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WOOD TYPE ARCHAEOLOGY:
AN INQUIRY INTO WORKER SKILL IN WOOD
PRINTING TYPE MANUFACTURE

By
Daniel Schneider

A THESIS

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

In Industrial Archaeology

MICHIGAN TECHNOLOGICAL UNIVERSITY

2015

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This thesis has been approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE in Industrial Archaeology.

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I want to thank the three former Hamilton employees who spent hours with me recording oral history interviews about their work experiences. I have preserved their anonymity in this thesis as per institutional research ethics guidelines, but their contribution to this project was great and essential. They are the only people who really *know* about the industrial manufacture of wood printing type.

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Abstract

Wood Type Archaeology uses the concept of *industrial skill* to frame an inquiry into the nature of workers' agency within the processes of wood printing type manufacture. The concept of industrial skill posits that industrialized manufacture gave rise to new kinds of knowledge of practice and manual engagement intrinsically linked to the technological and social environment of the factory. The thesis defines worker skill in relation to technological and social dimensions of the industrial workplace, argues for industrial skill's recognition as an intangible form of industrial heritage, and describes industrial skill in the context of wood printing type manufacture at the Hamilton Manufacturing Company in Two Rivers, Wisconsin. Throughout the late nineteenth and early twentieth centuries, Hamilton was the nation's leading producer of wood printing type, which printers for making posters, newspaper headlines, and other materials requiring large-scale letterforms. Wood type manufacture at Hamilton involved multiple processes and technologies requiring different kinds of manual engagement from the type shop's workers. Type cutters made wood type letters using a pneumatic router mounted to a pantograph mechanism; other workers produced decorative wood type borders using a belt-driven die-stamping machine. In both cases, machinery structured workers' activities strictly, but dexterity and tacit knowledge remained essential parts of the work. In this thesis, these processes provide case studies illustrating how industrial skill emerged as a particular type of manual engagement within wood printing type manufacture.

1: Introduction

Wood Printing Type, Worker Skill, and Machines

Throughout most of the era when wood printing type was used for printing posters, newspaper headlines, and other large-scale material, the Hamilton Manufacturing Company of Two Rivers, Wisconsin, was the predominant manufacturer of wood printing types in the U.S.A. Hamilton produced wood type in Two Rivers from 1880 until the mid-1980s, and wood printing type manufacture continued in Two Rivers using the same equipment at a descendent company called HWT until the mid-1990s. Because of the company's prominence in this relatively obscure field of manufacture, its history has featured prominently in what few histories exist related to wood printing type.¹ This thesis brings an archaeological perspective to that history, focusing on the role of worker skill in the wood type manufacturing process.

Hamilton's corporate history and the history of wood printing type, generally, receive some attention in this thesis, but its primary focus is the worker's role in the wood type production process. The thesis uses wood type manufacture as a case study for defining and describing worker skill in an industrialized, mechanized manufacturing process. Hamilton Manufacturing Company and wood type manufacture make an apt case study for inquiry into industrial skill for several reasons. Consonance between oral history accounts

¹ The most notable of these being Rob Roy Kelly's *American Wood Type: 1828-1900; Notes on the Evolution of Decorated and Large Types* (New York: Van Nostrand Reinhold, 1969). There are also accounts of the company's history and manufacturing techniques in some of the printing trade literature of the late nineteenth century.

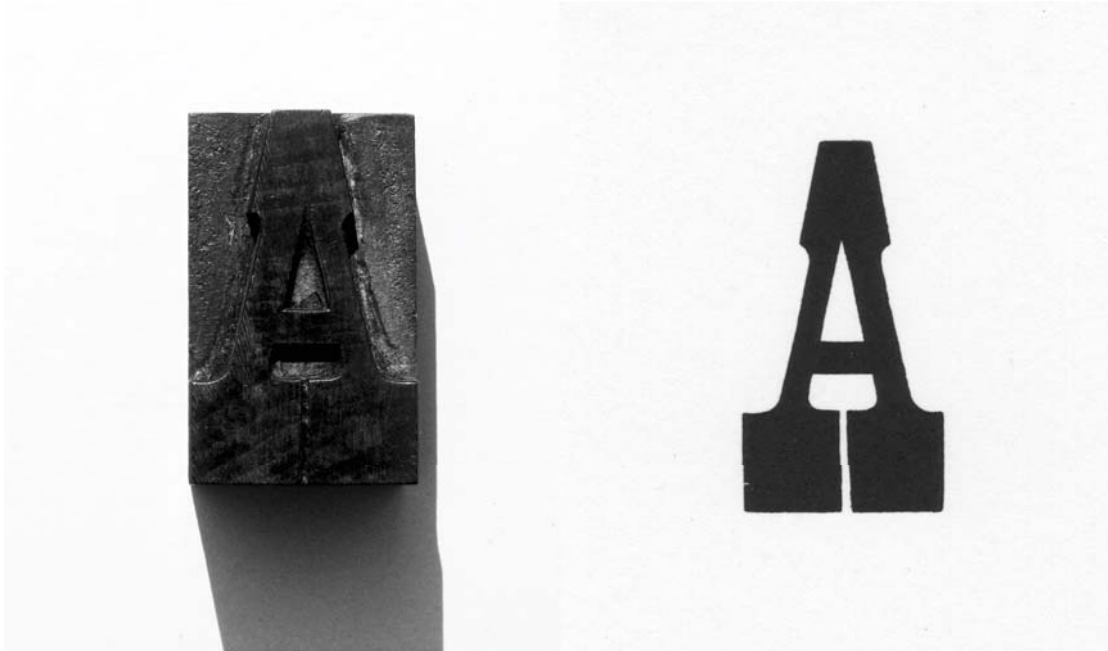


Fig. 1.1: Wood Printing Type

A piece of wood printing type manufactured at the Hamilton Manufacturing Company, and a specimen printed therefrom. Photograph and printed specimen by author.

of post-1960s wood type manufacture and primary- and secondary-source accounts of wood type manufacture as it was practiced in the mid- to late nineteenth century suggests the fundamental aspects of the process remained relatively constant throughout the time Hamilton was engaged in making wood type. This continuity makes the insights from this study applicable to a wide span of history. The wood type manufacturing process at Hamilton also encompassed a range of levels of mechanization, from hand work resembling craft production methods to work in which the operatives' activities were highly structured by the technologies of manufacture. This dimension of wood type manufacturing history makes the industry a useful one for exploring aspects of the transition from craft production to industrial manufacture as it was

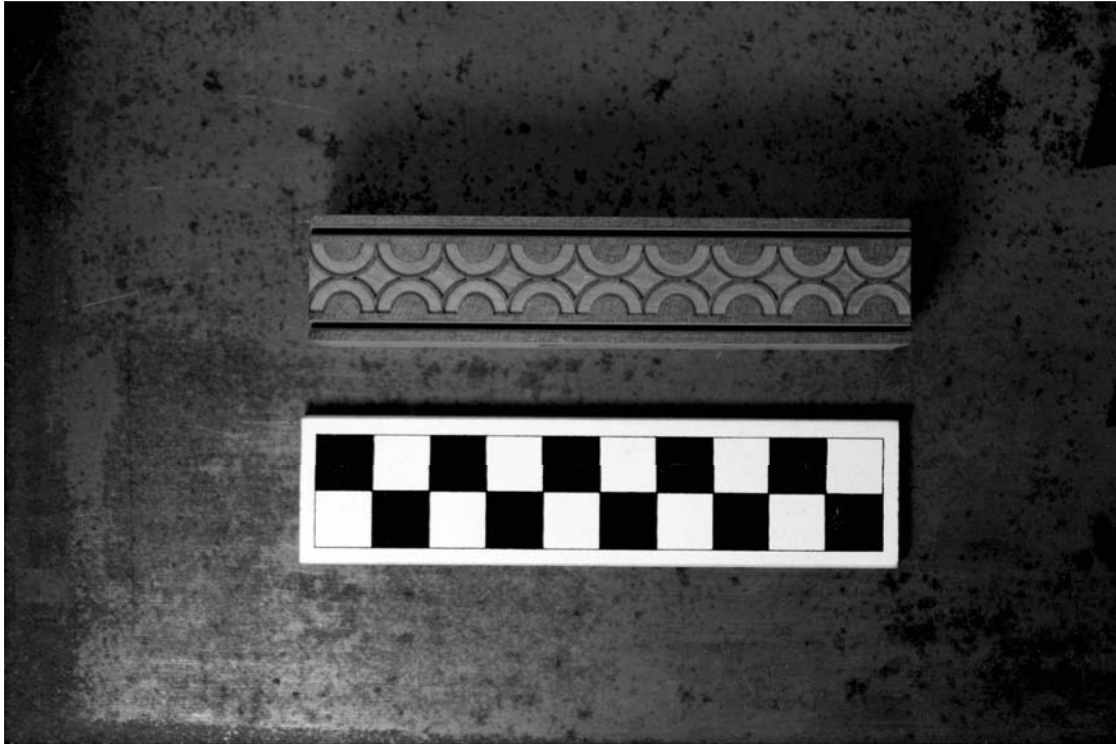


Fig. 1.2: Wood Type Border

A piece of decorative wood type border design No. 138 with 10-centimeter archaeological scale. Photograph by author.

experienced at the level of the individual worker. Wood type manufacture was also emphatically a multi-step, sequential process, in which the work of one operative influenced that of subsequent workers. This aspect makes the industry useful for describing social dimensions of factory work.

In describing the wood type manufacturing process as it was practiced at Hamilton Manufacturing Company, this thesis puts particular emphasis on the type cutting stage, in the manufacture of wood type letters (Fig. 1.1), and the die stamping stage, in the manufacture of decorative wood type borders (Fig. 1.2). These are the processes that rendered the most distinct formal changes upon the type pieces, and also represented the closest relations between



Fig. 1.3: The Pantograph Router

A pantograph router on display at the Hamilton Wood Type & Printing Museum. Photograph by author.

operator and machine. In operating the pantograph machine (Fig. 1.3), the type cutter traced a letterform pattern with a stylus or “tracing bit” attached to the left-hand arm of the machine. The pantograph’s articulated arms translated this motion to a pneumatic router mounted to the machine’s right-hand arm. The router cut the letterform, at a reduced scale, into a wood blank. This machine and the process of type cutting are described in chapters 4 and 6, respectively.

With a set of interchangeable dies, the die-stamping machine (Fig. 1.4) stamped designs into end-grain wood blanks, leaving the printing surface in

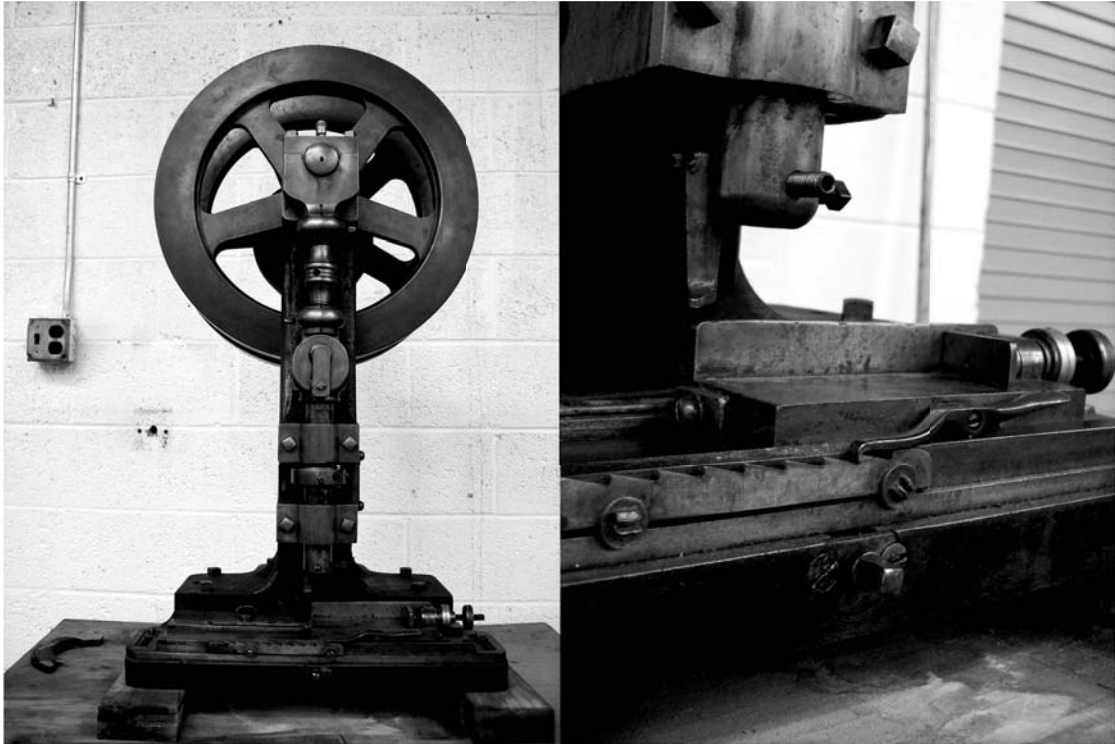


Fig. 1.4: The Die-Stamping Machine

Die-stamping machine (left) with close-up view of stamping piston and wood blank carriage (right). Photograph by author.

relief. The machine was powered and stayed in constant motion while in operation. Its operator moved the wood blank, on a carriage, into different positions for successive stamps. The machine's mechanical elements gauged this movement precisely, and the operator had to move the wood blank carriage in time with the machine's rhythm. Some border designs required multiple, precisely registered stamping dies and therefore multiple passes through the machine. Some designs were much simpler, requiring only one pass. The die-stamping of decorative wood type borders is the subject of Chapter 6.

Past Study of Industrial Skill

Work and workers have been a subject of acute interest to industrial archaeologists and historians of industry. In the latter field, labor history emerged early as its own sub-discipline, most often focused on organized labor and socioeconomic power relationships between labor and capital.² Historians of technology have studied industrial technologies' impact on work, but questions about industrial technology's direct impact on work *experience* seldom frame their inquiry. An exception to this was David Noble, whose explicitly Marxian analysis of industrial technology the wider community of historians of technology has kept at arm's length.³ Mechanization of work processes has shown up in the work of economists such as James Bright,⁴ sociologists such as Robert Blauner,⁵ and scholars who are less easily categorized, like Harry Braverman.⁶ When worker skill emerges as a subject of study within these various disciplines, it is usually in reference to the deskilling influence of technologies of industrial production, Ford's assembly line being

² Labor history is a broad field, its literature encompassing everything from histories of local strikes to broad surveys of union development spanning multiple industries and decades of history. An example of the former is Arthur Thurner, *Rebels on the Range: the Michigan Copper Miners' Strike of 1913-1914*, (Lake Linden, Mich.: John H. Forster Press, 1984). Wide-ranging historical surveys of the union movement include James Green's *The World of the Worker: Labor in Twentieth-Century America*, (New York: Hill and Wang, 1980). Other labor histories have focused on labor leaders, such as Nelson Lichtenstein's *The Most Dangerous Man in Detroit: Walter Reuther and the Fate of American Labor*, (New York: Basic Books, 1995).

³ See David Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism*, (New York: Knopf, 1977) and *Forces of Production: A Social History of Industrial Automation*, (New York: Oxford, 1984).

⁴ James R. Bright, *Automation and Management* (Boston: Harvard University Graduate School of Business Administration, 1958).

⁵ Robert Blauner, *Alienation and Freedom: The Factory Worker and His Industry* (Chicago: University of Chicago Press, 1964).

⁶ Harry Braverman, *Labor and Monopoly Capital: The Degeneration of Work in the Twentieth Century* (1973; New York: Monthly Review Press, 1998), 130.

the classic example. Worker skill has been of perennial interest to industrial archaeologists, though it often plays a peripheral role in their work. Notable exceptions include Thomas Leary's work related to steel manufacture, in which he uses material culture and oral history to challenge historical interpretations of the deskilling of steelworkers, and archaeological, documentary, and oral history to describe technology's structuring of work.⁷ Patrick Malone has studied workers' skill and resourcefulness as represented in the material culture of early nineteenth-century arms manufacture.⁸ Throughout *The Texture of Industry* co-authors Robert Gordon and Malone repeatedly assert a place for worker skill within the study of industrial manufacturing processes.⁹

This thesis uses experimental archaeology and a philosophical conceptual framework to examine industrial skill at the level of the industrial worker. Its larger objectives are threefold: first, to define worker skill in relation to significant characteristics of industrialized production, particularly technological and social dimensions of the industrial workplace; second, to characterize and describe the nature of industrial skill in the context of wood printing type manufacture as it was practiced at the Hamilton Manufacturing Company; and finally, to argue for industrial skill as an important subject for archaeological inquiry and as an intangible form of industrial heritage. In the

⁷ Thomas Leary, "The Work of Rolling Rails in the 32" Mill at Bethlehem Steel's Lackawanna Plant: Industrial Archeology and Labor History," *IA: The Journal of the Society for Industrial Archeology* 16, no. 1 (1990), 39-54; and "Men and Tongs: The Belgian Rod Mill at the Washburn Wire Company, East Providence, Rhode Island," *IA: The Journal of the Society for Industrial Archeology* 18, no. 1-2 (1992), 106-122.

⁸ Patrick Malone, "Little Kinks and Devices at Springfield Armory, 1892-1918," *IA: The Journal of the Society for Industrial Archeology* 14, no. 1 (1988), 59-76.

⁹ Robert Gordon and Patrick Malone, *The Texture of Industry* (New York: Oxford, 1996), 14, 30-32, 37-41, 261-262, 351, 357-558, and 361-365.

process, this thesis will elucidate the actual work processes performed in some steps in the wood type making process.

Methodology and Study Overview

This study employs experimental archaeology, oral history, documentary research, and material culture analysis to explore ways in which the technologies of wood printing type manufacture structured work for the people involved in the process. Documentary evidence consists mainly of Hamilton Manufacturing Company catalogs and printing trade literature from the late nineteenth and early twentieth centuries.¹⁰ Secondary literature and the author's own experience as a practicing letterpress printer contribute to descriptions of the printing industry—the context in which Hamilton's products were used—during the study's period of focus. Because wood type manufacture continued so late into the twentieth century at Hamilton/HWT, there are former employees still living who worked in these production processes. The study's oral history component comprises interviews with three narrators, each of whom worked in a different part of the wood type production process: a patternmaker and block cutter, a type cutter, and a type trimmer. The interviews focused on work processes and the narrators' experiences with the tools and machines associated with their work, along with their general descriptions of the wood type manufacturing process. There are no known living

¹⁰ Much of the archival material in the collection at the Hamilton Wood Type & Printing Museum was still in storage and inaccessible following the museum's relocation in early 2013. This material is likely to eventually cast useful light on the wood printing type manufacturing process.

former employees of the Hamilton Manufacturing Company who have working knowledge of the die-stamping machine that was used to manufacture decorative wood type borders at Hamilton, and documentary material related to the machine is scant. Therefore, the study used experimental archaeology to simulate the machine's operation and gather data about how this technology structured the work of its operator.¹¹ Artifact analysis, particularly of extant examples of decorative wood type border pieces and the die stamps that were used to produce them, contributed greatly to informing the archaeological experiment. Descriptions in this thesis of certain aspects of wood type letter production also derive from material culture analysis of wood type pieces and of the pantograph machine that produced them. These machines and most of these artifacts are in the collection of the Hamilton Wood Type & Printing Museum in Two Rivers. Hamilton wood type letters from the collection at the Copper Country Community Arts Center's letterpress studio in Hancock, Michigan were also used for artifactual analysis.

Fieldwork for this thesis took place over the course of five weeks, spread out between August 2014 and March 2015, at the Hamilton Wood Type & Printing Museum. Early work focused on documenting the die-stamping machine and on analysis of wood type border pieces in the Hamilton museum collection. Work sessions in January and February 2015 focused on motorizing the die-stamping machine for the experimental operation. Experimental archaeology work took place as a public demonstration at the museum from

¹¹ For a survey of some past work in experimental industrial archaeology, see: Patrick Malone, "Experimental Industrial Archeology: Imitation in Pursuit of Authenticity," *IA: The Journal of the Society for Industrial Archeology* 26, no. 1 (2000), 85-94.

March 10 through March 14. This work comprised three phases: initial, short stamping runs to study the machine's basic mechanical properties; longer stamping runs to simulate production-scale wood type border manufacture; and a third round of experimental operation focused on replicating more complex border designs. Oral history interviews and documentary research took place during the five weeks of fieldwork, mostly during the preparatory stages for the die-stamping experiment. These interviews focused on the narrators' experiences with their tools and machines, as well as on aspects of the wood type manufacturing process such as wood preparation and pattern fabrication. Documentary research focused largely on wood type catalogs, which reflected the range of wood type letter and border designs the Hamilton Manufacturing Company produced. The catalogs, known in the trade as "specimen books," also provided limited temporal information relating to the artifacts. The *Inland Printer* trade journal provided data that helped describe the broader context of the wood printing type industry, and of the printing industry in which Hamilton's wood type was put to use. Patent research informed some of the thesis's process descriptions.

Scope and Importance

The two characteristics of industrialized manufacture that have most bearing on workers' experience form the basis of the definition of industrial skill developed and applied throughout this thesis: the division of labor and the mechanization of work processes. Industrial manufacture inarguably has other defining characteristics, among them the application of external motive power

and the centralization of multiple workers and processes within a single building. This latter aspect of industrial production, the gathering together of multiple workers in the factory, does relate strongly to the factory as social environment, a concept that frames the thesis's analysis of the division of labor. But this thesis follows division and mechanization of work processes as its central paths of inquiry because they are the facets of industrial production most relevant to the lived experience of industrial workers in the context of wood printing type production. These are the themes, too, that resonate most strongly with the technological artifacts and oral history that form the primary body of evidence guiding the inquiry.

Temporally, this thesis focuses on the time period from 1880 to the mid-1940s, when Hamilton Manufacturing Company produced decorative wood type border in addition to wood type letters, and the period from the 1960s to the mid-1990s, when the study's oral history narrators worked for Hamilton and subsequently HWT. Most of the artifactual evidence used in developing this study is in the collection of the Hamilton Wood Type & Printing Museum, which was also the primary location for oral history interviews, documentary research, and experimental archaeology. However, the work processes described in this thesis took place historically in the Hamilton Manufacturing Company's type shop that was part of its complex of industrial buildings on the east side of Two Rivers' downtown. The Hamilton works, which stretched three blocks along the west bank of the East Twin River, has been an active demolition site throughout the researching and writing of this thesis, so the physical workspaces no longer

exist and all inferences have by necessity been made from fire insurance maps, other documentary evidence, and oral history accounts.

This research expands inquiry into a component of past industry that has been little studied to this point, despite the impact its products had on the visible lived environment in the form of posters, newspaper headlines, and other matter printed using wood type. The study's experimental archaeology component provides insight into a past industrial manufacturing process that has been lost completely to time. The study's significance for industrial archaeology stems from its inquiry focused at the level of the individual worker's experience, countering the discipline's preoccupation with structural facts of buildings and technical facts of machinery. The study describes a type of tactile knowledge intrinsically rooted in industrialization and in the factory. Its philosophical framework links this knowledge to a broader phenomenological perspective on human engagement with the external, physical world. This perspective is particularly relevant in today's work climate, wherein continued computer automation in manufacture and increasing emphasis on the "knowledge economy" in the world of work in general further divorce work from its manual and tactile dimensions. Through the lens of industrial skill, new meanings can emerge from the physical remnants of the industrial past. These structures and machines form industrial skill's context, and become important in their spatial arrangements and mechanical movements as the text from which industrial skill's nature can be read.

2: Industrial Skill & Its Components

Industrial Skill Defined

Industrial skill manifests itself in various ways within different kinds of industry. A coal miner setting up a drill column had to attend and respond to a wide range of factors: effective drilling required correct distance between the column and the rock face, the column's orientation affected the range of possible angles and placements for drill holes, and the miner needed to know the feel of a properly tightened jack screw to fix the column firmly in place in the rock tunnel.¹ In the stamp mills of Michigan's Lake copper district, "head feeders" had to carefully monitor the flow of ore into the stamp heads: when there was too little ore in the mortar, the stamp piston's steam cylinder would blow out, requiring replacement of its breakaway bolts. In doing this work, the head feeder relied on knowledge of practice related directly to the steam stamp machine.² Ben Hamper's description of a fellow "shoprat" working on the frame riveting line at the GM Truck and Bus Plant in Flint, Michigan in 1981 says something about the timing, dexterity, and physicality involved even in work he generally characterized as soul-sucking, dehumanizing drudgery:

He'd grab one end of a long rail and, with the help of the worker up the line from him, flip it over on its back. CLAAAANNN-NNNGGGG! He then raced back to the bench and grabbed a four-wheel-drive spring casting and a muffler hanger. He would rivet the pieces onto the rail. With that completed, he'd jostle the rail back into an upright position and grab a different rivet gun while

¹ H.B. Herr and Arthur La Motte, "Drilling and Blasting Coal," in *Drilling and Blasting* (Scranton, Penn.: International Textbook Company, 1922), 1-17.

² Dupuis, Jack, Oral history interview with Jo Urion, Calumet, Michigan, 13 October 2005, Keweenaw National Historical Park Oral History Collection.

fidgiting with the proper set of holes. He then inserted the rivets and began squashing the cross member into place.³

This thesis develops the following definition of *industrial skill*, using it to frame its inquiry into workers' skill in wood printing type manufacture:

Industrial skill comprises knowledge of practice and acquired bodily capacity situated within, derived from, and intrinsically linked to the social and technological environment of the industrial workplace.

This definition characterizes industrial skill as a type of knowledge rooted in tactile experience and linked to industrialized production, situating workers' knowledge of practice in relation to fundamental properties of industrialized work. The division of labor, for example, renders the industrial workplace a social environment—a complex of relationships among different workers who are each part of the same larger process. This is what Marx meant in labeling the product of the factory a “social product.”⁴ Mechanization of work processes is a fundamental technological aspect of work's industrialization. Industrial machines' properties most significant to the discussion of industrial skill are those that direct workers' movements, activities, and outcomes. Neo-Marxist Harry Braverman sees “the manner in which (a machine's) operations are controlled” as the key dimension of the evolution of workers' relationship with the machinery of production, stating “It is only when the tool and/or the work are given a fixed motion path by the structure of the machine itself that

³ Ben Hamper, *Rivthead: Tales from the Assembly Line* (New York: Warner Books, 1991), 90.

⁴ Karl Marx, *Capital: A Critique of Political Economy*, trans. Samuel Moore and Edward Aveling (New York: The Modern Library, 1906), 370.

machinery in the modern sense begins to develop.”⁵ Mechanically fixed paths of motion, as will be seen, are salient dimensions of the operation of both wood type manufacturing machines comprising the focus of this thesis.

This chapter uses Marx’s concept of the factory product as a social product to frame discussions of the social linkages between sequential operations involved in the manufacture of wood printing type. It also introduces David Pye’s concepts of “workmanship of risk” and “workmanship of certainty” to help characterize the changes rendered upon work in the transition from craft production to industrial manufacture, and help develop the inquiry into the ways in which machinery structured work. *Tacit knowledge* is a fundamental part of all manual work and tacit dimensions of industrial work are defined in this chapter’s fifth section. *Phenomenology* is the school of philosophical thought that sees existence as essentially rooted in a physical world that is external to the individual, and our being as realized through engagement with external reality. Industrial work is one species of this engagement, inextricably linked with the technologies of industrial production. Phenomenology, as a philosophical enterprise, is particularly concerned with describing lived experience. Under the heading “Phenomenology of the Factory,” this chapter will use Don Ihde’s concepts of *hermeneutic* and *embodied* technological relations to explore workers’ experience with the machinery of wood printing type manufacture.

⁵ Braverman, *Labor and Monopoly Capital*, 130.

The Factory as Social Environment

With the division of labor, manufacture became a social process, as Marx describes:

Instead of each man being allowed to perform all the various operations [of manufacturing an article] in succession, these operations are changed into disconnected, isolated ones, carried on side by side; each is assigned to a different artificer, and the whole of them together are performed simultaneously by the co-operating workmen. This accidental repartition gets repeated, develops advantages of its own, and gradually ossifies into a systematic division of labor. The commodity, from being the individual product of an independent artificer, becomes the social product of a union of artificers, each of whom performs one, and only one, of the constituent partial operations.⁶

The interrelation and interdependence among sequential steps is an important dimension of manufacturing work as a social practice. In many cases the success of one operative's work depends greatly upon the outcomes of preceding operations in the process. This was true in wood type border manufacture, wherein effective operation of the die-stamping machine depended upon precision in the cutting of wood blanks. In the manufacture of wood type letters, the final step in the process—hand trimming—was made easier when the type cutters operated their pantograph machines skillfully. Neither type cutting nor border stamping could produce a useable product—a piece of wood type that would print properly—if the preceding processes of wood preparation did not yield type-high, properly finished wood stock. These social linkages within wood type manufacture receive more detailed attention in Chapter 5.

⁶ Marx, *Capital*, 370.

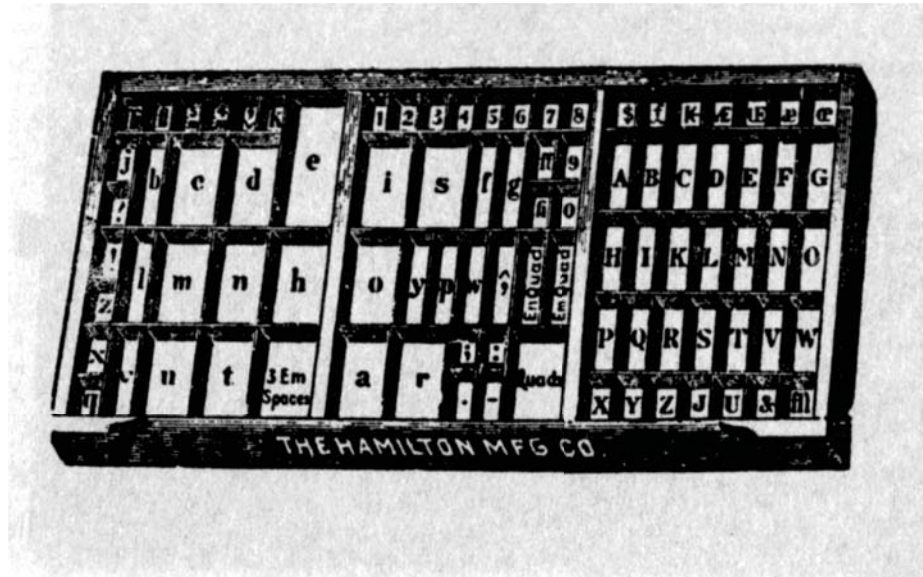


Fig. 2.1: The California Job Case

The design of the “California Job Case” enabled rapid typesetting by hand. The “lay of the case” was part of the specialized knowledge of the printing trades. Specimen printed by the author.

In some production processes, shared knowledge of technology is required for successful completion of work. In printing offices of the nineteenth century, for example, both the typesetter who set type out of the California job case (Fig. 2.1) and the assistant known as the printer’s devil, who redistributed the type after the end of a press run, needed to know how the letters were arranged within the case (“the lay of the case,” in printer’s parlance). The success of the typesetter’s work depended upon the devil correctly knowing the lay of the case: errors in type distribution begot errors in typesetting. Here, the social relationship consisted in a shared knowledge of the technology of production.

Marx uses the phrase “work into one another’s hands,” to describe the bringing together of multiple work processes under one factory roof:

A carriage . . . was formerly the product of the labor of a great number of independent artificers, such as wheelwrights, harness-makers, tailors, locksmiths, upholsterer, turners, fringe-makers, glaziers, painters, polishers, gilders, &c. In the manufacture of carriages, however, all these different artificers are assembled in one building, where they work into one another’s hands.⁷

This passage captures the interrelationship and interdependence among workers in sequential production processes. The phrase “social . . . environment of the industrial workplace” in the industrial skill definition at the beginning of this chapter evokes this facet of industrial manufacture: the factory is a social matrix in which industrial skill is exercised. A multitude of other social dimensions are strongly part of the narrative of the industrialization of work. The socio-economic power structure attendant to industrial capitalism, so central to Marx’s critique of the factory system, is one of these. Another is the factory’s managerial hierarchy. But it is the social linkages inherent within the performance of work on the factory’s shop floor, which manifest in the product of manufacture as it moves from one step in the process to the next, that are central to understanding industrial skill. The work’s attendant social relations are part of the external reality the industrial worker had to apprehend and respond to in the same way that he/she had to respond to the mechanical and material properties of machinery and of work pieces.

⁷ Marx, *Capital*, 369.

Workmanship and Industry

David Pye's concepts, "workmanship of risk" and "workmanship of certainty," define two ends of a continuum that is useful for characterizing worker agency in manufacturing processes. By coincidence, Pye introduces these concepts in the context of woodworking, resonating well with the subject at hand. In workmanship of risk, "the quality of the result is continuously at risk during the process of making."⁸ It is up to the workman, relying on skill, dexterity, judgment, and care (Pye places special emphasis upon care), to produce a quality result. An example of workmanship of risk can be found in Pye's own woodworking. The gently curving chisel strokes radiating from the center of his signature bowls run so close together, one slip of the hand would obliterate the fine ridge intentionally left between them. Pye did his work using hand tools, without guides helping determine the results of his work. In contrast, in the workmanship of certainty, "the quality of the result is exactly predetermined before a single salable thing is made."⁹ Pye counts jigs and templates among the technologies that add certainty to workmanship. Fully automated production processes represent workmanship of certainty in its purest form. Industrialized manufacturing processes, almost by definition, involve the workmanship of certainty to some extent. In wood type cutting, the pantograph router and letter-form pattern add certainty to the work. The die-stamping machine's mechanical structure strictly guided its operator toward movements that produced the desired results.

⁸ David Pye, *The Nature and Art of Workmanship* (Cambridge: Cambridge University Press, 1968); rpt. (London: A&C Black Publishers, 1995), 20.

⁹ *Ibid.*

Facets of industrial manufacture providing impetus toward certainty are many. Economy, in this regard, is a significant and multivalent consideration in the structuring of work. Economy here refers to economy of time through increased speed and the economy of reduced materials wastage, since the technologies of certainty reduce the possibility of spoiled type pieces. This facet is significant in wood printing type manufacture, by pantograph router or by die-stamping machine. By the time end-grain, hard maple blanks reached the type shop, they had already gone through several preparatory stages. Workers had cut half-logs of hard maple into end-grain slabs, cured them for a year or more, finished one surface of each slab for printing, and planed each piece down to type height (.921 inches for wood type). Each of these operations was expensive of energy, material, effort, and time. As Pye points out, care and the exercise of judgment in manufacturing activities takes time. The elements of the die-stamping machine that structured work—the brass rack and carriage track, for example—reduced the number of factors the operator had to consider in operating the machine, thereby reducing the work’s complexity and therefore the time necessary to perform it. In 1887 *The Norwich Bulletin* celebrated this characteristic in a similar machine that the William Page company used for die stamping wood type letters in Connecticut. *The Inland Printer* reprinted the story, stating in part: “It is something wonderful to see this unpretentious machine throwing out letters as fast as the blocks can be fed to it by the operator.”¹⁰ In experimental operation of the die-stamping machine at the

¹⁰ “To Revolutionize Wood Type Making,” *The Inland Printer* 5, no. 1 (October, 1887), 562.

