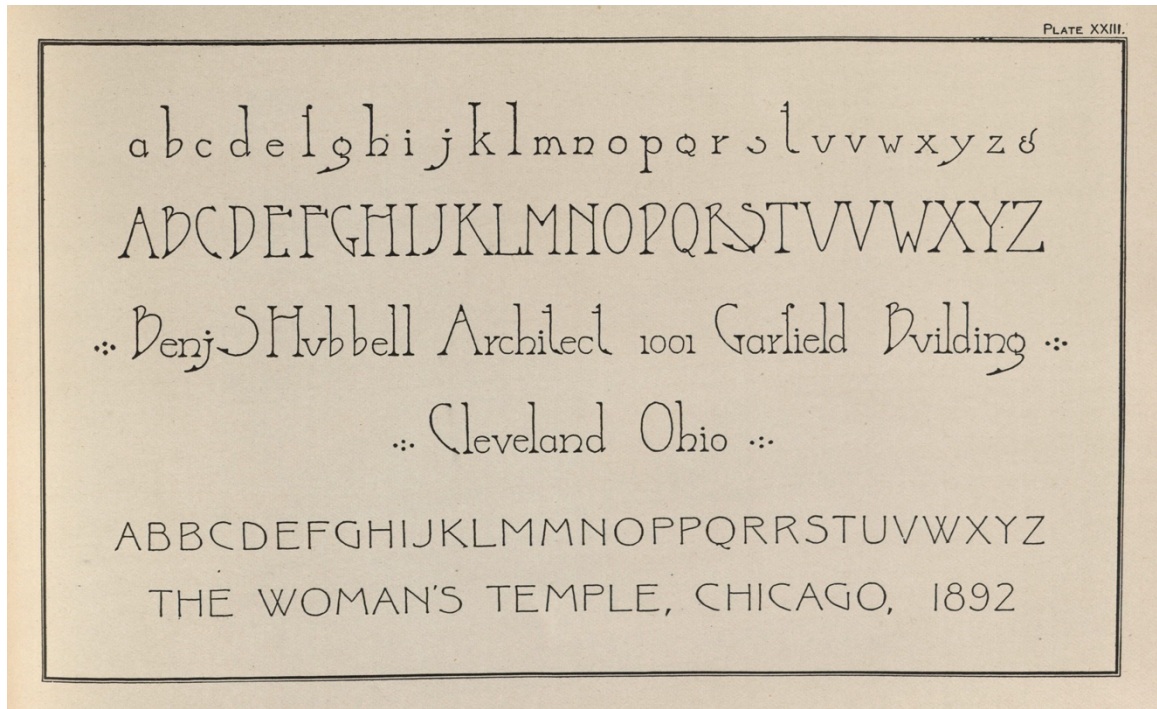


Figure 3.2. Henry S. Jacoby, plate 23, from *A Text-Book on Plain Lettering* (New York, 1895). MIT Libraries.



Figure 3.3. Nathaniel J. Bradley, “Front Elevation, Boston Public Library, Plan No. 1,” March 1855. Vol. 3, Bradley Architectural Collection, 1937.4, Boston Atheneum.

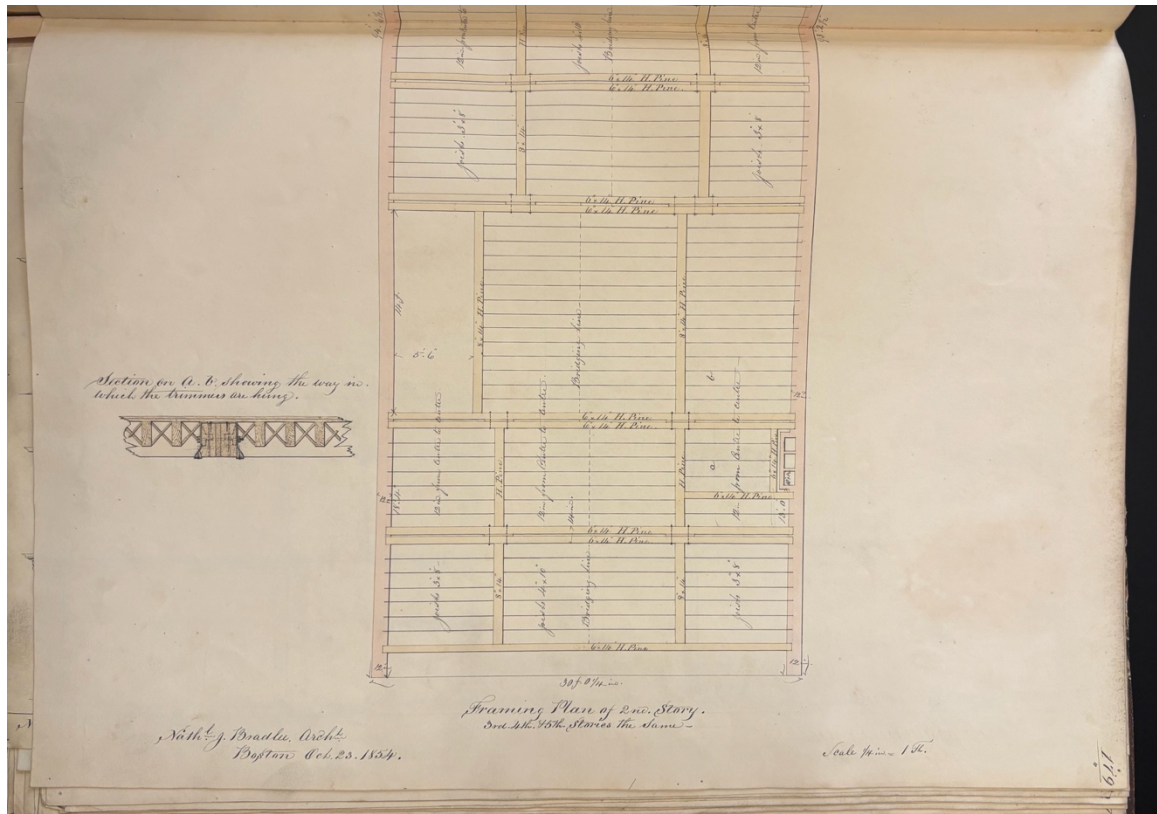


Figure 3.4. Nathaniel J. Bradlee, detail of “Framing Plan of 2nd Story,” Design for a Store Front for John Collamore Jr., Boston, 23 October 1854. Vol. 3, Bradlee Architectural Collection, 1937.4, Boston Atheneum.

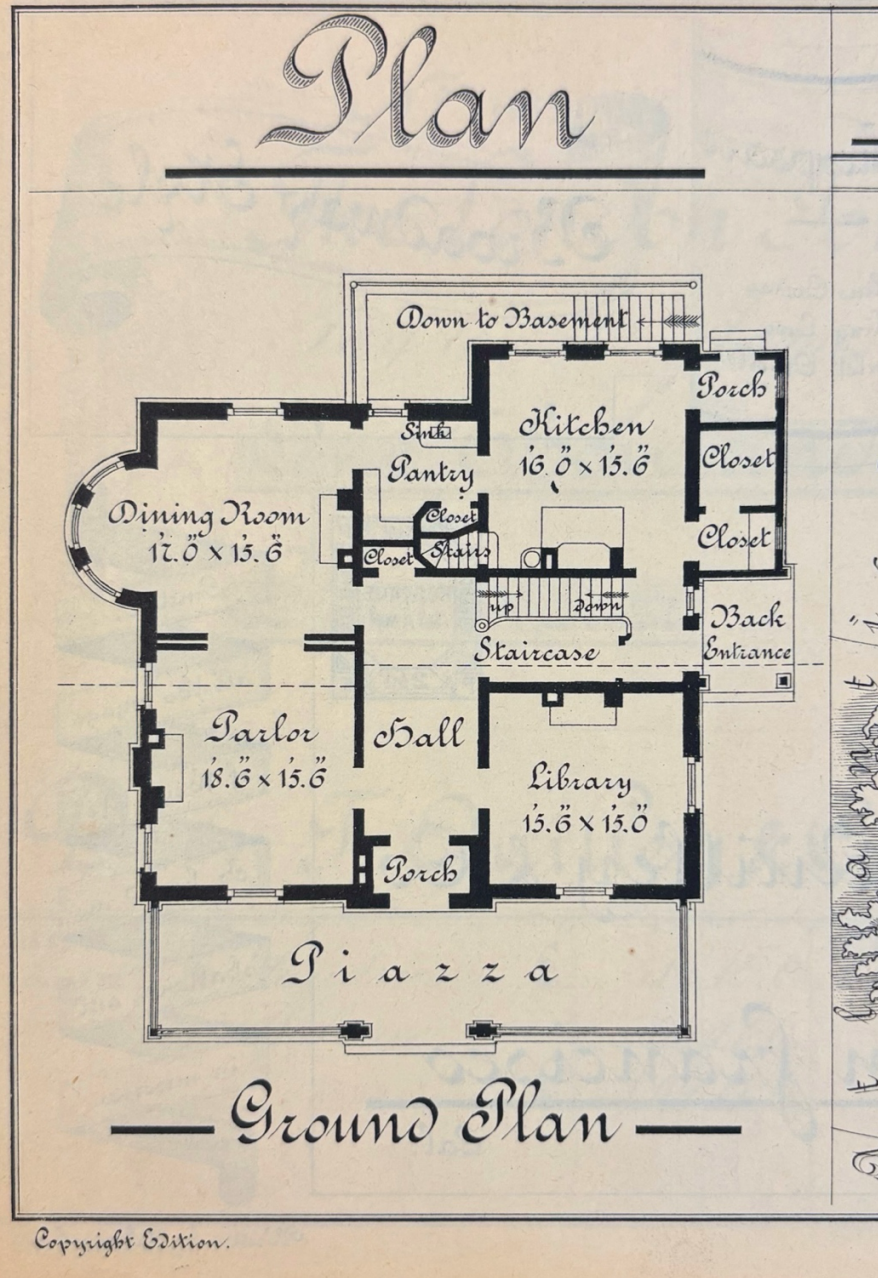


Figure 3.5. Friedrich Soennecken, “Plan,” from *Methodical Text Book to Round Writing*, 6th ed. (New York, 1878), 32. Historical Textbooks Collection, Gutman Library, Harvard Graduate School of Education.

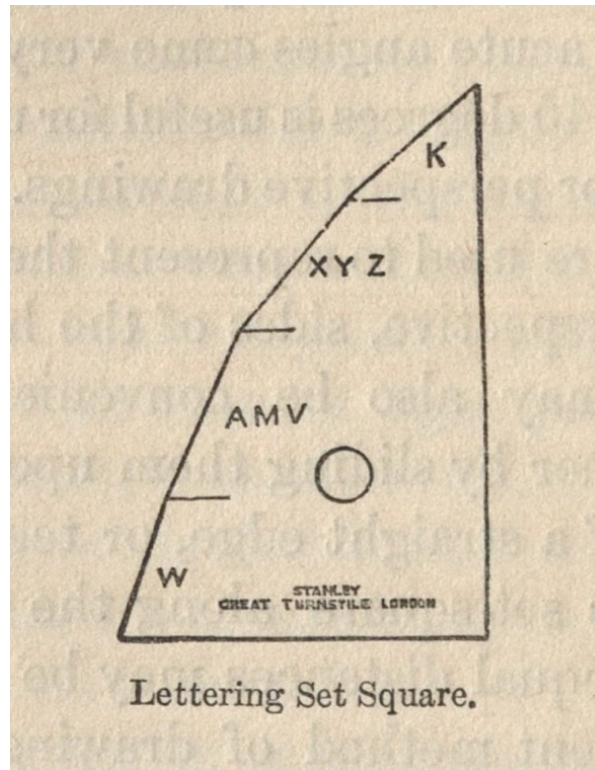


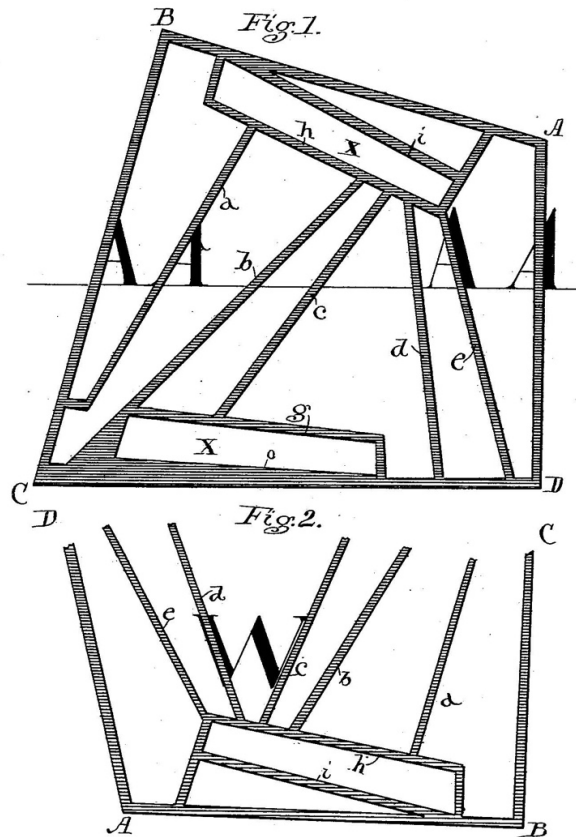
Figure 3.6. William Ford Stanley, “Lettering Set Square,” from *A Descriptive Treatise on Mathematical Drawing Instruments* (London, 1866), 158. MIT Libraries.

(No Model.)

J. SPRINGER.
LETTERING BLOCK.

No. 377,090.

Patented Jan. 31, 1888.



Witnesses:
Robert A. Davis.
John C. Jones

Inventor:
Job Springer
by S. M. Peters
his atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

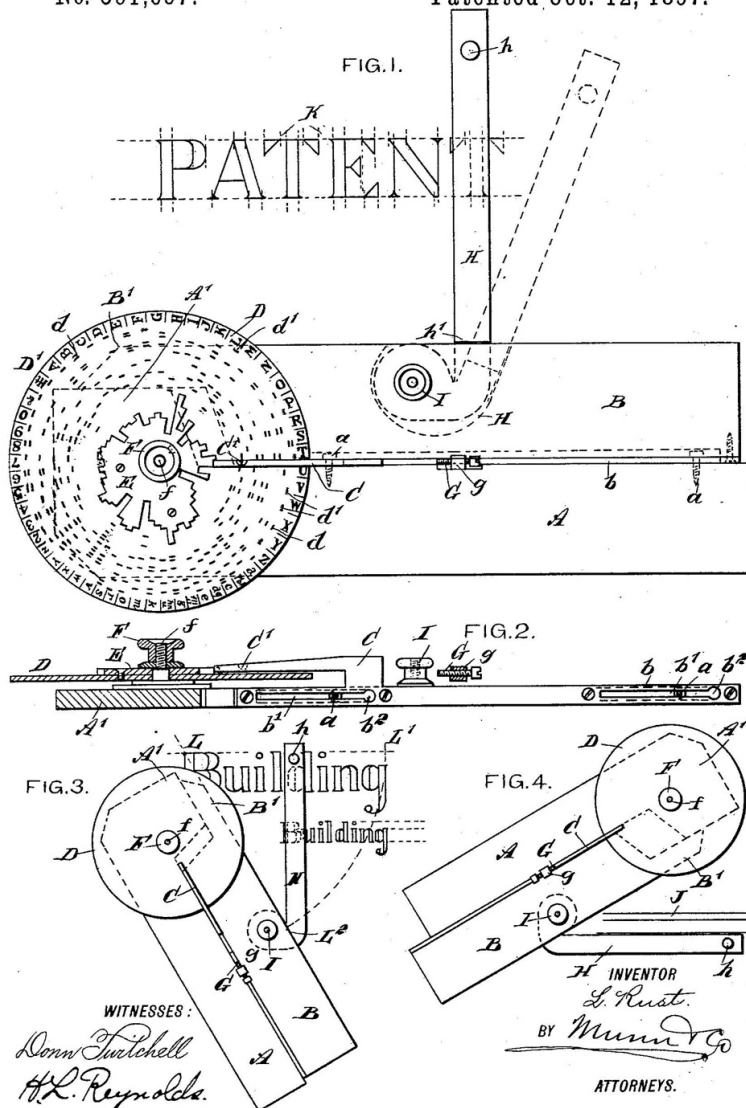
Figure 3.7. Job Springer, drawing from patent application for “Lettering Block,” patented 31 January 1888. Google Patents, US 377,090.