Hamilton museum, tactile dimensions of carriage movement demanded attention, but the brass racks and catch lever eliminated the carriage movement interval as a consideration. The machine turned out wood blanks as fast as its flywheels revolved. By reducing the number of considerations attendant to the work, the die-stamping machine made wood type border production into work fit for a less-expensive laborer. As Page and George Setchell wrote in their patent for an overlapping-die-stamp border production method, borders thus made were “not only far superior in beauty and in elaborateness of design to the ordinary cut and trimmed borders as now made, but they are also tenfold cheaper, inasmuch as they are stamped with great rapidity, wholly dispense with hand-trimming, and require no skilled labor.”¹¹

Tacit Knowledge in Industrial Work

Industrial skill is a form of tacit knowledge consisting in the worker’s understanding of the material dimensions of the work piece, the mechanical dimensions of machinery, and their interrelationship in the practice of manufacture. This is knowledge the worker *knows* and puts into practice, but cannot readily articulate verbally. As philosopher Michael Polanyi puts it, “we know more than we can tell.”¹² Polanyi related tacit knowledge directly to skill: “In the exercise of a skill, we are aware of its several muscular moves in terms of the performance to which our attention is directed.”¹³ Examples of tacit

¹¹ G.C. Setchell, 25 January 1881, “Method of Making Wood Borders,” U.S. Patent No. 237,054, filed 24 September 1878.

¹² Michael Polanyi, *The Tacit Dimension* (New York: Doubleday, 1966), 11.

¹³ *Ibid.*

knowledge abound within the various forms of work. To draw one example from letterpress printing practice, a hand typesetter must apprehend by feel whether two lines of type in the composing stick are the same length. The relative tightness of the lines' fit in the composing stick is the signifier, and must be perceived, tactilely, within a few thousandths of an inch. Failure to set the lines precisely results in a printing form that will not "lock up" properly in the chase; type may be loose in the form, resulting in poor printing, or the form may fall apart completely, creating a pile of "pi'ed" type that must be sorted.¹⁴ A master typesetter would have difficulty making an apprentice understand the feel of well-fit type lines without recourse to physical examples. J.R. Harris quotes at length from a French industrial inspector's observations about knowledge of practice among metallurgical workers in the Sheffield region of England. The inspector's remarks reflect on managers' estrangement from the actual work of production:

Such of the manufacturers who do show liberal intentions . . . are themselves rarely in a position to give enlightenment on the operations which they only direct for commercial profit and of which they leave the technical direction to simple workmen. These latter are truly the metallurgists of Yorkshire and it is among them that one can gather the elements of steelmaking. But there, as elsewhere, there is barely a common language between the workman and the savant; it is, for example, extremely difficult to determine in many cases what qualities a workman means when he says that an iron has "body," is "sound," "strong," "tough," etc.; all of these, however, are expressions which have a very precise

¹⁴ The chase is an iron frame in which the elements of a type form—type, cuts, ornaments, and the like—are held together by means of uniform pressure a device called a "quoin" exerts along the sides of the form. "Pi'ed type" is a printer's term describing jumbled, disordered type that must be sorted back into its proper compartments in a type case.

meaning and which distinguish properties which are perfectly clear to the workman handling the iron.¹⁵

Tacit knowledge in a mechanized, industrial setting emerges from the worker's relationship with machines as much or more than it does from the work piece. Because the machine is in an intermediary position between the worker and the work piece or raw material, part of the industrial worker's tacit knowledge is an understanding of the feedback from the machine, itself. An example from the later years of copper production in Michigan's Lake copper district illustrates this and involves aural, rather than tactile, perception. Bernie Schmitt worked on the ball mills in Calumet & Hecla's Tamarack reclamation plant in Houghton County, Michigan where mill tailings dredged from Torch Lake were reprocessed to recover copper values lost during earlier, less efficient milling operations. Ball mill operators had little direct interaction with the mills themselves, and in most cases one operator was responsible for several of the machines, his primary work being to regulate the flow of stamp sand slurry into the mills. At the Tamarack reclamation plant, Schmitt regulated the rate of stamp sand fed into the ball mills based on their sound:

A gate . . . would control the sand going into the ball mills . . . and you'd set the gate so that so much was going to each mill and that's how that was controlled. If you got too much, you'd close the gate off a little bit. You could tell . . . they were getting overloaded [because] the buzz would be a little softer, you know, and they wouldn't be grinding as good. You wanted to hear a rattling, you know.¹⁶

¹⁵ Quoted in J.R. Harris, "Skills, Coal, and British Industry in the Eighteenth Century," *History* 61, no. 202 (1976), 167-182. Gordon and Malone quote portions of this passage in *The Texture of Industry*, which is where the author first encountered it.

¹⁶ Bernie Schmitt, interview with author, Hubbell, Michigan, 14 November, 2014, Keweenaw National Historical Park Oral History Collection.

Schmitt would be hard-pressed to verbally characterize the rattle of a well-running Allis-Chalmers ball mill in a way that would allow an outsider to recognize the sound. Likewise, the muscular movements and sense of rhythm required for successful operation of the die-stamping machine are impossible to fully apprehend outside of a direct, tactile experience with the machine and its movements. And the apprentices learning to cut wood type on the pantograph machines at the Hamilton Wood Type & Printing Museum are able to make the necessary mechanical adjustments to vary the “heft”¹⁷ of a letterform they are cutting, but struggle to capture this process in words because their experience of the process is so rooted in the mechanical realities of the machine.¹⁸

Phenomenology in the Factory

Philosopher Don Ihde describes two forms of technological relations, *embodiment* relations and *hermeneutic* relations, which are useful in describing the way workers engaged with the machines used in the manufacture of wood type. In both types of relations, the worker’s interaction with the environment (work) is channeled through technology. The embodiment concept applies to dimensions of work in which the worker and the machine are bound together as a cohesive unit acting upon the work piece, while in hermeneutic relations, the strong linkage is between the machinery and the work piece—the worker “reads” changes being rendered upon the work piece through the machine and responds primarily to the machine, and thus the work is technologically

¹⁷ A term special to wood type cutting, “heft” is roughly equivalent to “stroke weight” in typographical parlance: the thickness of the lines in various parts of a letterform.

¹⁸ Personal conversation with type cutter and apprentice, 3 November 2014.

mediated.¹⁹ Specific technologies, specific machines, often implicate both of these types of relations in their operation. Such is the case with the pantograph routers and die-stamping machine used in the manufacture of wood type. With experience, several aspects of the machines' operations transition from hermeneutic relations requiring deliberate, conscious effort in "reading" the machines' mechanical movements, to embodiment relations in which certain of these movements become tacit knowledge for the operator. For example, a worker inexperienced at operating the die-stamping machine likely had to focus more attention on "reading" the machine's rhythm, from a variety of sensory feedback, than an experienced operator had to. For the experienced operator, this rhythm likely became practically second nature or, as Ihde would put it, "embodied."

Embodiment Relations

In embodiment relations, an individual's agency becomes "extended" through the technology into the material environment.²⁰ In type cutting, the pantograph machine mediates between the operator and the type piece. In manufacturing wood type border, the die-stamping machine is the intermediary. In both cases, the operator's body extends through the mechanics of the machine, and the machine "withdraws" from the user's experience. Ihde gives the example of eyeglasses, which fade from the wearer's consciousness so long as they are sufficiently transparent to transmit visual data clearly. The

¹⁹ Don Ihde, *Technology and the Lifeworld: From Garden to Earth* (Bloomington, Indiana: Indiana University Press, 1990), 72-97.

²⁰ *Ibid.*, 72-74.

eyeglass wearer goes about in the world as one with the eyeglasses, unconscious, for practical purposes, of their existence. Manufacturing machinery might seldom, if ever, withdraw to a comparable extent from the lived experience of its operators, so Ihde's example of parallel parking a car may be more readily consonant with cutting or stamping wood type:

One embodies the car . . . in such activities as parallel parking: when well embodied, one feels rather than sees the distance between car and curb—one's bodily sense is "extended" to the parameters of the driver-car "body" . . . the bodily tacit knowledge that is acquired is perceptual-bodily.

Ihde's parallel parking example is particularly well-suited to the purpose of discussing worker skill in wood type manufacture because it implies the driver-car embodiment is stronger for an experienced driver than for an inexperienced one. For the skilled driver, the car's materiality and mechanics recede from the forefront of experience.

In wood type manufacture, some aspects of machine operation recede in this way more readily than others. Experience in operating the pantograph machine brings with it less need to have certain tactile dimensions of machine operation at the forefront of consciousness. With experience in operating the pantograph machine the operator no longer needs to think actively about the speed with which she must move the router in order to avoid burning the type piece.²¹ So too, the feel of the tracer bit, kept in proper contact with the pattern, becomes less an object of conscious apprehension. In operating the die-

²¹ After burning the edges of a letter "S" with a pantograph router at the Hamilton Wood Type & Printing Museum, the author was very conscious of moving more quickly in cutting a letter 'A.' The A's edges still burned, however, and the unskilled workmanship could be smelled throughout the northern part of the museum.

stamping machine, the cadence of the machine's movement provides a rigid temporal framework for all of the operator's actions. Internalization of this rhythm was, in effect, an extension of the machine's rhythm into the body. Once this rhythm was embodied, the activities of die stamping—placing the wood blank, moving the carriage, removing the stamped blank—required less conscious effort to accomplish. This resonates with Marx, who wrote of industrialization's impact on work habits: "To work at a machine, the workman should be taught from childhood, in order that he may learn to adapt his own movements to the uniform and unceasing motion of an automaton."²²

Hermeneutic Relations

The second type of Idhe's technological relations, the hermeneutic, also relates to operation of both pantograph router and die-stamping machine. "Hermeneutics" generally refers to the reading of signs. As applied to technological relations, the term describes the process of "reading" a machine's mechanical actions, and apprehending the work the machine is doing, through sensory inputs. The die-stamping machine, for example, provides tactile, visual, and auditory feedback relating to various aspects of its operation. Idhe calls the hermeneutic relation "a special interpretive action within a technological context," and a "kind of activity [that] calls for special modes of active perception, modes analogous to the reading process."²³ Reading, in relation to the pantograph or die-stamping machine, consists of apprehending a suite of

²² Marx, *Capital*, 460.

²³ Idhe, *Technology and the Lifeworld*, 80.

sensory impressions related to the machine's materiality and its mechanics of motion, and attending to what they "say" about modifications being rendered upon the work piece. "Transparency" relates to hermeneutic relations, as well, referring to how accurately or completely feedback from the technology—a measuring instrument or a text, to again borrow Idhe's examples—represents the aspect of the environment to which that feedback refers. In manufacturing machinery, hermeneutic transparency most closely refers to the accuracy with which the apparatus links the operator's sensory perceptions and movements to the corresponding changes being rendered upon the work piece. The operator's primary engagement is with the machine, which conveys sensory information, with greater or lesser accuracy, about what is happening to the work piece. This perspective on technological relations sits comfortably alongside Marxian ideas about mechanization's effect of abstracting the work process. The more the machinery abstracts the work, the less transparent the hermeneutic relation it engenders. A fully automated manufacturing machine, such as a computer numerically controlled lathe, abstracts the work nearly to the point of total disembodiment, providing no immediate sensory feedback once the work piece has been locked in place.

What emerges from the analysis of wood type manufacture using Idhe's framework, described in more detail in chapters 5 and 6, is a picture of wood type manufacturing work, involving either the pantograph machine or the die-stamping machine, in which the operator experiences a fluidity between embodiment and hermeneutic relations with the machinery. These embodiment and hermeneutic relations comprised part of the cognitive environment of

industrial wood printing type manufacture. Hermeneutic relations with the die-stamping machine and the pantograph router provided the basis for the operators' spatial and temporal judgments about their movements: the direction and shape of movements for the pantograph operator, the rhythm and spatial increments of movements for the die-stamping machine operator. With acquired experience and skill in these operations, hermeneutic dimensions of the workers' experience receded from the forefront of consciousness, and work with the machines took on more of the character of embodiment relations.

Together, Marx, Pye, Polanyi, and Idhe provide a strong conceptual framework for exploring salient dimensions of workers' agency within the wood type manufacturing process. Marx's concept of social labor emphasizes both the sequential nature of factory production and the interrelationship/interdependence among the different workers engaged in the process. Pye's workmanships of risk and certainty provide a continuum for qualitatively describing workers' tool use based on the degree to which the tools predetermine the outcome of the work. Polanyi's "tacit dimension" isolates a type of knowledge deriving from sensorimotor engagement (This is what Martin Heidegger would call "pre-thematic" knowledge, as will be seen in Chapter 7). Finally, Idhe's concepts of hermeneutic and embodiment relations with technology help describe workers' direct experience with the machinery of production. These four categories of analysis guide subsequent chapters' inquiry into the nature of wood type manufacturing work.

3: Wood Type History

Printers of the late nineteenth and early twentieth centuries did their work primarily with letterpress printing technology. Their printing presses rendered text and images by physically impressing inked type forms onto paper. The technologies and work roles of past printing practices have been well and thoroughly documented elsewhere, but a description of certain aspects of this work here will provide helpful insight into the technological context wood printing type was used within. Primary among these aspects is the printing form itself. Printers assembled them from modular components. Metal and wood printing type, a variety of spacing materials, zinc or copper image plates called “cuts”—all of these were among the component pieces of a letterpress printing form.

The basic progression of work in letterpress printing went as follows. First, the printer set lines of type, letter by letter, in a composing stick (Fig. 3.1). He transferred the lines of type to the flat, smooth surface of a composing table, added additional lines of type, ornaments, cuts, and other components of the type form. He added spacing material to fill the open spaces within the type form, and to build it out into a rectangle. He then placed a cast-iron frame, called a chase, around the form. He filled in the space between the type form and the inside of the chase using larger pieces of spacing material called



Fig. 3.1: A Composing Stick

This photograph shows the author holding a nearly full composing stick. Note the precise arrangement of individual type pieces and lead spacing material. Photograph by author.

furniture,¹ leaving enough space at the top and right side for “quoins.” Available in a variety of different designs, quoins were devices that expanded in width with the turn of a key. At least two were required to put pressure on the printing form in two dimensions, and this pressure held the printing form together within the chase (Fig. 3.2). With the type form “locked up” in this way, the printer carried the form and chase together over to the printing press, fitted the chase in place on the press, and proceeded to print the edition. The platen

¹ Furniture pieces were made from cast iron, wood, and later aluminum. Hamilton, among other wood type manufacturers of the nineteenth century, manufactured wood furniture to supplement its income from wood type manufacture.

linotype machine cast molten lead from a gas-fired crucible elsewhere in the machine into lead type “slugs” that could replace full lines of type in a printing form. And so straight matter on the printed page remained the province of metal type.

Wood type forms for posters and other large-scale printed matter followed the same principles as metal type printing forms, the only differences being the letter sizes were larger and wood spacing material was usually used instead of metal. Wood was preferable to lead as a material for making large-scale type letters for a variety of reasons, prominent among them lead’s cost and weight. Another practical concern that discouraged use of lead in making large letters was its tendency to cool unevenly, causing concavities in the face the type. Such types inked unevenly and, as a consequence, printed poorly.²

Type Cutting by Hand, Type Cutting by Machine

During the first decades of the nineteenth century, wood type for printing posters and other large-scale printed matter was made by the “necessarily slow and tedious” method of hand cutting.³ Printers traced their letter designs onto a wood block, then turned the work over to hired carpenters who carved away the wood surrounding the letterform using hand tools.⁴ “The prices for this material were so excessive,” wrote the editors of the printing trade journal *The Inland Printer* in an 1891 retrospective article, “that the poster printing business was

² Theodore DeVinne, *The Practice of Typography: Plain Printing Types* (New York: Oswald, 1914), 345-346.

³ “The Manufacture of Wood Type,” *The Inland Printer* 8, no. 6 (March, 1891), 562.

⁴ DeVinne, *Plain Printing Types*, 347.

confined to a few large houses who had fortunes invested in wood type.”⁵ Darius Wells is credited with two important innovations in wood printing type manufacture. He introduced the first of these while he was still cutting type by hand at his print shop in New York City. Whereas previous wood type cutters had rendered their wood type letters in side-grain wood, Wells followed wood engravers’ practice and cut his letterforms into the wood’s end grain. This would become standard practice among nearly all industrial-scale wood type producers. More significantly, from the perspective of increasing wood type’s availability and lowering its cost, Wells made the first step in the mechanization of wood type production. This was his method:

To abridge the tedious labor of cutting away the counters and shoulders, Wells made use of a simple tool which he called the “router.” It was a flat-faced and half-round steel bit, made to rotate by steam power at high speed. The bit, suspended vertically over the wood to be cut, had attachments for raising or depressing it at will. The block of wood to be made into a type was firmly fastened under the router; then the operator, after applying the power, moved the cutter spindle until every part of the counter and shoulder was thoroughly removed.⁶

Wells developed his method in the late 1820s. William Leavenworth, of Allentown, New Jersey followed Wells and further evolved the process by attaching the router to a pantograph mechanism. This device allowed type cutters to trace letterforms from patterns, enabling them to produce wood type consistently from one piece to the next:

⁵ “The Manufacture of Wood Type” (March, 1891), 562. *The Inland Printer* ran a second article under the title “The Manufacture of Wood Type” in October, 1891, which is also cited in this thesis. When these articles are cited, the publication date is retained in parenthesis to differentiate the two articles.

⁶ DeVinne, *Plain Printing Types*, 347.

From one set of models attached to the pantograph an unskilled work man could cut on untraced wood various sizes from two-line pica upward, and every size would be a faithful reproduction of the model.⁷

This pantograph method of cutting wood printing type would carry on, unchanged in its basic form, as the predominant method throughout the rest of the history of industrial wood printing type manufacture, lasting into the late twentieth century.

A survey of some of the other early wood printing type manufacturers shows the industry initially concentrated in the eastern part of the country. In addition to Wells and Leavenworth, these manufacturers included Edwin Allen, who set up shop in South Windham, Connecticut, in 1836. He later built a water-powered plant just outside the same city, which he sold to John G. Cooley in 1852. Cooley made wood type at the Connecticut plant until 1893 when he moved the equipment to New York City and gradually shifted his focus from manufacturing wood type to manufacturing printer's equipment.⁸ William and Samuel Day, who built their works in Fredericksburg, Ohio, in 1845, are credited as the first wood type manufacturers west of the Alleghanies.⁹

One of Cooley's employees, William H. Page, started a career in wood type manufacturing in 1855 as a type finisher in Cooley's water-powered factory. He stayed in the Cooley concern just a little more than a year before striking out on

⁷ *Ibid*, 348.

⁸ Rob R. Kelly, *American Wood Type, 1828-1900: Notes on the Evolution of Decorated and Large Types and Comments on Related Trades of the Period* (New York: Van Nostrand Reinhold, 1969), 48.

⁹ Edward H. Hauenstein, "The Infancy of Wood Type West of the Alleghanies," *The Inland Printer* 64, no. 3 (1919), 297.

his own. With business partner James Bassett, Page purchased the equipment of Horatio and Jeremiah C. Bill, brothers whose wood type factory in Willimantic, Connecticut, had failed in 1854. Page moved the equipment to Greeneville, Connecticut, outside of Norwich, where he put it to more successful use. With the financial support of a new business partner, axle manufacturer Samuel Mowry, Page built a factory alongside the Shetucket River. There he employed as many as 50 workers in the production of wood type. By the end of the 1870s, William H. Page & Company had become the country's largest producer of wood type.¹⁰

William H. Page & Company's significance within this narrative derives mostly from its success in becoming the largest wood type manufacturer in the United States. But Page and his employee George Case Setchell also contributed several innovations to wood type manufacturing technology. Some of these relate to the die stamping of wood type, which is the subject of this thesis's experimental archaeology component. By 1887, Setchell and Page had patented a process for die stamping small wood type letters that eliminated the need for pantograph routing, reducing the worker's role to feeding wood stock into a stamping machine. *The Inland Printer* heralded the development under the headline "To Revolutionize Wood Type Making," reproducing a description from the Norwich, Connecticut *Morning Bulletin*:

This machine was in operation yesterday, cutting and throwing out letters at a rate of thirty a minute, which is about half its speed. The letters are stamped upon the wood with dies, and are done more perfectly than the letter can be done by hand. By this machine letters as small as two-line pica may be made at the rate

¹⁰ Kelly, *American Wood Type*, 43-44.

of ten or twelve thousand an hour, and sold for one-half the present price, and large letters turned out at the rate of three thousand an hour.¹¹

Page and Setchell patented various other processes implementing die stamping in the manufacture of wood type. Setchell's description for U.S. Patent No. 889,112, granted September 4, 1888, gives a description of the conventional method for cutting type:

Wood types have been most commonly produced heretofore by means of so-called "pantograph-machines" having swiftly-revolving cutters, which shape the type by cutting away the surplus stock to a considerable depth below the printing surface, while a corresponding traveler moves within or around a form or pattern and controls the movement of said cutter, producing a perfect facsimile of said pattern, or an enlarged or reduced counterpart, as desired. Such a method would be eminently satisfactory were it not for the many acute angles required to be made in most forms of type, and which must be trimmed out by hand, for the simple reason that it is impracticable to use a machine-cutter small enough to perform such work.¹²

In developing one of his die-stamping methods, Setchell sought to eliminate the hand trimming step in the wood type production process. "The object of this invention is to produce wood type in a cheaper and quicker manner than heretofore, preserving at the same time the sharpness of outline obtainable in machine cut type."¹³ His solution was to use the stamping machine to impress only the sharp points and tight corners of the letterform into the end-grain block, and remove the rest of the material surrounding the letterform with a pantograph router. His patent described various measures

¹¹ "To Revolutionize Wood Type Making," *The Inland Printer* 5, no. 1 (1887), 58.

¹² George C. Setchell, 4 September 1888, "Method of Making Wood Type," U.S. Patent 389,112, filed 19 March 1887.

¹³ *Ibid.*

that were necessary to precisely register the pantograph with the die-stamped type piece. It is not known how fully Page & Company implemented this method in its type factory, if it used it at all. But the patent is representative of wood type manufacturers' efforts to remove skilled labor from the type manufacturing process in order to reduce the cost of production.

By Kelly's account, the efficiency of the die-stamping method of making wood type letters hampered its potential for economic success. While the machine for die cutting wood type produced small type pieces of higher quality than the Hamilton Manufacturing Company's "holly wood" type at comparable prices, it produced them at a rate that outstripped demand. This was part of a larger reality Kelly describes that caused wood type manufacture to remain a small-scale industry in the United States: there was limited demand for wood type among the nation's printers. "Even with the older machine processes," Kelly writes, "it was possible for all wood type manufacturers to overproduce. With the speed and ease of the stamping process, Page could not sell as quickly as he could manufacture."¹⁴ As will be seen in the History of the Hamilton Manufacturing Company, diversification of product lines accounted for much of the longevity of the longer-lived wood type manufacturing concerns.

Wood Type on the "Frontier"

James Edward Hamilton was born 19 May 1852 in Two Rivers, Wisconsin. The son of a local businessman, he lived the early years of his life in Wisconsin before his family moved Lockport, New York, where he attended high

¹⁴ Kelly, *American Wood Type*, 56.

school for two years and worked a variety of part-time jobs. When his family moved back to Two Rivers in 1868, Hamilton began working in a string of industrial jobs, gaining knowledge that probably contributed, in various ways, to his later success as a manufacturer of wood printing type. Hamilton worked as a “tender of a clothespin lathe” for four years, tended steam boilers in his uncle’s brickmaking factory, dabbled on his own in furniture making, worked as a pile driving engineer on the Sturgeon Bay Canal, worked as a pieceworker in a chair factory back in Two Rivers, and mined for gold in the Black Hills of South Dakota. By 1877, he had returned to Two Rivers and the chair factory.¹⁵ At the chair factory, Hamilton built a local reputation as a highly skilled woodworker. This occasioned his meeting in 1880 with a local newspaper publisher in need of wood printing type. Lyman Nash, publisher of the *Two Rivers Chronicle*, needed to print “Grand Ball” in big letters on a poster for an upcoming town dance, and hadn’t time to order wood type in from the east coast. Hamilton’s reputation as a skilled woodworker prompted Nash to ask him to try to put something together in the way of wood printing type. Hamilton cut the letters spelling “Grand Ball” out of a sheet of holly wood veneer, essentially creating a stencil of the words which he glued to a block of softer wood to make the piece close to type high. “The finished work was a single piece, with that letters reversed (incised into the surface) so as to print white letters on a black background.”¹⁶ This was the first wood type produced by what Hamilton came to call the Holly Wood Type method. Holly wood seems an

¹⁵ *Ibid.*, 47-48.

¹⁶ *Ibid.*, 38-39.

odd choice for this application: while its fine grain is conducive to creating a smooth printing surface, it also has low dimensional stability and is typically full of knots and imperfections.¹⁷

Hamilton's early effort printed well enough on Nash's press that the newspaper proprietor ordered several full sets of wood type letters from Hamilton. Hamilton sent samples to his brothers George and Henry, who had recently purchased a newspaper in Detroit Lakes, Minnesota. They, too, were pleased with the way the holly wood type printed, and encouraged Hamilton to send samples to other printers around the upper Midwest. This Hamilton did, and when orders came in he filled them with type he manufactured using a foot-powered scroll saw set up in a back room of his mother's house in Two Rivers.¹⁸

Holly wood type was less expensive, though also less durable, than the end-grain wood type the east coast manufacturers had on offer. *The Inland Printer's* editors characterized the product this way: "While not so good an article as the old style of end wood type, it made a cheap article and enabled printers of moderate means to compete for the trade of poster printing."¹⁹ A Hamilton & Baker advertisement from 1886 gave price comparisons between Hamilton's holly wood type and unspecified competitors' end wood type. "Printers can compare our prices with other manufacturers and see for

¹⁷ U.K. Department of Environment, *Handbook of Hardwoods*, 2nd, ed. (London: Her Majesty's Stationary Office, 1972), 87-88.

¹⁸ Bill Moran et al., *Hamilton Wood Type: A History in Headlines* (St. Paul, Minn.: Blinc, 2004), 11.

¹⁹ "The Manufacture of Wood Type," (March, 1891), 562.

themselves,” read the ad copy, “whether we are stating *facts* or not.”²⁰ The accompanying table shows an ornate, 18-line (three-inch) typeface, made by the holly wood method, priced at 7 cents per letter, in comparison to 18 cents for a comparable letter manufactured with end wood. A gothic letter of the same size in holly wood sold for 6 cents versus 14 cents.²¹ The holly wood type caught on among the printers of the Midwest, who at that time were isolated from the centers of printing goods manufacture. The *Inland Printer* saw Hamilton’s “frontier” location, and attendant relative isolation, as a formative influence on the company’s production process, and the holly wood innovation as a product of Hamilton’s lack of foreknowledge of established methods of wood type manufacture: “Entering the field unaided and alone in the West . . . [he] proceeded to unravel the problems of the manufacture of wood type and wood goods, gathering . . . experience by hard knocks, and always triumphing in the end.”²²

Toward the end of the 1880s, Hamilton took on a partner, selling half the company to Milwaukee businessman Max Katz. The company’s name changed from J.E. Hamilton Holly Wood Type Company to Hamilton & Katz, and Hamilton set up his first proper factory in Two Rivers, a “small, barn-like” building costing \$1,600.²³ This two-story, wood-framed building is shown on the Sanborn fire insurance map for 1885 (Fig. 3.3), located on the south side of Main Street (now 16th Street), directly across from R.E. Mueller’s brewery. The

²⁰ *The Inland Printer* 4, no. 3 (1886), 215, emphasis in original.

²¹ *Ibid.*

²² *Ibid.*, 563.

²³ Kelly, *American Wood Type*, 48.

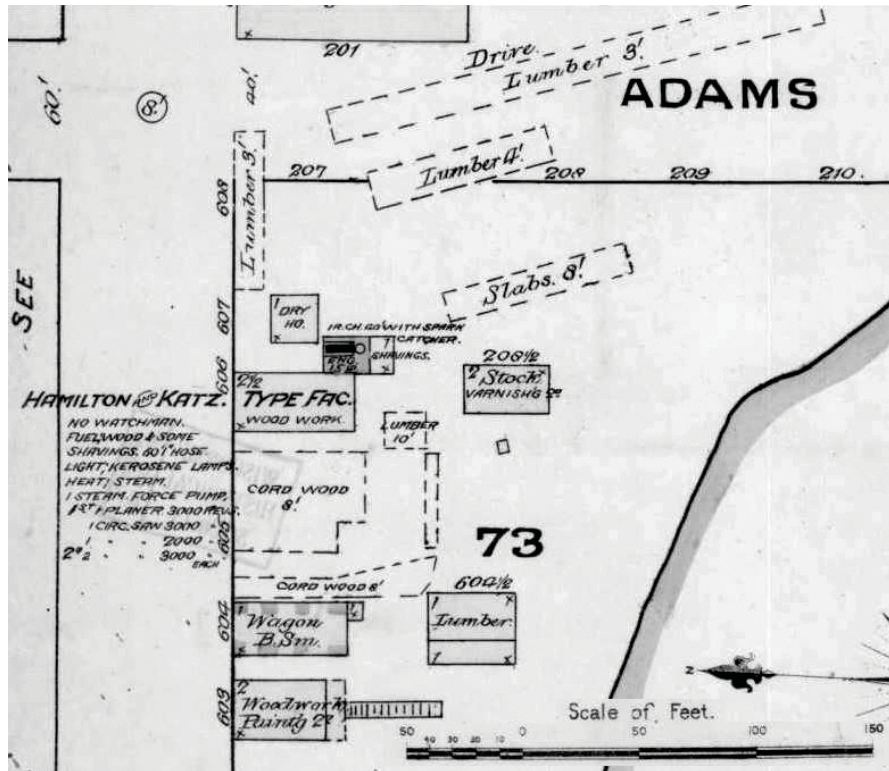


Fig. 3.3: Hamilton & Katz Works, 1885

A portion of the 1885 Two Rivers Sanborn fire insurance map showing Hamilton & Katz type factory on the south side of Two Rivers, Wisconsin. North is to the left. (Wisconsin Historical Society, WHS-TwoRivers1885-2. The scale shown has been reproduced from elsewhere on the sheet, at the appropriate size.)

brewery, a tannery, and the Two Rivers Manufacturing Company—likely the chair factory where James Hamilton worked before venturing into wood type manufacture—were the only industries in Two Rivers besides the Hamilton & Katz factory depicted on the Sanborn map. The type factory’s equipment included one planer and three circular saws, all belt driven. Power came from a 15-horsepower steam engine located in a brick boiler house attached to the factory’s southeast corner. The engine’s boiler had a 60-foot-tall iron chimney. Other structures on the site included a smaller wood drying shed just east of

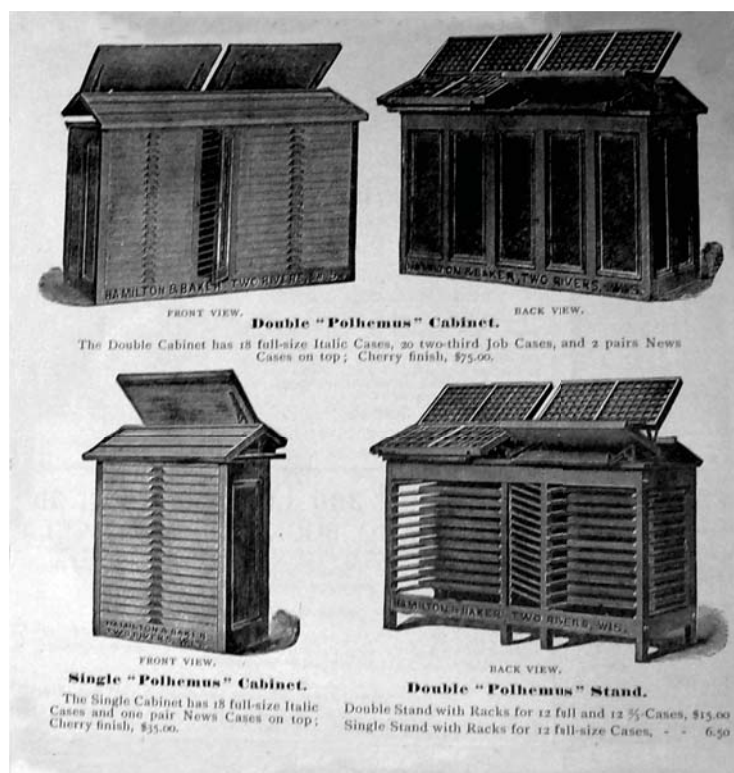


Fig. 3.4: The Polhemus Cabinet

An immediate success for the Hamilton & Baker Company, the Polhemus cabinet featured a combination of storage space for storing type cases, and inclined work surfaces for type setting out of them. (*The Inland Printer*, May 1899)

the factory, and a varnishing shed to the south. There was cordwood stacked to the west of the factory, and lumber stacked in a vacant lot to the east.²⁴

Katz sold his half of the company in 1895. In 1887, what had become the Hamilton & Baker Company bought a larger building that had formerly housed a wooden sash factory and began manufacturing printers' equipment in addition to wood type.²⁵ This included type cases, cabinets, and other print

²⁴ Two Rivers, Wisconsin [map], 1885, New York: Sanborn Map & Publishing Company, sheet 1.

²⁵ "Hamilton's Holly Wood Type," *The Two Rivers Chronicle* (September 13, 1887), 3.

shop furnishings. Hamilton immediately shifted its marketing emphasis to these new products. In an 1887 advertisement, wood type is advertised, in capital letters, at the top of the page, but most of the ad space is dedicated to a set of cuts depicting Hamilton's "Polhemus cabinet."²⁶ Combining inclined work surfaces above with type storage cases below, the Polhemus cabinet (Fig. 3.4) became a mainstay of Hamilton's product line. The source of the cabinet's name is not clear. A John Polhemus of New York City patented a style of printer's quoin in 1884, and may have had a hand in Hamilton's printer's cabinets as well.²⁷ Variants of the cabinet are not hard to find in book arts studios around the country today, as well as in those few commercial print shops that have retained their letterpress printing equipment. In April 1889, Hamilton was advertising type cut on end wood in addition to its holly wood type.²⁸ That year also saw the company's name change from Hamilton & Baker to the Hamilton Manufacturing Company, and the printer's equipment venture was getting on so well the renamed company quickly outgrew the sash factory building.²⁹ By the end of 1891, Hamilton built a completely new works, stretching a full block along both sides of East River Street and fronting the East Twin River.³⁰

Earlier in 1891, the Hamilton Manufacturing Company bought out its largest eastern competitor, William Page & Company. This was apparently not a hostile takeover, as Page had written Baker four years earlier offering his

²⁶ *The Inland Printer* 6, no. 8 (May, 1889), 676.

²⁷ John Polhemus, 26 April 1883, "Printer's Quoin," U.S. Patent 296056, Filed 1 April 1884.

²⁸ *The Inland Printer* 6, no. 7 (April, 1889), 619.

²⁹ "The Hamilton Manufacturing Company," *The Inland Printer* 6, no. 6 (February, 1889), 455.

³⁰ "The Manufacture of Wood Type," (March, 1891), 563.

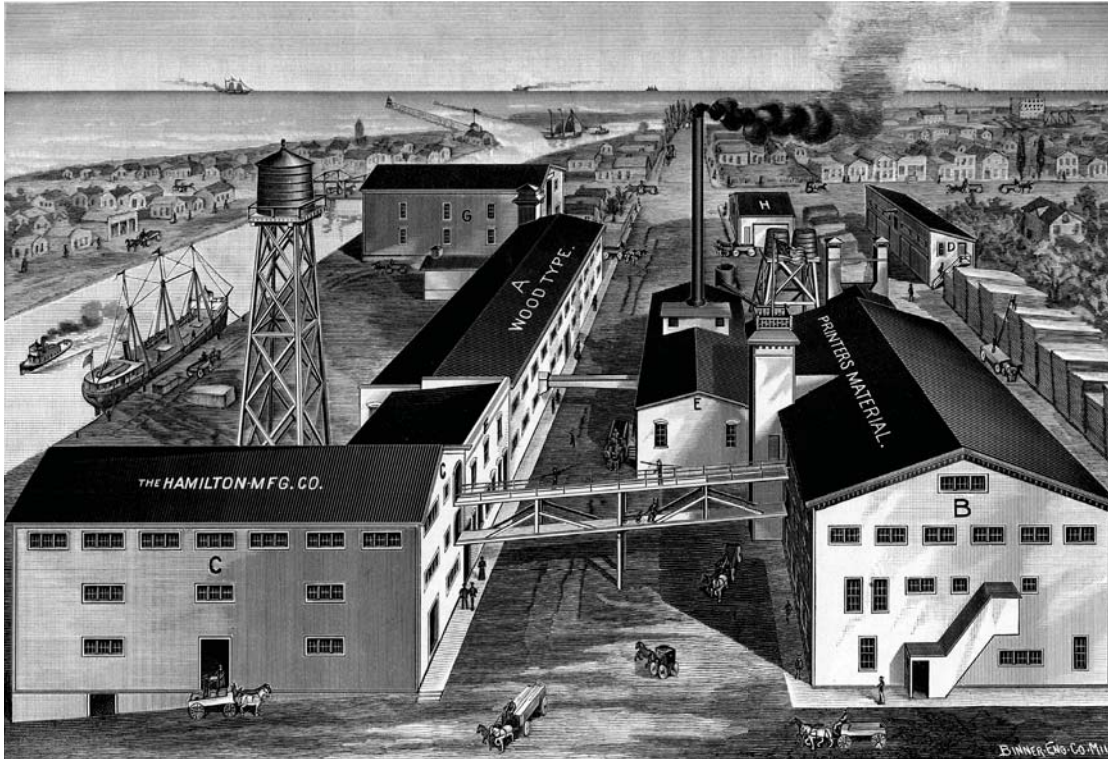


Fig. 3.5: Hamilton Manufacturing Company Works, 1891

This plate from an 1891 *Inland Printer* trade journal shows the Hamilton Manufacturing Company's works on the west bank of the East Twin River in Two Rivers (view is to the south). Its labeling is as follows: (A) Type Factory, (B) Case Factory, (C) Warehouse, (D) Wood Storage, (E) Boiler House, (F) Offices and Pattern Storage, (G) Wood Storage, (H) Carriage House. (*The Inland Printer*, November 1891)

company—"the largest . . . of any in the world of this kind of trade"—for sale.³¹ But Page was interested in pursuing business opportunities connected with patents he held for steam heating devices. And further, Page wrote, "the Wood Type business should go West as $\frac{3}{4}$ of all the trade now is West." Hamilton's

³¹ W.H. Page to W.B. Baker, 25 January, 1887. The text is quoted as David Shields reproduced it, from the handwritten original, in "The Wood Type business should go West . . . ' An 1887 letter from William H. Page to W.B. Baker," <<http://www.woodtyperesearch.com/the-wood-type-business-should-go-west...-a-letter-from-william-h-page-to-hamilton-baker/>>, accessed 24 February 2015.

new works, once constructed, would be large enough to hold both companies' machinery. But for a time, Hamilton continued to operate Page's plant in Norwich, Connecticut, in addition to its own in Two Rivers. The company had opened a branch house, with a retail office and warehouse, at 259 Dearborn Street in Chicago, "situated between the two great printing districts of the city," and would soon open a branch office in New York. With the Page purchase complete, the Hamilton Manufacturing Company rightly proclaimed itself the largest manufacturer of wood printing type in the world.³²

A printing plate reproduced in *The Inland Printer* (Fig. 3.5) shows the Two Rivers works as built in 1891 and gives details about the plants' equipment. The works' powerhouse, for example, contained a 200 horsepower Corliss steam engine.³³ This brick building, with its two horizontal steam boilers and 70-foot iron smokestack, was built almost entirely on the East River Street right of way. An elevated enclosure connected the powerhouse to the wood type factory. Through it ran the drive shafts to power the factory's equipment. The Sanborn map for 1891 (Figures 3.6 and 3.7) inventoried the plant's equipment as follows: two end wood planers, two glue pots, one facer, two sanders, one band saw, nine "little saws," and two "stamping type [*sic*]" on the first floor; 17 presses, eight type machines, nine saws, and one punch machine on the second

³² Hamilton Manufacturing Company advertisement, *The Inland Printer* 6, no. 12 (1889), 1040.

³³ This is the steam engine horsepower rating given in the description accompanying an illustration plate in "The Manufacture of Wood Type," *The Inland Printer* 9, no. 2 (October, 1891), 180. Sanborn maps rate the steam engine's horsepower at 150, and a separate *Inland Printer* account gives a rating of 250 horsepower.

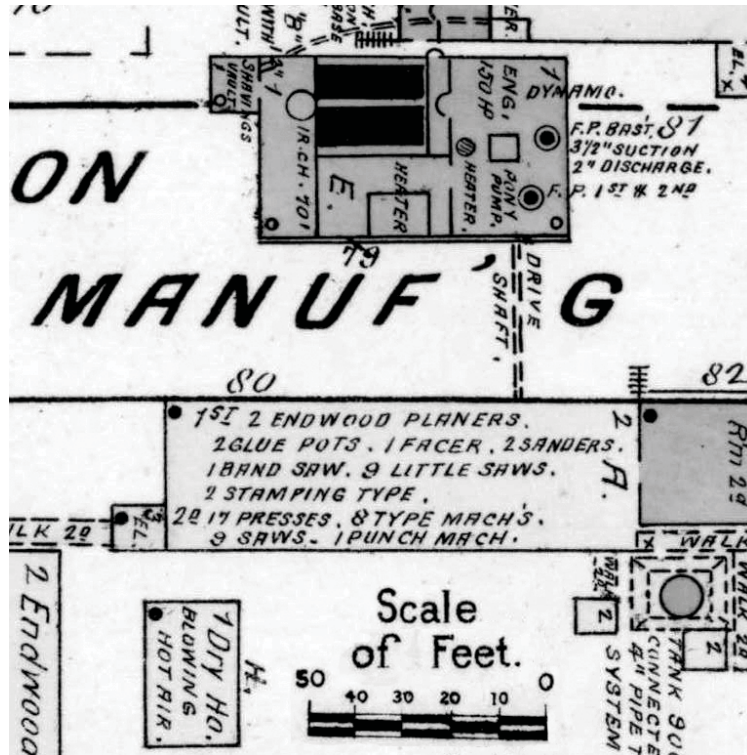


Fig. 3.7: Detail of 1891 Map

This detail from the 1891 Two Rivers Sanborn fire insurance map shows an inventory of the machinery in the Hamilton type. North is to the right in this figure. (Wisconsin Historical Society, WHS-TwoRivers-1891-5. The scale shown has been reproduced from elsewhere on the sheet, at the appropriate size.)

trays, job sticks, quoins, and other articles of printers' equipment were manufactured in this type factory building.³⁵

Adjoining the type factory on its north side was a two-story structure housing offices and pattern storage on its second floor. A door connected the pattern storage room with the type cutting room, granting type cutters easy access to the patterns for their pantograph machines. At the works' northeast corner, adjoining the office and pattern storage building but on its north side,

³⁵ "The Manufacture of Wood Type" (October, 1891), 180.

was a three-story building comprising a packing room, varnishing and finishing room, and warehouse. This warehouse held the output of the works' largest manufacturing building, a three-story, wood framed structure on the west side of East River Street that was "devoted entirely to the manufacture of printers' cases, cabinets, stands, and in short all articles of furniture used in a printing office."³⁶ Buildings for wood storage and preparation, as well as a horse stable, occupied the southern portion of the works. The view of the works reproduced in *The Inland Printer* shows lumber stacked in the open air along the property's western border, and a three-masted steamer vessel moored at the riverbank. This would remain the site of the Hamilton Manufacturing Company for the rest of its existence.

Diversification & Hamilton's Later Years

In the decades following the new works' construction, printer's cabinetry came to account for fully two thirds of Hamilton's business. During the 1890s, the company dispensed completely with the production of holly wood type, a move possibly influenced by Hamilton's acquisition of Page's end wood type cutting equipment.³⁷ By 1900, through its acquisitions of other wood type manufacturers and competitors' failures, Hamilton had a near monopoly on wood type production in the United States.³⁸

A Hamilton advertisement from 1894 presaged the company's expansion into the manufacture of products for use outside of print shops. The ad touts

³⁶ *Ibid.*

³⁷ Moran, *A History in Headlines*, 23.

³⁸ *Ibid.*, 19.

end-grain wood cutting boards for home kitchens with “The Hamilton Mfg. Co.” emblazoned on their front edges.³⁹ By the early decades of the twentieth century, the company was undergoing aggressive diversification. Drafting room tables and equipment followed dental office furniture. The company built cabinets for radio consoles and manufactured cribs and other furnishings for the household market. Around the same time, the company began manufacturing printers’ cabinets out of steel. It would later apply its steel fabrication expertise to the manufacture of goods for doctors’ offices and scientific laboratories. The company even put its steel fabrication capacity to work in the manufacture of the country’s first household automatic laundry dryer.⁴⁰

Throughout these decades of diversification, the Hamilton works on the East Twin River grew and grew. By 1904, the company had built another large woodworking plant, in a three-and-one-half-story brick building that ran along the east side of Two Rivers’s Jefferson Street for a full city block (Fig. 3.8). Three steam boilers and a 600-horsepower steam engine powered this “new works,” which also included new lumber sheds and dry kilns. By 1904 the “old works” had a new, 300-horsepower steam engine and the printers’ equipment plant had nearly doubled in size.⁴¹ By 1913, there was a new brick office building in the midst of the new works and Hamilton had built an extensive new complex of brick factory buildings, housing steel fabricating plants, on the south side of

³⁹ Hamilton Manufacturing Company advertisement. *Inland Printer* 12, no. 5 (1894), 434.

⁴⁰ Moran, *A History in Headlines*, 20.

⁴¹ Two Rivers, Wisconsin [map]. 1904. New York: Sanborn Map & Publishing Company, sheet 2.

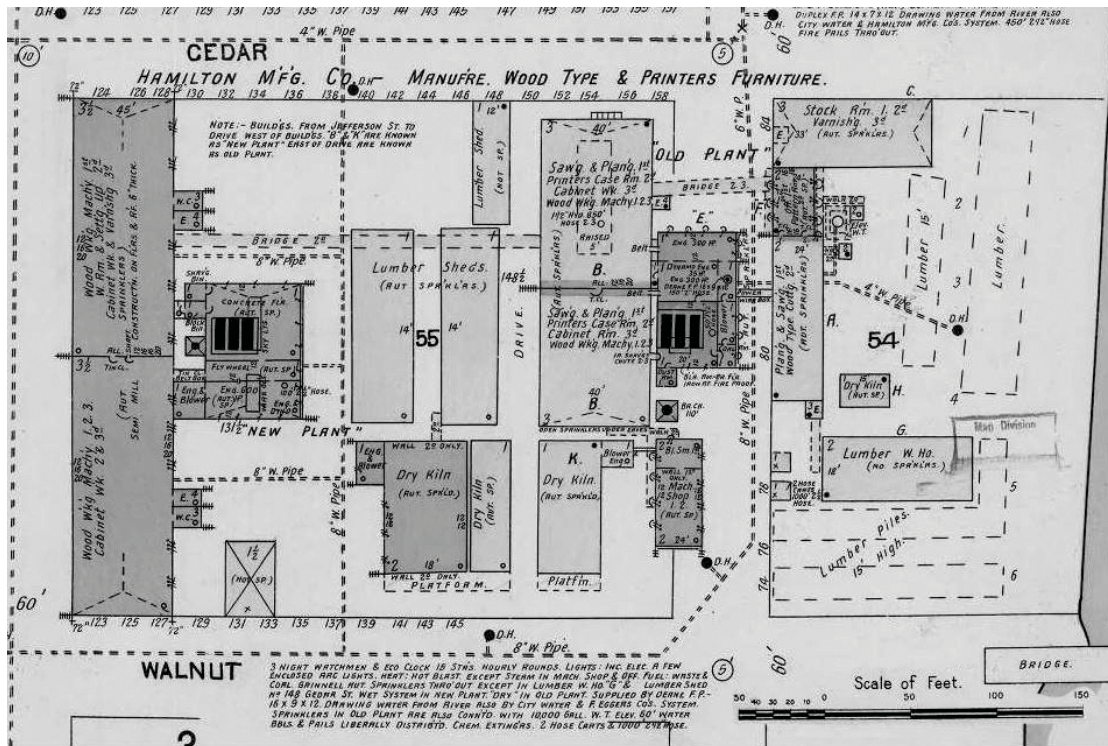


Fig.: 3.8: The Hamilton Works Expands

This detail from the 1904 Two Rivers Sanborn fire insurance map shows an expanded Hamilton works, reflected most significantly in a pair of brick buildings along Jefferson Street, on the left-hand side of this figure. (Wisconsin Historical Society, WHS-TwoRivers-1904-2. The scale shown has been reproduced from elsewhere on the sheet, at the appropriate size.)

Walnut Street. Elevated walkways connected many of the structures in the Hamilton works (Fig. 3.9).⁴²

Between 1922 and 1929, Hamilton tore down the type factory on East River Street, replacing it with a large drying shed, and moved the type cutting operations elsewhere in the works. During this time, the company erected its iconic, tile-clad smokestack, with “Hamilton Mfg. Co.” rendered upon it in white

⁴² Two Rivers, Wisconsin [map]. 1913. New York: Sanborn Map & Publishing Company, sheets 5 and 8.

against the red-brown stack.⁴³ The stack has been the focal point of Two Rivers' skyline since that time. Sanborn maps from 1929 and later do not label the type cutting plant. During the 1960s, and through to 1985 when Hamilton stopped manufacturing wood type,⁴⁴ the type shop was located on the second floor of the large brick building on Jefferson Street.⁴⁵ During this late period of wood printing type manufacture, Hamilton's primary wood type trade was no longer with printing shops. Rather, the company manufactured wood type for use on "showcard" presses, simplified presses marketed to retail establishments for making in-store display signs. *Popular Mechanics* magazine described the showcard press this way shortly after the press came on the market in 1932:

Showcard printing by hand can now be done speedily and economically by a new press now on the market. The equipment, which has been adopted by many business houses, can be operated by a person without previous knowledge of printing. Several fonts of showcard type come with the press.⁴⁶

This type was manufactured by the same process, and to the same specifications, as regular wood type, but with lateral grooves sawn into the back of the type to engage with rails on the showcard press's type bed. When Jim Kerns bought Hamilton's wood type manufacturing equipment, moved it across town, and started a company called HWT in 1985, he did so to ensure a type

⁴³ Two Rivers, Wisconsin [map], 1929, New York: Sanborn Map & Publishing Company, sheet 7.

⁴⁴ Moran, *A History in Headlines*, 35.

⁴⁵ Oral history interview with Hamilton Manufacturing Company type cutter, 19 February 2015.

⁴⁶ "Showcards Printed by Hand on Fast, Simple Press," *Popular Mechanics* (February, 1932), 188.

supply for his company in Chicago that manufactured showcard presses.⁴⁷ J.C. Penney was a major showcard customer, buying lots of sans-serif type during Hamilton's later years of wood type manufacture.⁴⁸

James E. Hamilton retired in 1919 and died 7 May 1940 in Two Rivers.⁴⁹ Throughout the second half of the twentieth century, the company he started found itself on the other side of corporate consolidation, as a succession of medical and scientific equipment companies became its parents. Hamilton Manufacturing Company became American Hamilton, a division of the American Hospital Supply Corporation, in 1968. Charles L. Barancik bought the company in 1982 and owned it until 1993 when Fisher Scientific International bought the company from him.⁵⁰ As late as 2002, Fisher Hamilton LLC still employed about 1,200 people in Two Rivers.⁵¹ Many of these jobs were lost to Reynosa, Mexico, after Fisher Hamilton opened a plant there in 2005. By the time Hamilton's parent company, having undergone yet another corporate permutation to become Thermo-Fisher Scientific, shuttered the last Hamilton production facility in Two Rivers in 2012, the workforce had dwindled to 200,

⁴⁷ Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

⁴⁸ Oral history interview with Hamilton Manufacturing Company type cutter, 6 November 2014.

⁴⁹ Moran, *A History in Headlines*, 20; Kelly, *American Wood Type*, 41.

⁵⁰ "Company History > Hamilton Scientific LLC," Hamilton Scientific, <www.hamiltonscientific.com/about-us/company-history/>, captured 17 August 2014, Internet Archive, <<https://web.archive.org/web/20140817145535/http://www.hamiltonscientific.com/about-us/company-history/>>, accessed 5 May 2015.

⁵¹ Barrett, Rick. "Thermo Fisher to close Two Rivers plant, 200 jobs lost." *The Milwaukee Journal-Sentinel*, 14 December, 2011, <<http://www.jsonline.com/business/thermo-fisher-to-close-two-rivers-plant-cut-120-jobs-iu3eqa4-135618743.html>>, accessed 26 February 2015.

with 120 of these workers engaged in production of wooden laboratory tables.⁵²
By late summer of 2014, the Hamilton Manufacturing Company works was under active demolition. Dynamite toppled the smokestack 31 May 2015.

⁵² *Ibid.*

4: Type, Wood, and Machinery

Chapter 3 provided a history of wood printing type manufacturing in the United States, focused on the Hamilton Manufacturing Company. The chapter also gave a brief description of the technological environment in print shops of the late nineteenth and early twentieth centuries, which constituted the primary use context for wood printing type. This chapter begins in the same vein, focusing on the specific properties letterpress printing technology demanded of wood type. This chapter describes the manufacturing process that created wood type to meet these technological demands, one salient demand being precise dimensionality. Wood preparation operations described in this chapter had particular bearing on the type pieces' "type-high" dimension. Physical descriptions of two machines that were central to the wood type production process—the pantograph-mounted router used to make wood type letters, and the die-stamping machine used to make decorative wood type borders—then provide background for the in-depth descriptions of type makers' work experience that follow in chapters 5 and 6.

Letterpress Printing Technology and Wood Type

The dominant printing technology of the late nineteenth and early twentieth centuries demanded certain properties of printing type, and the machinery and work processes of wood type production at Hamilton Manufacturing were designed and executed to produce type that had these properties. The most common letterpress printing presses of the late



Fig. 4.1: The Platen Press

A Chandler & Price platen press or “jobber.” Photograph by author.

nineteenth and early twentieth centuries were platen presses and flat bed cylinder presses. The most common types of platen presses were known in the trade as “jobbing presses” or “jobbers” (Fig. 4.1), as their primary use was printing small jobs such as handbills and flyers. On a platen press, a vertical chase bed holds the type form, “locked up” in an iron chase frame. The press operator feeds the printing stock onto the platen, a moving platform that brings the paper into contact with the inked type form, making an impression. Ink rollers passed over the type form, refreshing the ink, with each revolution of the press. In a cylinder press, the printer sets up the type form on a horizontal bed. The printing stock wraps around a cylinder, which presses the stock against

the type form as it rolls over the flat bed. This type of press was well suited for printing posters and other large-scale matter: the type of printing jobs for which wood type was most often used.

On a properly adjusted platen press, the platen surface becomes perfectly parallel with the chase bed at the time of impression, and a properly adjusted cylinder press unrolls the stock on a plane perfectly parallel with the type bed. Thus, in order for a type form to print evenly, all of the form's components must be the same height. "Type high" was the standard dimension from the type's foot to its face and for metal type was 0.918 inches (See Fig. 4.2).¹ Type foundries cast hand-set type at that height. Slugs from Linotype machines and other "hot types" were also made type high. In printing practice, consistent ink density across the type form and even impression onto the paper depended on consistently type-high type.

The imperative to maintain the type-high dimension had implications for the way material was used in wood type manufacture. Though James Hamilton made his mark in the world of wood type using his holly type manufacturing method, by 1890 Hamilton had changed over to the more widely used method of cutting letterforms into end-grain wood—hard maple in Hamilton's case—using pantograph-mounted routers. Using maple in this end-grain orientation

¹ According to DeVinne, there were slight variations in American type heights in the eighteenth century, and greater differences in height between American and various European types. "English and American foundry came to a practical agreement at the beginning of this (the nineteenth) century that the standard of height should be eleven-twelfths of an English inch," DeVinne wrote, but does not give the difference between an English and an American inch. Eleven-twelfths of a modern American inch is slightly less than 0.918 inches. Theodore DeVinne, *The Practice of Typography: Plain Printing Types* (New York: Oswald, 1914), 131.

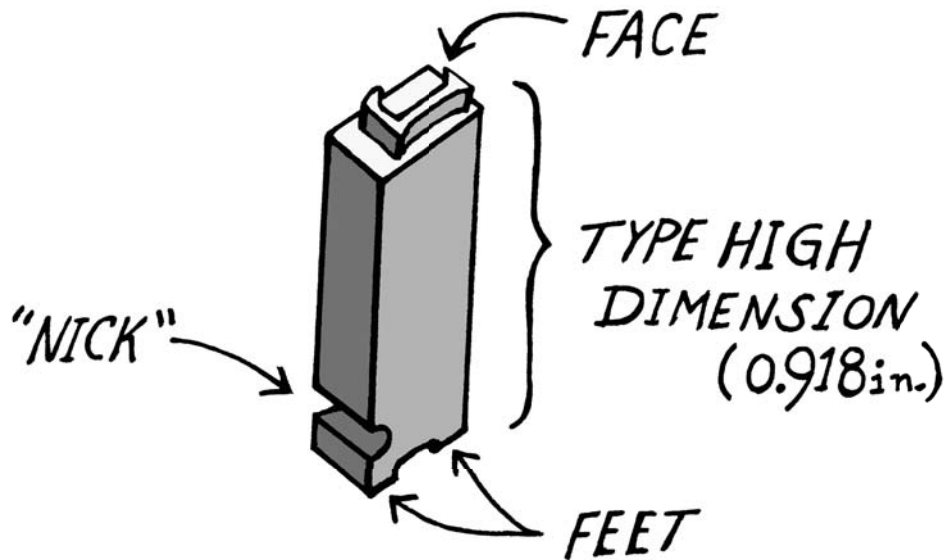


Fig. 4.2: “Type-High”

This drawing illustrates the type-high dimension of a piece of lead printing type. It is not to scale. Drawing by author.

made best use of wood’s structural properties for the purposes of letterpress printing. Wood is best able to withstand compression forces that are parallel to its grain, so manufacturing type using end-grain wood resulted in more durable type better able to withstand the printing press’s impression force. By cutting letterforms into end grain, wood type manufacturers also prioritized the stability of its type-high dimension, as “longitudinal shrinkage of wood (shrinkage parallel to the grain) is generally quite small.”² In locking up wood type forms, printers could compensate for fluctuations in the type’s other dimensions using one or more of the several types of spacing material that were part of the standard equipment in any printing shop.

² USDA Forest Service, *Wood Handbook: Wood as an Engineering Material* (Madison, Wis.: Forest Products Society, 1999), 3-8, 4-10.

Type-High Wood

The importance of wood type's type-high dimension is evident in the multi-step, labor-intensive process workers at Hamilton went through to make half-logs of hard maple into pieces of type-high, end-grain wood. So, too, the importance of dimensional stability for wood type is seen in the curing process wood underwent prior to being planed type-high and finished for printing. By drying the wood for a year or more before processing it further, Hamilton ensured its finished type would maintain close to the same dimensions throughout its use life.

In the early 1990s, when Hamilton's type shop floor leader went to work for HWT, the company that continued making wood type in Two Rivers after purchasing Hamilton's idled machinery, he was charged with recreating the wood curing process based on his general knowledge from working in Hamilton's type shop. He ordered the hard maple in the winter, when the sap was down. The wood arrived as logs cut in half lengthwise with the bark still on. These half logs sat for a few months before any work was done to them. In the spring—"the latest would probably be middle of April, maybe first of May"³—it was time to slice the wood into half-rounds. The saw for doing this work had a blade approximately three feet in diameter (Fig. 4.3). The half-logs of maple rode on a carriage that ran on two parallel tracks made of heavy angle iron, welded in place with the angle side facing upward to form a track with a

³ Oral history interview with Hamilton Manufacturing Company type shop floor leader, 9 January, 2015. This narrator worked in the type shop from 1964 to 1991, during which time he performed most of the jobs that were part of the wood type production process.



Fig. 4.3: Circular Saw

This saw, on display at the Hamilton Wood Type & Printing Museum, was used to cut hard maple half-logs into half-round cross-sections a little more than an inch thick. Photograph by author.

triangular profile. The tracks ran parallel to, and the half-logs sat perpendicular to, the saw blade. One worker moved the carriage back and forth: forward to make the cut, then back to push the log into place for the next cut. A robust cast iron block, bolted to the framework about one inch to the left of the plane of the saw blade, set the thickness of each end-grain half-round. A second worker removed cut half-rounds and set them up on edge on drying shelves (Fig. 4.4). “You had to put all that wood into this drying room,” the floor leader said. “And then you close the room. No air moving, no nothing in there. You seal it almost, you know. And the windows closed, everything closed.” The wood



Fig. 4.4: Shelved Wood

Cross sections of hard maple wood on display at the Hamilton Wood Type & Printing Museum. This is what the wood would have looked like after going through the cross-sectioning saw, which was the first step in wood preparation. Photograph by author.

half-rounds sat in the closed room under regular observation until they showed signs they were ready for the next stage:

As soon as you notice mold forming on a piece or two in there, that's a sign that you have to open up and then we had some big fans in there, blowing air around in there. And then we opened up all the works and Mother Nature took over drying it that way. If you dry it too fast, you get all these cracks in that wood.⁴

All told, it took about a year before the wood was fully cured, down to about 20 percent moisture content. The floor leader said Hamilton had once

⁴ *Ibid.*

used a kiln to speed the process, “but they hadn’t been doing that since I was there and I think they cut that outfit out a long time before that.” Kiln drying is much faster and more easily regulated, but very expensive.⁵

By the time the oral history narrators came to work at Hamilton in the late 1960s, the type shop was located in a brick building stretching a full block of Jefferson Street from 17th to 18th street. Type manufacturing equipment occupied parts of two floors at the north end of the building. Heavy machinery for preparing the end-grain half-rounds—including the large circular saw described above and a multi-stage sanding machine—was on the first floor of the building.

The Inland Printer described surface finishing the wood blocks, the first operation performed upon the end-grain half-rounds at the end of the curing process, as having been done by hand. However, the 1891 Sanborn maps lists two sanding machines among the equipment located on the first floor Hamilton’s type factory, then located at the corner of East River and 19th streets, and surface finishing was the only step in the wood type making process that required sanding to any great extent.⁶ In any case, during the later years of wood printing type manufacture at Hamilton, the surface sanding process was definitely mechanized. The machine that did this work was large,

⁵ Harry D. Tiemann, *The Kiln Drying of Lumber: A Practical and Theoretical Treatise*, (Philadelphia: J.B. Lippincott, 1921), 98-100.

⁶ The March, 1891 *Inland Printer* article “The Manufacture of Wood Type” discusses both the Hamilton Manufacturing Company’s and the William Page Company’s histories, but it is not always clear in the article’s descriptions of the type manufacturing process whether Hamilton’s or Page’s factory practice is being described. At the time the article was published Hamilton had purchased the Page company but had yet to move its manufacturing plant to Two Rivers.



Fig. 4.5: The Sanding Machine

This sanding machine, on display at the Hamilton Wood Type & Printing Museum, was used to put a smooth surface on one side of the wood half-round, the surface that would eventually be the face of a piece of wood type. Photograph by author.

about the size of a passenger car (Fig. 4.5). It had a conveyor carriage that moved the type through a series of four cylinders, wrapped with progressively finer-grit sandpaper. A wide, flat drive belt passed in serpentine fashion through a series of drive wheels to drive the conveyor and sanding drums. Although this process was highly mechanized, the type shop floor leader who operated the sanding machine early on in his career at Hamilton reported

achieving higher rates of production once he became more experienced at the work: “I loaded them up with so much wood the upstairs was all cluttered up with wood I sent up from the basement.”⁷ Before the half-rounds went through the sanding machine, workers cut off their bark using a band saw. After the half-rounds went through the sanding machine, workers loaded the sanded half-rounds onto pallets and transported them up to the third floor on a freight elevator.⁸

All of the rest of the work processes of wood type manufacture took place on the third floor. Three wood preparation steps remained to be completed. The first of these was putting the finished half-rounds through the height machine (Fig. 4.6). The wood rode, sanded-side down, on a carriage similar to the one on the sanding machine, with built-in clamps the operator tightened against the sides of the half-rounds to hold them in place. A horizontally mounted circular saw blade, hidden behind a guard in Fig. 4.6. cut the wood precisely to type-high.⁹ Second, after the wood went through the height machine, type shop workers arranged the half-rounds on racks and sprayed their sanded surfaces with shellac. Once this sealant had dried, they smoothed the sealed printing surface, by hand, using fine steel wool.¹⁰ The bottom of the type piece, bearing the height machine’s saw marks, was left unsealed.

⁷ Oral history interview with a Hamilton Manufacturing Company type shop floor leader, 9 January 2015.

⁸ Oral history interview with Hamilton Manufacturing Company type cutter, 19 February 2015.

⁹ Type high for lead type was .918 inches, but *The Inland Printer* gives .921 inches as type high for wood type. This latter measurement is generally consistent with most of the wood type border piece samples measured during preparatory research for the die-stamping machine (See Appendix C).

¹⁰ Personal conversation with retired Hamilton type cutter, 8 April, 2015.



Fig. 4.6: The Height Machine

Workers at the Hamilton Manufacturing Company type shop locked sanded but unfinished wood half-rounds onto the carriage bed of this “height machine,” now on display at the Hamilton Wood Type & Printing Museum. A horizontally mounted blade within the machine cut the half-rounds to precisely 0.921 inches thick, which was type-high for wood type. Photograph by author.

Wood Type Measurements

Type foundries mass produced the metal type used to print straight matter such as books’ body text and newspaper’s column text from lead alloyed with tin and antimony using casting machines of varying complexity. In the

United States, different sizes of metal type had quaint names—pearl, nonpareil, brevier, bourgeois, great-primer¹¹—until the United States Type Founders’ Association adopted the American Point System in 1886.¹² The system’s base unit, the point, was equivalent to 0.014 inches.¹³ Thus, the difference in set height between a 10-point lead type and a 12-point lead type is 0.028 inches; 18-point lead type is 0.084 inches taller than 12 point. Twelve points made a pica and six picas made an inch. Since wood type smaller than one inch was seldom manufactured or used, wood type body size measurements dispensed with the finer increments. Wood type sizes were given in “lines,” a line being equivalent to one pica (therefore, six lines made one inch).¹⁴ The letter R specimen reproduced as figure 4.7 is 18-line Gothic Extended. Decorative wood type border measurements were also given in lines. The narrowest decorative borders depicted in Hamilton’s specimen books were 1.5 lines wide, the widest measured 10 lines. Wood type border pieces were cut in 24-pica lengths (approximately four inches). Among the hundreds of border type pieces in the “sample” case at the Hamilton Wood Type & Printing Museum, there are a few pieces that are shorter in length, but these pieces carry evidence of having been cut to that length after their manufacture. There are two considerably longer wood type border pieces in the sample case, each

¹¹ Walt Whitman, the American poet and printer, used these type size names in his poem “A Font of Type.” Walt Whitman, *Leaves of Grass* (New York: Signet Classics, 1980), 386.

¹² DeVinne, *Plain Printing Types*, 150.

¹³ Taken to one more decimal place, the measurement is 0.0138, or 1/72 of an inch. *Ibid.*, 151.

¹⁴ Hugo Jahn, *Hand Composition: A Treatise on the Trade and Practice of the Compositor and Printer* (New York: John Wiley & Sons, 1931), 127-128.



Fig. 4.7: Letter 'R' Specimen

This letter 'R' specimen is 15 lines, or approximately 2 ½ inches, tall. Printed by author.

four lines wide. It is not known how these pieces were manufactured. The die-stamping machine at the museum, outfitted with its present equipment, could not produce border pieces much longer than 4.5 inches.