(No Model.)

L. RUST.
LETTERING DEVICE.

No. 591,697.

Patented Oct. 12, 1897.



THE MORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

Figure 3.8. Lucian Rust, drawing from patent application for “Lettering Device,” patented 12 October 1897. Google Patents, US 591,697.

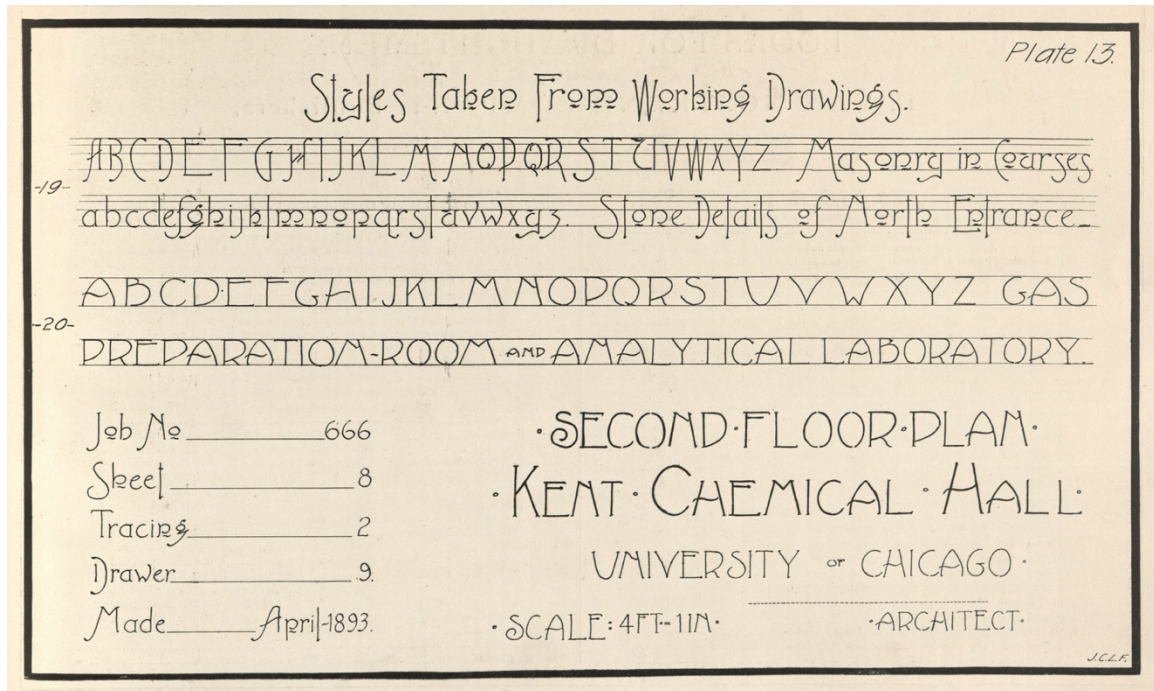


Figure 3.9. John C. L. Fish, “Styles Taken from Working Drawings,” plate 13, from *Lettering of Working Drawings* (New York, 1894). MIT Libraries.

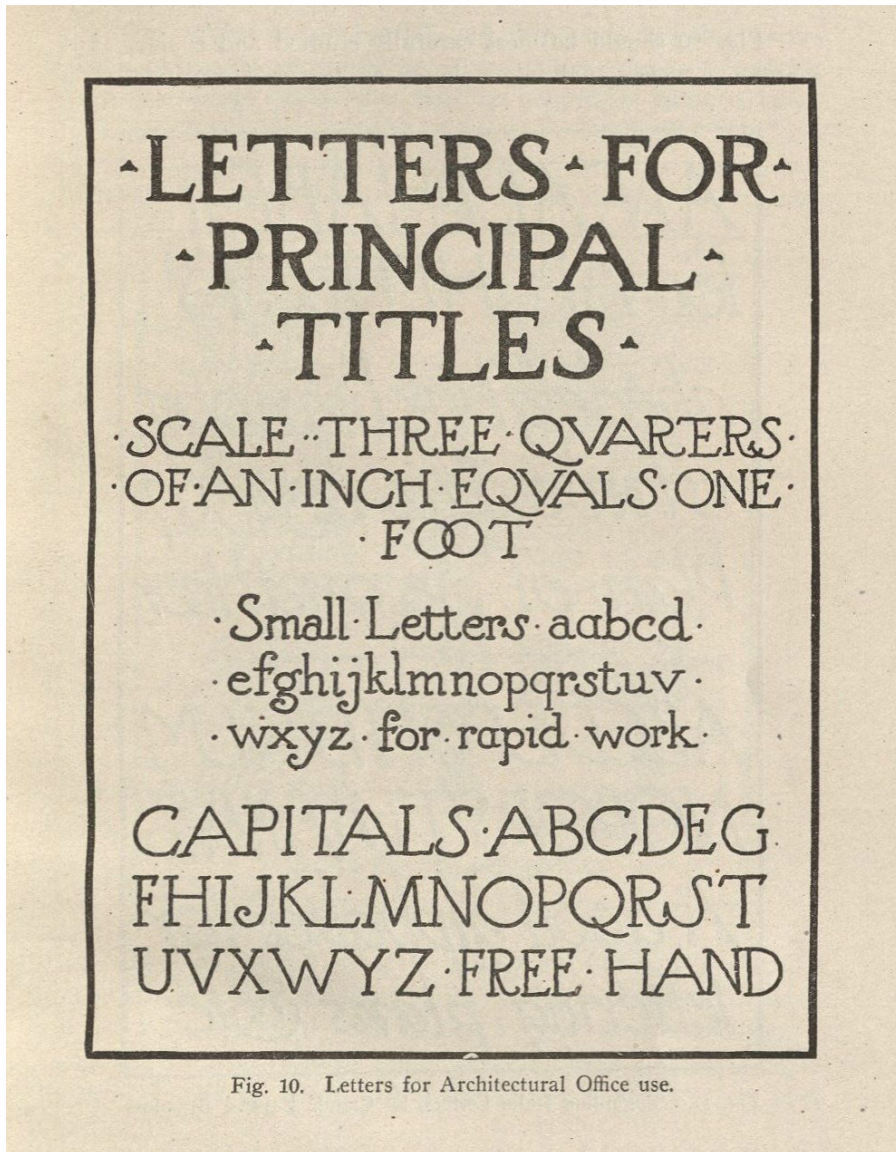


Fig. 10. Letters for Architectural Office use.

Figure 3.10. Frank Chouteau Brown, “Letters for Architectural Office use,” figure 10, from *Architectural Lettering* (American School of Correspondence, 1906), 13. MIT Libraries.

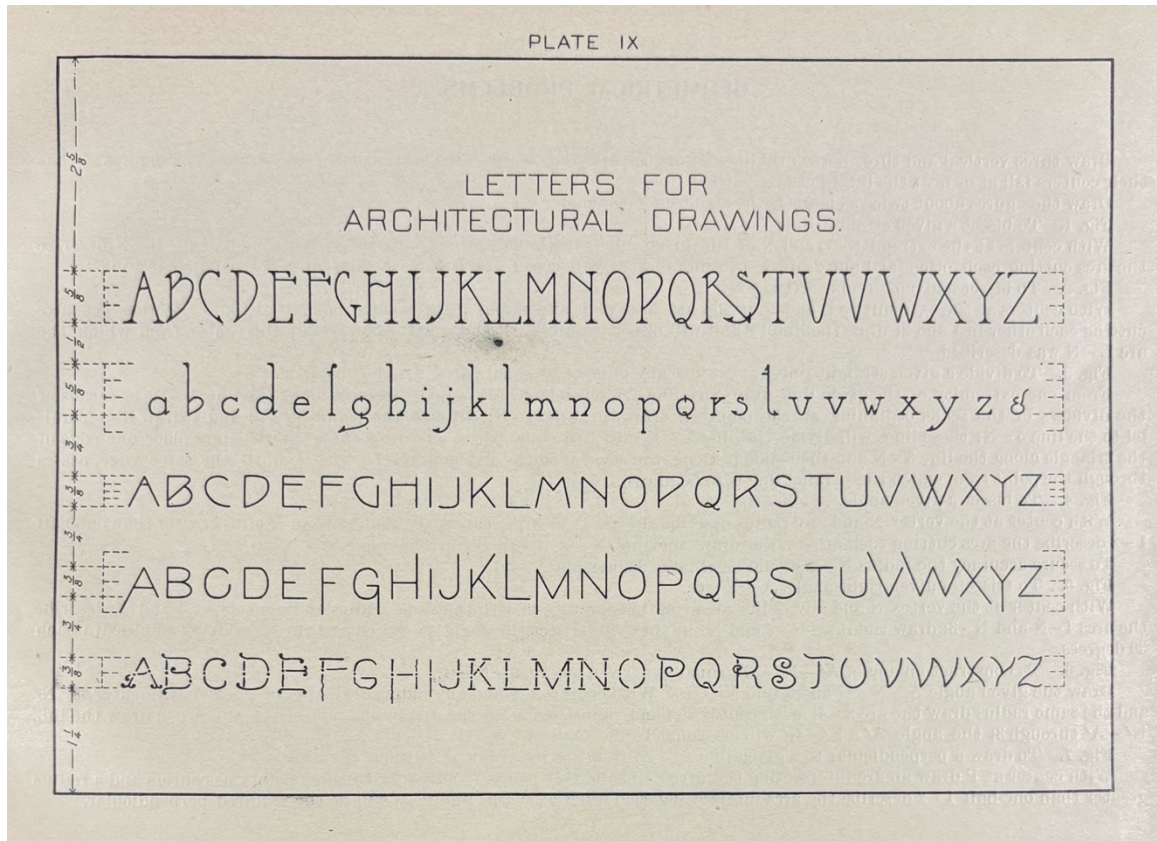


Figure 3.11. Frederick E. Giesecke, "Letters for Architectural Drawings," plate 9, from *Mechanical Drawing, Part I* (pub. by author, 1903). Historical Textbooks Collection, Gutman Library, Harvard Graduate School of Education.

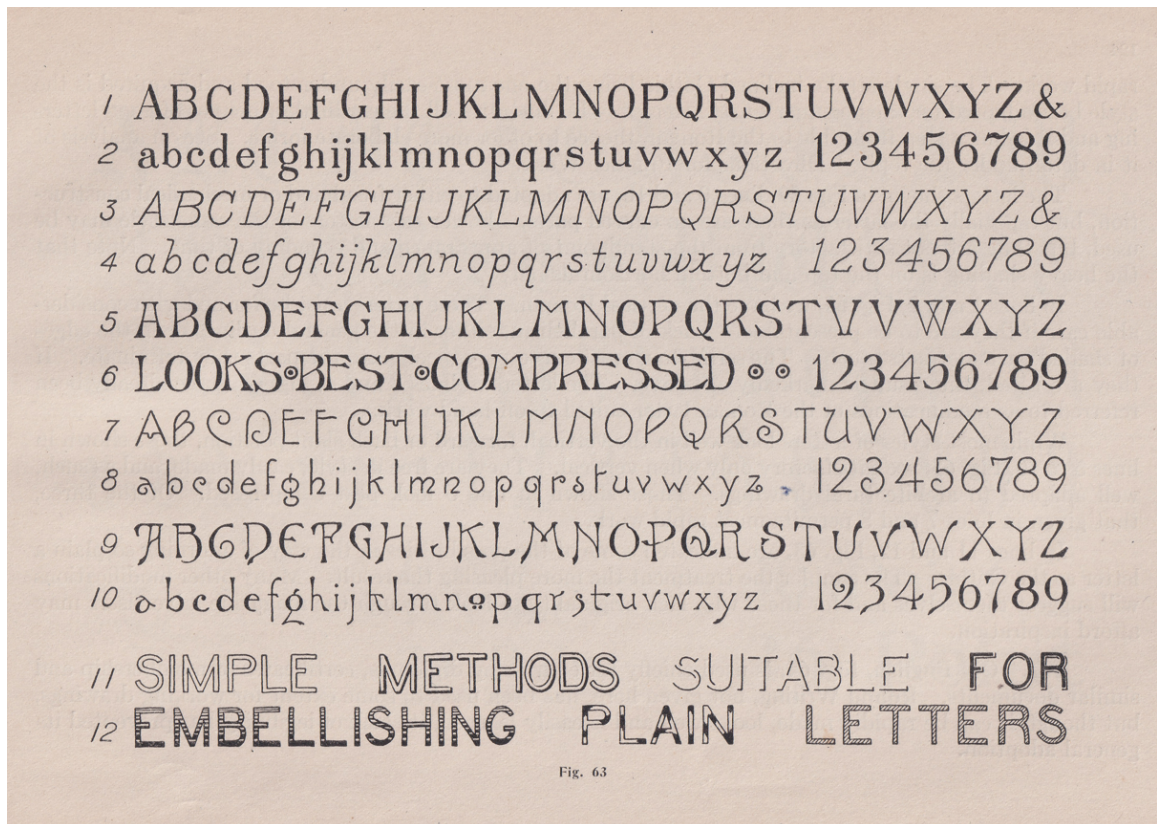


Figure 3.12. Alton L. Smith, figure 63, from *Notes on Technical Sketching and Free-Hand Lettering for Engineering Students* (pub. by author, 1912), 123. Author's collection.

ARCHITECTURAL
LETTERS

abcdefghijklmnop
qrstuvwxyz

A good letter for
Inscriptions and
General notes. A

Dignified letter.

ABCDEFGHIJK

LMNOPQRSTV

VWXYZ.—

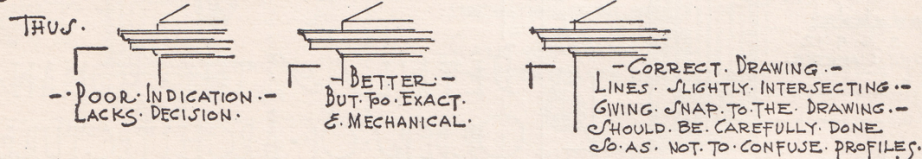
·FRONT ELEVATION·

Fig. 92. A Dignified Type of Letter for Inscriptions, General Notes, etc.