Type Wood, Cut to Line

In Hamilton's type shop, work areas were arranged in the sequential order of the manufacturing process around the perimeter of the building's north end (Fig. 4.8). Drawers containing patterns for cutting type with the pantograph occupied the middle of the space. The final wood preparation workstations, the height machine and the spray station, were located in the southwest part of the

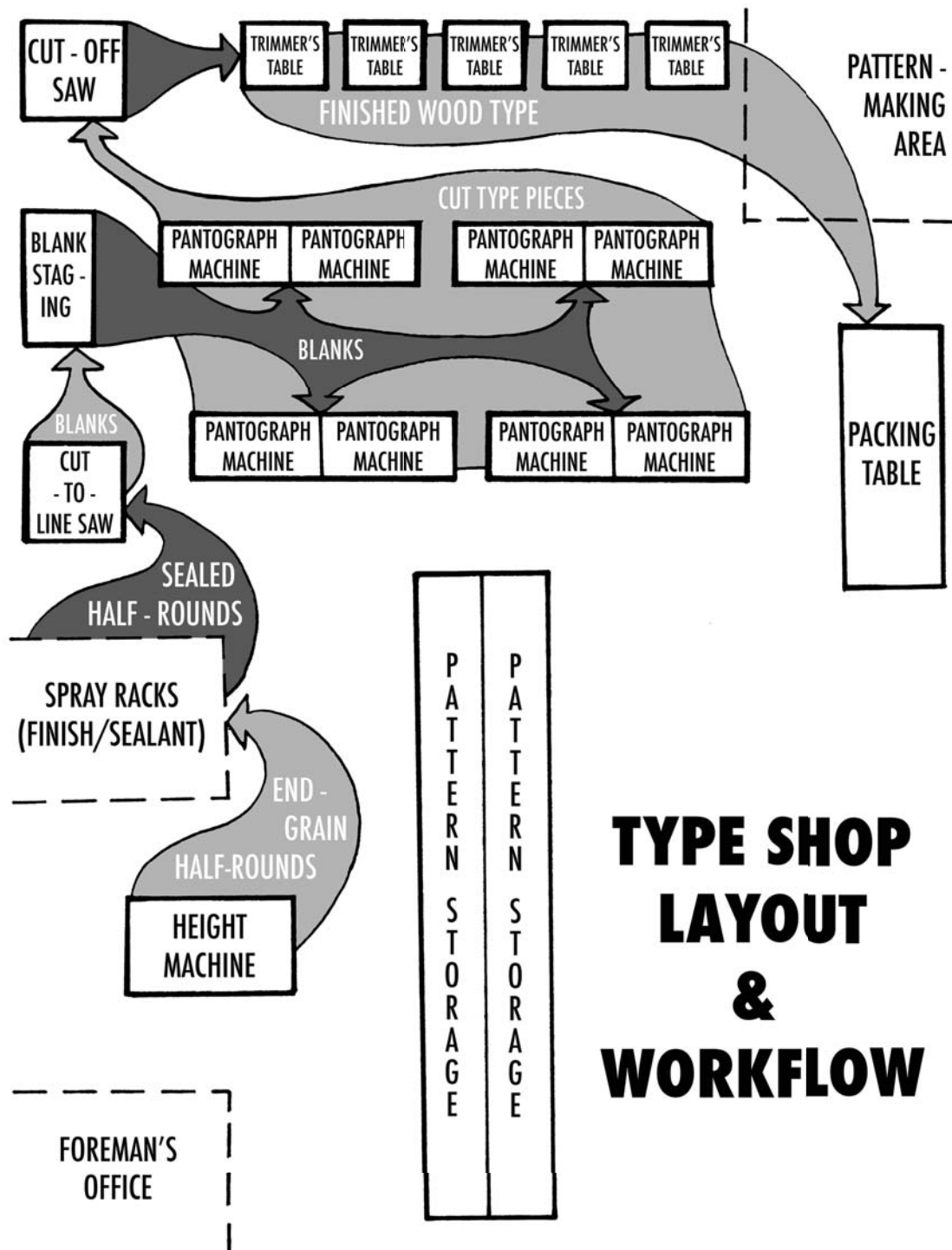


Fig. 4.8: Shop Diagram

This diagram shows the way work flowed through the type shop at the Hamilton Manufacturing Company during its later years of wood type manufacture. It is interpolated from oral histories and documentary evidence and it is not drawn to scale. Drawing by author.

space. The type shop shared the third floor with Hamilton's sewing department, where workers sewed together upholstery for the company's line of medical examination tables, dust covers for drafting tables, and cloth components for other products.

Moving clockwise, following the sequence of production, the next workstation after the spray rack was the cut-to-line saw.¹⁵ The workers and machines involved in the wood preparation operations up to this point had made the wood stock type high, and given it its smooth, relatively impervious printing surface. The worker operating the precisely gauged cut-to-line saw defined the wood blank's other dimensions: its body height and its set width (See Fig. 4.9). This workstation is where the finished, end-grain wood half-rounds began to look like printing type. The saw operator cut the wood into rectangular blanks, their size corresponding to the height of the letterform to be cut. "Cutting to line" referred to the line system of measurement printers used for wood type in the pressroom: 12-line, 15-line, 18-line, and the other sizes. The saw had a relatively complex and highly adjustable carriage system to guide the operator in making the saw cuts, enabling the operator to saw pieces to precise dimensions. The operator checked the work using one of a drawer full of steel gauge plates. Shaped like squared Cs, these gauges ensured the type piece was cut exactly to line. In cutting the wood type to line, the saw operator was careful to cut the maximum number of pieces from each half-round of wood. This reflected the wood's material value, derived partly from the wood as raw material, but especially from the preparatory work that had been done to it.

¹⁵ Oral history interview with Hamilton type cutter, 19 February, 2015.

ANATOMY OF WOOD TYPE

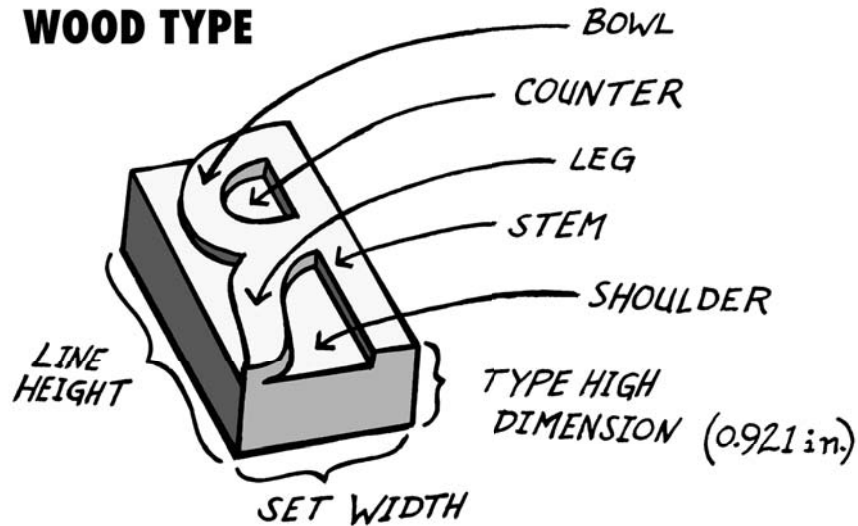


Fig. 4.9: Anatomy of Wood Type

This diagram shows the names, as used in printers' and typographers' parlance, for a wood type piece's different dimensions and the letterform's major parts. Drawing by author.

"That's what I would always tell people," the floor leader said. "Is that preparing the wood is the biggest thing."¹⁶ In cutting the type blanks, the cut-to-line saw operator avoided the pith wood as well as any imperfections such as knots and rot.¹⁷ The cut-to-line saw operator apparently gave little consideration to which way the wood's radial grain (the "rings" in the wood's cross section) ran across the face of the type blanks.

The cut-to-line saw is where the processes for making wood type letters and decorative wood type borders diverged. Blanks for wood type letters were cut to consistent height corresponding to the line size of the type pieces to be

¹⁶ Oral history interview with Hamilton type shop floor leader, 9 January 2015.

¹⁷ *Ibid.*

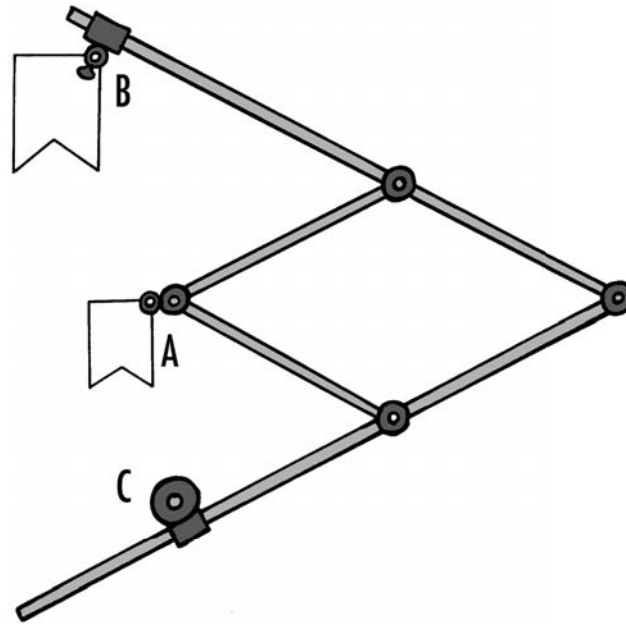


Fig. 4.10: Draftsman's Pantograph

This diagram shows a basic representation of a pantograph machine outfitted for its original use: enlarging drawings. The tracing stylus was located at (A), the drawing was attached at (B) the pivoting anchor point was at (C). Drawing by author based on Brown, *Five Hundred Seven Mechanical Movements*, 1896.

cut from them, and into a variety of widths to allow for different letterforms—'M' versus 'I', for example. Wood type border stock was cut into consistent rectangles in the dimensions of the border designs to be cut from them. After this point, the work flow split toward two separate workstations. The wood blanks for making letters went to the pantograph router and the blanks for decorative borders went to the die-stamping machine.

The Pantograph Router

The pantograph machine originally developed as a drafting apparatus used to enlarge plans and other drawings, and the word's etymology makes

more sense in this context: “panto-“ from the Greek “all” or “universal” and “-graph” from the Greek “draw.”¹⁸ The machine consists of four interlinked arms, arranged as shown in figure 4.10, with a tracing stylus attached at point A, a drawing implement attached at point B, and with point C being a pivoting anchor point. The drawing implement at B reproduces, at a larger scale, the image the operator traces using the stylus at A.¹⁹ William Leavenworth adapted this basic technology for use in cutting wood printing type in 1834, with a treadle-driven router replacing the drawing implement. The treadle-driven router gave way to a belt-driven router, much like the one depicted in DeVinne’s *Plain Printing Types* in 1902 (Fig. 4.11).²⁰ Aside from motive power, there was no significant difference between the belt-driven pantograph router illustrating DeVinne’s book and the pneumatic pantograph routers in use during the later years of wood type manufacture at Hamilton. The pantographs outfitted for cutting wood type differed from the draftsman’s pantograph in one key functional respect: the tracer bit and powered router, analogs to the drafting pantograph’s stylus and writing implement, switched places, so that the router was closer to the anchor point. This transformed the enlarging pantograph used for blowing up plan drawings into a reducing pantograph for cutting wood type. This reversal facilitated cutting more intricate letterforms, as the patternmaker could make a larger master pattern. This rescaling also had the effect of

¹⁸ *Oxford English Dictionary*, 2nd ed., s.v. “pantograph.”

¹⁹ Henry T. Brown, *Five Hundred Seven Mechanical Movements* (New York: Brown & Seward, 1896), 63.

²⁰ DeVinne, *Plain Printing Types*, 348.

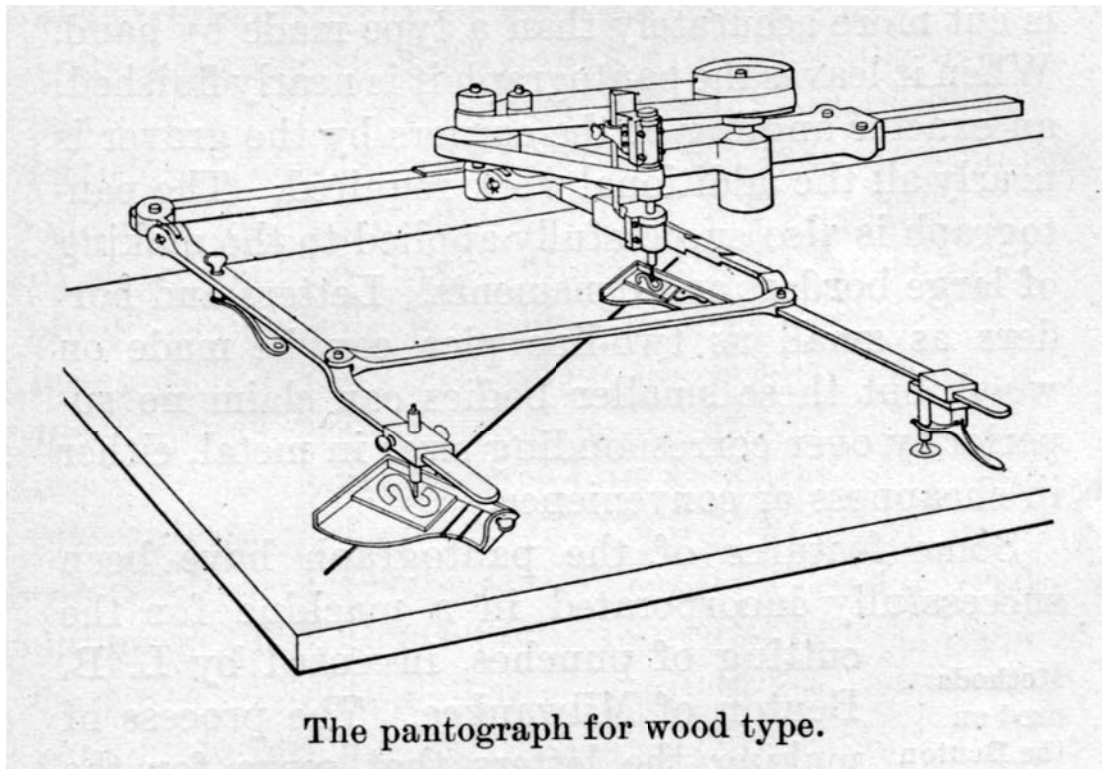


Fig. 4.11: DeVinne's Pantograph Illustration

This drawing from DeVinne's *Plain Printing Types* (1902) shows that the pantograph machines in use during the later years of wood printing type manufacture at Hamilton had changed little since 1902. (*Plain Printing Types*, 1902)

reducing the impact flaws in the pattern, such as mis-cut curves, had in the final type piece.²¹

Table 4.1, which approximates a computer-printed reference card found with one of the museum's pantograph machines,²² shows the different type

²¹ Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

²² Museum staff reported finding this dot-matrix-printed reference card with one of the pantograph machines after the museum collection moved from its original location within the Hamilton works to its present location on 10th Street in Two Rivers. They believe the card has been associated with the particular pantograph machine since the machine was in use in HWT type shop c. 1990. Based on oral history accounts, work practice at HWT mirrored that of the Hamilton Manufacturing Company.

Table 4.1: Pantograph Router Settings Table

This table approximates a computer-printed reference card Hamilton Wood Type & Printing Museum staff found in association with one of the pantograph router's in the museum's collection.

SETTINGS	PATTERNS
1/3 SET	4 LINES TAKES 12 L.
WILL CUT	6 LINES TAKES 18 L.
	12 LINES TAKES 36 L.
	24 LINES TAKES 72 L.
<hr/>	
5/12 SET	5 LINES TAKES 12 L.
WILL CUT	15 LINES TAKES 36 L.
	30 LINES TAKES 72 L.
<hr/>	
8/18 SET	8 LINES TAKES 18 L.
WILL CUT	16 LINES TAKES 18 L.
<hr/>	
1/2 SET	6 LINES TAKES 12 L.
WILL CUT	9 LINES TAKES 18 L.
	18 LINES TAKES 36 L.
	36 LINES TAKES 72 L.
<hr/>	
10/18 SET	10 LINES TAKES 18 L.
WILL CUT	20 LINES TAKES 36 L.
	30 LINES TAKES 72 L.
<hr/>	
THE END	

sizes an operator could produce using different combinations of pattern sizes and machine setups. A pantograph machine set to cut at one-half scale, for instance, would cut 18-line type from a 36-line pattern. In all, Hamilton's type cutters cut 14 different sizes of type, ranging from 4- to 36-line, using four different pattern sizes. Extending the pantograph router's main arm ("D" in Fig. 4.12) increased the machine's scaling ratio. For example, changing from a one-half setup to a one-third setup required extending the arm. The tracer bit and

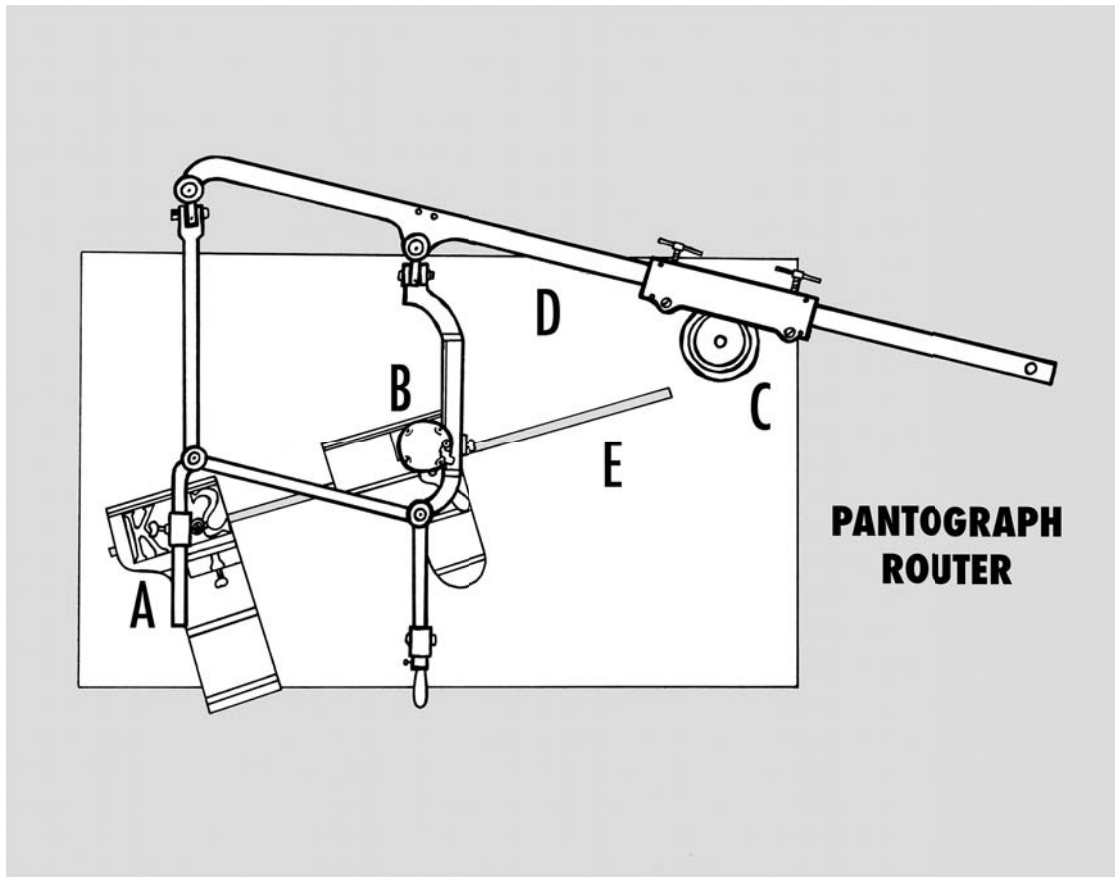


Fig. 4.12: Pantograph Machine for Wood Type

Plan view of pantograph machine with pneumatic router attached. Its significant parts are located follows: pattern lock-up base with pattern and tracer bit (A), wood blank lock-up base with wood blank (hidden behind pneumatic router at B), anchor point (C), main arm (D), lock-up base slot (E). Drawing by author.

router bit could also move along their respective arms as needed to properly position them relative to the pattern and wood blank.

The pantograph's right arm has a lever-actuated elevator column used to lift the spinning router bit clear of the typeface. This allows the operator to put the router bit into position to mill out a letter's counter, or move the bit to one side in order to change out a wood blank. The machine's control arms are hinged to facilitate this operation, which also enables the operator to lift the

entire assembly in order to move the router head and tracer bit completely out of the way while transitioning wood blanks and patterns. When the machine was in place at the Hamilton Manufacturing Company's type shop, a wire and spring stretched between the ceiling and the pantograph arms to counterbalance the weight of the router and pantograph assembly in order to make this lifting easier.²³

Pantograph routers at the Hamilton Manufacturing Company were mounted to heavy workbenches with solid steel tops, supported on robust cast iron legs. Each workbench had two pantographs mounted to it, oriented so that their operators worked on opposite ends of the bench, facing in opposite directions. At each workstation, a slot cut through the steel top runs at an angle from the lower left-hand corner to the upper right-hand corner of each workspace. This slot forms a track along which two machined steel lock-up bases move—the first base for holding the pattern and the second for holding the wood blank (At A and B in Fig. 4.12, photographed individually as Figures 4.13 and 4.14). In setting up the machine the operator moved each base into a position correlating to that of the router or tracer bit, tightening a pair of large, four-armed wing nuts below the bench top to fix the bases in place. A lip machined into the top edge of each lock-up base provided a stop for positioning the top edge of the pattern and type blank, respectively. Plates bolted to the bases' right sides provided a stop for the right-hand side of the pattern or type blank. Three channels, spaced at even intervals, ran laterally across the face of

²³ Oral history interview with Hamilton Manufacturing Company type cutter. 6 November 2014.

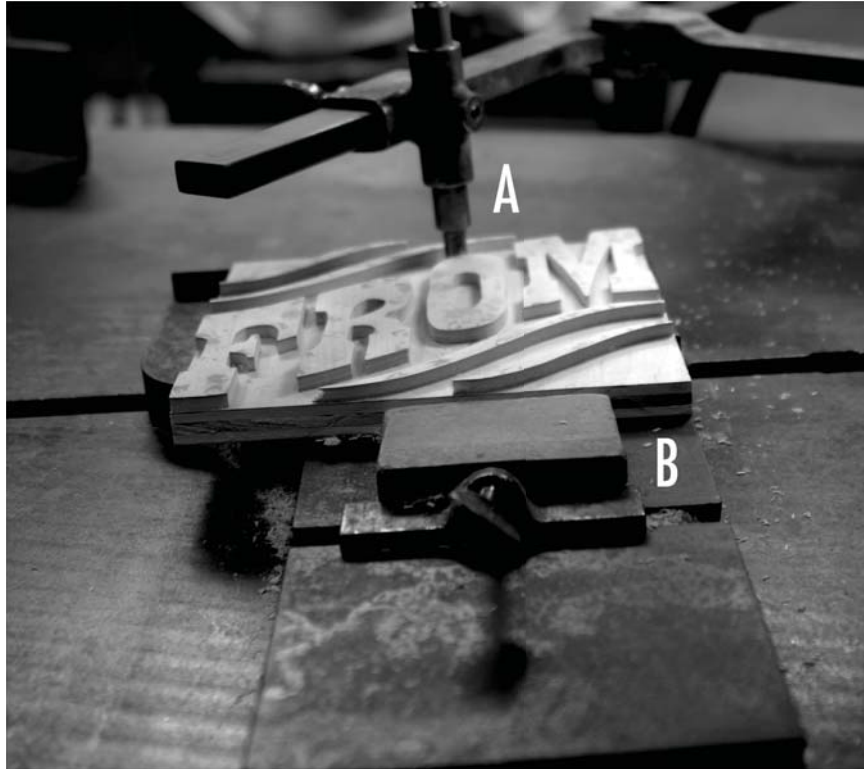


Fig. 4.13: Pattern in Place

A pantograph's tracer bit (A) is shown tracing a "catch word" pattern. The pattern lockup assembly is seen at (B). Photograph by author.

each lock-up base and received the apparatus that held the pattern or wood blank firmly in place. Each lockup assembly could be moved from one channel to another to accommodate different sized patterns or blanks. The lockdown assembly for patterns (B in Fig. 4.13) consisted of a rectangular metal piece that dovetails in the channel, with a thumbscrew that pushed a wood block upward, tight against the lower edge of the pattern. The assembly for holding wood blanks in place was somewhat more complex: a lever on an eccentric pivot point turned counterclockwise and pressed a curved metal piece tight against a wood block that held the type blank tightly against its backstop (C in Fig. 4.14).

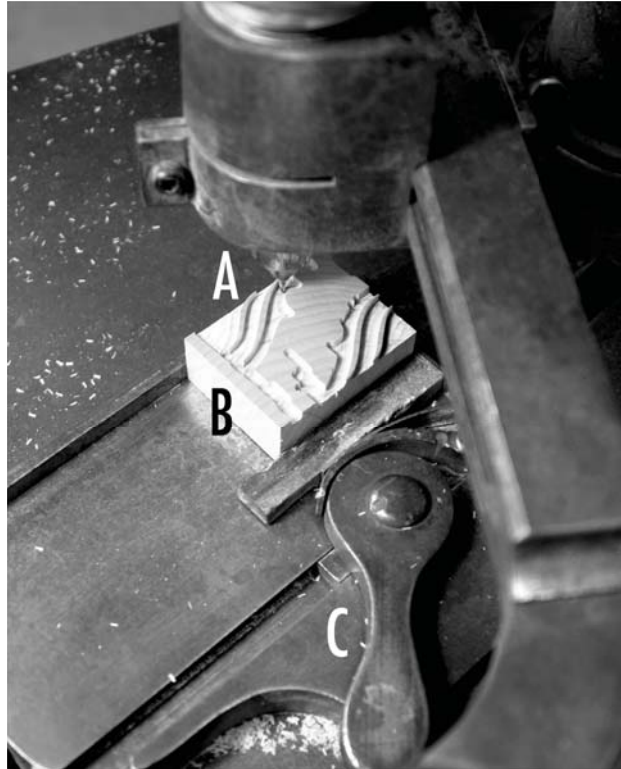


Fig. 4.14: The Wood Blank in the Pantograph

A pantograph's router bit (A) is shown engaged with a partially cut wood blank (B). The blank lockup lever is shown at (C). Photograph by author.

Though more complex in its construction, the locking mechanism for the wood blank was easier for the operator to engage than the lock for the pattern, requiring only a partial turn of the lever in contrast to loosening then tightening a thumbscrew. A design prioritizing wood blank transitions over pattern transitions makes sense given the fact that a type cutter cutting an order of type would have changed wood blanks far more frequently than patterns. Type orders usually required cutting multiples of frequently-used letters. Hamilton's basic 75-letter font of capitals, for instance, included four letter 'E's, four 'S's, three 'A's, and different multiples of several other characters. The most robust

font the company offered, comprising 625 capital letters, included no fewer than 38 ‘E’s, 10 ‘W’s and even eight ‘Q’s. A lower-case font having 510 characters included 40 ‘E’s.²⁴

The Die-Stamping Machine

The die-stamping machine Hamilton used to manufacture decorative wood type border (Figures 4.15 and 4.16) bears familial resemblance to a number of nineteenth-century machine tools. Its form and function most closely parallel punch press machines like the one the Bliss & Williams machine company manufactured in Brooklyn, New York in the 1880s (Fig. 4.17).²⁵ But the die-stamping machine was clearly purpose-built for manufacturing decorative wood type borders. Its frame’s rough casting suggests the machine was not built in quantity. Parts of the wood blank carriage assembly, which was highly specialized for the work of wood type border stamping, are integral to the machine’s frame. This frame comprises two castings. The first, a vertical frame 22½ inches high and 13½ inches deep, supports the machine’s drive mechanism and oscillating stamping column. The vertical element is bolted to a base 17 inches wide and 15¼ inches deep, the forward portion of which supports the carriage assembly that guides the motion of the wood blank through the stamping process (Fig. 4.18). This carriage assembly was the primary point of interaction between the operator and the machine.

²⁴ Hamilton Manufacturing Company Type Catalog, (c. 1920s), Hamilton Wood Type & Printing Museum collection.

²⁵ *American Machinist* 3, no. 14 (April 3, 1880), 16.

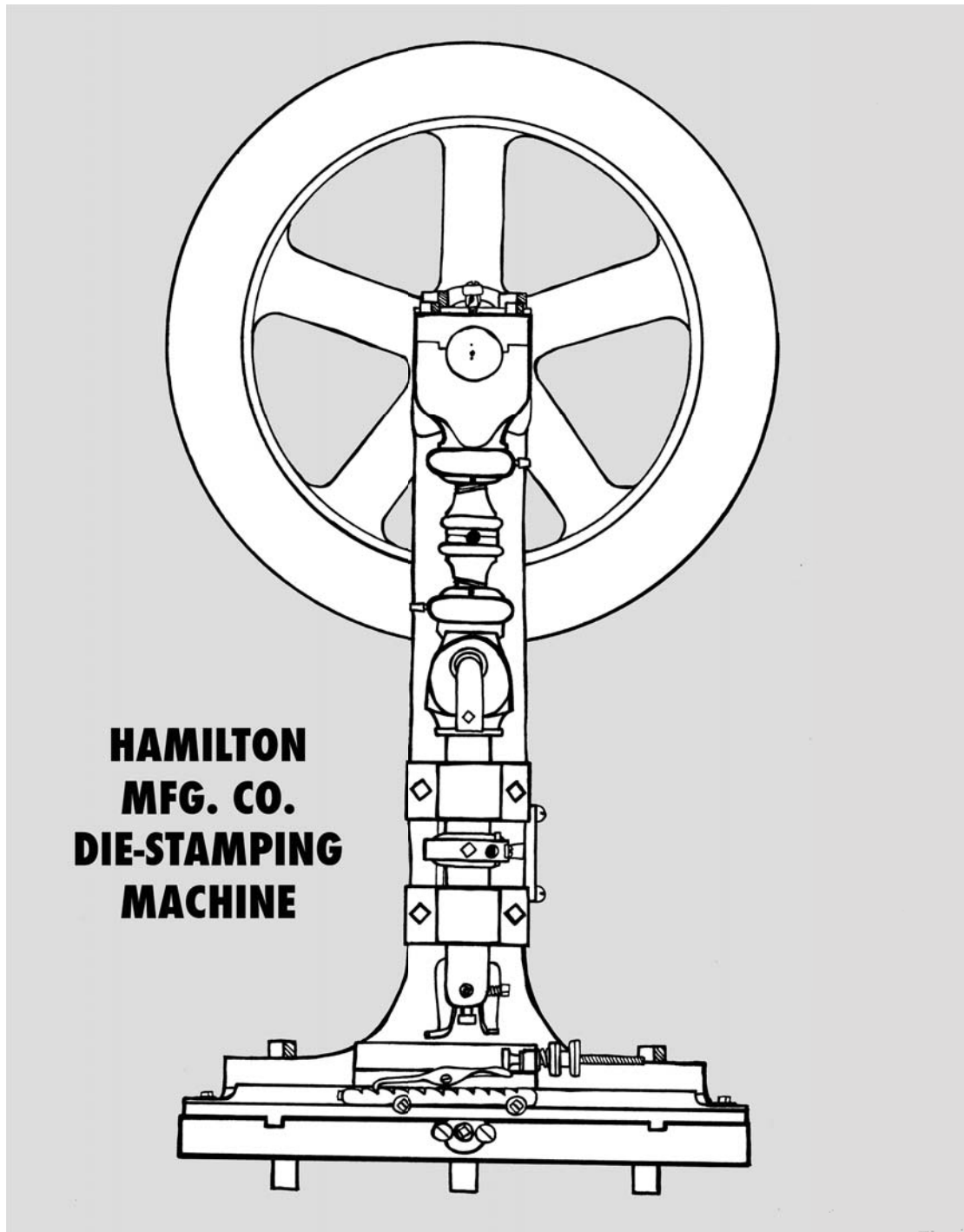


Fig. 4.15: Die-Stamping Machine

Front view of the die-stamping machine used to make decorative wood type border at the Hamilton Manufacturing Company. Drawing by author.

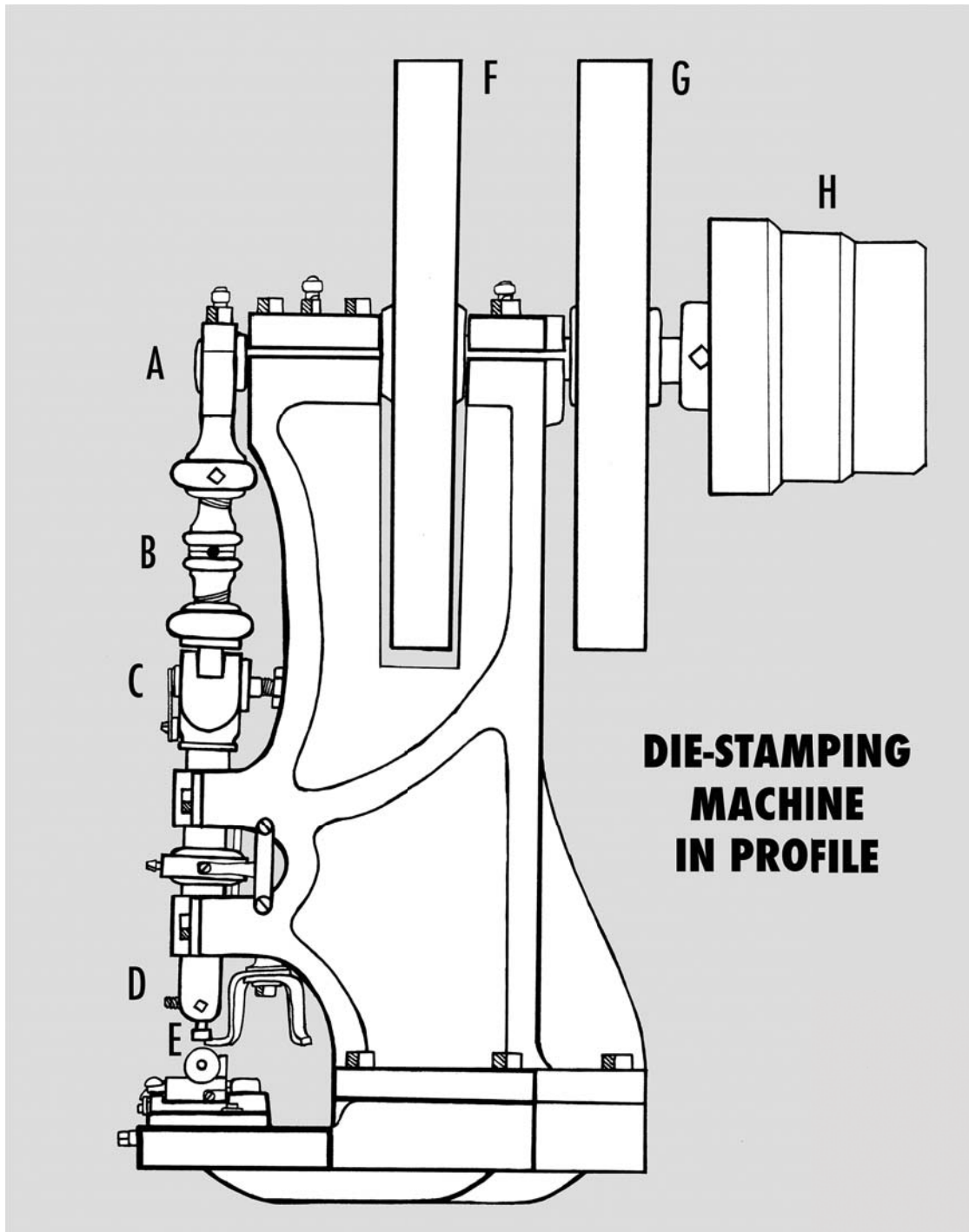


Fig. 4.16: Die-Stamping Machine Profile

The die-stamping machine in profile view, with parts of the stamping column labeled as follows: crank pin (A), jackscrew (B), pivot point (C), stamping piston (D), and stamping die (E). The machine's flywheels are shown at (F) and (G), and its pulley at (H). Drawing by author.