Figure 3.13. William A. Radford, “A Dignified Type of Letter for Inscriptions, General Notes, etc.,” figure 92, from *Radford’s Architectural Drawing* (Radford Architectural Company, 1912), 335. Texas Tech University Libraries.

LETTERING WHEN WELL DESIGNED AND PLACED ADDS GREATLY TO THE INTEREST & PROFESSIONAL APPEARANCE OF THE DRAWING. ~ AVOID MECHANICAL LETTERING & TECHNIQUE IN ARCHITECTURAL DRAWINGS; WHICH SHOULD DISPLAY THE INDIVIDUAL TECHNIQUE & FREEDOM OF THE ARCHITECTURAL DRAUGHTSMAN. ~ EXCEPT IN SPECIAL INSTANCES ALL LETTERING SHOULD BE CAREFULLY CONTAINED BETWEEN THE GUIDE LINES. ~ THOUGH THE CIRCULAR LETTERS C G O Q & S MAY BE SLIGHTLY LARGER. ~ MOST OF THE LETTERS EXCEPT THESE SHOULD BE NARROW & SNAPPY. ~ THUS A B D E F H J K L M N P R T U V W X Y & THE CIRCULAR LETTERS HOWEVER SHOULD BE DRAWN FULL & ROUND. ~ THUS C G O Q RATHER THAN C G O Q. THE S MAY BE NARROW. THE PREPOSITIONS *of* - *in* *for* *from* & *the* MAY BE USED IN SCRIPT FORM SPARINGLY IF BY SO DOING THE DESIGN OF THE LETTERING IS IMPROVED. ~ OCCASIONALLY ALSO LETTERING MAY BE OVERLAPPED. THUS - NORTH - CORINTH - FLOOR ETC. ~ THE TAILS OF THE R & THE J MAY ALSO EXTEND BELOW THE LINE BUT NOT TOO FREQUENTLY. - FORMS SUCH AS ~ ~ ~ WHEN USED CORRECTLY & SPARINGLY ADD TO THE DESIGN & BALANCE OF THE LETTERING. ~ ~ ~

~ THE CROSSING OF LINES IN ARCHITECTURAL DRAWING SHOULD NOT BE THOUGHT BY THE BEGINNER TO INDICATE HASTE OR CARELESSNESS BUT IS A STUDIED EFFORT ON THE PART OF THE DRAUGHTSMAN TO PRODUCE A CRISP, SNAPPY DRAWING.



~ HINTS ON LETTERING ~ TECHNIQUE ~ ETC. ~

Plate 35

Figure 3.14. George W. Seaman, "Hints on Lettering Technique etc.," plate 35, from *Progressive Steps in Architectural Drawing* (Manual Arts Press, 1919), 58. Harvard University Libraries.

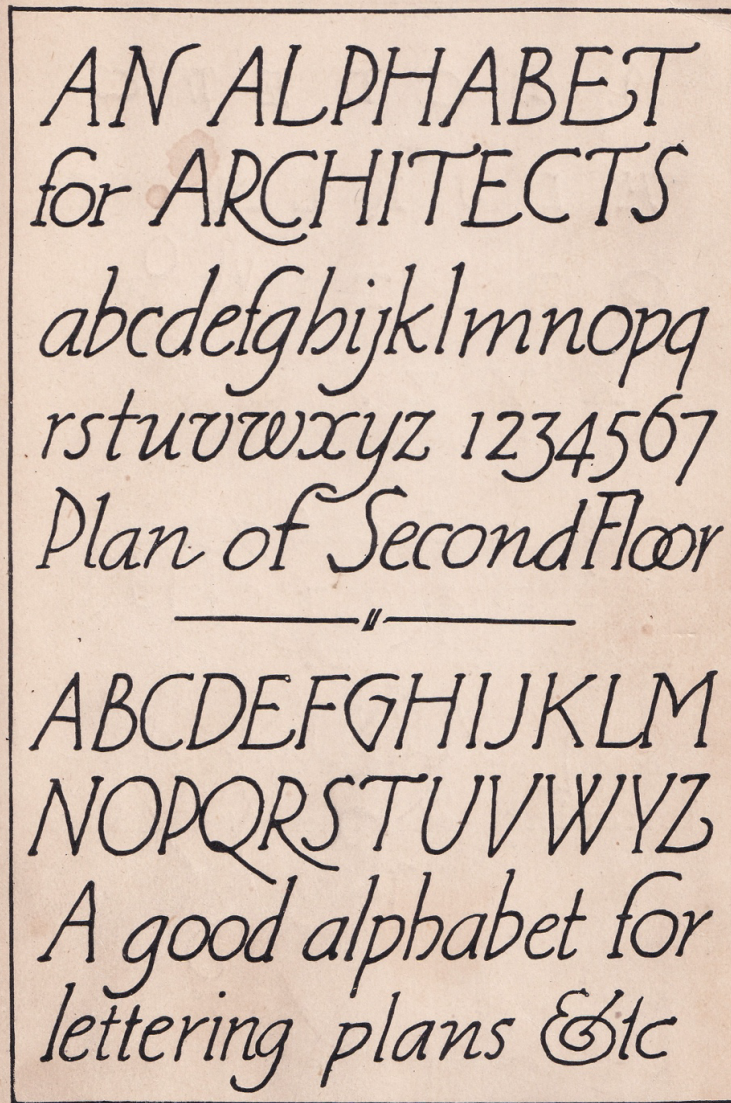
ARCHITECTURAL
LETTERS · FOR · DETAILS ·

Small Letters · abcdefg
hijklmnopqrstuvwxy
Free and yet Classic in
effect and feeling also.

ABCDEFGHI
JKLMNOPQ
RSTUVWXYZ

Always to be used in
Panel-form where possible

Figure 3.15. Frank Chouteau Brown, “Modern American Letters, for Rapid Use,” figure 138, from *Letters and Lettering* (Bates & Guild, 1902), 124. Harvard University Libraries.



139. MODERN AMERICAN ITALIC, FOR PLANS, ETC. C. F. BRAGDON

Figure 3.16. Claude Fayette Bragdon, “Modern American Italic, for Plans, etc.” figure 139, from Frank Chouteau Brown, *Letters and Lettering* (Bates & Guild, 1902), 125. Harvard University Libraries.

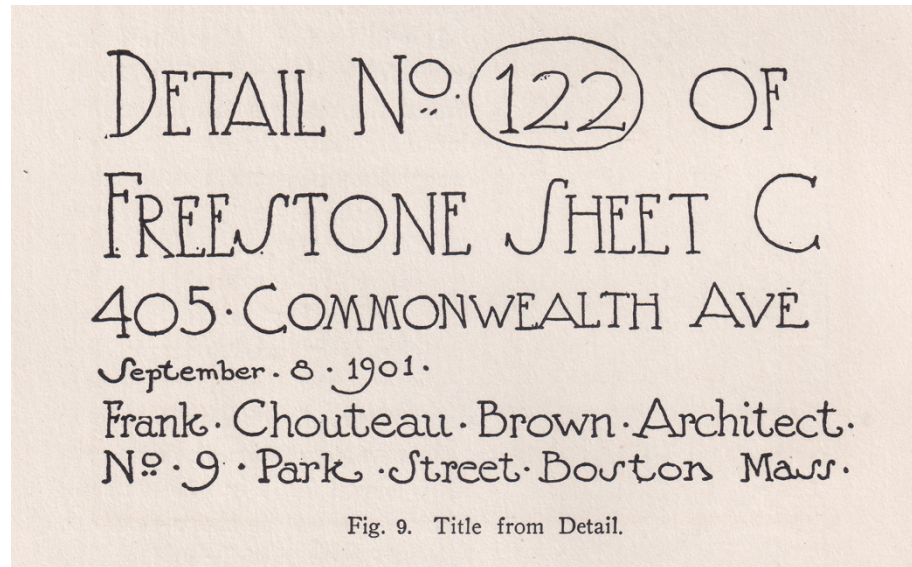


Figure 3.17. Frank Chouteau Brown, “Title from Detail,” figure 9, from *Architectural Lettering* (American School of Correspondence, 1906), 12. MIT Libraries.

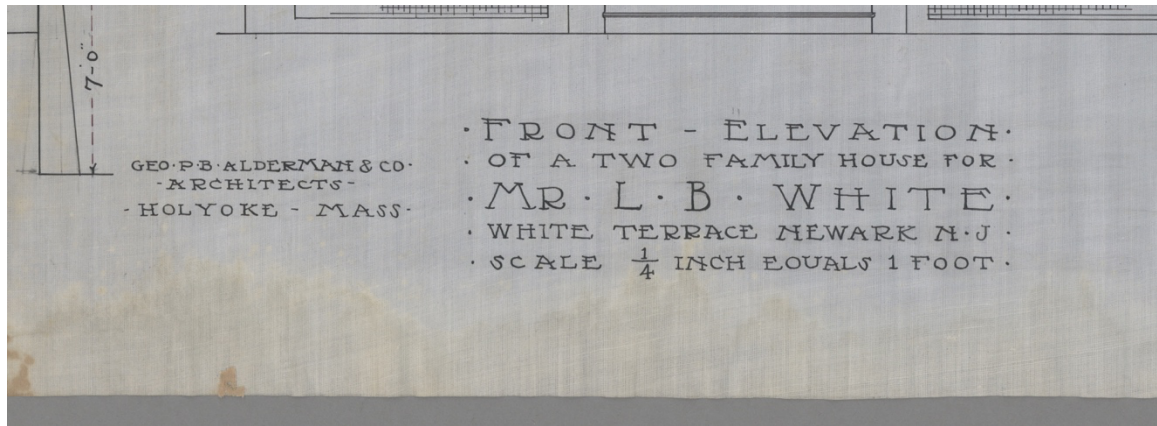


Figure 3.18. George Perkins Bissell Alderman & Co., detail of “Front Elevation of a Two Family House for Mr. L. B. White, White Terrace, Newark, NJ,” circa 1900. MIT Museum, George P. B. Alderman Collection, 2025.010, gift of Dorrie Alderman Blakney, Granddaughter. Courtesy MIT Museum.

BIBLIOGRAPHY

Archives and Special Collections

Boston Athenaeum

Bradlee Architectural Collection (1937.4)

Boston Public Library

Frank Chouteau Brown Correspondence (Ms. 3278)

Gutman Library, Harvard Graduate School of Education

Historical Textbooks Collection

Special Collections

John Hay Library, Brown University

Gorham Manufacturing Company Archive (Ms. 74)

Historic New England

General photographic collection (PC001)

Frances Loeb Library, Harvard Graduate School of Design

Special Collections

Massachusetts Historical Society

Chandler Family papers (Ms. N-2121)

Francis Ward Chandler correspondence (Ms. N-2009)

Henry Daland Chandler papers

MIT Libraries, Department of Distinctive Collections

MIT, Department of Architecture records (AC-0260)

Rotch Library Limited Access Collection

William R. Ware Papers (MC-0014)

MIT Museum

George P. B. Alderman Collection (2025.010)

Biographical/Subject Files Collection (GCP)

Israel P. Lord Collection (2016.002)

Maude Parlin Collection (1979.028)

Reference Collection

Schlesinger Library, Radcliffe Institute, Harvard University
Records of the North Bennet Street Industrial School (MC 269)

Published Primary Sources

Periodicals

Multiple articles in each of the following historic periodicals were consulted in the perpetration of this manuscript. Full article citations appear in the footnotes. Particularly important articles or articles referenced more than once in the text are cited by chapter in the sections that follow.

American Architect
American Architect and Building News
Architectural Review
Brickbuilder
Brochure Series of Architectural Illustration
Builder and Wood Worker
Building Age
Carpentry and Building
Engineering and Building Record
Engineering Record
Engineering Record, Building Record and The Sanitary Engineer
Illustrated American
Inland Architect and News Record
Scientific American
Technology Architectural Record
Technology Architectural Review
Technology Quarterly
Technology Review

Introduction

“In What Manner and By What Means Can the Practice of Architecture be Developed in Order to Win a Larger Recognition?” *Architectural Forum* 28, no. 3 (March 1918): 59–66.

Straus, S. J. T. “The Businessman-Architect.” *American Architect* 111, no. 2156 (18 April 1917): 237–239

United States Census Bureau. *Compendium of the Tenth Census, June 1, 1880*. Washington, 1895.

United States Census Bureau. *1920 Census, Volume 4: Population, Occupations*. Washington, 1923.

Upjohn, Richard, and A. J. Bloor. "Professional Practices and Charges of Architects." *American Architect and Building News* 2, no. 75 (2 June 1877): 174.

Vasari, Giorgio. *Vasari on Technique: Being the Introduction to the Three Arts of Design, Architecture, Sculpture and Painting, Prefixed to the Lives of the Most Excellent Painters, Sculptors and Architects*. Translated by Louisa S. Macle hose. Edited by G. Baldwin Brown. J. M. Dent, 1907.

Waid, D. Everett. "The Business Side of an Architect's Office I." *Brickbuilder* 11, no. 4 (April 1902): 69–70.

Waid, D. Everett. "The Business Side of an Architect's Office II." *Brickbuilder* 11, no. 5 (May 1902): 91–93.

Waid, D. Everett. "The Business Side of an Architect's Office III." *Brickbuilder* 11, no. 8 (August 1902): 157–160.

Waid, D. Everett. "The Business Side of an Architect's Office IV." *Brickbuilder* 11, no. 9 (September 1902): 191–195.

Waid, D. Everett. "The Business Side of an Architect's Office V." *Brickbuilder* 12, no. 2 (February 1903): 37–39.

Waid, D. Everett. "The Business Side of an Architect's Office VI: Architect's Fees." *Brickbuilder* 12, no. 11 (November 1903): 232–233.

Waid, D. Everett. "The Business Side of an Architect's Office VII: Architect's Contracts and Fees." *Brickbuilder* 12, no. 12 (December 1903): 254–256.

Waid, D. Everett. "The Business Side of an Architect's Office VIII: Architect's Contracts and Fees, con." *Brickbuilder* 13, no. 1 (January 1904): 13–15.

Waid, D. Everett. "The Business Side of an Architect's Office: The Office of Mr. Donn Barber." *Brickbuilder* 22, no. 9 (September 1913): 179–200.

Waid, D. Everett. "The Business Side of an Architect's Office: Description of the Offices of Messrs. Henry Bacon; Ford, Butler & Oliver; Ludlow & Peabody; H. Van Buren Magonigle and Kenneth Murchison." *Brickbuilder* 22, no. 11 (November 1913): 251–254.

Waid, D. Everett. "The Business Side of an Architect's Office: The Office of Messrs. McKim, Mead & White." *Brickbuilder* 22, no. 12 (December 1913): 267–270.

- Waid, D. Everett. "The Business Side of an Architect's Office: The Office of George B. Post & Sons." *Brickbuilder* 23, no. 2 (February 1914): 47–49.
- Waid, D. Everett. "The Business Side of an Architect's Office: The Offices of Mr. Howard Greenly and Messrs. Taylor & Levi." *Brickbuilder* 23, no. 3 (March 1914): 62–64.
- Waid, D. Everett. "How Offices Work I—Offices of Noted Architects." *Brickbuilder* 20, no. 12 (December 1911): 249–252.
- Waid, D. Everett. "How Offices Work II—Offices of Noted Architects." *Brickbuilder* 21, no. 1 (January 1912): 7–10.
- Waid, D. Everett. "How Offices Work III—Offices of Noted Architects." *Brickbuilder* 21, no. 2 (February 1912): 35–38.

Chapter One

- Adams, Charles L. *Mechanical Drawing: Technique and Working Methods for Technical Students*. George H. Ellis, 1905.
- American Institute of Architects. *Proceedings of the Annual Convention of the American Institute of Architects, Held at the Rooms of the New York Chapter, October 22nd and 23rd, 1867*. New York, 1867.
- Benjamin, Asher. *The Architect, or Practical House Carpenter*. Boston, 1843.
- Benjamin, Asher. *The Practical House Carpenter*. Boston, 1830.
- Bicknell, A. J. *Detail, Cottage and Constructive Architecture*. New York, 1873.
- Bicknell, A. J. *Specimen Book of One Hundred Architectural Designs*. New York, 1879.
- Boston Public Library. *Catalogue of the Books Relating to Architecture Construction and Decoration in the Public Library of the City of Boston*. Subject Catalogue no. 10. Boston, 1894.
- Boyden, Elbridge. *Reminiscences of Elbridge Boyden, Architect*. Worcester, 1890.
- Chandler, F. W. "Architectural Education—A Protest." *Inland Architect and News Record* 47, no. 4 (May 1906): 55.
- Chandler, Francis Ward. *Construction Details, Prepared for the Use of Students of the Mass. Institute of Technology, Boston*. Boston, 1892.

- Chandler, F. W. "Massachusetts Institute of Technology Department of Architecture Course of Instruction." *Architectural Record* 21, no. 6 (June 1907): 443.
- Chandler, Francis Ward. "Schoolhouse Planning and Construction." In *Municipal Architecture in Boston, From Designs by Edmund M. Wheelwright, City Architect, 1891 to 1895*. Edited by Francis W. Chandler. Boston, 1898.
- Chandler, Francis Ward. "The Study of Architecture." *Technology Quarterly* 5, no. 4 (December 1892): 374–379.
- Chandler, Francis Ward. "William Robert Ware, 1832–1915." *Technology Review* 17, no. 7 (July 1915): 423–425.
- Chandler, Francis Ward, Gaetano Lanza, George F. Swain, and Sam H. Woodbridge. "The Engineering Building." *Abstract of the Proceedings of the Society of Arts, Massachusetts Institute of Technology* 28, meeting 404 (1889–1890): 129–155.
- Comstock, William T. *Modern Architectural Designs and Details*. New York, 1881.
- Cooper Union for the Advancement of Science and Art. *Forty-Eighth Annual Report*. De Vinne Press, 1907.
- Downing, Andrew Jackson. *Cottage Residences: or, A Series of Designs for Rural Cottages and Cottage Villas, and Their Gardens and Grounds Adapted to America*. New York, 1842.
- Hagar, George J. "The United States Life-Saving Service: Its Origin, Progress and Present Condition." *Frank Leslie's Popular Monthly* 5, no. 2 (February 1878): 165–178.
- Hodge, George B. *Outlines of Courses of Study*. Young Men's Christian Association Press, 1908.
- Kidder, Frank E. *Building Construction and Superintendence, Part 1, Mason's Work*. New York, 1896.
- Kidder, Frank E. *Building Construction and Superintendence, Part 1, Mason's Work*. 2nd ed. New York, 1897.
- Kidder, Frank E. *Building Construction and Superintendence, Part 1, Mason's Work*. 9th ed. Edited by Thomas Nolan. William T. Comstock, 1911.
- Kidder, Frank E. *Building Construction and Superintendence, Part 2, Carpenters' Work*. New York, 1898.

- Kidder, Frank E. *Building Construction and Superintendence, Part 2, Carpenters' Work*. 6th ed. William T. Comstock, 1906.
- Kidder, Frank E. *Building Construction and Superintendence, Part 2, Carpenters' Work*. 9th ed. Edited by Thomas Nolan. William T. Comstock, 1918.
- Kidder, Frank E. *Building Construction and Superintendence, Part 3, Trussed Rooves and Roof Trusses*. William T. Comstock, 1906.
- Kimball, Sumner I. *Annual Report of the Operations of the United States Life-Saving Service for the Fiscal Year Ending June 30, 1876*. Washington, 1876.
- Laxton, Henry. *Examples of Building Construction: Intended as an Aide-Memoire for the Professional Man and the Operative, Being a Series of Working Drawings to a Large Scale Exemplifying the Arrangement and Details Adopted in Carrying Out the Several Branches of Trade Requisite for Public and Private Edifices*. 4 vols. London, 1857–1867.
- Library of Congress. *Catalogue of Title-Entries of Books and Other Articles Entered in the Office of the Librarian of Congress, at Washington, Under the Copyright Law, from May 9 to May 14, 1892, Inclusive*. Washington, 1892.
- Le Muet, Pierre. *Manière de bien bastir pour toutes sortes de personnes*. Paris, 1681.
- Martin, Clarence A. *Details of Building Construction*. Boston, 1899.
- Martin, Clarence A. *Details of Building Construction*. Bates & Guild, 1914.
- Massachusetts Institute of Technology. *First Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1865–1866*. Boston, 1865.
- Massachusetts Institute of Technology. *Second Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1866–1867*. Boston, 1866.
- Massachusetts Institute of Technology. *Third Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, of the School of the Massachusetts Institute of Technology, 1867–1868*. Boston, 1867.
- Massachusetts Institute of Technology. *Seventh Annual Catalogue of the Officers and Students, and Programme of the Course of Instruction, 1871–1872*. Boston, 1872.
- Massachusetts Institute of Technology. *Eleventh Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, 1875–1876*. Boston, 1875.

- Massachusetts Institute of Technology. *Sixteenth Annual Catalogue of the Officers and Students, with a statement of The Courses of Instruction, and a List of the Alumni, and of the Members of the Society of Arts, 1880–1881*. Boston, 1880.
- Massachusetts Institute of Technology. *Nineteenth Annual Catalogue of the Officers and Students, with a statement of The Courses of Instruction, and a List of the Alumni, and of the Members of the Society of Arts, 1883–1884*. Boston, 1884.
- Massachusetts Institute of Technology. *Twenty-Fourth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, and a List of the Alumni, 1888–1889*. Boston, 1888.
- Massachusetts Institute of Technology. *Twenty-Fifth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a List of the Alumni, 1889–1890*. Cambridge, 1889.
- Massachusetts Institute of Technology. *Twenty-Eighth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1892–1893*. Cambridge, 1892.
- Massachusetts Institute of Technology. *Thirty-Sixth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1900–1901*. Cambridge, 1900.
- Massachusetts Institute of Technology. *Thirty-Ninth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction and a Register of the Alumni, 1903–1904*. Boston, 1904.
- Massachusetts Institute of Technology. *Bulletin of the Massachusetts Institute of Technology, Catalogue of the Officers and Students with a Statement of the Requirements for Admission and a Description of the Courses of Instruction* 40, no. 1. Massachusetts Institute of Technology, 1904.
- McGill University. *Annual Calendar of McGill College and University, Montreal, Session 1904–1905*. McGill University, 1904.
- Mitchell, Charles F. *Forty Plates on Building Construction*. London, 1891.
- Moore, Francis C. *How to Build a Home, Being Suggestions as to Safety from Fire, Safety to Health, Comfort, Convenience, Durability and Economy*. New York, 1897.
- North Bennett Street School. *The Work of the North Bennet Street Industrial School from 1881 to 1887*. Boston, 1887.

Review of *Construction Details*, by Francis Ward Chandler. *American Architect and Building News* 36, no. 858 (4 June 1892): 153.

Review of *Constriction Details*, by Francis Ward Chandler. *The Nation* 55, no. 1412 (21 July 1892): 57–58.

Rose Polytechnic Institute. *Nineteenth Annual Catalogue of the Rose Polytechnic Institute, Terre Haute, Ind.* Rose Polytechnic Institute, 1901.

Rose Polytechnic Institute. *Twenty-Fifth Annual Catalogue of the Rose Polytechnic Institute, Terre Haute, Ind.* Rose Polytechnic Institute, 1910.

Salomon, Otto. *The Slöjd in the Service of the School*. Edited by Nicholas Murray Butler. Translated by William H. Carpenter. Monographs of the Industrial Education Association, vol. 1, no. 6. New York, 1888.

Secretary of the Treasury of the United States. *Plans of Public Buildings in Course of Construction*, vols. 1–31. Washington, 1855–1856. “American Architectural Books” microfilm, reel 113, no. 1456.

“Service, United States Life-Saving.” In *Appleton’s Annual Cyclopaedia and Register of Important Events*, n.s., vol. 3. New York, 1879.

Sloan, Samuel. *The Model Architect: A Series of Original Designs for Cottages, Villas, Suburban Residences, etc., Accompanied by Explanations, Specifications, Estimates, and Elaborate Details*. Philadelphia, 1852.

Smith, Darrell Hevenor. *The Office of the Supervising Architect of the Treasury: Its History, Activities, and Organization*. Institute for Government Research Service Monographs of the United States Government, vol. 23. Johns Hopkins Press, 1923.

Taylor, Rufus H. *History, Organization, and Functions of the Office of the Supervising Architect of the Treasury Department*. Washington, 1886.

“The United States Life-Saving Service.” *Scribner’s Monthly* 19, no. 3 (January 1880): 321–338.

[Untitled advertisement.] *American Architect and Building News* 36, no. 856 (21 May 1892): n.p.

[Untitled advertisement.] *Brochure Series of Architectural Illustration* 1, no. 9 (September 1895): n.p.

- Ware, William Robert. *An Outline of the Course of Instruction in Building and Architecture, Proposed for the School of the Massachusetts Institute of Technology*. Boston, 1866.
- Ware, William Robert. *Examples of Building Construction, With Suggestions to Teachers and Pupils for Their Practical Use*. Boston, 1876.
- Wells, Newton A., Robert C. Spencer, and John W. Case. "Architectural Education." *Inland Architect and News Record* 47, no. 1 (February 1906): 3–6.
- Woodbury, Charles J. H. *Fire Protection of Mills and Construction of Mill Floors: Containing Tests of Full Size Wood Mill Columns*. New York, 1882.

Chapter Two

- Theodore Altender & Sons. *Illustrated and Descriptive Catalogue and Price-List of Drawing Instruments, Protractors, Scales, etc.* Philadelphia, 1892.
- American Institute of Architects. *Proceedings of the Annual Convention of the American Institute of Architects, Held at the Rooms of the New York Chapter, October 22nd and 23rd, 1867*. New York, 1867.
- Barnes, P. "Note Upon the 'Blue' Process of Copying Tracings, etc." *Transactions of the American Institute of Mining Engineers* 6 (1877–78): 197–198.
- Bischoff, H. "Reproduction photographique in bleu de Prusse." *Bulletin de la Société Vaudoise des Sciences Naturelles* 5, no. 42 (March 1858): 403–404.
- Blake, Clinton Hamlin. *The Architect's Law Manual*. Pencil Points Press, 1924.
- "The 'Blue' Copying Process." *American Architect and Building News* 4, no. 136 (13 July 1878): 44.
- "The Blue Process of Copying Tracings." *Scientific American* 39, no. 22 (30 November 1878): 340.
- Brown, George Edward. *Ferric and Heliographic Processes: A Handbook for Photographers, Draughtsmen, and Sun Printers*. 2nd ed. Tennant & Ward, circa 1904.
- Clark, Theodore Minot. *Architect, Owner and Builder Before the Law*. New York, 1894.
- Clute, Eugene. *Drafting Room Practice*. Pencil Points Press, 1928.

- “The Custody of an Architect’s Drawings.” *American Architect and Building News* 3, no. 129 (15 June 1878): 206–208.
- “The Cyanotype Copying Process.” *Photographic Times* 7, no. 80 (August 1877): 175–176.
- Defiance Manufacturing Company. *Drawing Materials, Architects and Engineers’ Supplies, Blue and Black Prints, Lithographic Reproductions*. Defiance Manufacturing Company, 1916.
- Derosne, Charles. *La Photographie pour tous: traité élémentaire des nouveaux procédés*. Paris, 1882.
- Desborough, Walter. *Duplicating and Copying Processes*. Sir Isaac Pitman & Sons, 1930.
- Desborough, Walter. *Manual of Duplicating Methods by Various Office Machines*. Sir Isaac Pitman & Sons, 1917.
- Desborough, Walter. *Office Machines, Appliances and Methods*. Sir Isaac Pittman & Sons, 1921.
- Eugene Dietzgen Co. *Catalogue and Price List of Eugene Dietzgen Co., Manufacturers of Drawing materials and Surveying Instruments*. 9th ed. Eugene Dietzgen, 1910.
- “Draughting Department, Union Iron Works.” *Engineering Record* 41, no. 10 (10 March 1900): 226–228.
- Duchochois, Peter C. *Photographic Reproduction Processes: A Practical Treatise of the Photo-Impressions Without Silver Salts*. New York, 1891.
- Flanders, Ralph E., I. G. Bayley, A. L. Valentine, J. S. Watts, and A. B. Howk. *Drafting-Room Practice*. 2nd ed. Machinery’s Reference Series, vol. 2. New York, 1909.
- Freeman, Norman L. “The City of Chicago v. Patrick J. Sexton.” In *Reports of Cases at Law and in Chancery Argued and Determined in The Supreme Court of Illinois*, vol. 115. Springfield, 1884.
- Freeman, Norman L. “Patrick J. Sexton v. The City of Chicago.” In *Reports of Cases at Law and in Chancery Argued and Determined in The Supreme Court of Illinois*, vol. 107. Springfield, 1884.
- Friese, John F. *Blueprinting*. The Manual Arts Press, 1919.
- Gambier-Bousfield, R. W. *Architects and the Law: A Collection of Cases Tried in the English, Canadian, French and American Courts of Law, Relating to the Every-Day Practice of the Profession of Architecture*. Toronto, 1891.