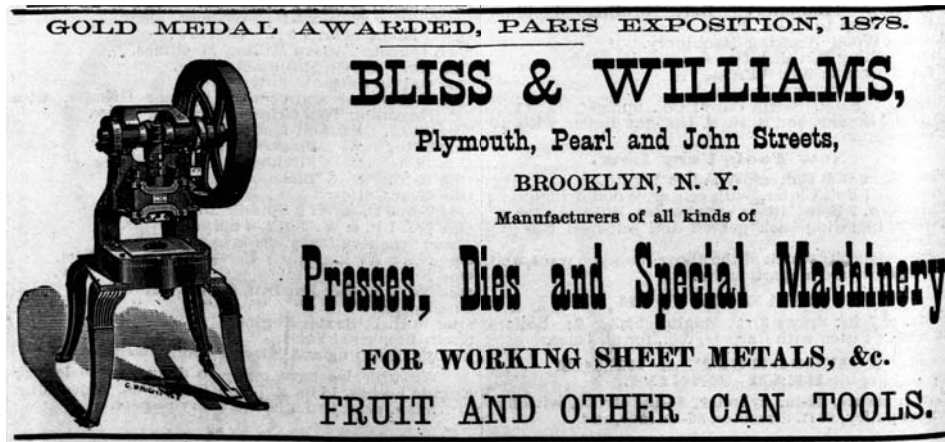


Fig. 4.17: Punch Press Machine

A punch press advertised in an 1880 *American Machinist*. (*American Machinist*, April 1880)

The stamping machine's drive shaft runs through two journal bearings built into the top of the frame. This shaft runs fore and aft and has two large steel flywheels to aid its rotation. The forward flywheel turns within a rectangular gap in the frame casting, while the second flywheel is mounted at the rear of the machine. Subtle differences in its casting suggest this rear flywheel was a later addition. Each was fabricated as a machined steel casting with five robust spokes joining the outer wheel to the hub. The machine's drive wheel is mounted on the rear end of the drive shaft: a three-step pulley built from circles of quarter-inch wood laminated together. When the stamping machine was a working installation in the Hamilton's type shop, its motive power would have come from an overhead drive shaft, transmitted to the drive wheel by means of a leather belt. The belt drive system must have included some kind of clutch mechanism between the overhead shaft and the machine; there is no clutch or throw-off mechanism built into the machine itself.

Changing the drive belt's position on the three-step pulley would have produced little change in the machine's speed of motion, as the change in diameter from one step to the next is only approximately half an inch. It is possible the three-step pulley had been repurposed from another machine that required more minute speed adjustment.

A crank assembly on the front end of the drive shaft transforms the shaft's rotary motion into the rectilinear motion of the stamping column. This column has four principal parts. From top to bottom, the first is a two-piece sleeve assembly at the top through which the drive shaft's crank pin passes (A in Fig. 4.16). The second element—a lathe-turned, coarse-threaded, steel jackscrew (B)—acts as a crank arm connecting the journal bearing assembly to a heavy, machined-steel pivot (C) that absorbs the lateral aspect of the crank's movement. The pivot's steel pin is a full inch thick to withstand the force of the machine's stamping action. Turning the jackscrew clockwise increases the column's length; turning it counterclockwise reduces it. This adjustment ultimately changes the depth of stamp impressions into the wood type border blanks, though the stamping column's stroke remains a constant $7/32$ of an inch. Connected to the underside of the pivot link is the stamping column's fourth and final component, the solid steel piston (D) that holds the stamping dies. A pair of two-part sleeves guides the shaft's reciprocating vertical movement. Each guide sleeve is partially cast into the vertical frame, and has a convex plate bolted on the front to completely surround the shaft. In the space between these sleeves, a collar is fixed to the shaft, held in place with a setscrew. Its purpose is not clear, but a guide column passing vertically



Fig. 4.18: Wood Blank Carriage

A view of the die-stamping machine's wood blank carriage shows the carriage, part of its base assembly, and part of one of the brass racks that gauged the interval for the carriage's movement. Photograph by author.

through its left side, and a plate spring attached to its right, suggest it plays some role in preventing the stamping shaft from rotating within the sleeves. The bottom of the stamping shaft is rounded, with a hole drilled in its axis to receive the stamping dies (E). Two setscrews, oriented at a right angle to each other, fix the dies in place.

The carriage assembly sits on the forward part of the machine's base. The assembly has three principle parts: the carriage bed, the carriage itself, and a toothed brass rack resembling an upturned saw blade (Fig. 4.18). The carriage assembly's bed is a steel plate approximately one inch thick with a

track cut into it, two inches wide and 1/3 inch deep, in which the carriage rides. This track fixes the wood block's lateral placement relative to the stamping die. The bed's lateral position can be precisely adjusted by turning a threaded rod built into the machine's cast iron base. The bed's position is then fixed by tightening square-headed bolts located on its left and right side.

A brass rack is attached to the forward edge of the bed plate, giving the appearance of a saw blade with teeth pointed to the left. The slotted heads of the two brass screws that hold the rack in place have been greatly deformed through use. The wear evident on these screw heads exceeds any wear discernable elsewhere on the machine, showing the brass racks were changed with relative frequency. The brass rack sets the step-intervals for the wood blank carriage's left-to-right motion and can be switched out to accommodate different sized stamping dies. Dozens of these brass racks were stored in a specially built box having 120 slots. The 96 surviving racks found in the box, including two racks fabricated from wood instead of brass, are all approximately the same length, about 5 7/8 inches long. Each rack is stamped or otherwise marked with a number indicating its place in the rack storage box, and each has two notches cut into it to receive the mounting screws. The length of the racks' teeth, and therefore the length of the intervals they prescribe for stamping, ranges from a fraction of a pica to a little more than an inch. Most racks have teeth between two and five picas in length. The depth to which these teeth are cut varies from rack to rack, as does the teeth's shape. All of the racks' teeth have one flat, vertical edge. Though the plates could be mounted to

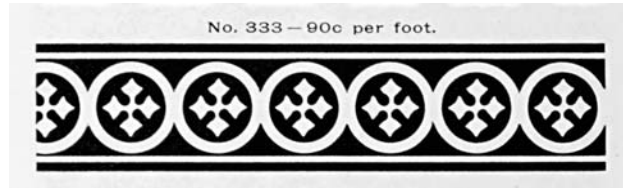


Fig. 4.19: Border Design No. 333

A specimen from one of Hamilton Manufacturing Company's type catalogs shows decorative wood type border design No. 333. (Hamilton Manufacturing Company Catalog, 1903)

carriage base facing in either of two directions, the teeth's vertical edges had to face left to properly engage with the tooth on the carriage's catch lever.

Some of the racks are marked with additional numbers. Rack No. 65, marked with the number 333, was of particular interest as 333 matches Hamilton's catalog number for the wood type border design emulated during phases one and two of this thesis's experimental archaeology component (Fig. 4.19). Stamping intervals produced using this rack proved to be the right size for producing that border style. However, rack No. 65 was also stamped with the number 328, and the stamping interval for border design 328 in no way corresponded with the length of the teeth on the rack, so the match with design 333's stamping interval may be coincidence.

The carriage itself was the stamping machine component most central to the operator's experience. Its base is 2 inches wide, $5\frac{3}{4}$ inches long, and $\frac{2}{3}$ inches thick, with a backstop milled into the same block of steel. The carriage rides in the track of the base plate, fitting so closely that only very thin oil can

be used to lubricate its movement.²⁶ On the right-hand side, the carriage has a stop assembly composed of a plunger at the end of a threaded rod. Its adjustment is by means of a pair of knobs, one brass and the other steel. The brass knob is spring-loaded against the stop's mount, and is used to make fine adjustments to the stop's position, and therefore to the lateral positioning of the wood blank. The steel knob jams the brass knob, fixing the adjustment in place. In the center of the carriage's front face, with a slotted screw for a fulcrum, is a spring-loaded lever nearly as long as the carriage itself. A tooth on the lever's left side engages with the teeth of the brass rack, allowing the operator to move the carriage at the rack's specified intervals. Depressing the right arm of this catch lever disengages the tooth from the brass rack, allowing the operator to freely move the carriage from left to right. In moving the carriage from right to left, the spring-loaded catch lever rides over the teeth, ratchet style. To move the carriage from left to right requires actuating the catch lever with each incremental movement of the base to clear each tooth on the rack.

This chapter completed the description of wood printing type's technological use context begun in chapter 3, with particular emphasis on nineteenth- and early twentieth-century letterpress printing technology's implications for wood type's dimensionality. This led into a description of the initial preparatory steps wood went through in the Hamilton type factory,

²⁶ "White oil" (sewing machine oil) was the oil used during the archaeological experiment. Using too much oil resulted in hydraulic suction between the blank carriage and the track, complicating machine operation.

resulting in wood blanks having the necessary dimensions to become wood printing type. Descriptions of the pantograph-mounted router and the die-stamping machine—machines used to cut wood type letters and stamp wood type border—ended this chapter and set the stage for a detailed analysis of the way these machines structured their operators' experience of agency in the manufacture of wood printing type.

5: Type Cutting & the Pantograph Router

Wood printing type manufacture, as it was performed at Hamilton Manufacturing Company, was a process involving multiple steps encompassing varying degrees of technologically structured work practice. Social relationships between operatives working at different stages in the process are evident in oral history narrators' accounts of their work experience, and in the material culture of the work process and its products. This chapter focuses on wood type letters and the pantograph routing process used to cut them. Descriptions in this chapter attend to workers' technological relations with the machine and its structuring of work practice. Material culture in the form of wood type pieces from the letterpress printing studio at the Copper Country Community Arts Center in Hancock, Michigan, also provide evidence for this work process analysis. These type pieces bear evidence of work processes, particularly in their tool marks.

Type Cutting

After the cut-to-line saw operator cut the wood blanks to size, a type cutter cut out the letterform using a pantograph-mounted router. DeVinne described this part of the process in detail:

Each movement of the operator's hand in guiding the index around the pattern letter is followed by a corresponding exactness of movement in the router that cuts the block. The type is often made in as short a time as one could trace the outlines of the pattern in pencil, and it is cut more accurately than a type made by hand. When it leaves the pantograph it is nearly finished; an

exacter angling of the corners by the graver is nearly all the additional work required.¹

The shop foreman wrote out orders on forms describing each type-cutting job: type design number, size, number of fonts, and pay rate. During the later years of wood printing type manufacture at Hamilton, type cutters made type to order, as opposed to building up back-stocks of different fonts.² The type cutters also used another form, a long, thin form printed on card stock with the letters of the alphabet, numbers, and figures printed on it with blanks to fill in the number of each that should be cut. Hamilton's most basic font of capital letters had four Es, two Hs, and 3 Ls, for example, while its most robust font of capitals contained 38, 17, and 22 of these letters, respectively. Type cutters' pay rate varied based on a number of factors, the most important of these being the design's complexity. "The easier they were to cut, the less pay you got, the fancier they were, the more."³

Hamilton's type cutters were paid on a modified piece rate, with a quota of type pieces to cut each day, to receive the base rate, and the opportunity to make additional money for type pieces they cut above the quota. This payment structure offered the type cutters significant autonomy in setting their work. The foreman usually wrote up job slips for two or three days' work at a time, so type cutters could choose what type designs they wanted to work on in what

¹ Theodore DeVinne, *The Practice of Typography: Plain Printing Types* (New York: Oswald, 1914), 349-350.

² Oral history interview with former Hamilton Manufacturing Company type cutter, 6 November 2014.

³ Oral history interview with Hamilton Manufacturing Company type cutter, 19 February 2015.

order. “You might want to do easier ones first.”⁴ If the type cutters were fast enough, they could cut type ahead, and turn it in to fulfill another day’s quota. “I always made enough ahead that if I didn’t feel like working that day, I had enough in stock that could just turn it in.”⁵ In this way, the type cutters could achieve a measure of freedom in setting their work schedules.

Work orders in hand, the type cutters collected the supplies they would need to cut the order described on the slip: wood from the shelf and the appropriate set of letterform patterns. Patterns were stored in a bank of drawers of different sizes to accommodate patterns ranging in size from 12 lines (approximately two inches) to 72 lines (approximately one foot).⁶ A large, framed chart with hand-written numbers indexing type designs to drawer numbers hung on the wall of the type shop. Type cutters used this chart to find the needed pattern set among the hundreds present in the type shop. They carried the wood blanks and the pattern sets to their pantograph machines. These machines were not formally assigned to operators, but each type cutter stayed with her own machine.⁷ “You pretty much had the same one every day. You never changed.”⁸ Machine repairs were among the few circumstances that would cause a type cutter to transition to a different machine. Most common

⁴ *Ibid.*

⁵ *Ibid.*

⁶ Type cutters reference card found in association with pantograph workstations at Hamilton Wood Type & Printing Museum.

⁷ During the later years of wood type production at the Hamilton Manufacturing Company, seven of the eight type cutters employed in the type shop were women. This was not unusual in the wood type industry. Kelly describes William Page hiring women to work type-cutting machines in the midst of manpower shortages during the Civil War, and continuing to hire women until he sold his business to Hamilton in 1891.

⁸ Oral history interview with Hamilton Manufacturing Company type cutter, 6 November 2014.

among repairs the machine required was replacement of its pneumatic motor: the motor's bearings would seize up from time to time, freezing the router's motion.⁹ Other aspects of shop practice, besides force of habit, factored into operators' consistently using the same machine. A type cutter might be partway through cutting a font of type at the end of a shift and return to the complete the job the next day. The shop's mode of work assignment and pay structure encouraged this situation, which in turn encouraged the informal, assigned-machine arrangement. However, the Hamilton type cutter suggested familiarity with the machine just as strongly encouraged this arrangement.

During the later years of wood type manufacturing at Hamilton, there were eight pantograph workstations, comprising four pairs of conjoined workbenches, in the type shop. Of these, six were in near-continuous operation.¹⁰ The machines were located in the northwest part of the type shop, with about eight feet of floor space between each paired set of workbenches. Each pantograph machine had about 9 square feet of bench-top space (four feet by two feet, four inches), with the pantograph machine, itself, occupying most of it. While the pantograph machine, and the clearance necessary for its movement, left little extra space available on the workbench, the type cutters had considerable freedom to set up their work materials—both wood blanks and patterns required space in close proximity to the pantograph machine—by placing small tables to the left and right of their standing workspaces. A shelf built into the right-hand side of each bench top provided additional space for

⁹ *Ibid.*

¹⁰ *Ibid.*

materials and for tools used to calibrate the machines. This shelf had an integrated drawer for storing router bits and other small tools.

Among all of the operations constituting the wood type manufacturing process, the work of the type cutter using the pantograph machine rendered the greatest formal change upon the work pieces, causing letterforms to emerge from what was previously a plain wood block. This process also involved the most balanced relationship between machine constraint and worker input. The router bit, the machine's most basic element as well as the part of the machine most closely engaged with the work piece, structured work practice even in its rotational direction. Its clockwise spinning motion required the operator to move the tracer bit around the pattern in a counter-clockwise direction. "Otherwise the wood splits out."¹¹ The pantograph machine itself, its mechanical movements and especially the patterns that defined the letterforms, structured and defined the work of type cutting in a more pronounced way.

Type Patterns

Type patterns (Fig. 5.1) that guided the type cutter's motion, through the pantograph's tracing bit and mechanical linkages, toward rendering specific type designs were such a central aspect of the human-technology relationship in wood type manufacture, their production deserves its own description and analysis. The pattern-making workstation was likely located near the windows at the north end of the type shop. Such a location would fit with historic factory layout practice, which typically located meticulous, visually intensive work in

¹¹ *Ibid.*



Fig. 5.1: Type Cutting Pattern

Wooden patterns, such as this one for cutting a script letter ‘A,’ were part of the technological structuring of type cutting, and of the type shop as a social environment Photograph by author.

proximity to windows.¹² Patternmakers in other industries, such as metal casting, were often given workspaces with ample provision of natural light.¹³

The patterns used to cut wood printing type started out as sheets of paper bearing a rendering of all of the letters and other characters necessary to produce a font of a given type design. During the later years of wood printing type manufacture at Hamilton, customers ordering wood type provided these

¹² Betsy Hunter Bradley, *The Works: The Industrial Architecture of the United States* (New York: Oxford, 1999), 27.

¹³ Herman Ewig, “Building Patterns for Quality Machine Tools,” in *Pattern Design* by B. Rupert Hall and Henry Kiley (Scranton, Penn.: International Textbook Company, 1939), 107.

sheets.¹⁴ At other times in its history, Hamilton may have employed its own type designers. The letterforms on these sheets, which were the basis for the patterns, were usually less than an inch in height. Hamilton's front office provided the patternmaker with photographic enlargements of the letterforms, usually a full 12 inches (72 lines) high. The patternmaker's first task was to transfer the letterform to the sheet of wood veneer that would become the raised part of the pattern. This was done using a pencil and a sheet of carbon paper. Enlarging the letterforms to more than 12 times their original size almost necessarily degraded their quality, and the carbon tracing on the veneer often required significant alteration to produce a suitable pattern for cutting type. The patternmaker had considerable autonomy in using hand-drawing tools to correct the letterforms on the veneers. "Sometimes the lines don't come together, so then you'd have to use a French curve to make a nice even curve, there . . . you had to alter it from your original a little bit on that, which you'd think is right which probably a little off, you know. But then nobody notices that. And then when you use a big pattern and then you put it on a smaller outfit, any little imperfection isn't noticed on the type, anyway."¹⁵ Once the wood type patternmaker had "cleaned up" the traced letterform on the veneer, he would cut it out using a scroll saw. This particular power tool reflected Hamilton's reluctance to invest in new equipment during wood printing type's

¹⁴ Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

¹⁵ Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

twilight era. “The scroll saw they had at Hamilton, it was really damaged. Parts were worn . . . it was hard to keep a straight line with that saw.”¹⁶

The patternmaker affixed the veneer letterforms to wood bases using glue and small nails. This 72-line pattern set became the master pattern set. From it, the type cutters would cut sets of 36-line patterns and 24-line patterns, then from these 18- and 12-line patterns, respectively. This created the array of patterns from which type cutters could produce the full range of type sizes Hamilton offered in its catalogs. These smaller patterns were usually cut into side-grain birch wood. Once they had been cut, the patternmakers dipped the smaller patterns in light oil, completely submerging them. The oil soaked into the wood and strengthened the patterns against damage during the type-making process. Still, the patterns needed periodic repairs, as type-cutters sometimes damaged them by striking the finer points with the pantograph machine’s tracing bit.¹⁷

The patternmaker’s work falls into the “workmanship of risk” side of David Pye’s continuum. The saw moved by its own power and in a set motion, but the patternmaker’s movements—essentially freehand manipulations of the veneer pieces, determined the pattern’s shape. This type of work makes an awkward fit with either of Idhe’s modes of technological relations discussed in chapter 2, because the patternmaker’s engagement was not with the machine. Rather, the patternmaker manipulated the work piece, moving the veneer so

¹⁶ Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

¹⁷ Oral history interview with Hamilton Manufacturing Company type cutter, 6 November 2014.

that the jigsaw blade, fixed in its position, cut through the lines the patternmaker had traced onto the veneer's surface.

Among the work processes involved in wood printing type manufacture, the work of the patternmaker most strongly exemplifies technologically bound social relations between workers. Locked in its place on the pantograph machine, the pattern became the type cutter's primary object of engagement, guiding her motions in tracing the shape of a letterform. The patternmaker's work created what would become a part of the technological structure for the type cutter's work. In this way, the pattern itself constitutes a material social connection between the patternmaker and the type cutter.

Phenomenology and the Pantograph

DeVinne wrote that the pantograph machine made the work of cutting wood type suitable for unskilled labor.¹⁸ Yet the work required significant manual engagement from the type cutter, and dexterity and a tacit understanding of the machine, its movements, and how both related to the material properties of the wood. Hamilton's type cutter described two different phases of the primary routing process for each type piece, reflecting a more- and a less-direct hermeneutic relation, respectively. In the first phase, that of tracing the initial outline of the letterform, her visual and tactile focus was on the pattern. As she moved the tracing bit around the pattern with her left hand, the pantograph's interlinked arms transferred these motions to the router head cutting the type piece, while simultaneously reducing them in scale. Once the

¹⁸ DeVinne, *Plain Printing Types*, 248.

letterform's outline had been cut, the type cutter shifted her attention directly to the type piece and the router's cutting head to work away the remaining material on the shoulder of the type. Her movements, made primarily with her right hand, were still transmitted through a metal arm, but were no longer reduced in scale. Her left hand continued to move at the larger scale of the pattern, but the tracing arm was no longer the primary point of input, and the tracer bit now served only to prevent the router bit from cutting into the letterform. Her visual hermeneutic relation was with the type piece, directly, though the tactile relation remained extended through the pantograph's router arm.¹⁹

Type cutters' embodiment relations with their machines were evident in the type factory's shop practice, specifically in the fact that each type cutter had a machine she considered her own. Subtle differences in another machine's movements, caused by a loose pivot point or the like, made the unfamiliar machine less transparent than the type cutter's regular machine. "Once you got used to a machine, you know, like say this one would break down and they would put you on another one. It was hard to get used to. Even setting up the machine you knew just exactly where to but the bars and all that. Well, when you're on a new machine . . . everything's different."²⁰ The type cutter spent most of her time working with the type of pantograph machine described in chapter 4. These machines were capable of cutting type up to six inches high. Hamilton had one pantograph machine that was dramatically larger than the

¹⁹ Oral history interview with Hamilton Manufacturing Company type cutter, 6 November 2014.

²⁰ *Ibid.*

rest, for cutting much larger type pieces. Its main arm was 12 feet long, compared to the five-foot arms on the regular pantographs. The type cutter interviewed for this study was the only one who operated this larger pantograph during the later years of wood type manufacturing at Hamilton. She described the weight of its movements making it more difficult to effectively trace type patterns. “That one was really hard to manage . . . you had to really just hang on and cut away.”²¹ The weight of the machine’s movements brought them into the forefront of consciousness, in contrast to the embodied movements of the smaller machine she had become accustomed to.

During the later years of wood printing type manufacture at Hamilton, type cutting training was relatively informal. “First you had about an hour to practice. They didn’t give you much time to practice. Then they’d give you an order and then you just kept going from there.”²² She started out cutting relatively simple letterforms—gothics and sans-serif faces like Helvetica. Over time, type cutters learned to cut more ornate faces. The rate of this learning progression, like the pace of type cutting work, was seemingly up to the type cutters. Initially, the foreman set the machine up to whatever line height the type cutter was to work on. In time, type cutters would learn this part of the process, as well. Hamilton’s pay structure for type cutters incentivized proficiency in machine setup, as each type order allowed a certain amount of time for setting up the machine. Setting up the machine in less than that time

²¹ *Ibid.*

²² *Ibid.*

left the type cutter more time to meet or exceed her daily quota of type pieces cut.²³

The Cut-Off Saw & Type Trimming

After the type cutter cut an order's worth of type on the pantograph machine, she carried the type pieces over to the type cut-off-saw. At this workstation the saw operator cut off excess wood from the type piece, so that the letterform's outside edges would be flush with the edge of the type piece. In some cases, this involved cutting apart two letters that had been cut into the same wood blank. Here, work practice again reflected the importance of economy in the use of finished type wood. If the wood blank had enough open wood between the two pantograph-cut letterforms, the cut-off-saw operator would set it aside for type cutters to use for cutting a narrow letter, such as a lowercase 'L,' or punctuation marks, or any other letter or character that would fit on the fragment's face.

The final step in the type making process, type trimming, involved hand work using a variety of specialized tools. There were five trimmers' workstations on the third floor of the brick factory building on Jefferson Street. During the later years of wood type manufacture at Hamilton, four of these workstations were in regular use. Type trimmers used a variety of tools, many of them highly specialized for this specific work. The type trimmer's job was to smooth out imperfections around the edges of the types' faces, and to render sharp corners and counters the smallest pantograph router bits could not reach. Like the

²³ *Ibid.*

patternmaker's work station, the visually intensive work of type trimming took place near windows. The type trimming tables in the factory on Jefferson Street were set up next to eastward-facing windows in the northern part of the shop.²⁴ A type trimmer used a standard flat file to smooth the round outside edge of a letter 'O,' or the external edge of the bowl on a letter 'P.' Other shapes called for more specialized tools, many of which Hamilton's machinists fabricated from re-used materials. The collection of type trimmer's punches at the Hamilton Wood Type & Printing Museum includes several triangular punches machined from discarded steel files. Type cutters used these punches to render sharp points in the letters—a letter 'A's counter, for example. They would hold the punch in place on the typeface, then strike the top of the punch with a hammer to impress the shape into the end-grain wood. Different punches produced different angles to correspond with different sharp angles present in the letterforms. Among the more interesting punches in the museum's collection is one fabricated from a cut-off 16-penny nail, machined so that the bottom formed a C-shape.²⁵

Type trimmers were free to choose the appropriate tool for the job from among several at hand, so patterns of tool use likely varied to some degree based on different workers' preferences. The most versatile among these tools, and likely the one type cutters used most often, was a simple cutting tool with a teardrop-shaped handle and a small, triangular blade. The type trimmer held

²⁴ Oral history interview with Hamilton Manufacturing Company type cutter, 19 February 2015.

²⁵ Oral history interview with Hamilton Manufacturing Company type trimmer, 12 March 2015.

the handle in the closed fist of his left hand, with the blade end protruding between the ring and pinky fingers, the blade's cutting edge pointed upward. Thus the knuckles of the pinky finger, resting against the work surface, could act as a fulcrum, hence a guide, for controlling the cutting blade's motion while the trimmer manipulated the type piece with his right hand.²⁶ The type trimmer used this tool to clean up rough edges of typefaces, trim around tight shapes, and for a variety of other tasks. The social relationship between the type cutter and type trimmer is visible in this cleaning up of the typeface's edges. A type trimmer inexperienced at operating the pantograph would not be able to trace a pattern as closely as an experienced operator, resulting in type pieces that needed more trimming than those made by an experienced type cutter. A skilled type cutter produced less work for the type trimmer. Shop practice accounted for this fact in that foremen tried to distribute the well-cut and less-well-cut fonts of type equitably among the type trimmers who, like the type cutters, were paid based on a modified piece-rate schedule.²⁷

The hand-held cutting blade is a tool that represents workmanship of risk. And at the trimming stage of wood type manufacture, the previous labor that had accumulated in the type pieces magnified the consequences of an errant tool movement. Another cutting tool added more certainty to the workmanship of type trimming: a table-top trimming plane with an angled blade. The blade was mounted to a carriage-and-track system that guided its

²⁶ Observation of type cutter at work at Hamilton Wood Type & Printing Museum, 7 November 2014.

²⁷ Oral history interview with a Hamilton Manufacturing Company type trimmer, 12 March 2014.

motion in a precise, straight line. The type trimmer could use this tool to chamfer straight edges that were flush with the edge of the type piece, such as the top of a gothic capital 'T,' or the outside edge of a letter 'P's leg. A capital 'H' in a gothic design provided a multitude of opportunities to use this tabletop planer.

At the center of each type trimming work station there was a specialized work surface on a small, raised platform. The platform's surface was smooth to allow the type trimmer to easily rotate a type piece placed on top of it. The platform had an L-shaped wooden bracket fitted to it with triangular notches cut into the back side of the L's leg. These notches created a purchase for the corners of the type piece, allowing the type trimmer to more easily hold the piece still while working with the hand-held trimming blade, or the flat file, or one of the punches.

Packing of the completed type orders took place at a large table located along the east wall of the type shop. The packers arranged the type letters, with their varying widths, into square-sided rectangular stacks before wrapping them up for shipping.²⁸ This process must have been easier for the wood type borders, which were of uniform dimensions.

Evidence of Workmanship in Wood Type Letters

Evidence of the work process is visible in wood type letters. Circular saw marks are visible on the sides of an expanded gothic letter 'P,' for example (Fig.

²⁸ Oral history interview with former Hamilton Manufacturing Company type cutter, 6 November 2014.

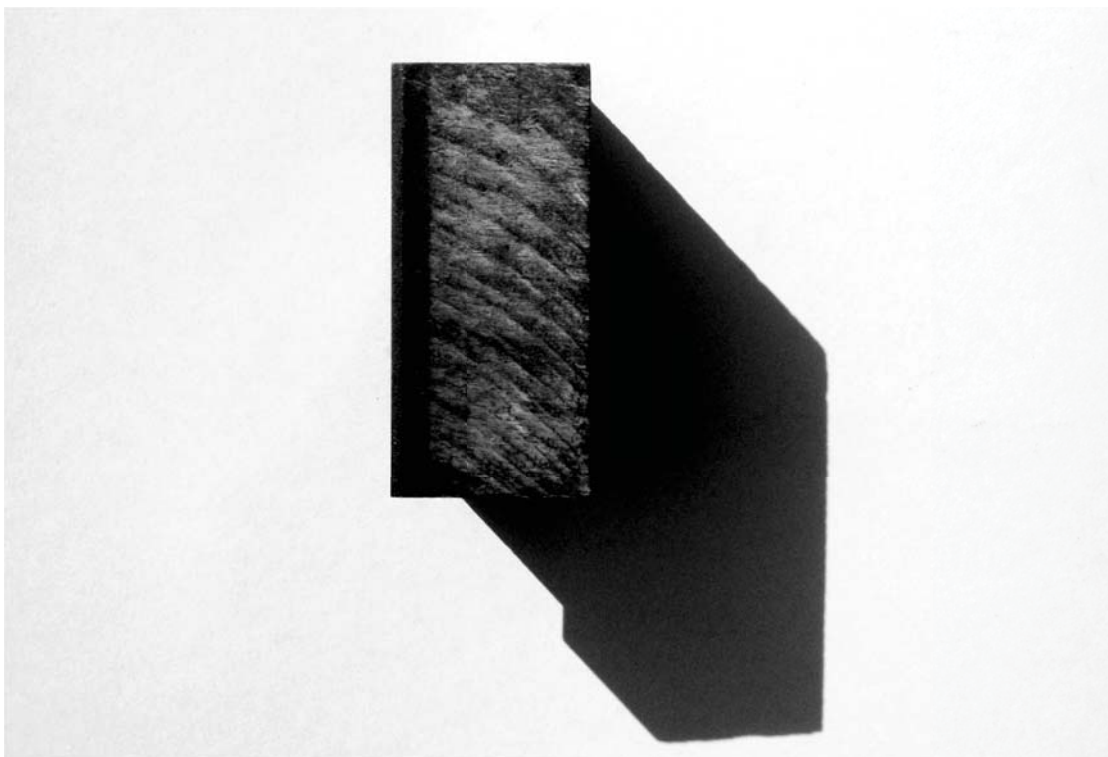


Fig. 5.2: Cut-To-Line Saw Marks

In this photograph of the right-hand profile of a gothic capital 'P', saw marks from the cut-to-line saw are visible. Photograph by author.

5.2). The typeface went by No. 29 in the 1899 Hamilton catalog. The saw marks on the top, bottom, and left-hand side show where the wood blank was cut to size from an end-grain half round prior to pantograph work. The saw marks on the left-hand side of the type piece are finer and more evenly spaced, suggesting a different saw cut this side and that this type piece was one of two letters originally cut into the same block of wood, then cut apart following the pantograph work. The type piece's underside (Fig. 5.3) shows a different kind of tool marks: those of the height machine's horizontally mounted blade, which

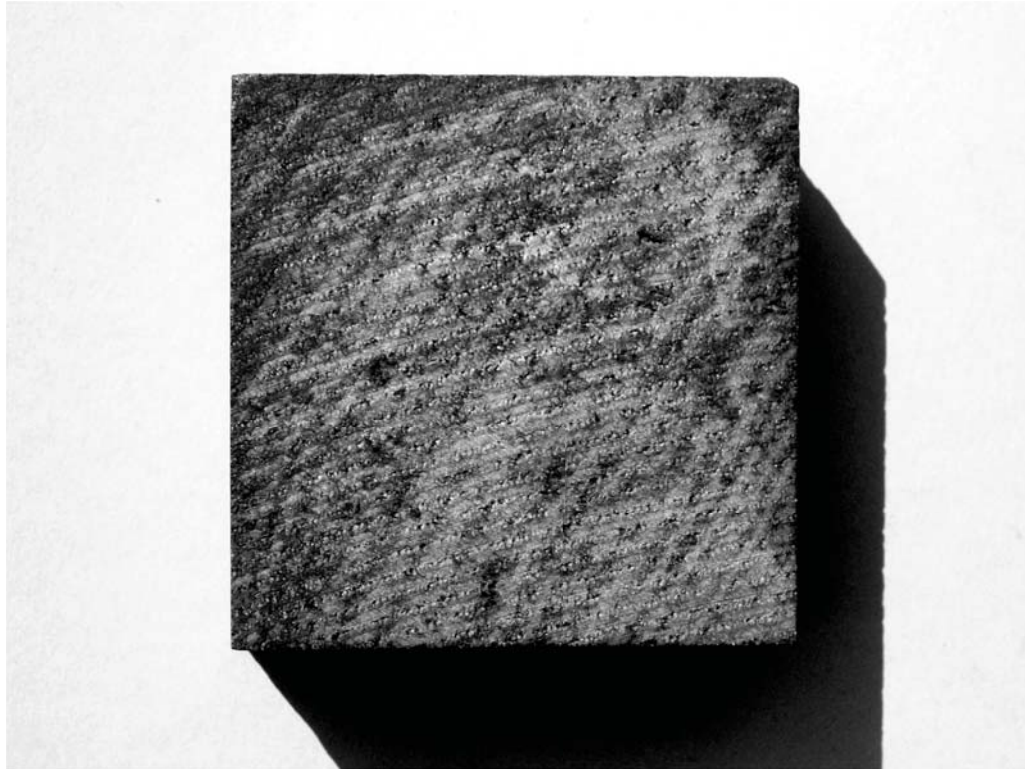


Fig. 5.3: Height Machine Marks

On the underside of the same piece of type shown in Fig. 5.2, a different kind of saw marks are visible. These were left by the height machine, which was located on the third floor of Hamilton's type factory during the later years of the company's wood type manufacturing. Photograph by author.

cut the wood to type high while it was still a half-round cross section of maple. The curvature of the blade marks show the large diameter of the height machine's blade. Despite ink caked on the type piece from its years of print shop use, tool marks remain visible on the type's shoulder, below the letter 'P's bowl. These show the path the type cutter followed with the router in removing wood from the shoulder. The router's path was strictly defined in tracing the 'P's outline. The router marks below the bowl, however, show the type cutter exercised more freedom in manipulating the router to remove this material, no

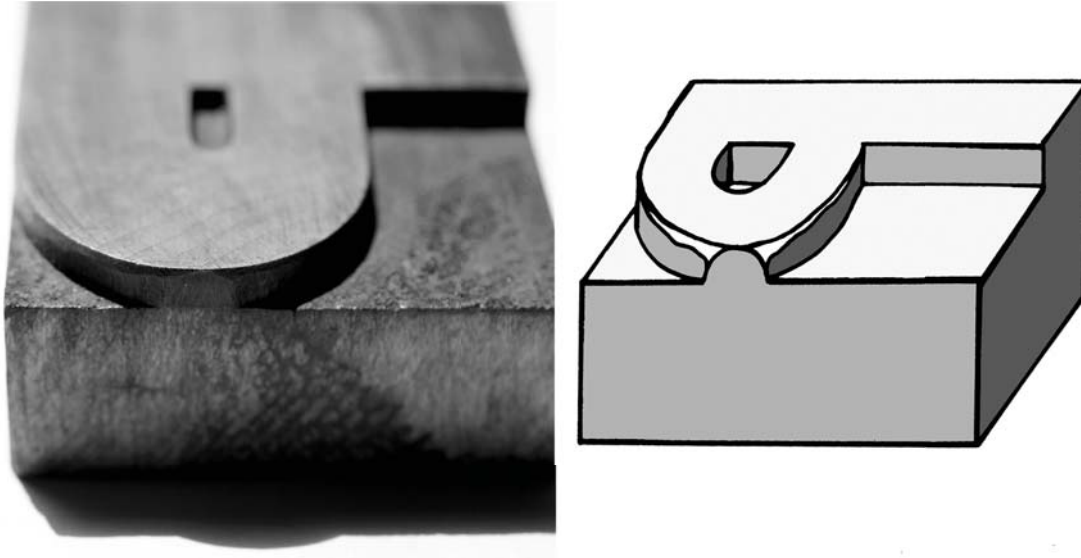


Fig. 5.4: Hand Trimming Marks

Visible in this photograph, and clarified in the accompanying sketch, are the marks of the type trimmer's hand cutting tools on the bowl of the 'P.' The type trimmer used a hand-held cutting blade to smooth the curvature of the type face, producing a slight chamfer along the edge of the bowl. Photograph and drawing by author.

longer guided by the template and tracing bit. "It didn't make no difference what way you went after you had the outline done."²⁹

Viewing the type piece in profile from the left-hand side (Fig. 5.4) shows the tool marks where the type trimmer corrected the bowl's curvature using a hand-held cutting blade. A slight chamfer is visible along most of the bowl's outer edge. A letter 'M' from the same font bears the markings of the two-stage routing process required to manufacture it. The type cutter initially cut partway into the counter between the 'M's steeply angled strokes with a relatively wide router bit, later cutting further in with a smaller router bit and correspondingly smaller tracing bit. The initial cut, with the larger router bit, is deeper than the

²⁹ *Ibid.*

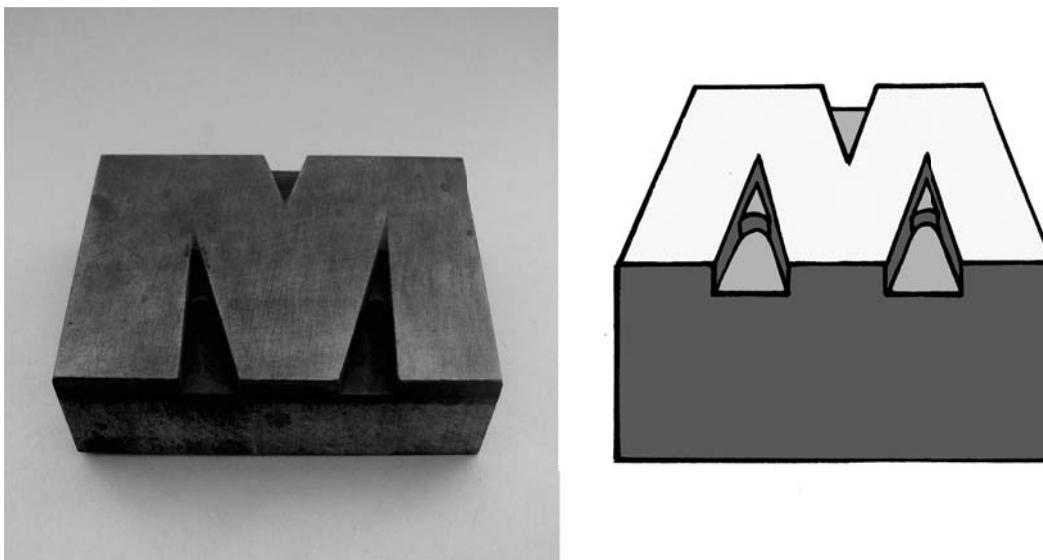


Fig. 5.5: “Second Router”

This gothic letter ‘M’ bears the marks of having been cut twice on the pantograph router with successively smaller router bits. Using a smaller bit, and a proportionately smaller tracing bit, the type cutter was able to cut further into the ‘M’s apexes on the “second router.” The smaller router bit was set to cut less deeply into the type, creating the tiers visible in the ‘M’s counter in the photograph and accompanying sketch. Photograph and drawing by author.

router cut that followed, creating visible tiers of wood within the counter (Fig. 5.5). It is difficult to tell on this particular type piece whether the type trimmer used a punch, a hand-held cutting blade, or a combination of the two to render the points of the counter. The type trimmer’s hand is visible in the slight chamfer on the inside edges of the M’s strokes. The chamfer on the stems’ outside edges, both more precise and more pronounced, shows the type trimmer used the tabletop chamfer plane to make these cuts (identical to the chamfer visible along the right-hand edge of the ‘P’s stem).

On another gothic type piece, a letter ‘T’ from a font of Hamilton’s No. 45 type, the tool marks were clear enough to photograph despite ink build-up (Fig. 5.6). These markings are much straighter and more uniform than the marks on

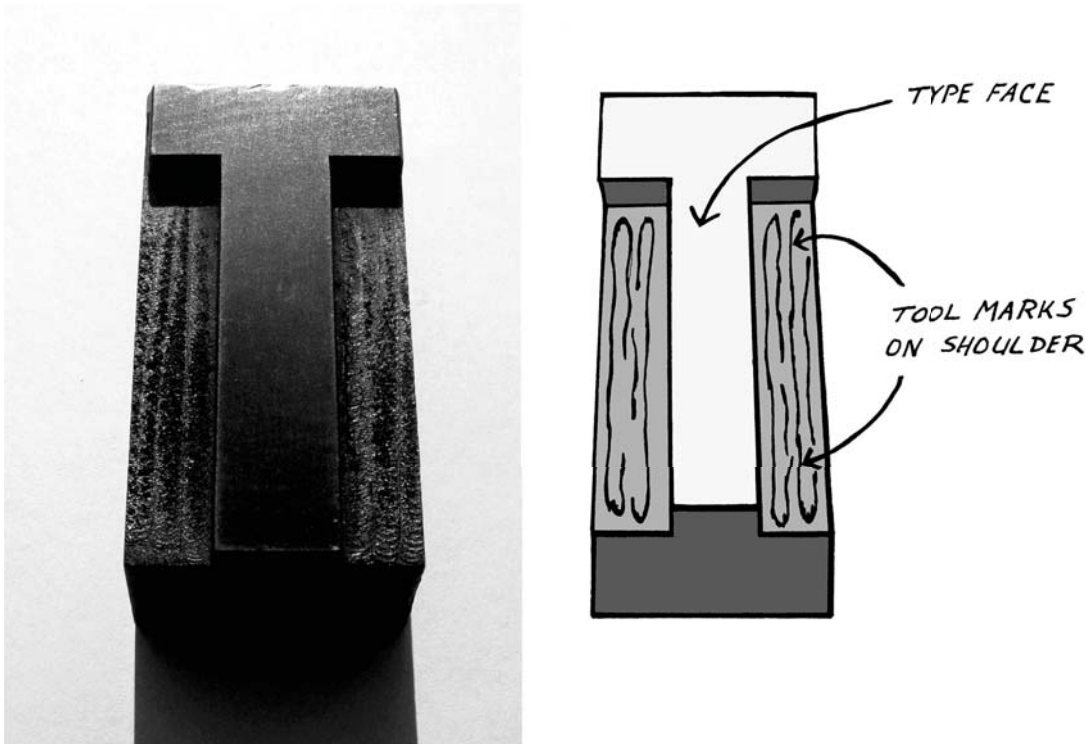


Fig. 5.6: Tool Marks on the Counter

Visible in this photograph, and clarified in the accompanying sketch, are the marks the router left when the type cutter cleared the wood away from this gothic letter 'T's counters. These marks show the type cutter moved the router bit in straight paths, though at this stage in the type cutting, the pattern was no longer guiding his/her motions. Photograph and drawing by author.

the shoulder below the letter 'P's bowl, showing the operator moved the router in a precise and efficient manner, though at this stage in the cutting process, the pantograph and the pattern no longer compelled this type of motion.

6: Die Stamping Decorative Borders

The die-stamping machine used to manufacture decorative wood type border in the Hamilton Manufacturing Company type shop structured work more strictly than the pantograph-mounted router used for cutting wood type letters. The die-stamping process required the operator to perform only one type of action: moving the wood carriage from one position to another along a fixed path, at intervals the machine prescribed. This chapter uses data from experimental archaeology to explore the operator's tactile engagement with the die-stamping machine. Experimental operation of the die-stamping machine also provided insights into technologically bound social relationships within the border stamping process: in this case, between the die-stamping machine operator and the cut-to-line saw operator, and between the die-stamping machine operator and the machinists who fabricated the machines' brass racks. In combination with the archaeological experiment, material culture analysis of stamping dies and printed specimens of wood type border from Hamilton's type catalogs yielded insights into the relative complexity of die-stamping machine setup and operation for different wood type border designs.¹

Die Stamping

The die-stamping machine rendered decorative patterns in wood type blanks by making a succession of stamping impressions in the end-grain wood with one of a number of interchangeable stamping dies. This process left the

¹ Stamping die shapes are shown in Appendix B.

printing surface in relief with the ornamental shape on the die stamp itself as negative space when the type was printed. Type shop workers could create a wide variety of different designs by using different stamping dies, or the same stamping die in different orientations, during successive runs through the machine. Corner pieces were stamped in generally the same manner as straight border pieces, but into L-shaped pieces of wood. The die-stamping machine operator could stamp one leg of the 'L,' rotate it 90 degrees, and then stamp the second leg. Some of the more complex designs may have required additional attention to properly align the designs where the two legs meet.

By the 1960s, the die-stamping machine was no longer in use for its original purpose in the Hamilton type shop, and had not been for some time. Hamilton's 1938 wood type catalog advertises no decorative wood type border and the 1905 catalog contains only one page of border designs. By the 1960s, the die-stamping machine's location in the shop no longer reflected its spatial situation within the type-making process, and the machine no longer had motive power. The machine, and another one like it that is no longer in the collection at the Hamilton Museum, sat on workbenches in the type shop. Type trimmers used them for limited tasks, including stamping decorative elements into especially ornate letters, or rendering the dividing line between block-serifs, such as the block-serifs at the base of the letter 'W' shown in figure 6.1. The

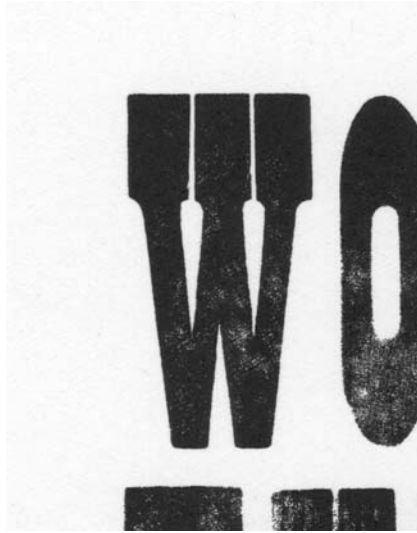


Fig. 6.1: Block-Serif Letter

During the later years of wood printing type manufacture at the Hamilton Manufacturing Company, type trimmers used the die-stamping machine and another like it to render type elements such as the dividing line between the block serifs at the bottom of this letter 'W.' Printed by author.

type trimmers turned the machine's flywheel by hand to accomplish these tasks.²

Once the machine had been set up for a given stamping run, it required only that the operator move the wood blank carriage from one position to the next within the milled channel in the carriage base, at the intervals the brass racks prescribed. Experimental archaeology revealed this work required close attention to often subtle tactile cues related to the carriage's movement. Reading the machine's rhythm, and matching movements to it, required similar focus. These sensory engagements were required in just the rote operation of

² Oral history interview with Hamilton Manufacturing Company floor leader, 9 January 2015.

the machine. Setting the machine up for work was a comparatively complex operation.

The die-stamping machine was designed to permit the wide range of adjustments necessary to produce diverse decorative wood type border designs. Its stamping dies required different movement intervals for the wood blank carriage. Many designs required multiple stamping dies, precisely registered to each other, and still other border styles used overlapping stamps to create the desired design. As described in chapter 4, an array of interchangeable brass racks, mounted to the front of the die-stamping machine's carriage base, prescribed the side-to-side movement intervals for moving the wood blank to the right positions relative to the stamping die to produce the different patterns.

A brass knob on the right-hand side of the wood blank carriage provided the means to make fine-grained adjustments to the blank's left-to-right positioning for the initial stamp. It was important that the first and last stamps on a piece of border be precisely located relative to the edge of the border piece so that when a printer locked up several pieces end-to-end, the border pattern would repeat seamlessly. Turning the brass rack a quarter turn adjusted the blank's position by 0.013 inches. This is strikingly, if coincidentally, close to one point (0.014 inches) in the printers' measurement system.

A quarter turn of the lateral adjustment screw, which moved the entire carriage base toward or away from the operator, yielded an adjustment of 0.016 inches. This adjustment was necessary to precisely center the stamps on the type piece, or to register two or more different die stamps for making a more complex pattern. Border design No. 138 (Fig. 6.2), the pattern emulated in

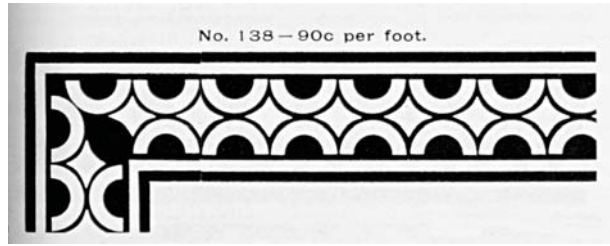


Fig. 6.2: Border No. 138

Hamilton's border design No. 138 required three passes through the die-stamping machine using two different stamping dies. The upper and lower row of 'C'-shaped stamps could be rendered using the same machine setup, so long as the wood blanks had been cut to precisely the right length. (Hamilton Manufacturing Company Catalog, 1903; Courtesy RIT Cary Graphic Arts Collection)

phase three of the archaeological experiment, required placing die stamping impressions with little more than one point of space between them. In this design, one row of diamond-shaped stamps, made with artifact S-133 (See Appendix B), ran down the center of the border piece, interposed between two parallel rows of half-circle stamps made with artifact S-019.

The die-stamping machine operator may have calibrated the machine himself. It is also possible the shop foreman set the machine up, then turned it over to another type shop worker to operate, similar to the shop's practice of setting up the pantograph for newly trained type cutters. Which arrangement worked best depended upon as-yet-unknown aspects of wood type border production. If Hamilton produced its border type in large enough batches, it would have been advantageous for the foreman to calibrate the machine, then turn it over to a less skilled, lower-paid worker to operate. If border manufacture involved frequent transitions from one design to another, it would have been advantageous to train an operator to make the necessary

adjustments him- or herself. The sheer number of different decorative border designs—Hamilton advertised 151 different borders in its 1899 catalog—would seem to favor the latter practice, though we have no idea how many of these sold, or how often.

It is unlikely any hand trimming was required to finish decorative wood type borders, as was the case for wood type letters cut with the pantograph router. The stamping dies in the Hamilton Wood Type & Printing Museum's collection perfectly match the shapes in the type specimens printed in Hamilton's catalogs, and the die-stamping operation was unlikely to produce errors that hand-tool work could correct. Most of Hamilton's border designs did undergo one additional process in which parallel lines were cut into the upper and lower edges of the type piece. A type shop worker cut these lines using a table saw equipped with a "star" blade. This blade had teeth that were triangular in profile, like an inverted 'V', so the operator could change the lines' width by raising or lowering the blade: higher for wider lines, lower for finer ones. Like the die-stamped ornaments, these lines appeared as negative space in the printed type. Whether these lines were cut before or after the die-stamping operation would have made no difference in the type's printability and would have had few implications for the efficiency of the type shop's operations. Wastage may have been cut by a small margin by cutting the lines after the stamping operation was complete. The stamping operation, in Pye's terms, was a somewhat higher risk operation than the line cutting, and work pieces fouled during stamping could have been discarded without needing lining.

Tacit Dimensions and the Die-Stamping Machine

Contradictions between the die-stamping machine as apprehended by the detached observer and the die-stamping machine as experienced by the engaged operator reveal tacit dimensions of the knowledge required to operate the machine. The die-stamping machine's designer provided the operator with a firm stop for placing the carriage, with precision and certainty, in the proper initial position for a right-to-left stamping pass. Adjustable and fixed in place with a thumbscrew, the stop catches a post that protrudes from the back of the carriage, and greatly simplifies this aspect of the operation. The orientation of the brass rack's teeth, too, would seem to argue the designer's intention was for the carriage to move from right to left. Moving in this direction, the tooth on the catch lever rides over the top of each tooth. The operator sets the carriage in position with a simple, slight backward motion of the wrist. In moving the carriage from right to left, depressing the catch lever is necessary at the end of each stamping pass, only, in order to return the carriage to the start position for the next pass.

While the foregoing aspects of the machine appear to point toward a design intention for right-to-left movement, in practice, the tactile differentiation between moving the carriage right to left versus moving the carriage left to right is ambiguous. For example, depressing the catch lever to move the carriage into place for each successive stamp, as is necessary when moving the carriage left to right, provided a more pronounced tactile effect that facilitated movement in time with the machine's cadence—analogous to stomping a kick-drum pedal versus strumming the string of a rhythm guitar.

The initial tactile impression that attended each movement step, in moving the carriage from right to left, was faint. The impact of the catch lever snapping into place, slight to begin with, is practically imperceptible by the time it transmits through the solid steel carriage block to the operator's hands. True, the backward wrist motion that sets the catch lever's tooth against that of the brass rack is an assertive tactile reaction, but this movement depends on apprehending the initial, faint signal from the catch lever and its leaf spring.

In moving the carriage from left to right, positioning the carriage for the first stamp of each pass was a less certain proposition. Without the benefit of the built-in stop, the operator must rely on more subtle cues, such as aligning the carriage, by sight, with the setscrews at the stamping piston's base. This initial location need only be approximate: the catch lever engages precisely with the leftmost brass rack tooth when the operator pushes the wood blank into place against the stops on the carriage. In moving the carriage from left to right, the pressure the operator exerts on the wood block, with the side of the left index finger, serves also to push the carriage along the track. On a related note, the feel of the wood block against the fingers is marginally less harsh, from an ergonomic standpoint, than the feel of the carriage block's metal edges.

Which direction the operator chose for moving the blank carriage was, ultimately, of little consequence in the machine's operation. But the foregoing examination of this small aspect of the machine's operation effectively illustrates the subtleties of tactile engagement with the machine, as well as the marked differences between knowing from detached observation (as in

extrapolating design intention from visual analysis of the machine) and knowing from bodily practice (which is central to industrial skill).

Experimental archaeology revealed that seemingly small changes in the die-stamping machine made marked differences in the tactile feedback it provided the operator. For example using too much oil to lubricate the channel in which the blank carriage rides had the unanticipated effect of causing hydraulic suction to form between the carriage and the bottom of the channel. This made it much more difficult to move the carriage, resulting in numerous mis-stamps. A counter-example involved changing the brass rack from rack No. 65, which closely matched the stamping interval used to produce border design No. 333 but which had shallowly cut teeth, with brass rack No. 53, which only approximated the stamping interval but had deeper, more triangular teeth. This change made no perceptible difference in the feel of the blank carriage's catch lever engaging with the brass rack's teeth, defying the expectation that the deeper, sharper teeth would create a more pronounced tactile impression of the lever tooth's engagement.

Phenomenology and the Die-Stamping Machine

Experimental operation of the die-stamping machine focused on carriage movement and cadence. The machine's belt drive and flywheels kept it in constant motion, making one stamp impression per revolution of the driveshaft. Experimental work with the machine suggests the shaft probably turned at a rate of between 30 and 60 revolutions per minute. Since the steel carriage block's mass abstracted the tactile sensation of the catch lever engaging with

the brass rack's teeth, depressing the catch lever at each movement interval, as was necessary when moving the carriage from left to right, created a more pronounced tactile engagement. Operational practice contributed to the machine's hermeneutic reality. Multiple sensory engagements with the die-stamping machine contribute to the operator's perception of its rhythm in operation. The visual dimension most directly related to the type piece, at least spatially, was the stamping piston's oscillation. However, watching the bottom of the stamping piston move was difficult because of the low height of the machine's display table at the museum. This speaks to another dimension of the ergonomics of this machine, but varying the bench height was not part of the experimental investigations for this study. Other sensory impressions proved more practical in apprehending the machine's cadence. The electric motor used to drive the machine in the operational experiment would bog down with each stamping impression as it drove the stamp face into the end-grain wood, providing an audio cue to facilitate this "reading" of rhythm. In the machine's original context in Hamilton's type shop, its leather drive belt may have provided a similar auditory prompt as it sagged and rebounded against the drive wheels.

Once an operator achieved sufficient tactile familiarity with the moving carriage, and no longer had to visually monitor the carriage and brass rack in order to achieve the proper intervals of movement, he was free to find other visual cues to apprehend the machine's cadence. One such cue that readily presented itself during the operational experiment, being directly at eye level, was a pair of machine marks on the crank pin's external face. One of these

marks was the center point dimple from the lathe that turned the pin. The other was a very pronounced punch mark, slightly offset from the lathe center, which had probably been added to show the crank arm's orientation. This mark would be in the 4 o'clock position on each of the machine's revolutions just as the die stamp was about to engage with the wood blank, and at 6 o'clock when the piston was at the bottom of its stroke. This visual sign could be used to read the machine's rhythm, allowing the operator to focus more attention on other sensory impressions, such as those related to moving the carriage. With the machine running at 30 revolutions per minute, stamping each four-inch border piece in this study's experimental archaeology component became a relaxed, if repetitive experience.

Social Relations in Wood Type Border Manufacture

There are several border designs incorporating the same stamp shape, stamped as mirror images along the top and bottom edges of the type piece. Border No. 138 is an example, with half-circle shapes stamped along the top and bottom of the type piece in precise symmetry. The die-stamping machine afforded two approaches to rendering these symmetrical rows of stamps. In one approach, the operator could set the machine up for running the blank through with the stamping die in one orientation, then rotate the die 180 degrees and adjust the carriage base's lateral positioning to make the second stamping pass. A much easier approach is to set the die up once in an offset position, make a stamping pass along one edge of the wood blank, rotate the piece 180 degrees, and make a second stamp run along the other edge. For this to work in a way

that maintains the border's symmetry, the wood blanks must be cut to precisely match the stamps' modulus, as prescribed by the brass rack, so that each series of stamped impressions stretches precisely from the left to the right edge of the type piece.³ This reality ties the work of the die-stamping machine operator to the work of the cut-to-line saw operator: a technologically bound social relationship. To use Marx's terminology, the cut-to-line saw operator "works into the hands" of the die-stamping machine operator.⁴

Another example of a technologically bound social relationship in border stamping involves the brass racks that set the interval for the wood blank carriage's motion. A machinist would have fabricated these racks elsewhere in the Hamilton works, apart from the type shop. The work of the machinist, in the form of the brass racks, contributed to the technological structure of the die-stamping machine operator's work in a way that was analogous to the way the patternmaker's work, in the form of letterform patterns, contributed to structuring the type cutter's work with the pantograph router.

Evidence of Complexity in Wood Type Border Specimens

Matching the shapes on the stamping dies used to make decorative wood type border with the shapes that appear as negative space within the various border designs advertised in Hamilton's specimen books provides insight into

³ Precision in wood-blank cutting was beneficial for producing all border designs, but if a design did not involve symmetrically stamped shapes, a too-long wood blank could be cut to the proper length after stamping.

⁴ Karl Marx, *Capital: A Critique of Political Economy*, trans. Samuel Moore and Edward Aveling (New York: The Modern Library, 1906), 369.

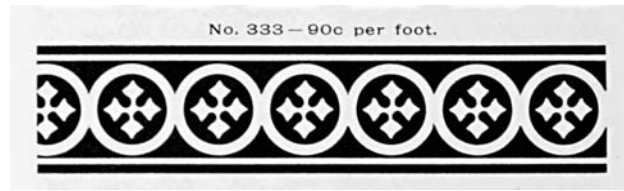


Fig. 6.3: Border No. 333

Border No. 333, one design emulated during experimental trials with the die-stamping machine, required only one pass through the machine. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

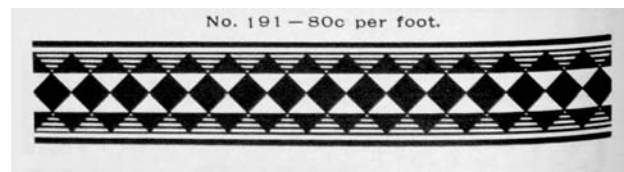


Fig. 6.4: Border No. 191

Border No. 191 required four passes through the die-stamping machine and two different die stamps. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

the relative complexity of the work process that produced each design. Design No. 333 (Fig. 6.3), the design emulated in the first two phases of the die-stamping machine's experimental operation required only one pass through the die stamping machine using artifact S-034, then two passes on the table saw to render the rule lines along the edges of the border piece. By comparison, producing design No. 138 (Fig. 6.2) would have required three stamping passes using two different die stamps (Artifacts S-019 and S-133), followed by the circular saw work. Additionally, the operator would have had to recalibrate the machine as part of the transition from the arch shape to the diamond shape.

Design No. 191 (Fig. 6.4), advertised in Hamilton's 1899 and 1905 catalogs, utilized two different stamps (Artifacts S-006 and S-126), one producing a solid triangle, the other a triangle of the same size, broken into lines running parallel to its base, in two different orientations, to produce an argyle-pattern border design. The broken triangle shapes run along the bottom of the border piece, peak upward, and in inverted orientation along the top. Manufacturing design No. 191 required passing each wood blank through the stamping machine four times, one for each stamp in each of its orientations. This design, too, included parallel lines running along the top and bottom edges of the type pieces, cut using the star blade and table saw. Hamilton's 1899 and 1905 catalogs advertise design No. 60 (Fig. 6.5) on the same page with No. 191. This simpler design has the same parallel lines across top and bottom (these being wider than the lines in No. 191), and a single row of stamped shapes (stamped using Artifact S-028), set widely apart down the middle of the border. Thus, this border design required only one pass through the stamping machine, and fewer stamp repetitions on each pass because of the wider spacing interval, than were required for each stamping pass for No. 191.

In 1899, Hamilton advertised both design No. 191 and design No. 60 at the same price of 80 cents per foot, indicating the relative amount of stamping machine work required to produce the different border designs did not factor into pricing considerations. Rather, price transitions in the catalog correlate with changes in border width. Nos. 191 and 60 were both four lines thick and thus sold for the same price. No. 186 (Fig. 6.6), a design requiring two stamping runs to render two different shapes, was three lines wide and sold for 70 cents

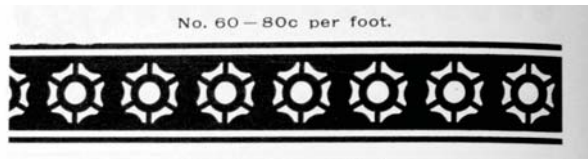


Fig. 6.5: Border No. 60

Producing border No. 60 required fewer stamping passes and fewer stamping impressions per pass than No. 191, and required only one stamping die. But the two designs sold for the same price. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

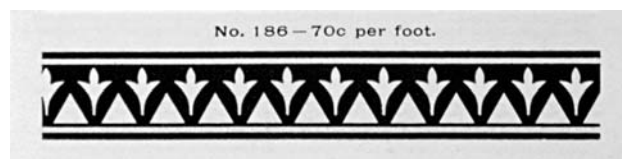


Fig. 6.6: Border No. 186

Producing border No. 186 required two passes through the die-stamping machine using two different stamping dies. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

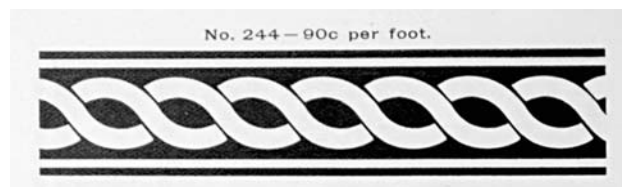


Fig. 6.7: Border No. 244

Border No. 244 required only one pass through the die-stamping machine using one stamping die. It had a higher price than No. 186 because it was wider and therefore required more material to make. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

per foot, as did the rest of the three-line border advertised in the 1899 catalog. Five-line borders, including designs such as Nos. 244 (Fig. 6.7) and 333 (each requiring only a single run through the die-stamping machine), sold for 90

cents per foot in 1899. The borders' prices were tied to material usage (i.e., width) rather than labor input.

Hamilton priced its decorative wood type border by the foot, but it does not necessarily follow that it manufactured border in foot-long lengths. In fact, the preponderance of artifactual evidence points to four inches as the length at which Hamilton manufactured its border type. Among the hundreds of border pieces in the "sample" case at the Hamilton museum, only a few pieces were longer than four inches. None of the border pieces in the museum's printing studio collection were longer than four inches, and pieces shorter than four inches showed evidence of having been cut to a smaller size after their manufacture. The stamping machine and its accessories, too, suggest Hamilton manufactured border type in four-inch-long pieces. None of the brass racks used to gauge the wood blank carriage's movement are long enough to allow the stamping of border pieces any longer than four and a half inches, and a block much more than that would exceed the size of the wood blank carriage. It is possible another carriage assembly existed with the capacity to cut longer pieces of type, but end-grain wood blanks as long as a foot would have been more difficult to come by and would be more prone to warping with changes in humidity. Hamilton type catalogs advertise wood type border as being "cut to labor saving lengths."⁵ Letterpress printing practice relies on the modularity of type, cuts, spacing material, and other components of type forms to allow for design flexibility. Four-inch border pieces, manufactured so that design patterns would cross from one border piece to the next without visible

⁵ Hamilton Manufacturing Company catalogs, 1889, 1899, 1903, 1905.

interruption, fit with the modular character of letterpress printing technology. Manufacturing border pieces in four-inch lengths gave printers the flexibility to construct borders of various dimensions without having to precisely cut their borders.⁶

⁶ It is worth noting in this context that many print shops were equipped with trim saws that could cut wood with a high degree of precision. The Trim-O-Saw was one popular brand. These saws were used for cutting wood spacing material. In cutting a piece of wood border into two parts, however, the saw blade's kerf would produce a discontinuity in the border pattern.

7: Conclusion

This thesis has shown what industrial skill looked like in the manufacture of wood printing type during the late nineteenth and the twentieth centuries. At the same time, it has demonstrated how the concept of industrial skill can frame questions about the human experience of agency within the context of the industrial workplace. Chapter 2 defined industrial skill and described the concept's philosophical underpinnings. Chapter 3 provided necessary historical background about wood printing type's technological use context in the printing offices of the late nineteenth and early twentieth centuries. Most of that chapter was devoted to historical background relating to wood printing type manufacture, in general, and the Hamilton Manufacturing Company, in particular. Chapter 4 expanded the description of wood printing type's technological use context, began to describe the wood type production process, and provided detailed descriptions of the two machines most integrally connected with making wood into wood type. Chapters 5 and 6 then analyzed the work of these two machines' operators within a philosophically derived framework for understanding industrial skill. Now it remains to propose some ways the concept of industrial skill can be used to focus inquiry into the industrial past. This inquiry should be particularly concerned with questions about industrial workers' experience of agency.

Industrial Skill, Revisited

In the type shop at Hamilton Manufacturing Company, Marx's defining characteristics of industrial machines expressed themselves in both the die-stamping machine and the pantograph-mounted router:

Manufacture is characterized by the differentiation of the instruments of labor—a differentiation whereby implements of a given sort acquire fixed shapes, adapted to each particular application, and by the specialization of those instruments, giving to each special instrument its full play only in the hands of a specific detail labourer. The manufacturing period simplifies, improves, and multiplies the implements of labor, by adapting them to the exclusively special functions of each detail labourer.¹

In comparison to the pantograph-mounted router, the die-stamping machine was adapted to a more specific kind of work. Its mechanical structure greatly limited the operator's range of motions and prescribed these motions very strictly. The operator had only to move the carriage from right to left the distance the brass rack determined with each cycle of the stamping piston's movement. The operator's action was a one-dimensional motion, and it remained the same no matter what border design was being manufactured. Switching from one wood blank to the next in time with the machine required dexterity but this action, too, remained the same from one border design to the next. On the other hand, the type cutter moved the pantograph machine in two dimensions, though in motions that were also prescribed in large measure by the mechanical structure of the machinery. In this case, the pattern determined the limits to motion (while the carriage track on the die-stamping machine

¹ Karl Marx, *Capital: A Critique of Political Economy*, trans. Samuel Moore and Edward Aveling (New York: The Modern Library, 1906), 374.

determined the *only* path of motion). The cutting of each type piece took place in two stages: tracing the letterform and then cleaning out the shoulder and counters. The type cutter had more autonomy in the second stage, as her movements no longer had to follow the shape of the pattern. Hamilton's modified-piece-rate pay structure made it advantageous for the type cutter to remove the material from the counters and shoulders in the most efficient way possible, but nothing inherent to the machine's mechanical structure compelled any one type of motion at this stage. Rather, the type cutter's own work practice structured these movements.

In contrast to the die-stamping machine process, wherein the nature of the operator's movements remained fundamentally the same no matter what border design was being produced, the types of movements required in the type cutting process varied, sometimes greatly, from one typeface to another. This had implications for the tactile engagement and tacit knowledge these operations required. The movements of type cutting were always in two dimensions, and the patterns always guided them. But different typeface designs—a script face versus a gothic, for example—entailed different shapes to follow, different curvatures of line, different transitions from rectilinear to curvilinear motion and back again. Within a single gothic typeface, the pattern for a letter 'O' presented a strikingly different set of motions from the pattern for a letter 'T.' A letter like 'D' or 'P' involved two types of motion within the process of cutting a single letter. Such differences were more marked from one typeface to another. Both the pantograph router and the die-stamping machine were, in David Pye's terms, machines of certainty. These machines directed their

operators' movements toward predetermined results: a letterform of a particular shape in the case of the pantograph router, a wood border piece with a particular pattern in the case of the die-stamping machine. In both cases, however, the certainty the machine afforded its operator was contingent on the operator's tactile engagement with the machine. Type cutting's tactile dimension expressed itself in the importance of keeping the pantograph machine's tracer bit in close and continuous contact with the pattern being traced. Failure to do this resulted in irregularities along the typeface's edges that created additional work for type trimmers. The tacit knowledge this engagement required of the operator is analogous to the tacit knowledge the die-stamping-machine operator needed to move the carriage sure-handedly along its track. In contrast to die-stamping wood type border, which involved constantly reading the same tactile feedback from the wood blank carriage as its catch lever engaged with each tooth on the brass rack, the tacit knowledge of type cutting had to encompass a broad range of traced shapes. In both type cutting and die-stamping, the machines structured the operators' work, but different kinds of tacit knowledge emerged from these different processes. From a technological relations standpoint, too, differences manifested between the two operations. The movements involved in die-stamping wood type border, taking place always within one dimension, would have been much more readily embodied than the movements involved in pantograph router operation, which changed in character from one typeface to another and from one letter to the next within the same font.