- Gilbreth, Frank B. [and Lillian M. Gilbreth]. *Brick-Laying System*. Myron C. Clark, 1909.
- Hall, Benjamin James. *Blue Printing and Modern Copying for the Engineer and Architect, Draughtsman and the Print Room Operative*. Sir Isaac Pitman & Sons, 1921.
- Herschel, John F. W. "On the Action of the Rays of the Solar Spectrum on Vegetable Colours, and on Some New Photographic Processes." *Philosophical Transactions of the Royal Society of London* 132 (1842): 81–114.
- Hills, Ralph Winchester. *Machine Drawing, Prepared in the Extension Division of the University of Wisconsin*. McGraw-Hill, 1917.
- Hodgson, Frederick Thomas. *Builders' Architectural Drawing Self-Taught*. Frederic J. Drake, 1917.
- Hunt, Robert. *A Manual of Photography*. 5th ed. London and Glasgow, 1857.
- Hurd, Harvey B., ed. *The Revised Statutes of the State of Illinois*. Chicago, 1897.
- Jones, George J. "Electric Blue-Print Making." *Scientific American* 89, no. 3 (18 July 1903): 45–46.
- Kerr, Robert. *The Consulting Architect: Practical Notes on Administrative Difficulties and Disputes*. London, 1886.
- Keuffel & Esser Co. *Catalogue of Keuffel & Esser Co., Manufacturers and Importers, Drawing Materials, Surveying Instruments, Measuring Tapes*. 34th ed. Keuffel & Esser, 1913.
- Kolesch & Co. *Illustrated Catalogue and Price-list of Drawing and Tracing Papers, Sun Print Papers and Equipments, Drawing Instruments and Materials, Surveying Instruments, Accessories, etc.* Kolesch & Co., 1917.
- Lehner, Sigmund. *The Manufacture of Ink: Comprising the Raw Materials, and the Preparation of Writing, Copying, and Hektograph Inks, Safety Inks, Ink Extracts and Powders, Colored Inks, Solid Inks, Lithographic Inks and Crayons, Printing Ink, Ink or Aniline Pencils, Parking Inks, Ink Specialties, Sympathetic Inks, Stamp and Stencil Inks, Wash-blue, etc. etc.* With additions by William T. Brannt. Philadelphia, 1892.
- Lietze, Ernst. *Modern Heliographic Processes: A Manual of Instruction in the Art of Reproducing Drawings, Engravings, Manuscripts, etc., by the Action of Light; for the use of Engineers, Architects, Draughtsmen, Artists, and Scientists*. New York: D. Van Nostrand, 1888.

- Magonigle, Harold Van Buren. "Some Suggestions as to the Making of Working Drawings." *Brickbuilder* 22, no. 7 (July 1913): 147–153.
- Mahan, Dennis Hart. *Industrial Drawing: Comprising, the Description and Uses of Drawing Instruments, the Construction of Plane Figures, the Projections and Sections of Geometrical Solids, Architectural Elements, Mechanism, and Topographical Drawing*. 2nd ed. New York, 1863.
- "The Management of an Architect's Office—II." *American Architect and Building News* 33, no. 819 (5 September 1891): 147–149.
- A. Marion et Cie. *Procédés nouveaux de photographie: ou, notes photographiques*. Paris, 1865. "History of Photography," microfilm, reel 120, no. 1299.
- Marion, A. *Initiation aux procédés anciens et nouveaux, sels d'argent, ferro-prussiate et charbon*. Paris, 1870. "History of Photography," microfilm, reel 120, no. 1294.
- Mason, George Champlin. *Architects and Their Environment, 1850–1907, Together with Notes and Reminiscences of the Fathers of the Profession, Their Clients and Assistants*. Rubblestone, 1907.
- Massachusetts Institute of Technology, *Fourteenth Annual Catalogue of the Officers and Students, with a Statement of the Courses of Instruction, 1878–1879*. Boston, 1878.
- Massachusetts Institute of Technology. *Notes on Mechanical Engineering and The Blue Process*. Boston, 1890.
- McAllister, F. W. *Catalogue of Mathematical Instruments, Drawing Paper, Surveying Instruments, Levels, Paints and Drawing Materials*. Baltimore, 1890.
- "The Organization of an Architect's Office, No. I." *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 6 (11 January 1890): 83–84
- "The Organization of an Architect's Office, No. II." *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 11 (15 February 1890): 165.
- "The Organization of an Architect's Office, No. III." *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 12 (22 February 1890): 181.
- "The Organization of an Architect's Office, No. IV." *Engineering Record, Building Record and The Sanitary Engineer* 21, no. 13 (1 March 1890): 195.
- "The Organization of an Architect's Office. No. VII." *Engineering Record, Building Record and The Sanitary Engineer* 24, no. 23 (7 November 1891): 362–363.

C. F. Pease Company. *Catalog B: Blue Print Machinery and Drafting Room Supplies*. 2nd ed. C. F. Pease, 1918.

Perkins, H. E. "System in Architects' Offices." *Inland Architect and News Record* 17, no. 1 (February 1891): 3–4.

Pettit, James Sumner. *Modern Reproductive Graphic Processes*. New York, 1884.

Reinhardt, Charles W. *The Preparation of Drawings and Other Illustrations for Photo-Reproduction*. Engineering News Publishing, 1906.

Reinhardt, Charles. *The Technic of Mechanical Drafting; A Practical Guide to Neat, Correct and Legible Drawing*. Engineering News Publishing, 1904.

Reist, H. G. "Bue-Printing by Electric Light." *Transactions of the American Society of Mechanical Engineers* 22, no. 904 (1901): 888–898.

Root, Marcus Aurelius. *The Camera and the Pencil*. New York, 1864.

Schulze, J. William. *The American Office: Its Organization, Management and Records*. Key Publishing, 1913.

"Séance de 2 Août 1872." *Mémoires et compte rendu des travaux de la Société des Ingénieurs Civils*. Paris, 1872.

"Séance du 26 Juillet 1872." *Bulletin de La Société d'Encouragement pour l'Industrie Nationale* 71, 2nd series, 19 (1872): 670–672.

Skeel, Adelaide. "Blues." In *American Annual of Photography and Photographic Times Almanac*. Edited by C. W. Canfield. New York, 1889.

Soltmann, E. G. *Price List of Drawing Materials, Architects and Engineers' Supplies, Blue Process Papers, etc.* New York, 1885.

Soltmann, E. G. *Price List of Drawing Materials, Architects and Engineers' Supplies, Blue Process Papers, etc.* New York, 1887.

Sturtevant, W. W. *How To Make Blue Prints*. Bruce Publishing Company, 1929.

Talbot, Romain. *Der Lichtpaus-Prozess*. Berlin, circa 1873.

Taylor, Frederick Winslow. *Principles of Scientific Management*. Harper & Brothers, 1911.

- Tennant, John A. "The 'Blue Print' and Its Variations." *Photo-Miniature* 1, no. 10 (January 1900): 481–514.
- Thwaite, Benjamin H. "Engineering Heliography, Or the Sun-Print Copying of Engineering Drawings." *Transactions of the Federated Institution of Mining Engineers* 10 (1895): 69–88.
- Thwaite, Benjamin H. "Heliography, or the Actinic Copying of Engineering Drawings." *Scientific American Supplement* 23, no. 584 (12 March 1887): 9320–9321.
- Tronquoy, C. *Reproductions photographiques par le papier au ferro-prussiate de M. Marion*. Paris, 1872.
- Tuthill, William Burnet. *Practical Lessons in Architectural Drawing: Or How to Make the Working Drawings and Write the Specifications for Buildings*. 10th ed. New York, 1897.
- Tuthill, William Burnet. *Practical Lessons in Architectural Drawing: Or How to Make the Working Drawings and Write the Specifications for Buildings*. 11th ed. William T. Comstock, 1902.
- United States Patent Office. *Rules of Practice in the United States Patent Office*. Washington, 1880.
- United States Patent Office. *Rules of Practice in the United States Patent Office*. Washington, 1899.
- Verry, H. R. *Document Copying and Reproduction Processes*. Fountain Press, 1958.
- Vidal, Jerome Léon. *Cours de reproductions industrielles: exposé des principaux procédés de reproduction graphiques, héliographiques, plastiques, hélioplastiques et galvanoplastiques*. 2 vols. Paris, 1882.
- Wait, John Cassan. *Engineering and Architectural Jurisprudence*. New Work, 1898.
- Wallace, Donald K., and U.S. Bureau of Foreign and Domestic Commerce. *A Nationwide Survey of the Blue Print and Allied Industries: A Study of Production and Distribution Factors Including Costs, Profit and Loss*. International Association of Blue Print and Allied Industries, 1933.
- Ware, William Robert. *An Outline of the Course of Instruction in Building and Architecture, Proposed for the School of the Massachusetts Institute of Technology*. Boston, 1866.
- Warren, S. Edward. *A Manual of Drafting Instruments and Operations*. New York, 1872.

Waterhouse, James. *Practical Notes on the Preparation of Drawings for Photographic Reproduction*. London, 1890.

James Watt and Company. *Directions for Using the Machine for Copying Letters and Other Writings*. Birmingham, 1780.

Whitaker, Channing. "Apparatus for Printing by the Blue Process." *Association of Engineering Societies* 1, no. 10 (August 1882): 349–360.

Worthen, W. E., ed. *Appleton's Cyclopaedia of Drawing, Designed as a Text-Book for the Mechanic, Architect, Engineer, and Surveyor*. New York, 1857.

Chapter Three

Arke, Simon [Clifford Howard]. *Graphology: Or How to Read Character from Handwriting*. American Institute of Graphology, 1903.

Baldi, Camillo. *Trattato come da una lettera missiva si conoscano la natura, e qualità dello scrittore*. Carpi, 1622.

Baldwin, Joseph. *Elementary Psychology and Education*. New York, 1893.

Balkin, Harry H. *The New Science of Analyzing Character*. 2nd ed. Four Seas Company, 1919.

Baughan, Rosa. *Character Indicated by Handwriting*. London, 1880.

Becker, George J. *Ornamental Penmanship: A Series of Analytical and Finished Alphabets*. Philadelphia, 1854.

Brewster, Edwin Tenney. *Vocational Guidance for the Professions*. Rand McNally, 1917.

Brown, Frank Chouteau. "Architectural Lettering." In *Cyclopedia of Drawing*. Edited by Alfred E. Zapf. American School of Correspondence at Armour Institute of Technology, 1905.

Brown, Frank Chouteau. *Architectural Lettering*. American School of Correspondence, 1906. Also published in 1914, 1916, 1917, and 1921 and as a separate "Instruction Paper" in 1906 and 1914.

Brown, Frank Chouteau. "Architectural Lettering." In *Cyclopedia of Drawing*. 4 vols. Edited by Alfred E. Zapf. American Technical Society, 1907.

Brown, Frank Chouteau. "Architectural Lettering." In *Architectural Drawing and Lettering*. Technical World Magazine, 1908. Also Published in 1910.

- Brown, Frank Chouteau. "Architectural Lettering." In *Architectural Drawing and Lettering*. American Technical Society, 1913. Also published in 1914, 1917, 1919, and 1920.
- Brown, Frank Chouteau. *Letters and Lettering: A Treatise with 200 Examples*. Bates & Guild, 1902. Also published in 1906 (5th ed.), 1914 (14th thousand), and 1921.
- Brown, Frank Chouteau. "Office Lettering, Part I." *Architectural Review* 8, no. 7 (July 1901): 87–92.
- Brown, Frank Chouteau. "Office Lettering, Part II." *Architectural Review* 8, no. 10 (October 1901): 123–127.
- Chapman, John Gadsby. *The American Drawing-Book: A Manual for the Amateur; and Basis of Study for the Professional Artist, Especially Adapted to the Use of Public and Private Schools, as Well as Home Instruction*. New York, 1847.
- Claflin, Roy C. *Standard Lettering*. Columbia School of Drawing, 1916.
- Committee on Vocational Guidance. *Vocational Information*. Leland Stanford Junior University, 1919.
- Copley, Fredrick S. *A Set of Alphabets of All the Various Hands in Modern Use with Examples in Each Style*. New York, 1870.
- Crépieux-Jamin, Jules. *Handwriting and Expression*. Translated by John Holt Schooling. London, 1892.
- Dale, L. Burdette. *Drawing for Builders: A Problem Course in Architectural Drawing*. John Wiley & Sons, 1916.
- Daniels, Frank T. *A Text-Book of Free-Hand Lettering*. Boston, 1895.
- Daniels, Frank T. *A Text-Book of Free-Hand Lettering*. Rev. ed. D. C. Heath, 1909.
- Day, Lewis F. *Alphabets, Old and New*. London, 1897.
- Decker, Wilbur F. *A Manual of Industrial Drawing for Carpenters and Other Wood-Workers*. New York, 1892.
- Desbarrolles, Adolphe, and Jean-Hippolyte Michon. *Les mystères de l'écriture: art de juger les hommes sur leurs autographes*. Paris, 1872.
- Eugene Dietzgen Co. *Catalogue and Price List of Eugene Dietzgen Co., Manufacturers of Drawing Materials and Surveying Instruments*. 9th ed. Eugene Dietzgen, 1910.

- Downy, June E. *Graphology and the Psychology of Handwriting*. Warwick & York, 1919.
- Eastman, Seth. *Treatise on Topographical Drawing*. New York, 1837.
- Erlenmeyer, Albrecht. *Die Schrift: Grundzüge ihrer Physiologie und Pathologie*. Stuttgart, 1879.
- Esser, Hermann. *Draughtsman's Alphabets: A Series of Plain and Ornamental Alphabets Designed Especially for Engineers, Architects, Draughtsmen, Engravers, Painters etc.* 17th ed. New York, 1870.
- Field, Wooster, Bard. *Architectural Drawing*. McGraw-Hill, 1922.
- Fish, John C. L. *Lettering of Working Drawings*. New York, 1894.
- Fish, John C. L. *Linear Drawing and Lettering for Beginners*. 3rd ed. Engineering News Publishing, 1901.
- Foster, Benjamin Franklin. *Practical Penmanship, Being a Development of the Carstairian System*. Albany, 1832.
- Frazier, Persifor. *A Manual of the Study of Documents to Establish the Individual Character of Handwriting and to Detect Fraud and Forgery*. Philadelphia, 1894.
- French, Thomas E. *A Manual of Engineering Drawing for Students and Draftsmen*. McGraw-Hill, 1911.
- French, Thomas E. *A Manual of Engineering Drawing for Students and Draftsmen*. 2nd ed. McGraw-Hill, 1919.
- French, Thomas E., and Robert Meiklejohn. *The Essentials of Lettering: A Manual for Students and Designers*. 2nd ed. Varsity Supply Company, 1910.
- Frith, Henry. *A Guide to the Study of Graphology, with an Explanation of the Mysteries of Handwriting*. London, 1886.
- Giesecke, Frederick E. *Mechanical Drawing, Part 1: Use of Instruments, Lettering, Geometrical Problems, and Projections*. 2nd ed. Eugene Dietzgen, 1908.
- Gould, Nathaniel D. *Penmanship: or, The Beauties of Writing Exemplified in a Variety of Specimens, Practical and Ornamental*. Boston, 1822.
- Graphique [pseud.]. *Graphology for All: A Key to the Character Reading of Handwriting*. Frank Hollings, 1916.

Grapho [pseud.]. *Character Reading from Handwriting: A Simple Guide with Numerous Examples*. David McKay, 1915.

“Graphology.” *Journal of the American Medical Association* 24 (18 June 1895): 1019–1020.

Greene, George G. *Exercises in Lettering: Architectural and Other Alphabets*. Vest Pocket Series. Bruce Publishing, 1920.

Griffin, Charles L. “Working Drawings.” In *Compendium of Drawing*. American School of Correspondence at Armour Institute of Technology, 1904.

Harris, Franklin Stewart. *The Young Man and His Vocation*. Richard G. Badger, 1916.

Hawkins, Nehemiah. *Rogers’ Drawing and Design: An Educational Treatise Relating to Linear Drawing, Machine Design, Working Drawings, Transmission Methods, Steam, Electrical and Metal Working Machines and Parts, Lathes, Boiler and Parts, Instruments and their Use, Tables, etc.* T. Audel, 1913.

Heyny, William. *Modern Lettering: Artistic and Practical*. William T. Comstock, 1909.

Hodgson, Fred T. *Architectural Drawing Lessons for Carpenters and Builders*. National Builder, 1915.

“Instruments for Mechanical Drawing.” *Manufacturer and Builder* 9, no. 2 (February 1877): 29.

International Correspondence Schools. *A Textbook on Architectural Drawing: Geometrical Drawing, Architectural Drawing, Ornamental Drawing, Advanced Architectural Drawing*. International Correspondence Schools, 1901.

International Textbook Company. “Geometrical Drawing.” In *International Library of Technology: A Series of Textbooks for Persons Engaged in the Engineering Professions and Trades, or for Those who Desire Information Concerning Them*. International Textbook Company, 1908.

Jackson, John. *The Theory and Practice of Handwriting: A Practical Manual for the Guidance of School Boards, Teachers, and Students of the Art*. Rev. ed. New York, 1894.

Jacoby, Henry S. *A Text-Book on Plain Lettering*. New York, 1895.

Jacoby, Henry S. *A Text-Book on Plain Lettering*. Engineering News Publishing, 1901.

James, William. “Automatic Writing.” *Proceedings of the American Society for Psychical Research* 1, no. 4 (1889): 548–564.

- James, William. *Principles of Psychology*. 2 vols. New York, 1890.
- James, William. *Psychology*. Henry Holt, 1909.
- Jamison, Alpha Pierce. *Elements of Mechanical Drawing, their Application and a Course in Mechanical Drawing for Engineering Students*. John Wiley & Sons, 1904.
- Keene, J. Harrington. *The Mystery of Handwriting: A Handbook of Graphology*. Boston, 1896.
- Kerekes, Frank. *Engineering Drawing Theory with Applications, with Appendix Engineering Lettering and Drafting*. John Wiley & Sons, 1928.
- Keuffel & Esser Co. *Catalogue and Price-List of Keuffel and Esser, Importers and Manufacturers of Drawing-Materials*. 17th ed. New York, 1883.
- Keuffel & Esser Co. *Catalogue and Price-List of Keuffel and Esser Co., Manufacturers and Importers of Drawing-Materials and Surveying Instruments*. 23rd ed. New York, 1892.
- Lineham, Wilfred J. *A Treatise on Hand Lettering for Engineers, Architects, Surveyors and Students of Mechanical Drawing*. Chapman and Hall, 1915.
- Lubschez, Ben J. *Over the Drawing Board: A Draftsmen's Hand Book*. Journal of the American Institute of Architects, 1918.
- Mahan, Dennis Hart. *Industrial Drawing: Comprising, the Description and Uses of Drawing Instruments, the Construction of Plane Figures, the Projections and Sections of Geometrical Solids, Architectural Elements, Mechanism, and Topographical Drawing*. 2nd ed. New York, 1863.
- McCullough, Ernest. *Engineering as a Vocation*. David Williams, 1911.
- Michon, Jean-Hippolyte. *Système de graphologie: l'art de connaitre les hommes d'après leur écriture*. 7th ed. Paris, 1884.
- N., S.F. Review of *Alphabets, Old and New*, by Lewis F. Day. *Brochure Series of Architectural Illustration* 5, no. 6 (June 1899): 87–95.
- Newell, Frederick Haynes, and C. E. Drayer, eds. *Engineering as a Career: A Series of Papers by Eminent Engineers*. D. Van Nostrand, 1916.
- Peale, Rembrandt. *Graphics: A Manual of Drawing and Writing, for the Use of Schools and Families*. New York, 1835.

- Perrigo, Oscar E. *Mechanical Drawing, Part 1: Instruments—Geometrical Problems*. Machinery's Reference Series, no. 85. The Industrial Press, 1912.
- Preyer, William T. *Zur Psychologie des Schreibens*. Hamburg and Leipzig, 1895.
- James W. Queen & Co. *Priced and Illustrated Catalogue of Mathematical Instruments and Materials for Drawing, Surveying and Civil Engineering*. Philadelphia, 1877.
- James W. Queen & Co. *Priced and Illustrated Catalogue and Descriptive Manual of Mathematical Instruments and Materials for Drawing, Surveying and Civil Engineering*. Philadelphia, 1883.
- Radford, William A. *Radford's Architectural Drawing: Complete Guide to Work of Architect's Office; Drawing to Scale, Tracing, Detailing, Lettering, Rendering, Designing, Classic Orders of Architecture*. Assisted by Loring E. Provine and Alfred S. Johnson. Radford Architectural Company, 1912.
- Reid, John S. *A Course in Mechanical Drawing*. New York, 1898.
- Reinhardt, Charles W. *Lettering for Draftsmen, Engineers, and Students: A Practical System of Freehand Lettering for Working Drawings*. New York, 1895.
- Reinhardt, Charles W. *Lettering for Draftsmen, Engineers, and Students*. 9th ed. D. Van Nostrand, 1904.
- Reinhardt, Charles W. *Lettering for Draftsmen, Engineers and Students: A Practical System of Freehand Lettering for Working Drawings*. 13th ed. D. Van Nostrand, 1912.
- Remont, Fritz. *The Revelation of Character in Handwriting: A Simple Guide to Character Delineation*. Los Angeles, 1918.
- Review of *A Text-Book on Plain Lettering*, by Henry S. Jacoby. *Brochure Series of Architectural Illustration* 2, no. 4 (April 1896): 59–61.
- Rexford, John. *What Handwriting Indicates: An Analytical Graphology*. G. P. Putnam's Sons, 1904.
- Rice, Louise Guest. *Practical Graphology: Or, the Science of Reading Character through Handwriting*. The Library Shelf, 1910.
- Rintelmann, Emil H. John. "The Relation between an Individual's Handwriting and His Ability to Learn to Letter." PhD diss., University of Chicago, 1932.
- Robinson, Helen Lamson, and M. L. Robinson. *Talks on Graphology: The Art of Knowing Character Through Handwriting*. Boston, 1892.

School of Architecture, University of Pennsylvania. *School Training in Architecture. A Statement Explanatory of the Course of Instruction in the School of Architecture, University of Pennsylvania, Philadelphia.* Philadelphia, 1892.

Seaman, George W. *Progressive Steps in Architectural Drawing.* Manual Arts Press, 1919.

Sherman, Christopher E. *The Theory and Practice of Lettering: Designed for the Use of Engineers and Draftsmen Generally but Especially for the Use of Students in Engineering.* 2nd ed. Columbus, 1897.

Sherman, Christopher E. *The Theory and Practice of Lettering, Designed for the Use of Engineers and Draftsmen Generally but Especially for the Use of Students in Engineering.* 6th ed. Midland Publishing Company, 1904.

Smith, Albert J. *Applied Graphology: A Textbook on Character Analysis from Handwriting.* Gregg Publishing, 1920.

Smith, Alton L. *Notes on Technical Sketching and Free Hand Lettering for Engineering Students.* Published by the author, 1909.

Smith, Alton L. *Notes on Technical Sketching and Free Hand Lettering for Engineering Students.* Published by the author, 1912.

Soennecken, Frederick. *Methodical Text Book to Round Writing for Self-Instruction and for Use in Schools.* 6th ed. New York, 1878.

Soennecken, Friedrich. *Methodical Text Book to Round Writing for Self-Instruction and for Use in Schools.* 17th ed. New York, 1887.

Soltmann, E. G. *Price List of Drawing Materials, Architects and Engineers' Supplies, Blue Process Papers, etc.* 2nd ed. New York, 1885.

Spencer, Robert C., Platt R. Spencer, Henry C. Spencer, Harvey A. Spencer, and Lyman P. Spencer. *New Spencerian Compendium of Penmanship: A Comprehensive Work upon the Art and its Various Departments; Practical Writing, Calligraphy, Text and Lettering, Flourishing, Pen-Drawing.* New York and Chicago, 1887.

Stanley, William Ford. *A Descriptive Treatise on Mathematical Drawing Instruments, Their Construction, Uses, Qualities, Selection, Preservation, and Suggestions for Improvements, with Hints upon Drawing and Colouring.* 3rd ed. London, 1868.

Stocker, R. Dimsdale. *Clues to Character: Being a Complete Text-Book of the Law of Scientific Physiognomy and Graphology.* Modern Medical Publishing Company, 1903.

- Stocker, R. Dimsdale. *The Language of Handwriting: A Text-Book of Graphology*. George Routledge and Sons, 1904.
- Strange, Edward F. *Alphabets: A Handbook of Lettering with Historical, Critical and Practical Descriptions*. London: 1895.
- Teale, Oscar S. *How to do Architectural Drawing: A Text Book and Practical Guide for Students in Architectural Draftsmanship*. Published by the author, 1914.
- Tuthill, William Burnet. *Practical Lessons in Architectural Drawing: Or, How to Make the Working Drawings and Write the Specifications for Buildings*. New York, 1881.
- Vars, Émilie de. *Histoire de la graphologie*. 2nd ed. Paris and Orleans, 1877.
- Vocational Bureau of Boston. *The Architect*. Vocations for Boys, vol. 5. Vocational Bureau of Boston, 1911.
- W. & L. E. Gurley. *A Manual of the Principal Instruments used in American Engineering and Surveying*. 25th ed. Troy, NY, 1884.
- W. & L. E. Gurley. *A Manual of the Principal Instruments used in American Engineering and Surveying*. 36th ed. W. & L. E. Gurley, 1902.
- Willson, Frederick Newton. *Practical Engineering Drawing and Third Angle Projection*. Princeton, 1897.
- Willson, Frederick Newton. *Theoretical and Practical Graphics: An Educational Course on the Theory and Practical Applications of Descriptive Geometry and Mechanical Drawing Prepared for Students in General Science, Engineering or Architecture*. New York, 1898.
- Wilme, Benjamin P. *A Hand-Book for Mapping, Engineering, and Architectural Drawing*. London, 1846.
- Wilme, Benjamin P. *A Manual of Writing and Printing Characters, Both Ancient and Modern, for the Use of Architects, Engineers and Surveyors, Engravers, Printers, Decorators and Draughtsmen*. London, 1845.
- Wilson, Victor T. *Free-Hand Lettering: Being a Treatise on Plain Lettering from the Practical Standpoint for Use in Engineering Schools and Colleges*. John Wiley & Sons, 1905.
- Windoos, Ralph F., and Harvey B. Campbell. *Architectural Drawing for Secondary Schools*. Webb Publishing, 1917.

Wood, George W. *Scientific Handwriting Testimony: Higher Art of Handwriting and Typewriting Investigation Explained and Illustrated*. Cramer, 1922.

Conclusion

Bragdon, Claude Fayette. *The Beautiful Necessity: Seven Essays on Theosophy and Architecture*. Manas Press, 1910.

Mead, George Herbert. *Mind, Self and Society from the Standpoint of a Social Behaviorist*. Edited by Charles W. Morris. University of Chicago Press, 1934.

Weber, Max. *From Max Weber: Essays in Sociology*. Edited and translated H. H. Gerth and C. Wright Mills. Routledge, 2009.

Secondary Sources

Abbott, Andrew. *The System of Professions: An Essay on the Division of Expert Labor*. University of Chicago Press, 1988.

Alexander, Zeynep Çelik. *Kinaesthetic Knowing: Aesthetics, Epistemology, Modern Design*. University of Chicago Press, 2017.

Alexander, Zeynep Çelik, and John May, eds. *Design Technics: Archaeologies of Architectural Practice*. University of Minnesota Press, 2020.

Alexander-Shilland, Kimberly. "Ware and Van Brunt: Architectural Practice and Professionalization (1863–1881)." PhD diss., Boston University, 1999.

Alkhotany, E. L. "Nature and Function of Lettering: A Study in Cartographic Design Based on Cultural Factors." Master's thesis, Carleton University, 1985.

Amhoff, Tilo. Nicholas Beech, and Katie Lloyd Thomas. "Further Reading Required." *arq* 16, no. 3 (2012): 197–199.

Anderson, Christina Z. *Cyanotype: The Blueprint in Contemporary Photography*. Routledge, 2019.

Andrew, James H. "The Copying of Engineering Drawings and Documents." *Transactions of the Newcomen Society for the Study of History of Engineering and Technology* 53 (1981–82): 1–15.

- Andrzejewski, Anna Vemer. "Architecture and the Ideology of Surveillance in Modern America, 1850–1950." PhD diss., University of Delaware, 2000.
- Angulo, A. J. *William Barton Rogers and the Idea of MIT*. Johns Hopkins University Press, 2009.
- Arendt, Hannah. *The Human Condition*. University of Chicago Press, 1958.
- Arendt, Hannah. "Labor, Work, Action." In *Amor Mundi: Explorations in the Faith and Thought of Hannah Arendt*. Edited by James W. Bernauer. Boston College Studies in Philosophy 7. Martinus Nijhoff, 1987.
- Ashwin, Clive. *Drawing and Education in German-Speaking Europe, 1800–1900*. UMI Research Press, 1981.
- Balmori, Diana. "George B. Post: The Process of Design and the New American Architectural Office (1868–1913)." *Journal of the Society of Architectural Historians* 46, no. 4 (December 1987): 342–355.
- Banham, Reyner. *The Architecture of the Well-Tempered Environment*. Architectural Press and University of Chicago Press, 1969.
- Barr, Mariana, and Gershon Ben-Shakar. *Science, Pseudo-Science, Non-Sense, and Critical Thinking: Why the Differences Matter*. Routledge, 2019.
- Baudez, Basile. *Inessential Colors: Architecture on Paper in Early Modern Europe*. Princeton University Press, 2021.
- Becker, Peter, and William Clark, eds. *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*. University of Michigan Press, 2000.
- Bedini, Silvio A. *Thomas Jefferson and His Copying Machines*. University of Virginia Press, 1984.
- Bellin, Eric. *Detailing Worlds: A Conceptual History of Architectural Detail*. Bloomsbury Visual Arts, 2025.
- Belofsky, Harold. "Engineering Drawing: A Universal Language in Two Dialects." *Technology and Culture* 32, no. 1 (January 1991): 23–46.
- Beniger, James R. *The Control Revolution: Technological and Economic Origins of the Information Society*. Harvard University Press, 1986.
- Bentel, Paul Louis. "Modernism and Professionalism in American Architecture, 1919–1933." PhD diss., Massachusetts Institute of Technology, 1992.