Workers had to attend to a wide range of factors and variables in industrial wood printing type manufacture. What distinguishes these various factors and this attention from those involved in craft production is that the variables emanate from the machine, and the attention is directed toward the machine more directly than the work piece. In cutting wood type by hand, the printers of the early nineteenth century would have used cutting tools similar to those modern artists use for analogous work, such as making woodcut plates for fine printing. Considerations related to one of these cutting tools include the feel of its handle in the hand, the shape and orientation of its blade, the blade's sharpness. These aspects of the tool are significant only in relation to the material properties of the work piece. The wood's structural qualities—resistance, grain orientation, fiber density—all define the range of possible successful motions for the woodcutter, and the amount of force he/she should exert. The factors influence the way the woodworker holds the tool and manipulates it in order to cut the desired shapes. And this set of considerations emerges from the material relatively directly. In both the pantograph machine and the die-stamping machine, the response to many of these physical considerations has been engineered into the machine. The pantograph machine's router bit spins so rapidly its cutting edge is guaranteed to remove wood. The die-stamping machine's drivetrain, when connected to an adequate source of motive power, guarantees the die stamp's impression into the end-grain border blank (and the stamp itself guarantees the desired shape will be rendered).

Particularly in type cutting with the pantograph machine, physical characteristics of the wooden work piece still emerge in the operator's experience, but the machinery shapes this emergence. For example, the type cutter has to move the tracer bit in a counterclockwise direction, or else the router bit will splinter the work piece. This practical demand was a function of the nature of the wood's grain and the direction of the router bit's rotation. This consequence of the wood's physical structure emerged for the operator through the machine. Similarly, wood's tendency to char compelled the type cutter to work quickly, moving the router bit along before it burned the wood blank. This risk existed because of the fast-spinning router bit. In the manufacture of decorative wood type border, the die-stamping machine operator's attention focused even more squarely on the technology as opposed to the work piece. In moving the carriage the tactile feedback requiring attention—the feel of the catch lever engaging with the brass rack, the friction resistance accompanying the carriage's movement within its track—emerged from the machine's characteristics with little connection to the work piece itself. This work had a pronounced temporal structure emerging entirely from the machine's spinning driveshaft and the cadence of its oscillating stamping piston.

All of this shows how Marx's thoughts on mechanization in manufacture were realized in the type shop:

The machine . . . is therefore a mechanism that, after being set in motion, performs with its tools the same operations that were formerly done by the workman with similar tools. Whether the motive power is derived from man, or from some other machine, makes no difference in this respect. From the moment that the tool proper is taken from man, and fitted into a mechanism, a machine takes the place of a mere implement. The difference

strikes one at once, even in those cases where man himself continues to be the prime mover.²

In the case of the pantograph router, the “tool proper” is the router bit, fitted into the mechanism of the pneumatic router and its pantograph apparatus. The bit, in the industrial manufacture of wood type, served the same purpose hand cutting tools served for the printers who carved wood type letters during the early decades of the nineteenth century. In the manufacture of decorative wood type border, the tool proper was the stamping die, fitted into the die-stamping machine’s reciprocating piston. In both of these cases, the defining characteristic of industrial skill, with regard to the machinery, was that the machine, more than the work piece, was the direct object of manual engagement. This distinction was more completely realized in the die-stamping machine than in the pantograph router. Particularly during the second stage of cutting a piece of type, when the type cutter had already traced the letterform and was removing material from the type’s shoulder and counters, she focused attention on the work piece rather than the pattern, though her actions were transmitted through the articulated arms of the pantograph mechanism. As part of a manufacturing process, these machines provided a constellation of variables requiring attention and response from workers.

Analogous constellations emerged in other, very different forms of industrial work, with workers striking different balances between attention to machine and attention to work piece. Installing windshield glass on the automotive assembly line in mid-twentieth-century Flint, Michigan, the

² Marx, *Capital*, 353-354.

windshield man attended to the mechanics of the lifting mechanism, but also to the spatial considerations required to properly align the glass with the vehicle's windshield opening. Like the die-stamping machine, this work had a temporal structure, but it emerged from the factory as social environment more than from the machine. In this case, the factory itself functioned as something like a machine, with the vehicle's movement through the different stages of the assembly line setting the pace for work. To Ben Hamper, describing his father's work in *Rivethead* (1991), the work looked like this:

A car would nuzzle up to the old man's work area and he would be waiting for it, a cigarette dangling from his lip, his arms wrapped around the windshield contraption as if it might suddenly rebel and bolt off for the ocean. Car, windshield. Car, windshield. Car, windshield. Car, windshield.³

In using a percussive power drill to drill into a body of coal in an early twentieth-century coal mine, the miner's engagement was primarily with his drilling machine and secondarily to physical aspects of the coal itself. For the miner, the coal was effectively the work piece. Technology structured the miner's mode of engagement with the coal: the physics of the dynamite or black powder explosions determined the spacing, depth, and orientation of the miner's drill holes.⁴ Between 1920 and 1970, steelworkers working on the 32-inch rail mill at Bethlehem Steel's plant in Lackawanna, New York had to attend and respond to a range of variables emanating from material and machinery. The mill's rollers revolved at a constant speed, setting the pace of

³ Ben Hamper, *Rivethead: Tales from the Assembly Line* (New York: Warner Books, 1991), 2.

⁴ H.B. Herr and Arthur La Motte, "Drilling and Blasting Coal," in *Drilling and Blasting* (Scranton, Penn.: International Textbook Company, 1922), 17-67.

work. The steel's temperature, one of the factors influencing the rolling operation's success, depended on the activities of workers—the “heater” and his assistant—stationed earlier in the steel rolling process. The rolling mill machine provided the compression power and dimensional control necessary for rolling rails. But the mill's tendency to go out of adjustment during rolling, and the steel's varying chemical composition and temperature demanded the steelworker's attention. Leary described it this way:

In the 32” mill the price of satisfactory rails was eternal vigilance by the roller and crew. Ability to recognize defects and their probable causes was a key part of the roller's job. He had to determine the factors that were affecting the finished rail before he could make corrections for common section and surface defects.⁵

The above examples illustrate how industrial skill, a form of knowledge of practice and manual engagement, emerged from the technological and social environment of the industrial workplace. In each case, machinery stood as an intermediary between the worker and the work piece. The steel roller modified the mill's adjustment to affect change in the steel rail. The miner engaged with the rock through the drill. The windshield installer used the lifting machine in time with the assembly line. In wood printing type manufacture, the pantograph router and the die-stamping machine were the worker's direct point of engagement with the work process. These machines asserted themselves far more strongly than the hand cutting tools that had previously been used to do the same kind of work at a craft production scale. The knowledge and acquired

⁵ Thomas Leary, “The Work of Rolling Rails at Bethlehem Steel's Lackawanna Plant: Industrial Archeology and Labor History,” *IA: The Journal of the Society for Industrial Archeology* 16, no. 1 (1990), 51-53.

bodily capacity associated with working with these machines in these contexts emerge in such strong association with defining characteristics of industrialized work—mechanization and division of labor—that these forms of manual engagement must be called *industrial* skill.

Industrial Skill as Manual Engagement

In *Shop Class as Soulcraft*, Matthew Crawford makes a compelling case for the value of manual trades as enriching human enterprise. He uses the work of automotive mechanics, industrial electricians, and other tradespeople to explore humanistic dimensions of manual work—that is, those aspects of manual work that in his words contribute to “human flourishing.”⁶ Crawford contrasts the manual engagement of trades work with the detached abstraction of the modern “knowledge economy” and its attendant computer-saturated and virtualized work environment. In this passage, which effectively captures his central thesis, Crawford uses the example of a carpenter to demonstrate the cognitive dimensions of manual work:

At the beginning of the Western tradition, *sophia* (wisdom) meant “skill” for Homer: the technical skill of a carpenter, for example. Through pragmatic engagement, the carpenter learns the different species of wood, their fitness for such needs as load bearing and water holding, their dimensional stability with changes in the weather, and their varying resistance to rot and insects. The carpenter also gains a knowledge of universals, such as the right angle, the plumb, and the level, which are indispensable for sound construction. It is in the crafts that nature first becomes a thematic object of study, and that study is grounded by a regard for human utility.⁷

⁶ Matthew Crawford, *Shop Class as Soulcraft: An Inquiry into the Value of Work* (New York: Penguin Press, 2009), 64.

⁷ *Ibid.*, 21.

Much of the immediately apparent strength of Crawford's argument derives from the level of complexity such work as carpentry entails, represented in the passage quoted above by properties of wood and geometry that change from project to project. Part of a passage he quotes from a nineteenth-century wheelwright's memoir, in which the wheelwright describes wood characteristics, captures the dynamic character of the tradesperson's cognitive environment:

Knots here, shakes there, rindgalls [deformations from tree wounds], waney edges (edges with more or less bark on them), thicknesses, thinnesses, were for ever affording new chances or forbidding previous solutions, whereby a fresh problem confronted the workman's ingenuity every few minutes.⁸

In wood printing type manufacture, these properties of wood had effectively been removed as considerations by the time the work pieces arrived at the type-cutting or die-stamping workstations. The machines themselves nullified other variables such as the spatial positioning of the work pieces, the directions of operators' movements, and the pace of work. Such routinization of work, actively pursued by industrialists of the early twentieth century and eventually codified in Taylorism, would seem to disqualify industrial work as a species of cognitively rich enterprise. Indeed, Crawford invoked Braverman's *Labor and Monopoly Capital* (1974) by name in identifying the Taylorist logic, and its manifestation within the industrial workplace, as a primary agent in "the separation of thinking from doing."⁹ By breaking up the steps involved in

⁸ George C. Sturt, *The Wheelwright's Shop* (Cambridge: Cambridge University Press, 1993), 45, as quoted in Crawford, *Shop Class*, 41.

⁹ Crawford, *Shop Class*, 37-53.

manufacturing an article into separate, smaller tasks, each assigned to a separate individual in a work process, the division of labor reduces the aggregate cognitive complexity the job had previously required of one individual.

This thesis does not dispute this Marxist perspective on the division of labor's deskilling effect on work. But chapters 5 and 6 demonstrate the complexity in workers' engagement with mechanized, though pre-Taylorist, methods of wood type manufacture. Fundamentally, the question involved here is not one of complexity. What makes industrial skill significant, particularly when considered alongside modern-day "knowledge work," is the basic manual engagement that remained a part of work in wood type manufacture and other industries. Martin Heidegger's *Being and Time*, and its radical refutation of the solipsistic philosophical tradition, is useful in making this significance clear on an ontological level. While the solipsistic tradition views the existence of a world external to the individual mind to be uncertain, Heidegger and the philosophers who followed in his footsteps held our situation in a physical, external world to be a fundamental aspect of being.

Crawford works from Heidegger and some of the philosophers Heidegger influenced in his chapter titled "To Be Master of One's Own Stuff," where he asserts that,

Thinking about manual engagement seems to require nothing less than that we consider what a human being is. That is, we are led to consider how the specifically human manner of being is lit up, as it were, by man's interaction with his world through his hands.¹⁰

¹⁰ *Ibid.*, 63-64.

This statement resonates well with Heidegger. According to his perspective, manual engagement with one's external, physical surroundings is a salient characteristic of our "being-in-the-world." Heidegger wrote, "The nearest kind of association is not mere perceptual cognition, but, rather, a handling, using, and taking care of things which has its own kind of knowledge."¹¹ He relates this nearness of association using his famous example of the hammer: "The less we just stare at the thing called hammer, the more actively we use it, the more original our relation to it becomes and the more undisguisedly it is encountered as what it is, as a useful thing."¹² From this statement it is clear that to Heidegger true knowledge of a useful thing comes through using it. This knowing a thing through use is a "pre-thematic" knowing—a knowing primarily through practical, as opposed to intellectual, engagement with the useful object. This kind of knowledge also fits Polanyi's description of tacit knowledge. For Crawford, the important aspect of this being in relation to useful things is that it entails a structure outside of the self that gives rise to a particularly potent form of agency. The useful thing, be it Heidegger's hammer or the pantograph-mounted router, calls forth something from a person, and on terms that person does not entirely define. "In any hard discipline," Crawford writes, "Whether it be gardening, structural engineering, or [learning the] Russian [language], one submits to things that have their own intractable ways."¹³

¹¹ Martin Heidegger, *Being and Time*, trans. Joan Stambaugh (Albany, New York: State University of New York Press, 1996), 63.

¹² *Ibid.*, 67.

¹³ Crawford, *Shop Class*, 65.

The idea of submission to external, structuring reality still further resonates with philosopher Albert Borgmann's concept of "commanding reality." He uses music making as an example of a "focal practice" occurring within a technologically derived structure:

The stereo as a *device* contrasts with the instrument as a *thing*. A thing, in the sense in which I want to use the term, has an intelligible and accessible character and calls forth skilled and active human engagement. A thing requires practice while a device invites consumption. Things constitute commanding reality, devices procure disposable reality.¹⁴

Borgmann's "things," Crawford summarizes, "convey meaning through their own inherent qualities."¹⁵ The musical instrument is part of "commanding reality" whereas the stereo (and Crawford adds the iPod) is part of "disposable reality." An instrument is commanding reality because it structures the practice of the musician. On oboe, for example, "commands" the oboist to depress the right combination of keys and blow air past its reed in the right way in order to produce the desired tone and volume of sound. It calls forth his/her abilities in terms that are not his/her own and involves a participatory element not present in playing a compact disc.

If, as Heidegger holds, our most original relation to useful things is realized through using them, and this original association is a species of our broader association with an external physical reality that is fundamental to our *being-in-the-world*, then relation to industrial machines like the die-stamping

¹⁴ Albert Borgmann, *Power Failure: Christianity in the Culture of Technology* (Grand Rapids, Mich.: Brazos Press, 2003), 31, as quoted in Crawford, *Shop Class*, 65-66, emphasis added.

¹⁵ Crawford, *Shop Class*, 65.

machine or the rivet gun or the rock drill is fundamental to industrial workers' *being-in-the-factory*: a way of being-in-the-world singularly derived from industrial work, and tied to its particular structuring context. This structure emerged from technologies, such as the die-stamping machine that strictly limited and defined its operator's actions. It emerged from the social environment of the factory, like the steel mill where the metal's temperature affected the success of the steel rail rolling and depended on the work of operatives whose work occurred earlier in the process. Social relationships and technological structure manifested simultaneously in wood type cutting, wherein the work of the patternmaker became part of the technological structuring of the type cutter's work. These work environments demanded a singular form of tacit knowledge and manual engagement from industrial workers.

Industrial Skill, Industrial Heritage

Skill is a physical and cognitive trait assigned high value in society, one that in recent years has been increasingly recognized as a form of intangible cultural heritage. To date, skill in production and manufacture has typically been highly valued and recognized only so long as it fits cultural definitions of "craft" or "artisanal" skill. "Industrial skill," as a concept, presents challenges to the commonly held beliefs and value systems associated with skill. The mechanization and division of labor that are defining characteristics of industrial production processes have been viewed in popular culture and in

Marxist social theory as threats to skill—indeed, they are studied as “deskilling”—and as impediments to human agency.

Increasingly, particularly within academic circles, heritage is being understood not as a thing but as a process: specifically, a process of creating meaning. As Rodney Harrison puts it, “Humans and non-humans are linked by chains of *connectivity* and work together to keep the past alive in the present for the future.”¹⁶ Critical heritage studies forefather Richard Lowenthal emphasizes heritage’s narrative-building project as being quite different from history’s:

Heritage is not history at all; while it borrows from and enlivens historical study, heritage is not an inquiry into the past but a celebration of it, not an effort to know what actually happened but a profession of faith in a past tailored to present-day purposes . . . The heritage fashioner, however historically scrupulous, seeks to design a past that will fix the identity of some chosen individual or folk.¹⁷

Lowenthal’s use of the word “folk” is almost ironic here, given he argues elsewhere that folk, as in “common folk,” are seldom in control of the heritage process. Rivetheads seldom get to play a prominent role in heritage narratives or in crafting them: “Populism notwithstanding, heritage normally goes with privilege: elites usually own it, control access to it, and ordain its public image.”¹⁸

Also standing in the way of the recognition of industrial skill as a form of intangible cultural heritage is a set of biased cultural associations akin to those

¹⁶ Rodney Harrison, *Heritage: Critical Approaches* (New York: Routledge, 2013), 4-5, emphasis in original.

¹⁷ David Lowenthal, *The Heritage Crusade and the Spoils of History* (New York: Cambridge University Press, 1998), x-xi.

¹⁸ *Ibid.*, 90.

creating dissonance between routinized labor and the idea of skill, itself. Cultural expressions abound which negatively portray industry, particularly from the late nineteenth and early twentieth centuries, when Americans were still becoming acclimated to life during the Industrial Revolution. In “The Paradise of Bachelors and the Tartarus of Maids” (1855), Herman Melville’s textile workers are depicted as sunken-cheeked wraiths, their souls depleted by the industrial work environment and its machinery.¹⁹ In “Modern Times” (1936), Charlie Chaplin’s “little tramp” character becomes a victim of mass production, literally churned through the gears of industrial machinery.²⁰ In Lewis Hine’s famous Works Progress Administration photograph “Power House Mechanic Working on Steam Pump” (1920), industrial work is portrayed in a positive, even romantic light. But the mechanic is bent over, humbled before the cast-iron machinery.²¹ The positive light cast on the mechanic is attached to his strength and masculinity; Hine’s gaze does not account for the mechanic’s understanding of the steam pump’s operation, or his kinesthetic relationship with the bolt he is tightening. The photograph does not depict skill, just as the other cultural expressions described here confound any association between valued skill and demonized industry.

Among the five domains in which intangible cultural heritage manifests, according to the United Nations Educational Science and Cultural Organization

¹⁹ Herman Melville, “The Paradise of Bachelors and the Tartarus of Maids,” in *Great Short Works of Herman Melville* (New York: Harper & Row, 1962), 210-222.

²⁰ Charlie Chaplin, *Modern Times*, directed and performed by Charlie Chaplin (Los Angeles: United Artists Films, 1936), film.

²¹ Lewis Hine, *Power House Mechanic Working on Steam Pump*, 1920, Photograph, 13¾ x 9 ¾ in., Brooklyn Museum, Brooklyn, New York.

(UNESCO) Convention for the Safeguarding of Intangible Cultural Heritage, the domain most closely related to skill is “traditional craftsmanship.”²² Thus, the convention explicitly privileges skills of the craft and artisanal variety, and would seem to necessarily exclude industrial skill. A representative example of a skill-based practice UNESCO recognizes as intangible heritage that is particularly relevant to this thesis is “Wooden Moveable Type Printing of China,” which UNESCO inscribed onto its Representative List of the Intangible Cultural Heritage of Humanity in 2010. The process resembles DeVinne’s 1902 description of wood type manufacture as it was conducted in the early nineteenth century by printers using hand cutting tools: the craftsman traces a letterform in black on a block of wood, then cuts away the surrounding material, leaving the character in relief.²³ This is emphatically hand work, epitomizing what Pye calls the workmanship of risk. Another production process inscribed as intangible cultural heritage under the convention has the division of labor, but little else, in common with industrial manufacturing processes: “Traditional Skills of Carpet Weaving in Kashan, Iran,” in which yarn spinning, yard dying, yarn drying, and the actual weaving of carpets are performed in separate workspaces by separate people. UNESCO’s rationale for granting this process recognition as intangible heritage invokes “traditional craftsmanship” along with “knowledge and practices concerning nature and the

²² UNESCO, 2003, “Convention for the Safeguarding of Intangible Cultural Heritage,” <<http://www.unesco.org/culture/ich/index.php?lg=en&pg=00006>>, accessed 20 April 2015.

²³ UNESCO, “Wooden Movable-Type Printing of China,” <<http://www.unesco.org/culture/ich/index.php?lg=en&pg=00011&USL=00322>>, accessed 20 April 2015.

universe” (relating here to knowledge of various types of wool and their location on the sheep).²⁴

By narrowly defining heritage-worthy skill in a way that so explicitly privileges handicraft, UNESCO ignores a category of skill—industrial skill—that has been a salient dimension of life and livelihood for a broad swath of humanity. The International Committee for the Conservation of Industrial Heritage (TICCIH) defines industrial heritage in a way that is more potentially inclusive of industrial skill. According to the Joint ICOMOS-TICCIH Principles for the Conservation of Industrial Heritage Sites, Structures, Areas and Landscapes (“The Dublin Principles”), industrial heritage

includes both material assets—immovable and movable —, and intangible dimensions such as *technical know-how*, the organization of work and workers, and the complex social and cultural legacy that shaped the life of communities and brought major organizational changes to entire societies and the world in general.”²⁵

Industrial skill is part of the human experience of a force—industrialization—that has had profound effects in shaping the modern world. Industrial skill may not be in immediate danger of disappearing from existence, but in many places it is in danger of fading from consciousness. In some parts of the world it is vulnerable to the continued progress of automation in manufacture, and in others it falls victim to more general forces of deindustrialization.

²⁴ UNESCO. “Traditional Skills of Carpet Weaving in Kashan,” <<http://www.unesco.org/culture/ich/index.php?lg=en&pg=00011&RL=00383>>, accessed 20 April 2015.

²⁵ TICCIH-ICOMOS, 2011, “Joint ICOMOS-TICCIH Principles for the Conservation of Industrial Heritage Sites, Structures, Areas and Landscapes,” emphasis added, <<http://ticcih.org/about/about-ticcih/dublin-principles/>>, accessed 3 May 2015.

A Role for Industrial Archaeology

With its demonstrated engagement with the technological, built, and social environments of the industrial era, industrial archaeology as a discipline is well positioned to help provide a more complete picture of the industrial past, as it relates to workers, than the one that emerges from popular culture and authorized heritage narratives. Industrial skill, by recognizing the manual engagement industrial work entails, provides a useful framework for doing this work. Inquiry into industrial skill compels a focus on the people who were involved in industrial work, providing an opportunity to counter industrial archaeology's tendency, as a discipline, to focus intrinsically on buildings and machines. Over the course of 38 volumes of *IA: The Journal of the Society for Industrial Archaeology*, spanning 1975 to 2014, articles focused on structures, machines, and technological systems outnumbered articles focused on workers by greater than a seven-to-one ratio (see Table 7.1). Chapter 1 of this thesis referred to exceptions to this tendency in the work of industrial archaeologists such as Thomas Leary and Patrick Malone. And historical archaeologists have paid great attention to workers' home-life conditions in company towns and other industrial communities, but industrial skill, as a subject for archaeological inquiry, provides an impetus for broader attention to past workers' lives *inside* the factory.²⁶

²⁶ For an example of historical archaeology focused on life in industrial communities, see Stephen Mrozowski, *et al.*, *Living on the Boott: Historical Archaeology at the Boott Mills Boardinghouses, Lowell Massachusetts* (Amherst, Mass.: University of Massachusetts Press, 1996).

Table 7.1: Industrial Archaeology and Workers

The table shows results of a survey of article titles in *IA: The Journal of the Society for Industrial Archeology* from 1975 to 2014. The “Buildings & Structures” category includes bridges. The “Workers” category includes all articles with titles suggesting that workers, individually or collectively, are the article’s central focus. The “Other” category includes articles about archaeological practice and methodology, “state of the field” essays, landscape-scale and regional surveys, and other subjects that did not fit neatly into other categories. The journal’s periodic “I.A. in Art” theme issues added substantially to the tally in this column.

Subjects of Articles in IA: The Journal of the Society for Industrial Archeology, Vols. 1 - 38							
Volume Range	Building or Structure	Machine , Tech. or Tech. System	Process	People Other Than Workers	Workers	Other	Total Number of Articles
1 - 5 (1970s)	12 (54%)	4 (18%)	1 (5%)	1 (5%)	0 (0%)	4 (18%)	22
6 - 15 (1980s)	16 (35%)	4 (9%)	6 (13%)	1 (2%)	7 (15%)	12 (26%)	46
16 - 25 (1990s)	20 (32%)	8 (13%)	12 (19%)	3 (5%)	2 (3%)	18 (28%)	63
26 - 35 (2000s)	21 (27%)	10 (13%)	5 (6%)	3 (4%)	3 (4%)	35 (44%)	77
36 - 38 (2010s)	3 (14%)	4 (19%)	0 (0%)	3 (14%)	2 (10%)	9 (43%)	21
Totals	72 (31%)	30 (13%)	24 (11%)	11 (5%)	14 (6%)	78 (34%)	229

Industrial skill’s rootedness in physical and technological contexts presents challenges to its preservation as a form of intangible cultural heritage and to its interpretation for the public. Significant among these characteristics is the scale of an industrial works. The Tamarack reclamation plant on the Torch Lake shore in Houghton County, Michigan, where Bernie Schmitt exercised his tacit knowledge based on the sound of stamp sand being re-

ground in ball mills, was a giant facility.²⁷ Reconstructing and operating even one ball mill—and the reclamation plant held several mills, to say nothing of the processing equipment preceding and following them—would be a thoroughly impractical enterprise. Models and animations can effectively convey spatial relationships within a factory and the mechanical movements of machines, but industrial skill is so strongly embodied and so strongly situated in a physical, technological environment that it cannot be effectively preserved by these means. Fortunately, smaller-scale machines exist that manifest salient dimensions of the industrial work experience and present opportunities for preserving and interpreting industrial skill. The die-stamping machine at the Hamilton Wood Type & Printing Museum is one example. And the museum is to be commended for its efforts to preserve the skills associated with wood type production through an apprenticeship program in which museum volunteers are learning skills from the same type shop workers who provided oral histories for this thesis. Similar efforts should be made wherever practical to preserve the specialized, embodied knowledge of participants in past industry who are still living.

Efforts along these lines will reward industrial archaeologists and heritage professionals with the opportunity to relate questions of interest within their fields to a broader and interested public audience. The popularity of Crawford's book, a *New York Times* bestseller, is evidence of public interest in these themes of manual engagement and human agency within technologically structured work. An anecdotal example of this interest relates directly to

²⁷ Oral history interview with Bernie Schmitt, 14 November 2014.

letterpress printing, which has been vigorously revived within the past few decades as a form of artisanal printing. The Hamilton museum's annual Wayzgoose, styled after printer's social gatherings of the nineteenth century and prominently featuring participatory printing workshops, annually draws upwards of 200 letterpress enthusiasts to a remote city in northern Wisconsin.²⁸

This public interest affords new meanings to the material remains of past industry, whether they be machines that structured workers' agency directly like the pantograph-mounted routers and die-stamping machine, or machine mounts in the floor of a factory that speak to how work was divided and spatially structured, or even mill tailings in Torch Lake that relate to Bernie Schmitt's work experience at the Tamarack reclamation plant. Industrial skill, as a concept related to human agency, provides a powerful lens for interpreting the industrial past.

²⁸ The author attended Wayzgoose gatherings at the Hamilton Wood Type & Printing Museum in 2012 and 2014. Attendance at each event exceeded 200 people.

Appendix A

Experimental Archaeology

Fieldwork for this thesis consisted primarily of an archaeological experiment with the die-stamping machine that was used to make decorative wood type border at the Hamilton Manufacturing Company. Experimental archaeology has been employed in various contexts as a methodology for exploring past cultural practices. This includes inquiry into past production processes going all the way back to flint-knapping techniques used to make stone tools during the Paleolithic era. Though it was published in 1979, John Coles's *Experimental Archaeology* remains the standard work surveying this archaeological subdiscipline.¹

Archaeological experiments involving pottery kilns have sought to provide insight into kiln firing techniques, but have also addressed other questions. Geoffrey Bryant, for example, used experimental archaeology to test the practicability of different hypothetical superstructures for medieval pottery kilns,² while B.N. Hartwell built a replica of a medieval kiln to provide data for reinterpreting archaeological investigations of kilns from the same general time period.³ Metal smelting experiments have explored technological aspects of furnace design and construction, along with other dimensions of the smelting

¹ John M. Coles, *Experimental Archaeology* (New York: Academic Press, 1979).

² Geoffrey Bryant, "Experimental Kiln Firings at Barton-on-Humber, S. Humberside 1971," *Medieval Archaeology* 21 (1977), 106-123.

³ B.N. Hartwell, "The Experimental Firing of a Replica Double-Flued Kiln Based on an Excavated Medieval Example from Downpatrick," *Ulster Journal of Archaeology* 56 (1993), 152-162.

process such as fuel consumption and furnace firing techniques. Examples include Henry Cleere's,⁴ Peter Crew's,⁵ and Carl Blair's⁶ experiments with low-, mid-, and tall-shaft smelting furnaces, respectively.

Experimental industrial archaeology work has focused particularly on different facets of machinery in industrial manufacturing processes. Robert Gordon and Patrick Malone describe some examples. One involves experiments with a replica of Thomas Blanchard's irregular lathe, famous as an early example of a self-acting machine. The experiments revealed skills and specialized knowledge the machine operator had to have to successfully set the lathe up for work.⁷ Experimental operation of a Lincoln milling machine at the National Museum of American History examined wear rates of the machine's cutting tool and their implications for machine shop practice in the nineteenth century.⁸

An archaeological experiment that parallels the die-stamping machine experiment in surprising ways is the Trireme Project. The trireme was an ancient Greek sail- and oar-powered warship with three tiers of rowers. Between 1987 and 1994, sea trials of *Olympias*, a reconstruction of a trireme, revealed how different aspects of the vessel's physical construction may have structured the rowing practice of ancient Greek oarsmen. This archaeological experiment differed dramatically in context and scale from the experimental

⁴ Henry Cleere, "Ironmaking in a Roman Furnace, *Britannia* 2 (1971), 203-217.

⁵ Peter Crew, "The Experimental Production of Bar Iron," *Historical Metallurgy* 25 (1991), 21-36.

⁶ The author's knowledge of Carl Blair's work on the "Smelt!" project derives from a directed study with Blair during fall term of 2014.

⁷ Gordon and Malone, *The Texture of Industry*, 363-365.

⁸ *Ibid.*, 349-351.

operation of the die-stamping machine, but Boris Rankov's description of the project's findings relating to rowing skill resonate with the die-stamping machine experiment's central subject of inquiry. One example relates to the way the rowers timed their oar strokes. Rowers on Olympias's upper tier, who were above deck, had relatively unrestricted views and therefore access to diverse visual cues that helped them properly locate and time their oar strokes. Rowers on the two tiers below had almost no visual basis for timing their strokes. Located below deck, their view of the sea surface was restricted to what they could see through their oar holes, on either side of their oars. The hull's timber framing obstructed these lower rowers' views of each other. They therefore had to rely on other sensory feedback. During one year's sea trials, this included outfitting the hull of the ship with loudspeakers to broadcast a stroke caller's voice.⁹ This relates strongly to the hermeneutic aspects of operating the die-stamping machine described in Chapter 6 of this thesis.

Experiment Design

The experiment's design addressed two basic questions: first, how the machine works mechanically, and second, how it structured its operator's work experience in the manufacture of decorative wood type border. The experiment was conducted in three phases during late February and early March of 2015 at the Hamilton Wood Type & Printing Museum in Two Rivers, Wisconsin. Each phase consisted of a series of stamping runs involving putting a set number of

⁹ Boris Rankov, "Rowing Olympias: A Matter of Skill." In *The Trireme Project: Operational Experience, 1987-1990: Lessons Learnt*, ed. Timothy Shaw (Oxford: Oxbow Books, 1993), 50-57.

wood test blanks (usually 10 or 30) through the machine in imitation of the die-stamping process Hamilton's type shop workers would have followed in making decorative wood type border. Each experimental stamping run concluded with photographic documentation of the resulting stamped wood blanks and recorded observations about the machine's operation. Field notes emphasized the tactile and other sensory feedback the machine produced which would have had bearing on a worker's interactions with the machine.

Assessment of the quality of the results was based on the hypothetical printability of the stamped wood test blanks. A stamped test blank was deemed "acceptable" if it had all of the stamp impressions that its referent border design required, in proper alignment and in uninterrupted sequence. Figure A.1 shows the results of a stamping run that yielded 8 acceptable blanks. A blank with missed stamping impressions (such as the fourth blank from the left in Fig. A.1), or improperly overlapping stamp impressions (such as the sixth blank from the left in Fig. A.1), would not have been useable for printing, even if its surface were properly finished and sealed.¹⁰

Phase 1 of the experiment involved a series of 27 short, 10-piece stamping runs to investigate the different modes of operation the die-stamping machine's mechanics permitted, and inform interpretations about how the machine was most likely used in practice. Short stamping runs served not only to conserve maple test blanks, but also to abbreviate the elapsed time between field note

¹⁰ In some cases where an operator missed a stamping impression during actual border production at Hamilton, he could have realigned the machine's carriage after the stamping pass to render the missing stamp. This practice was disallowed during the experiment to provide a more accurate picture of the level of risk, in David Pye's terms, involved in operating the machine.

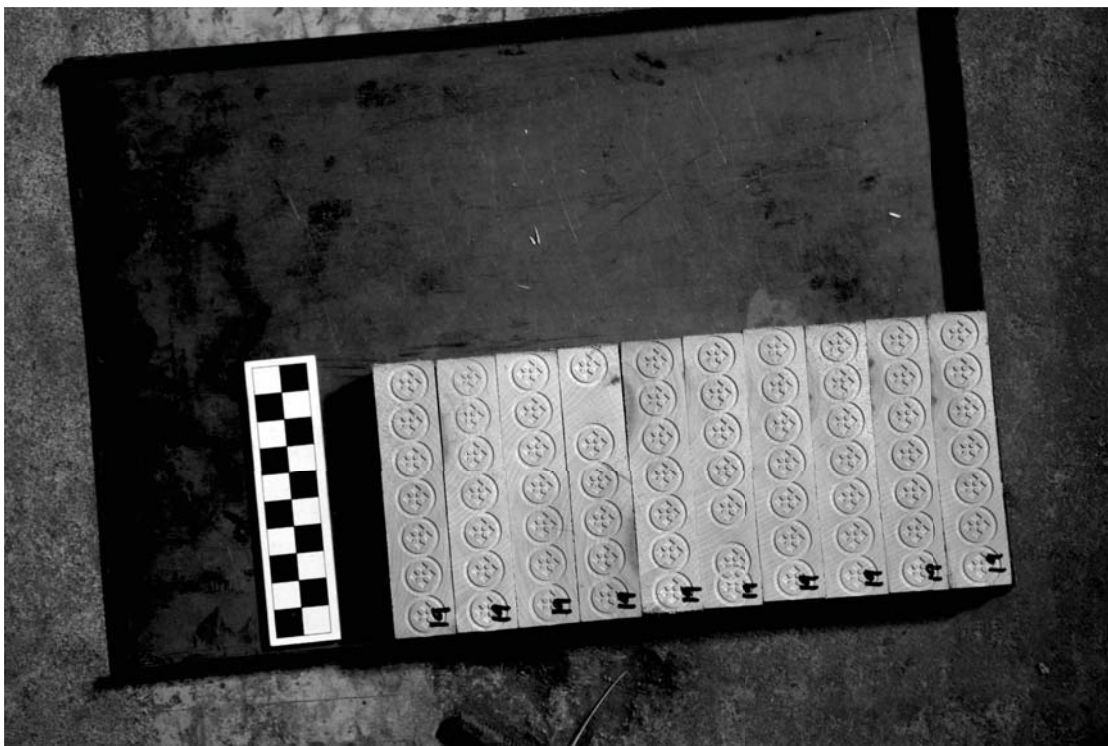


Fig. A.1: Stamped Wood Blanks

This photograph shows a run of stamped blanks from Phase 1 of the archaeological experiment. Photograph by author.

recording sessions, facilitating more detailed descriptions of different facets of the operator's experience.