- Beyerstein, Barry L., and Dale F. Beyerstein, eds. *The Write Stuff: Evaluations of Graphology—The Study of Handwriting Analysis*. Prometheus Books, 1992.
- Bishir, Catherine W., Charlotte C. Brown, Carl R. Lounsbury, and Ernest H. Wood III. *Architects and Builders in Carolina: A History of the Practice of Building*. University of North Carolina Press, 1990.
- Blaschke, Estelle. “‘Installed For Your Protection’: Mikrofilm als Medium der Bürokratie.” In *Medien der Bürokratie*. Edited by Friedrich Balke, Bernhard Siegert, and Joseph Vogl. Wilhelm Fink, 2016.
- Blau, Judith R. *Architects and Firms: A Sociological Perspective on Architectural Practice*. MIT Press, 1984.
- Blau, Judith R., Mark Lagory, and John S. Pipkin, eds. *Professionals and Urban Form*. State University of New York Press, 1983.
- Block, Kenvin P. *The Ware Course: Architecture as a Useful, Liberal, and Fine Art*. PhD diss., University of California, Berkeley, 2019.
- Booker, Peter Jeffrey. *A History of Engineering Drawing*. Northgate, 1979.
- Bortolozzi, Anna. “Transparent Paper as a Medium of Copying and Design in the Early Modern Architectural Workshop,” *RIHA Journal* (2024).
- Brain, David. “Discipline & Style: The Ecole des Beaux-Arts and the Social Production of an American Architecture.” *Theory and Society* 18, no. 6 (November 1989): 807–868.
- Braverman, Harry. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. 25th anniversary ed. Monthly Review Press, 1998.
- Brett, David. “Drawing and the Ideology of Industrialization.” *Design Issues* 3, no. 2 (Autumn 1986): 59–72.
- Briggs Martis S. *The Architect in History*. Oxford University Press, 1927.
- Brown, John K. “Design Plans, Working Drawings, National Styles: Engineering Practice in Great Britain and the United States, 1775–1945.” *Technology and Culture* 41, no. 2 (April 2000): 195–238.
- Burke, Chris. “Peter Behrens and the German Letter: Type Design and Architectural Lettering.” *Journal of Design History* 5, no. 1 (1992): 19–37.
- Burns, Nancy Kathryn, and Kristina Wilson, eds. *Cyanotypes: Photography’s Blue Period* (Worcester Art Museum, 2016).

- Calvert, Monte A. *The Mechanical Engineer in America, 1830–1910: Professional Cultures in Conflict*. Johns Hopkins Press, 1967.
- Carmo, Mario. *The Alphabet and the Algorithm*. MIT Press, 2011.
- Carmo, Mario, ed. *The Digital Turn in Architecture, 1992–2012*. Wiley, 2013.
- Carmo, Mario, and Frédérique Lemerle, eds. *Perspective, Projections and Design: Technologies of Architectural Representation*. Routledge, 2008.
- Carr-Saunders, A. M., and P. A. Wilson. *The Professions*. Oxford University Press, 1933; repr., Frank Cass, 1964.
- Carver, Erik. “‘This Whole Maze of Evidence’: Revisiting Professionalism and Property through *Hunt v. Parmlly*.” In *Writing Architectural History: Evidence and Narrative in the Twenty-First Century*. Edited by Aggregate. University of Pittsburgh Press, 2021.
- Caspar Hirschi, “Dreyfus, Zola und die Graphologen: Vom Expertenversagen zum Intellektuellensieg?” *Historische Zeitschrift* 303, no. 3 (2016): 705–747.
- Chandler, Alfred D. Jr. *The Visible Hand: The Managerial Revolution in American Business*. Belknap Press of Harvard University Press, 1977.
- Chewning, John Andrew. “William Robert Ware and the beginnings of architectural education in the United States, 1861–1881.” PhD diss., Massachusetts Institute of Technology, 1986.
- Chewning, John Andrew. “William Robert Ware at MIT and Columbia.” *Journal of Architectural Education* 33, no 2 (November 1979): 25–29.
- Clark, Linda. *Building Capitalism: Historical Change and the Labour Process in the Production of the Built Environment*. Routledge, 1992.
- Cogan, Morris L. “Toward a Definition of Professions.” *Harvard Educational Review* 23, no. 1 (Winter 1953): 33–50.
- Cohen, Jeffrey A. “Building a Discipline: Early Institutional Settings for Architectural Education in Philadelphia, 1804–1890.” *Journal of the Society of Architectural Historians* 53, no. 2 (June 1994): 139–183.
- Colonnese, Fabio, Nuno Grancho, and Robin Schaefferbeke, eds. *Approaches to Drawing in Architectural and Urban Design*. Cambridge Scholars Publishing, 2024.

- Compston, Christine, Stephen Senge, and Walter McDonald. *Rewarding Work: A History of Boston's North Bennett Street School*. North Bennett Street School, 2018.
- Cook, Karen Severud. "Labeling Techniques." In *Cartography in the Twentieth Century*. Vol. 6 of *The History of Cartography*, edited by Mark Monmonier. University of Chicago Press, 2015.
- Cook, Michael. "Towards a History of Recording Technologies: The Damp-press Copying Book." *Journal of the Society of Archivists* 32, no. 1 (April 2011): 35–49.
- Craig, Barbara L. "The Introduction of Copying Devices into the British Civil Service, 1877–1889." In *The Archival Imagination: Essays in Honour of Hugh A. Taylor*, edited by Barbara L. Craig, 105–133. Association of Canadian Archivists, 1992.
- Crossman, Kelly. *Architecture in Transition: From Art to Practice, 1885–1906*. McGill-Queen's University Press, 1987.
- D'Elboux, Jose Roberto. "Architectural Lettering: From Information to Identity; A Study on Gregori Warchavchik's *Condomínio Cícero Prado*." In *Design Frontiers: Territories, Concepts, Technologies*. Conference of the International Committee for Design History and Design Studies, 2012.
- Daston, Lorraine. "Scientific Objectivity with and Without Words." In *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*. Edited by Peter Becker and William Clark. University of Michigan Press, 2001.
- Daston, Lorraine, and Peter Galison. *Objectivity*. Zone Books, 2007.
- Daston, Lorraine, and Peter Galison. "The Image of Objectivity." *Representations* 40 (Autumn 1992): 81–128.
- Deamer, Peggy, ed. *The Architect as Worker: Immaterial Labor, the Creative Class, and the Politics of Design*. Bloomsbury Academic, 2015.
- Deamer, Peggy, and Phillip G. Bernstein, eds. *Building (in) the Future: Recasting Labor in Architecture*. Yale School of Architecture and Princeton Architectural Press, 2010.
- Deamer, Peggy, and Tsz Yan Ng. "Work." *Journal of Architectural Education* 73, no. 2 (Fall 2019): 138–140.
- Deforge, Yves. *Le graphisme technique: son histoire et son enseignement*. Champ Vallon, 1981.

- Drucker, Johanna. *The Alphabetic Labyrinth: The Letters in History and Imagination*. Thames and Hudson, 1995.
- Dubbs, Katherine Pearl. “‘A Great Civilizing Agent’: Architecture at MIT, Drawing Education, and Boston’s Cultural Elite, 1865–1881.” Master’s thesis, Massachusetts Institute of Technology, 2021.
- Elliott, Cecil D. *Technics and Architecture: The Development of Materials and Systems for Buildings*. MIT Press, 1992.
- Emmons, Paul. “Demiurgic Lines: Line-making and the Architectural Imagination.” *Journal of Architecture* 19, no. 4 (2014): 536–559.
- Emmons, Paul. *Drawing Imagining Building: Embodiment in Architectural Design Practices*. Routledge, 2019.
- Evans, Robin. *The Projective Cast: Architecture and its Three Geometries*. MIT Press, 1995.
- Fallan, Kjetil. “Architecture in action: Traveling with actor-network theory in the land of architectural research.” *Architectural Theory Review* 13, no. 1 (2008): 80–96.
- Fatta, Francesca. “Lettering and Expressiveness: When Characters Tell a Story.” In *Proceedings of the 2nd International and Interdisciplinary Conference on Image and Imagination*. Edited by Enrico Cicalò. Springer, 2020.
- Feldhaus, Franz Maria. *Geschichte des technischen Zeichnens*. Franz Kuhlmann, 1967.
- Ferguson, Eugene S. *Engineering and the Mind’s Eye*. MIT Press, 1992.
- Fitchen, John. *Building Construction before Mechanization*. MIT Press, 1988.
- Fireman, Belinda. “The Technology and Conservation of Blueprints.” *Paper Conservation News* 81 (March 1997): 3–6.
- Floyd, Margaret Henderson. *Architectural Education and Boston: Centennial Publication of the Boston Architectural Center, 1889–1989*. Boston Architectural Center, 1989.
- Franch i Gilabert, Eva, Ana Milijački, Ashley Schafer, Michael Kubo, and Amanda Reeser Lawrence, eds. *Office US Agenda*. Lars Müller, 2014.
- Fried, Michael. *Realism, Writing, Disfiguration: On Thomas Eakins and Stephen Crane*. University of Chicago Press, 1987.

- Ganz, David. “‘Mind in Character’: Ancient and Medieval Ideas about the Status of the Autograph as an Expression of Personality.” In *Of the Making of Books: Medieval Manuscripts, their Scribes and Readers*. Edited by P. R. Robinson and Rivkah Zim. Scholar Press, 1997.
- Garascia, Ann. “Impressions of Plants Themselves.” *Victorian Literature and Culture* 47, no. 2 (Summer 2019): 267–303.
- Gartman, David. *From Autos to Architecture: Fordism and Architectural Aesthetics in the Twentieth Century*. Princeton Architectural Press, 2009.
- Geraniotis, Roula. “The University of Illinois and German Architectural Education.” *Journal of Architectural Education* 38, no. 4 (Summer 1985): 15–21.
- Gitelman, Lisa. *Paper Knowledge: Toward a Media History of Documents*. Duke University Press, 2014.
- Gitelman, Lisa. *Scripts, Grooves, and Writing Machines: Representing Technology in the Edison Era*. Stanford University Press, 1999.
- Glück, Eva, Irene Brückle, and Eva-Maria Barkhofen, eds. *Papier – Linie – Licht: Konservierung von Architekturzeichnungen und Lichtpausen aus dem Hans-Scharoun-Archiv*. Akademie der Künste, 2012.
- Gray, Milner, and Ronald Armstrong. *Lettering for Architects and Designers*. Reinhold, 1962.
- Gray, Nicolette. “Alphabet.” *Architectural Review* 120, no. 715 (August 1956): 109–114.
- Gray, Nicolette. “Expressionism in Lettering.” *Architectural Review* 125, no. 747 (April 1959): 272–276.
- Gray, Nicolette. “Lettering and Society.” *Visible Language* 8, no. 3 (Summer 1974): 247–260.
- Gray, Nicolette. “Lettering: Craft, Art, or Technology.” *Crafts* 8, no. 42 (January/February 1980): 22–25.
- Gray, Nicolette. *Lettering on Buildings*. Reinhold, 1960.
- Gray, Nicolette. *A History of Lettering: Creative Experiment and Letter Identity*. Phaidon, 1986.
- Gray, Nicolette. *Lettering as Drawing*. Oxford University Press, 1971.

- Gospel, Howard F., ed. *Industrial Training and Technological Innovation: A Comparative and Historical Study*. Routledge, 1991.
- Guillén, Mauro F. *The Taylorized Beauty of the Mechanical: Scientific Management and the Rise of Modernist Architecture*. Princeton University Press, 2006.
- Gutman, Robert. *Architectural Practice: A Critical View*. Princeton Architectural Press, 1988.
- Haber, Samuel. *The Quest for Authority and Honor in the American Professions, 1750–1900*. University of Chicago Press, 1991.
- Hanke, Edith, Lawrence A. Scaff, and Sam Whimster, eds. *The Oxford Handbook of Max Weber*. Oxford Academic, 2019.
- Hanson, Brian. *Architects and the “Building World” from Chambers to Ruskin: Constructing Authority*. Cambridge University Press, 2003.
- Hardwig, Florian, and Thomas Maier. “From Lettering Guides to CNC Plotters—A Brief History of Technical Lettering Tools.” 15 January 2017. www.typotheque.com.
- Hill, Melvyn A., ed. *Hannah Arendt: The Recovery of the Public World*. St. Martin’s, 1979.
- Hills, Richard. “James Watt and His Copying Machine,” in *The Oxford Papers*, Studies in British Paper History 1, ed. Peter Bower (British Association of Paper Historians, 1996), 81–88.
- Hull, Matthew S. “Documents and Bureaucracy.” *Annual Review of Anthropology* 41 (2012): 251–267.
- Hyde, Timothy. “The Building Site, Redux.” *Journal of Architectural Education* 75, no. 1 (2021): 84–93.
- Ivins, William M., Jr. *Prints and Visual Communication*. Harvard University Press, 1953.
- John, Richard R. “Elaborations, Revisions, Dissents: Alfred D. Chandler, Jr.’s, *The Visible Hand* after Twenty Years.” *The Business History Review* 71, no. 2 (Summer 1997): 151–200.
- Johnston, George Barnett. *Assembling the Architect: The History and Theory of Professional Practice*. Bloomsbury Visual Arts, 2020.
- Johnston, George Barnett. *Drafting Culture: A Social History of Architectural Graphic Standards*. MIT Press, 2008.

- Jones, Michael Anthony. "Models for Educating Architects in this Century and the Next." Ph.D. diss, Georgia Institute of Technology, 1989.
- Jussim, Estelle. *Visual Communication and the Graphic Arts: Photographic Technologies in the Nineteenth Century*. R.R. Bowker, 1974.
- Kafka, Ben. *The Demon of Writing: The Powers and Failures of Paperwork*. Zone Books, 2012.
- Kafka, Ben. "Paperwork: The State of the Discipline." *Book History* 12 (2009): 340–353.
- Kaye, Barrington. *The Development of the Architectural Profession in Britain: A Sociological Study*. George Allen & Unwin, 1960.
- Kindel, Eric. "Fit to be Seen: Stencils for Architects, Engineers and Surveyors." *AA Files* 61 (2010): 100–109.
- King, Rachael Scarborough, ed. *After Print: Eighteenth-Century Manuscript Cultures*. University of Virginia Press, 2020.
- Kissel, Eléanore, and Erin Vigneau. *Architectural Photoreproductions: A Manual for Identification and Care*. 2nd ed. Oak Knoll Press and The New York Botanical Garden, 2009.
- Kline, Ronald R. "From Progressivism to Engineering Studies: Edwin T. Layton's *The Revolt of the Engineers*." *Technology and Culture* 49, no. 4 (October 2008): 1018–1024.
- Kostof, Spiro, ed. *The Architect: Chapters in the History of the Profession*. University of California Press, 1977.
- LaRocca, David. "Object Lessons: What Cyanotypes Teach Us About Digital Media." In *Photography's Materialities: Transatlantic Photographic Practices over the Long Nineteenth Century*. Edited by Geoff Bender and Rasmus R. Simonsen. Leuven University Press, 2021.
- Laroque, Claude. "History and Analysis of Transparent Papers." *Paper Conservator* 28 (2004): 17–32.
- Larson, Magali Sarfatti. *The Rise of Professionalism: A Sociological Analysis*. University of California Press, 1977.
- Latour, Bruno. "On Actor-Network Theory: A Few Clarifications." *Soziale Welt* 47, no. 4 (1996): 369–381.

- Latour, Bruno. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press, 2005.
- Latour, Bruno. *Science in Action: How to Follow Scientists and Engineers through Society*. Harvard University Press, 1988.
- Latour, Bruno and Albenä Yaneva. “‘Give Me a Gun and I Will Make All Buildings Move’: An ANT's View of Architecture.” In *Explorations in Architecture: Teaching, Design, Research*. Edited by Reto Geiser. Birkhäuser, 2008.
- Laurence, Peter L., ed. *Histories of Architecture Education in the United States*. Routledge, 2024.
- Layton, Edward T., Jr. *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession*. Johns Hopkins University Press, 1986.
- Lee, Antoinette J. *Architects to the Nation: The Rise and Decline of the Supervising Architect's Office*. Oxford University Press, 2000.
- Lefèvre, Wolfgang. *Picturing Machines: 1400–1700*. MIT Press, 2004.
- Leslie, Thomas. “Built Like Bridges: Iron, Steel, and Rivets in the Nineteenth-century Skyscraper.” *Journal of the Society of Architectural Historians* 69, no. 2 (June 2010): 234–261
- Lommen, Mathieu. “Lettering in the ‘Age of Ugliness’: Nineteenth-Century Dutch Lettering Model Books.” *Quaerendo* 46 (2016): 20–52.
- Lucking, Maura. “Settler Campus: Racial Uplift, Free Labor, and Land Tenure in American Design Education, 1866–1929.” PhD diss., UCLA, 2023.
- Lynn, Kenneth S., ed. *The Professions in America*. Houghton Mifflin, 1965.
- Mattes, Mark Alan, ed. *Handwriting in Early America: A Media History*. University of Massachusetts Press, 2023.
- Meiksins, Peter. “The ‘Revolt of the Engineers’ Reconsidered.” *Technology and Culture* 29, no. 2 (April 1988): 219–246.
- Meiksins, Peter, and Chris Smith, eds. *Engineering Labour: Technical Workers in Comparative Perspective*. Verso, 1996.
- McGill, Meredith L. “The Duplicity of the Pen.” In *Language Machines: Technologies of Literary and Cultural Production*. Edited by Jeffrey Masten, Peter Stallybrass, and Nancy Vickers. Routledge, 1997.

- Moonkin, Jennifer L. "The Image of Truth: Photographic Evidence and the Power of Analogy." *Yale Journal of Law and the Humanities* 10, no. 1 (1998): 1–74.
- Murray, Jeffrey S. "Blueprinting in the History of Cartography." *Cartographic Journal* 56, no. 3 (August 2009): 257–261.
- Nadeau, Louis. *Encyclopedia of Printing, Photographic, and Photomechanical Processes*. Atelier Louis Nadeau, 1994.
- Nedoluha, Alois. *Kulturgeschichte des technischen Zeichnens*. Springer, 1960.
- Neef, Sonja, José van Dijck, and Eric Ketelaar, eds. *Sign Here! Handwriting in the Age of New Media*. Amsterdam University Press, 2006.
- Nesbitt, Alexander. *The History and Technique of Lettering*. Dover, 1950.
- Newhall, Beaumont. *Latent Image: The Discovery of Photography*. Doubleday, 1967.
- Newhall, Beaumont. *The History of Photography from 1839 to the Present*. Rev. ed. Museum of Modern Art, 1982.
- Nickel, Douglas R. "Impressed by Nature's Hand": Photography and Authorship." In *Using Visual Evidence*, edited by Richard Howells and Robert W. Matson. Open University Press and McGraw-Hill, 2009.
- Nickel, Douglas R. "Nature's Supernaturalism: William Henry Fox Talbot and Botanical Illustration." In *Intersections: Lithography, Photography, and the Traditions of Printmaking*. Edited by Kathleen S. Howe. University of New Mexico Press, 1998.
- Nicolas, Serge, Bernard Andrieu, Rasyid Bo Sanitioso, Romain Vincent, and David J. Murray. "Alfred Binet and Crépieux-Jamin: Can Intelligence be Measured Scientifically by Graphology?" *L'année psychologique* 115, no. 1 (2015): 3–52.
- Noble, David F. *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. Oxford University Press, 1977.
- Noffsinger, James Phillip. "The Influence of the École des Beaux-Arts on the Architects of the United States." PhD diss., Catholic University of America, 1955.
- Nystrom, Eric C. *Seeing Underground: Maps, Models, and Mining Engineering in America*. University of Nevada Press, 2014.
- Nystrom, Eric Charles. "Learning to See: Visual Tools in American Mining Engineering, 1860–1920." PhD diss., Johns Hopkins University, 2008.

- O’Gorman, James F. “Builder: Orlando Whitney Norcross (Norcross Brothers).” In *The Makers of Trinity Church in the City of Boston*. Edited by James F. O’Gorman. University of Massachusetts Press, 2004.
- Ockman, Joan, ed. *Architecture School: Three Centuries of Educating Architects in North America*. MIT Press, 2012.
- Oliver, Richard, ed. *The Making of an Architect, 1881–1981: Columbia University in the City of New York*. Rizzoli, 1981.
- Osman, Michael. *Modernism’s Visible Hand: Architecture and Regulation in America*. University of Minnesota Press, 2018.
- Pai, Hyungmin. *The Portfolio and the Diagram: Architecture, Discourse, and Modernity in America*. MIT Press, 2002.
- Pause, Michael. “Teaching the Design Studio, A Case Study: MIT’s Department of Architecture, 1865–1974.” PhD diss., Massachusetts Institute of Technology, 1976.
- Peters, Tom F. *Building the Nineteenth Century*. MIT Press, 1996.
- Picon, Antoine. *French Architects and Engineers in the Age of Enlightenment*. Translated by Martin Thom. Cambridge University Press, 1992.
- Port, H. M. “The Office of Works and Building Contracts in Early Nineteenth-Century England.” *The Economic History Review* 20, no. 1 (April 1967): 94–110.
- Price, Lois Olcott. “The History and Identification of Photo-Reproductive Processes Used for Architectural Drawing Prior to 1930.” *Topics in Photographic Preservation* 6 (1995): 41–49.
- Price, Lois Olcott. *Line, Shade and Shadow: The Fabrication and Preservation of Architectural Drawings*. Oak Knoll Press and Winterthur Museum and Garden & Library, 2010.
- Reed, Roger G. “Francis W. Chandler, 1844–1926.” *Biographical Dictionary of Architects in Maine* 5, no. 4 (1988).
- Reifenstein, Rtilo. “Drawing the Letter.” *Drawing: Research, Theory, Practice* 3, no 2 (2018): 171–186.
- Rhodes, Barbara, and William Wells Streeter. *Before Photocopying: The Art and History of Mechanical Copying 1780–1938*. Oak Knoll Press, 1999.

- Robertson, Craig. *The Filing Cabinet: A Vertical History of Information*. University of Minnesota Press, 2021.
- Robertson, Frances. “‘Mere Adventurers in Drawing’: Engineers and Draughtsmen as Visual Technicians in Nineteenth-century Britain.” In *Art versus Industry? New Perspectives on Visual and Industrial Cultures in Nineteenth-century Britain*. Edited by Kate Nichols, Rebecca Wade, and Gabriel Williams. Manchester University Press, 2016.
- Robertson, Frances. “Blueprints as Master Plans: Photomechanical Reproduction, Industrial Duplication and the Machine Aesthetic.” *Studies in Photography* (2013): 45–51.
- Rohdenburg, Theodore K. *A History of the School of Architecture, Columbia University*. Columbia University Press, 1954.
- Sadighian, David. “Classical Economics: On the Currency of the Beaux-Arts System.” In *L’art en France à la croisée des cultures*. Edited by Thomas Kirchner, Déborah Laks, and Elvan Zabunyan. University of Heidelberg, 2023.
- Saint, Andrew. *Architect and Engineer: A Study in Sibling Rivalry*. Yale, 2007.
- Saint, Andrew. *The Image of the Architect*. Yale University Press, 1983.
- Salz, Laura. “Natural/Mechanical: Keywords in the Conception of Early Photography.” In *Photography and Its Origins*. Edited by Tanya Sheehan and Andrés Mario Zervigón. Routledge, 2015.
- Schaaf, Larry J. *Out of the Shadows: Herschel, Talbot and the Invention of Photography*. Yale University Press, 1992.
- Schaaf, Larry J., and Hans P. Krauss Jr. *Sun Gardens: Victorian Photograms by Anna Atkins*. Aperture, 1985.
- Schäfer, Armin. “Graphology in German Psychiatry (1870–1930).” *History of Psychiatry* 27, no. 3 (2016): 307–319.
- Schiegg, Markus, and Deborah Thorpe. “Historical Analyses of Disordered Handwriting: Perspectives on Early 20th-Century Material From a German Psychiatric Hospital.” *Written Communication* 34, no. 1 (2017): 30–53.
- Schlicht, Laurens. “Graphology in Germany in the 1920s and 1930s: Amateurs, Psychologists, and the Police on the Scientific Nature of Graphology.” *NTM Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin* 28 (2020): 149–179.

- Scolari, Massimo. *Oblique Drawing: A History of Anti-Perspective*. MIT Press, 2012.
- Shillaber, Caroline. *Massachusetts Institute of Technology School of Architecture and Planning 1861–1961: A Chronicle*. Massachusetts Institute of Technology, 1963.
- Shortridge, Barbara Gimla. “Map Lettering as Quantitative Symbol: A Preliminary Investigation.” PhD diss., University of Kansas, 1977.
- Simmel, Georg. “The Metropolis and Mental Life.” In *The Blackwell City Reader*. Edited by Gary Bridge and Sophie Watson. Blackwell, 2002. Originally published in 1903 as “Die Großstädte und das Geistesleben.”
- Smith, Merritt Roe. ““God Speed the Institute’: The Foundational Years, 1861–1894.” In *Becoming MIT: Moments of Decision*. Edited by David Kaiser. MIT Press, 2010.
- Smith, Vicki. “Braverman’s Legacy: The Labor Process Tradition at 20.” *Work and Occupations* 21, no. 4 (November 1994): 403–421.
- Snyder, Joel. “Res Ipsa Loquitur.” In *Things that Talk: Object Lessons from Art and Science*. Edited by Lorraine Daston. Zone Books, 2004.
- Spencer, Chelsea Ann. “The Contract, The Contractor, and The Capitalization of American Building.” PhD diss., Massachusetts Institute of Technology, 2024.
- Spiro, Annette, and David Ganzoni, eds. *The Working Drawing: The Architect’s Tool*. Park Books, 2013.
- Staples, Clifford L., and William G. Staples. “Rereading Harry Braverman’s *Labor and Monopoly Capital* After Twenty Years.” *Social Thought and Research* 23, no. 1/2 Social Thought in America (2000): 227–238.
- Stevens, Sara. *Developing Expertise Architecture and Real Estate in Metropolitan America*. Yale University Press, 2016.
- Stratton, Julius A., and Loretta H. Mannix. *Mind and Hand: The Birth of MIT*. MIT Press, 2005.
- Stulik, Dusan C., and Art Kaplan. *The Atlas of Analytical Signatures of Photographic Processes: The Cyanotype*. Getty Conservation Institute, 2013.
- Tait, Alex. “Typography and Map Design.” In *Cartography in the Twentieth Century*. Vol. 6 of *The History of Cartography*, edited by Mark Monmonier. University of Chicago Press, 2015.
- Tait, Robyn. “Hectographs—Their History, Technology and Conservation Treatment.” *AICCM Bulletin* 22, no 1 (1997): 65–67.

- Thomas, Katie Lloyd. *Building Materials: Material Theory and the Architectural Specification*. Bloomsbury Visual Arts, 2021.
- Thomas, Katie Lloyd, Tilo Amhoff, and Nick Beech, eds. *Industries of Architecture*. Routledge, 2016.
- Thornton, Tamara Plakins. *Handwriting in America: A Cultural History*. Yale University Press, 1996.
- Thorpe, Deborah Ellen. “‘Nonsense Rides Piggyback on Sensible Things’: The Past, Present, and Future of Graphology.” In *Medical Paratexts from Medieval to Modern: Dissecting the Page*. Edited by Hannah C. Tweed and Diane G. Scott. Palgrave Macmillan, 2018.
- Titus, Sonja, Regina Schneller, Gerhard Banik, Enke Huhsmann, and Ulrike Hähner. “The Copying Press Process: History and Technology, Part 1.” *Restaurator* 27 (2006): 90–102.
- Tucker, Jennifer. “‘Diseases in the Darkroom’: Morality and Mortality in Nineteenth-century Photographic Chemical Work.” *PhotoResearcher* 41 (2024): 17–31.
- Tucker, Jennifer. *Nature Exposed: Photography as Eyewitness in Victorian Science*. Johns Hopkins University Press, 2005.
- Upton, Dell. “Pattern Books and Professionalism: Aspects of the Transformation of Domestic Architecture in America, 1800–1860.” *Winterthur Portfolio* 19, no. 2/3 (Summer/Autumn 1984): 107–150.
- Usselman, Steven W. “Still Visible: Alfred D. Chandler’s *The Visible Hand*.” *Technology and Culture* 47, no. 3 (July 2006): 584–596.
- Vandenberghe, Frédéric. “Reconstructing Humants: A Humanist Critique of Actant-Network Theory.” *Theory, Culture and Society* 19, no. 5/6 (2002): 51–67.
- Ware, Mike. “Cyanotype: A Blueprint for Visual Vandalism?” *Studies in Photography* (2013): 24–44.
- Ware, Mike. “Herschel’s Cyanotype: Invention or Discovery?” *History of Photography* 22, no. 4 (1998): 371–379.
- Ware, Mike. “Prussian Blue: Artist’s Pigment and Chemist’s Sponge.” *Journal of Chemical Education* 85, no. 5 (May 2008): 612–621.

- Ware, Mike. *Cyanomicon II. History, Science and Art of Cyanotype: photographic printing in Prussian blue*. rev. ed. 2016. http://www.mikeware.co.uk/downloads/Cyanomicon_II.pdf
- Weatherhead, Arthur Clason. "The History of Collegiate Education in Architecture in the United States." PhD diss., Columbia University, 1941.
- Wickersham, Jay. "Learning from Burnham: The Origins of Modern Architectural Practice." *Harvard Design Magazine* 32, Design Practices Now (Spring/Summer 2010): 18–27.
- Wigley, Mark. "Prosthetic Theory: The Disciplining of Architecture." *Assemblage* 15 (August 1991): 6–29.
- Wodehouse, Lawrence. "Alfred Mullett and his French Style Government Buildings." *Journal of the Society of Architectural Historians* 31, no. 1 (March 1972): 22–37.
- Wood, Alexander. *Building the Metropolis: Architecture, Construction, and Labor in New York City, 1880–1935*. University of Chicago Press, 2025.
- Wood, Alexander. "Teamwork at McKim, Mead & White." *Journal of the Society of Architectural Historians* 83, no. 3 (September 2024): 340–357.
- Woods, Mary N. "The First American Architectural Journals: The Profession's Voice." *Journal of the Society of Architectural Historians* 48, no. 2 (June 1989): 117–138.
- Woods, Mary N. *From Craft to Profession: The Practice of Architecture in Nineteenth-Century America*. University of California Press, 1999.
- Worsley, Giles, ed. *Georgian Architectural Practice: Papers given at the Georgian Group Symposium, 1991*. Georgian Group, 1992.
- Yates, JoAnne. *Control through Communication: The Rise of System in American Management*. Johns Hopkins University Press, 1989.
- Zimmerman, Claire. "Albert Kahn in the Second Industrial Revolution." *AA Files* 75 (2017): 28–44.
- Zakim, Michael. *Accounting for Capitalism: The World the Clerk Made*. University of Chicago Press, 2018.
- Zunz, Olivier. *Making America Corporate 1870–1920*. University of Chicago Press, 1990.