Phase 2 of the experiment involved longer, timed test runs of 30 blanks each. This number corresponds to the number of pieces required to make 10 feet of border, as Hamilton advertised in its type specimen books: "Ten feet of border and one set of corners required for full sheet."¹¹ This phase of the experiment provided insight into the operator's work experience in longer, production-scale stamping runs. Both phase one and phase two of the

¹¹ Hamilton Manufacturing Company Type Catalog No. 15, 1893. It is not clear what is meant by "a full sheet," but 10 feet of border, with corners, would produce a rectangular frame approximately two feet wide and three feet high.

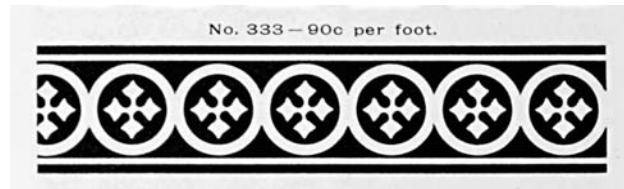


Fig. A.2: Border Design No. 333

Border design No. 333, revisited. This is the design that was emulated in phases 1 and 2 of the archaeological experiment. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

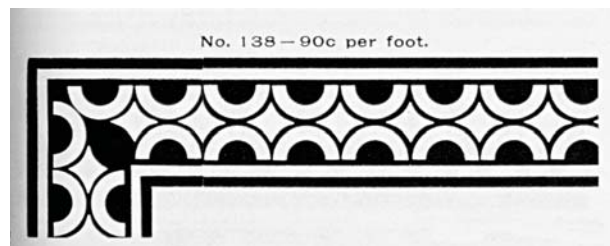


Fig. A.3: Border Design No. 138

Border design No. 138, revisited. This is the design that was emulated in Phase 3 of the archaeological experiment. (Hamilton Manufacturing Company Catalog, 1903, Courtesy RIT Cary Graphic Arts Collection)

experiment imitated the process for manufacturing Hamilton's design No. 333 (Fig. A.2). This design required only one stamping die (artifact S-034) and one pass through the stamping machine per work piece. The simplicity of this design and its production process made it well suited for testing the machine's basic, rote operation.

In the third phase of the experiment, attention shifted back to the machine's mechanics, specifically those related to its adjustment and calibration. Imitating the more complex border design No. 138 (Fig. A.3) required three stamping passes with two different stamping dies (artifacts S-

019 and S-133) in two different positions. The half-circle stamps (S-019) could be made along the top and the bottom edge of the wood blank, with the machine in the same setup, just by rotating the stock 180 degrees on the carriage and putting it through for a second pass. Setting the machine up for the diamond shape (S-133) down the middle required manipulating the adjustment knob on the carriage and the adjustment screw on the carriage base. Brass rack No. 4 (artifact R-004) prescribed the correct stamping interval for all three of the stamping runs needed to produce border No. 138. Phase 3 of the experiment employed shorter stamping runs, often using only a single test blank for a run, to allow for recording the effects of small changes in the machine's calibration.

Several short demonstration runs, performed for museum visitors, were interspersed among the die-stamping runs comprising the experiment's three phases. These demonstration runs consisted of stamping five test blanks designated for demonstration purposes. Results of the demonstrations were not recorded.

Practical Matters

Putting the die-stamping machine, itself, into operable condition required very little effort. All parts of the machine necessary to successfully stamp wood type were still present and there was no visible evidence of other parts having been present. The exception was a broken bracket that held wood blanks to the carriage's surface. This was one of two hold-down feet (the other one remained intact) that counteracted the machine's tendency to lift wood blocks off the

carriage after the stamp engaged with the wood block with each stamping action. Replacing the broken foot with one fabricated from a piece of 3/16-inch mild steel rod early in the second phase of the experiment resulted in easier machine operation, as described in the field notes transcribed below and synthesized in Tables A.1 through A.3. Aside from this hold-down foot, the machine required only lubrication: 30-weight oil for the drive shaft's journal bearings, 3-in-1 oil for the stamping column's moving parts, and light white oil (sewing machine oil) for the carriage track.

Motorizing the die-stamping machine (Fig. 3.4) required no modification of the machine itself. Motive power for the experimental operation came from a Techtop AC electric motor producing 1 hp at 1,730 R.P.M. A 15:1 Worldwide Electric Corp. worm-gear reducer mounted to the motor's faceplate provided initial speed reduction. A standard Type A V-belt conveyed power from a cast-iron pulley with a datum diameter of 4.7 inches on the gear reducer's output shaft to a large, wooden drive wheel retrofitted to the machine itself. The author's thesis advisor, Dr. Steven Walton, fabricated the large drive wheel out of three-quarter-inch plywood. The drive wheel mounted to a three-piece wooden hub that wrapped around the machine's existing three-step drive pulley. With a datum diameter of approximately 18 inches, the wooden wheel provided the remaining step necessary to reduce drive speed to approximately 30 R.P.M.

The wood test blanks used in the experiment started out as rough-sawn white maple flooring lumber provided by Horner Sports Flooring in Dollar Bay, Michigan. These boards were planed to a thickness of 7/8 of an inch, ripped to

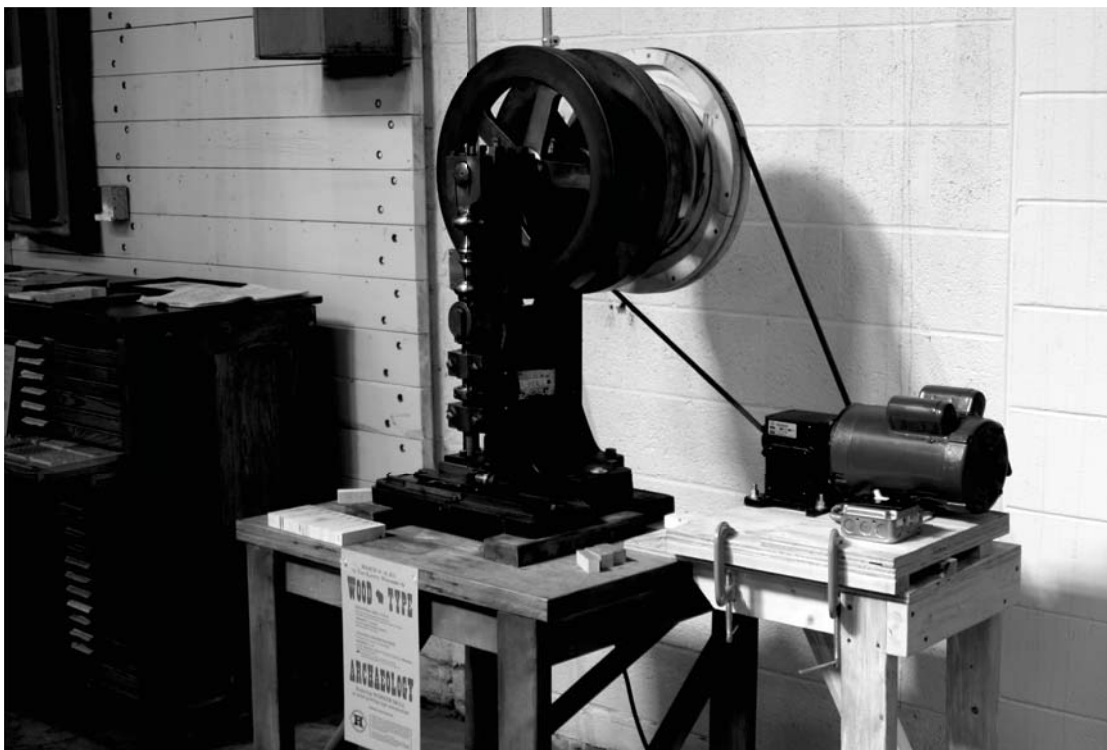


Fig. A.4: Motorized Machine

The die-stamping machine is shown with motor and belt-drive assembly attached. Photograph by author.

four-inch width, and then cut into approximately type-high cross sections using a DeWalt power mitre saw. This process resulted in wood blanks four inches long, $7/8$ of an inch wide, and as close to type high, in end-grain orientation, as the power saw's precision permitted (usually within a few thousandths of an inch, as measured using the same Vandercook No. 9 plate gauge Hamilton used to measure its type stock). In all, more than 800 wood blanks were produced in this manner. Since both sides of each blank could be stamped, this allowed for more than 1,600 stamping passes. In the end, the experiment consumed about

half of the wood test blanks. The rest were left at the museum for future use, as was the motor assembly.



Fig. A.5: Final Wood Blank Preparation, 1

The author is shown numbering wood blanks for use in the archaeological experiment. Photograph courtesy Hamilton Wood Type & Printing Museum.



Fig. A.6: Final Wood Blank Preparation, 2

The author is shown measuring the type-high dimension of a wood blank on a Vandercook No. 9 plate gauge. Photograph courtesy Hamilton Wood Type & Printing Museum.



Fig. A.7: Machine Operation

The author is shown operating the die-stamping machine during a preliminary test run in February, 2015. Photograph courtesy Hamilton Wood Type & Printing Museum.

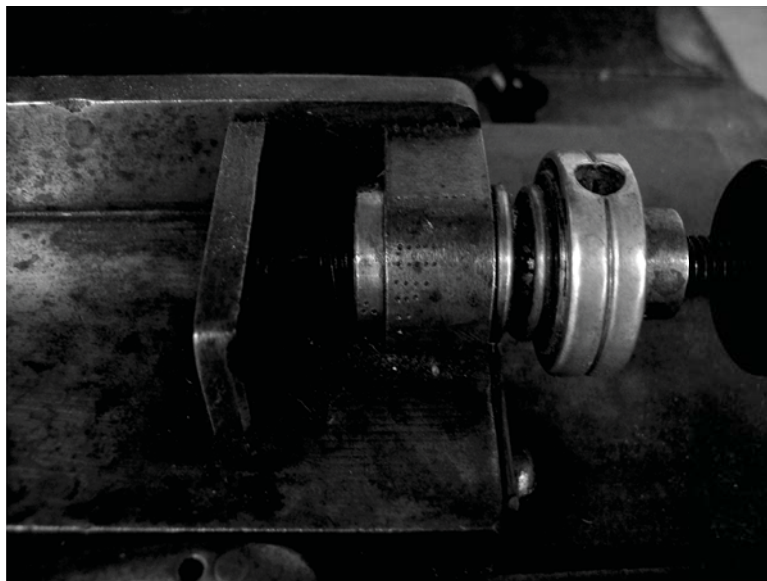


Fig. A.8: Machine Calibration

This image shows punch marks on the wood blank carriage that were likely used for calibrating the wood blank carriage. Photograph by author.

Notes on Experimental Data Tables

Trial No. & Blank ID No.:

“Trial No.” refers strictly to the sequence of experimental stamping runs, while “Blank ID No.” refers to the identification number marking each batch of wood blanks used in the experiment. Blank identification numbers do not always align with the sequence of the stamping runs because batches of wood blanks were prepared and numbered in batch sizes of 10, 20, and 30 blanks sometimes well in advance of the experimental runs. The batch of wood blanks for each stamping run was then chosen on the basis of number of pieces needed for the stamping run, rather than on the batch’s identification number.

Date:

Date experimental stamping run took place.

No. Acceptable:

Acceptable border pieces are pieces that could hypothetically have been made into printable wood type pieces, based on the results of the die-stamping operation. Acceptable blanks have the full number of stamps required for the border design, and they are in the proper position.

Brass Rack No.:

“Brass Rack No.” refers to the numbers stamped into the brass racks that prescribed the wood blank carriage’s movement intervals. In Hamilton Manufacturing Company’s type shop, this number was indexed to slot numbers in the brass racks’ storage box.

Direction:

Direction of carriage movement, right to left versus left to right.

Time:

Timed trials were timed using the stopwatch feature on an LG Electronics CF360 cellular phone.

Table A.1: Die-Stamping Machine Experimental Operation, Phase 1a

Trial No.	Blank ID No.	Date	No. of Blanks	No. "Acceptable"	Brass Rack No.	Direction	Time	Notes
1	1	2/19/15	10	1	65	RTL	NR	
2	2	2/19/15	10	5	65	RTL	NR	
3	3	2/19/15	10	7	65	NR	NR	
4	4	2/20/15	10	8	65	RTL	NR	
5	5	2/20/15	10	4	65	LTR	NR	
6	6	2/20/15	10	7	65	LTR	NR	
7	7	2/20/15	10	NR	65	LTR	NR	
8	8	2/20/15	10	6	65	LTR	NR	
9	11	2/20/15	20	9	65	RTL	NR	
10	9	2/20/15	10	7	65	RTL	NR	
11	12	2/20/15	20	15	65	LTR	NR	
Key								
"NR" = Not Recorded								
"LTR" = Left To Right (carriage movement direction)								
"RTL" = Right to Left (carriage movement direction)								

Table A.2: Die-Stamping Machine Experimental Operation, Phase 1b

Trial No.	Blank ID No.	Date	No. of Blanks	No. "Acceptable"	Brass Rack No.	Direction	Time	Notes
12	11	3/10/15	10	2	65	RTL	NR	
13	13	3/10/15	10	3	65	RTL	NR	
14	14	3/10/15	10	5	65	LTR	NR	
15	15	3/10/15	10*	7	53	RTL	NR	* Stopped to adjust carriage knob after two blanks
16	16	3/10/15	10	7	53	RTL	NR	
17	17	3/11/15	10	7	53	LTR*	NR	* Blank stockpile on the right by mistake
18	18	3/11/15	10	7	53	RTL	NR	
19	19	3/11/15	10	8	53	LTR*	03:02.5	* Blank stockpile on the right this time
20	20	3/11/15	10	7	53	RTL	NR	
21	23	3/11/15	10	7	53	RTL	02:58.3	
22	21a	3/11/15	10	8	53	LTR	02:49.3	
23	21	3/11/15	10	9	53	RTL	02:52.8	
24	21b	3/11/15	10	5	53	RTL	NR	
25	24	3/11/15	10	10	53	RTL	2:50:58	
26	25	3/11/15	10	6	53	RTL	03:03.2	
27	26	3/11/15	10	0*	53	LTR	NR	* "Hold-down foot" moved (see field notes)

Table A.3: Die-Stamping Machine Experimental Operation, Phase 2

Trial No.	Blank ID No.	Date	No. of Blanks	No. "Acceptable"	Brass Rack No.	Direction	Time	Notes
28	32	3/11/15	30	17	53	RTL	09:28.8	
29	34	3/12/15	30	28*	53	RTL	08:41.8	* Second "hold-down foot" installed
30	35	3/12/15	30	27	53	RTL	8:47.84*	* With dropped pieces
31	30	3/12/15	10	9	53	RTL	02:53.0	
32	36	3/12/15	30	25	53	RTL	8:47.94*	* With piece dropped all the way to floor
33	37	3/12/15	30	25	53	LTR	09:18.7	
34	38	3/13/15	30	27	53	LTR	08:55.0	
35	39	3/13/15	30	23	53	LTR	7:49.46*	* With different blank handling (see field notes)
36	42	3/13/15	30	3*	53	RTL	08:50.2	* Carriage stop bracket was out of place
37	43	3/13/15	30	27	53	RTL	08:51.5	
38	44	3/13/15	30	29	53	LTR	08:01.5	
39	45	3/13/15	30	23	53	LTR	07:39.0	

Selected Field Notes

Selected Observations Taken from Field Notes Recorded During the Die-Stamping Machine Experiment

Trial No. 1

- Moving carriage from left to right, difficult to keep base of blank on surface of carriage for first stamp because gripper [hold-down] “foot” cannot engage with blank
- Stamping interval consistent, such that several stamps overlap each other substantially [appropriate overlap for border design]
- Working from right to left, it was difficult to achieve [proper] alignment using rack No. 65
 - The carriage needed to be moved slightly beyond the tooth each time, then moved back to engage with the tooth
 - The teeth are not as deep on No. 65 as on most other brass racks

Trial No. 2

- One advantage of working right to left is it is easy to remove the finished work piece from the carriage
- Also, the machine’s built-in stop [stop guide] can be used to easily position the carriage for the next run
- The noise of the electric motor makes it easier to keep the cadence. The motor bogs down when it stamps, so there is a distinguishable change in tone with each revolution of the press

Trial No. 3

- Click of piece snapping back down onto carriage also helps keep cadence

Trial No. 5

- Harder to set carriage up for first stamp (moving left to right)
- Harder to move carriage because the tooth lever must be actuated each time it is moved
- On the plus side, in moving the carriage to the right, the motion of the carriage pushes the lever tooth firmly against the brass rack teeth
- First stamp is easier because the foot that holds the stock down is able to engage with the blank right away
- Still awkward standing position because the table is so low
- Noticed I do not use the milled depression on the back side of the carriage (visual analysis suggested this depression may have been a handhold)

Trial No. 6

- Moving left to right it is possible to put the carriage in approximately the right place (provided the lever tooth is to the left of the desired rack tooth) and then set the lever tooth against the rack tooth with the same motion of pushing the piece [wood blank] against the [carriage’s] stops

Trial No. 7

- Moving carriage to “start” position becomes easier with practice (getting used to where it should be based on visual reference)

Trial No. 8

- The other danger with moving from left to right is it is very easy to move the carriage too far (the catch lever’s tooth slips past a rack tooth and misses a stamp)
 - It requires tactile finesse to depress the lever just the right amount before moving the carriage. This is a “soft” action, compared to the action of placing the stock on the carriage and that of moving the carriage. The mind has to think differently about this aspect (lightly depressing a small lever while the heavy machine rolls on)
 - Initially, this tendency to skip a tooth seemed to argue against the left-to-right motion of the carriage, but this becomes less difficult with experience.

Trial No. 9

- This operation was very telling:
 - Right to left movement now seems more difficult
 - Specifically, it is challenging to press down on the blank to hold it down for the first stamp, and then transition to moving the carriage in time for the next stamp
 - Pushing the carriage using the side with the adjustment knobs is problematic. It is both uncomfortable from an ergonomic perspective, and runs the risk of putting the knobs out of adjustment

Trial No. 11

- Noticed right hand tended to be on the carriage anyway, with the adjustment knobs in the way, but not as problematic when going left to right because pushing force is not being exerted
- If I had to choose a direction for it to travel, I would choose left to right
- But this operation brought to mind the possibility that the operator may have made stamping passes going in both directions. This eliminates the “dry run” carriage motion between type pieces

Trial No. 13

- Feel of the catch lever engaging with the brass rack is very difficult to apprehend. It feels like the “click” into place is moving through a lot of metal. Tactile disengagement. Spring may not be as strong as it once was

Trial No. 14

- Still difficult to disengage blank from stamp when foot is not in place for the last stamp
- Still difficult to feel when the lever tooth is properly engaged with the rack
- NOTE: Test blanks have yet to produce the rounded-over effect that was seen in some of the finished-for-printing blocks

Trial No. 15

- No. 53 does not have teeth that are much deeper than No. 65's, but they are sharp edged. Interval is just slightly shorter
- Stopped after two blanks to adjust lateral positioning knobs:
 - Brass knob is attached via set screw to a cylinder that rotates within its mount on the carriage
 - The adjuster mount is a separate piece welded or otherwise attached to the carriage
 - Punch marks on the cylinder align with punch marks on the adjuster mount
 - Still not clear how these punch marks functioned, although I did use them to ensure the knobs were back in the right position when I moved the knobs to double-check the punch marks on the cylinder

Trial No. 17

- Left to right worked quite well this time
- Positioning the blank for the first punch was easier:
 - Place blank on carriage to the left of the stamping impression one, push it to the right, simultaneously putting the piece in place against the guard and "firming" the lever tooth's engagement with the rack tooth
- Short sharp depressions of the lever yield good results

Trial No. 19

- Time Trial procedure:
 - Turn machine on
 - Carriage in start position
 - Start timer
 - Run stamps
 - Stop timer
 - Turn machine off

Trial No. 24

- Hold-down foot on the right side
- Disadvantage of this setup is that the left thumb is responsible for both holding the blank in place during carriage motion and the strength-intensive action of holding the blank down to disengage it from the stamp

Trial No. 27

- Moving left to right with the hold-down on the right side . . . (it is) nearly impossible to hold the blank manually for the first stamp then move the carriage in time for the second stamp when the lever must also be depressed
 - Too complicated
 - Also, carriage movement sometimes caused the carriage to slip past rack teeth, bringing left thumb precariously close to moving stamping die
- Safety concerns preclude further testing in this configuration

Trial No. 28

- This run was very problematic because there was too much oil on the carriage track and this created suction that made it more difficult to move the carriage

Trial No. 29 (With fabricated right-hand hold-down foot installed)

- New lubrication technique: dot of sewing machine oil (dime-sized) at bottom of carriage, move carriage back and forth, wipe off track ahead of carriage
- Little problem with hydraulic suction, most of the oil having been wiped off
- Hold-down worked well

Trial No. 30

- Really helps, when picking up (wood blank), to have some kind of stop along the back (of stockpile surface) to push the blank into. "Type boxes" (like the type cutters used to move stock around the shop) would have had a backstop high enough to back up multiple layers of blanks
- Machine's work bench must have had adequate surface on either side to set pieces down

Trial No. 32

- Timing blank insertion with upward movement of shaft is helpful

Trial No. 33

- Easier to put stock in from the left (sliding it under both hold-down feet)
- Lining up right-hand stop (on carriage) with front set screw (on stamping piston), visually, to align for first stamp
- More comfortable pushing carriage from left to right with left hand's thumb and forefinger pushing against blank
- Right hand's index, middle, and ring finger glide along back side of carriage track
- Right thumb actuates toothed lever (catch lever) with each movement for stamping

Trial No. 35

- Moving from left to right, with the blanks positioned on the left-hand side allows for the left hand to pick up and ready the blank while the right hand moves the carriage over
- This resulted in a major time savings

Trial No. 36

- Tried moving the carriage without looking at hands. This was difficult, resulting in messed up pieces

Trial No. 38

- Holding onto blank gives better tactile impression of rhythm (left hand feels the blank disengage from the stamp)

- Looked away from hands after each (blank) transition, was able to watch rotation of crank's indentation (to gauge timing) and also judge stamp positioning by this means
- Depressing the (catch) lever at each movement of the carriage creates a surer sensory impression of the carriage's locking in place (against a brass rack tooth)

Measurements of Adjustment Knob Threading in Advance of Phase 3

Carriage Track Base Adjuster Screw (Moves carriage forward, toward operator, and backward)

- 16 threads per inch
- Clockwise moves base toward operator
- Counterclockwise moves base away from operator

Knob on Carriage (Provides minute adjustment for right-hand stop on wood blank carriage)

- 20 threads per inch
- Clockwise moves stop to the right
- Counterclockwise moves stop to the left
- Total range of adjustability is approximately one inch

Jackscrew (Changes length of stamping shaft, thereby changing stamping depth)

- 4 threads per inch
- Clockwise lengthens shaft, increasing stamp depth
- Counterclockwise shortens shaft, decreasing stamp depth

Summary of Phase 3

(Simulation of Stamping Border Design 138)

Phase 3 of the experiment consisted of eight trial runs, each using between five and 10 border blanks. Border design 138 required three passes through the die-stamping machine, using brass rack No. 4 and two different stamping dies: artifact S-019 (See Appendix B) stamped in mirror image rows along the upper and lower edge of the blank (two passes); and artifact S-133 in one row down the middle of the blank. The stamping passes with S-019 were done first, with adjustments noted in the field notebook:

Trial No. 40 (First trial of Phase 3)

- Test blank 51A: Rough (left/right) alignment
- Test blank 51B: Corrected (left/right) alignment

- Test blank 51C: Attempted front-to-rear alignment
- Test blank 51D: Adjusted front-to-rear alignment, ran two passes
- Test blank 51E: Further adjusted front-to-rear alignment (1/8 turn clockwise)

Trial No. 41

- Ran five test blanks through, two passes per blank, using the same setting as was used for test blank 51E

Trial No. 42

- 10 blanks
- Same settings as blank 51E from Trial No. 40
- Stamps align (well) on these correct length blanks (the blanks were precisely the same length as pieces of border No. 138 from Hamilton's sample case, and so could be run through one pass then rotated 180 degrees for a second pass, producing two mirror-image rows of stamps along the outside edges of the blank)

After building up a stock of blanks stamped with two rows each of S-019, incremental adjustments were made to the left/right alignment and the front-to-rear alignment in advance of the stamping runs using S-133. The number of turns to each adjustment knob, and the direction of the turning, was recorded in the field notes over the course of trial numbers 43-46, resulting in the following set of directions for re-calibrating the machine to make the transition from stamping with S-019 to stamping with S-133. The instructions could be written like this:

Transition from S-019 to S-133

- Turn carriage track base adjuster screw 2-9/16 rotations Clockwise
- Turn knob on carriage 4-1/2 rotations Counterclockwise so that [2] aligns with [[6]]¹²
- Turn jackscrew 1/2 rotation Clockwise

Following these instructions yielded mixed results in the reproduction of border No. 138's closely registered stamp shapes (See Fig. A.8). Further experimental trials work are necessary prove their viability. Die-stamping machine operators may or may not have used formal instructions for setting up the die-stamping machine to make different borders (they may have relied on any number of "shop tricks" that were part of a collective knowledge now forgotten). Nevertheless, Phase 3 results reflect something of the nature and precision of the adjustability that was part of the die-stamping machine's design.

¹² "[2]" refers to a set of punch marks visible on the shaft of the knob while "[[6]]" refers to the number of punch marks visible on the stop's mounting block. (See Fig. A.9).

Appendix B

Stamping Dies Recordation Sheets

The following pages contain documentation of shapes on surviving stamping dies that were used in the die-stamping machine to make decorative wood type borders at the Hamilton Manufacturing Company. The shapes were recorded using the actual stamping dies and a rubber stamp inking pad. The recordation sheets are reproduced here at a slightly smaller scale. The numbering system reflects the arrangement of the stamping dies as they were found in a storage rack at the Hamilton Wood Type & Printing Museum, but that arrangement had no discernable pattern that suggested a relationship to type shop work practice. In references to specific stamping dies in this thesis, the stamp's number is given with "S-" as a prefix, as in "artifact S-034."

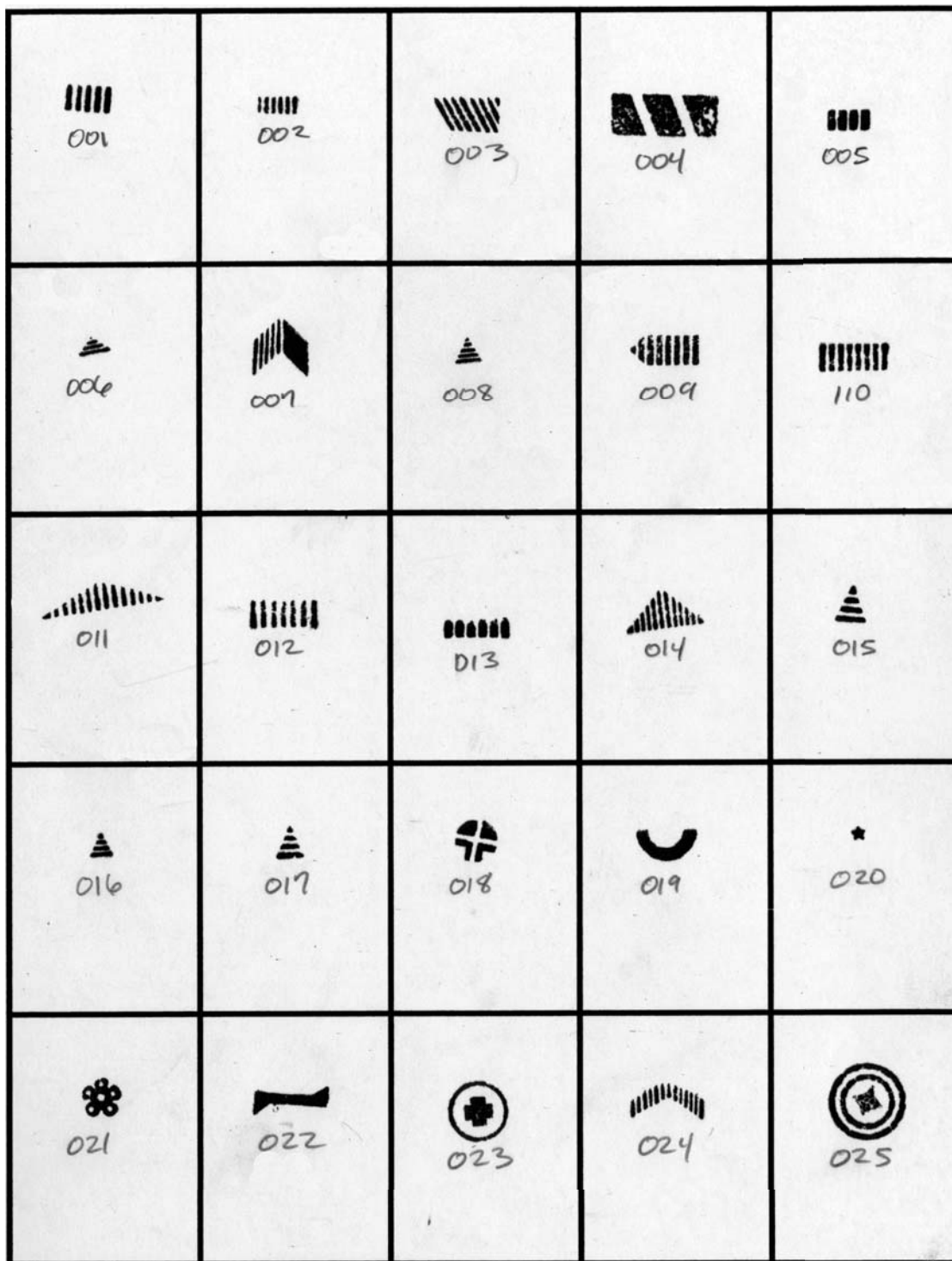


Fig. B.1: Die-Stamp Recordation Sheet 1

Figures B.1 – B.7 created by author using stamping dies—artifacts from the Hamilton Manufacturing Company type shop, now in the collection of the Hamilton Wood Type & Printing Museum.


























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 031	 032	 033	 034	 035
 036	 037	 038	 039	 040
 041	 042	 043	 044	 045
 046	 047	 048	 049	 050

Fig. B.2: Die-Stamp Recordation Sheet 2




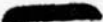





















 051	 052	 053	 054	 055
 056	 057	 058	 059	 060
 061	 062	 063	 064	 065
 066	 067	 068	 069	 070
 071	 072	 073	 074	 075

Fig. B.3: Die-Stamp Recordation Sheet 3








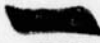

















 076	 077	 078	 079	 080
 081	 082	 083	 084	 085
 086	 087	 088	 089	 090
 091	 092	 093	 094	 095
 096	 097	 098	 099	 100

Fig. B.4: Die-Stamp Recordation Sheet 4


























 101	 102	 103	 104	 105
 106	 107	 108	 109	 110
 111	 112	 113	 114	 115
 116	 117	 118	 119	 120
 121	 122	 123	 124	 125

Fig. B.5: Die-Stamp Recordation Sheet 5


























 126	 127	 128	 129	 130
 131	 132	 133	 134	 135
 136	 137	 138	 139	 140
 141	 142	 143	 144	 145
 146	 147	 148	 149	 150

Fig. B.6: Die-Stamp Recordation Sheet 6



Fig. B.7: Die-Stamp Recordation Sheet 7

Appendix C

Border Piece Dimensions

Table C.1 on the following page shows type-high dimensions and depth of stamp impressions for 30 wood type border pieces selected at random from the “sample” cabinets at the Hamilton Wood Type & Printing Museum. These two cabinets hold 48 type drawers, mostly filled with new-old-stock decorative wood type border. Museum staff believe the Hamilton Manufacturing Company kept these examples of wood type border on hand to show customers the precision of the type shop’s work. Measurements of the type-high dimension were made using a Vandercook No. 9 Plate Gauge. A Starrett depth micrometer was used to measure the depth of stamp impressions. The sample was collected randomly using a list of number sequences generated with Microsoft Excel’s “random number generator” feature: first a number 1-48 (corresponding to the 48 drawers between the two cabinets); then a number 1-4 (corresponding to the rows of type pieces in each drawer); then a number 1-20 (piece number), corresponding to the piece selected from each row, counting left to right. In cases where the above procedure failed to locate a piece of type suitable for testing, either because the specified type row had too few pieces or because the specified type piece could not be measured using the depth micrometer (some stamp impressions were too small to fit the depth micrometer’s probe), a piece was selected using a secondary piece number (1-10, counting right to left within the row), or switching to the nearest row containing enough suitable type pieces to use the original piece number. In the few cases where an entire drawer

contained no suitable border pieces, the entire number sequence was crossed out and the next one used, instead.

Table C.1: Wood Type Border Piece Measurements

Table C.1 shows the type-high dimension measurement (in inches) and depth of stamp (in inches) for a random sample of wood type border pieces from the Hamilton Wood Type and Printing Museum's collection.

Wood Type Border Piece Measurements		
No.	Piece Height	Stamp Depth
1	0.919	0.032
2	0.919	0.028
3	0.919	0.028
4	0.92	0.027
5	0.919	0.030
6	0.920	0.015
7	0.919	0.036
8	0.920	0.016
9	0.920	0.039
10	0.920	0.034
11	0.919	0.028
12	0.920	0.032
13	0.921	0.029
14	0.919	0.035
15	0.918	0.035
16	0.920	0.038
17	0.919	0.074
18	0.919	0.032
19	0.920	0.044

Wood Type Border Piece Measurements, Continued		
No.	Piece Height	Stamp Depth
20	0.919	0.029
21	0.920	0.037
22	0.920	0.033
23	0.920	0.031
24	0.919	0.037
25	0.920	0.020
26	0.920	0.024
27	0.919	0.030
28	0.920	0.024
29	0.920	0.027
30	0.920	0.028
Averages:	0.920	0.032

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Oral Histories

Dupuis, Jack. Oral history interview with Jo Urion. Calumet, Michigan. 13 October 2005. Keweenaw National Historical Park Oral History Collection.

Hamilton Manufacturing Company type shop floor leader. Oral history interview with author. Two Rivers, Wisconsin. 9 January 2015. Hamilton Wood Type & Printing Museum Oral History Collection.

Hamilton Manufacturing Company type shop type cutter. Oral history interview with author. Two Rivers, Wisconsin. 6 November 2014 and 19 February 2015. Hamilton Wood Type & Printing Museum Oral History Collection.

Hamilton Manufacturing Company type shop type trimmer. Oral history interview with author. Two Rivers, Wisconsin. 12 March 2015. Hamilton Wood Type & Printing Museum Oral History Collection.

Schmitt, Bernie. Oral history interview with author. Hubbell, Michigan, 14 November 2014. Keweenaw National Historical Park Oral History Collection.

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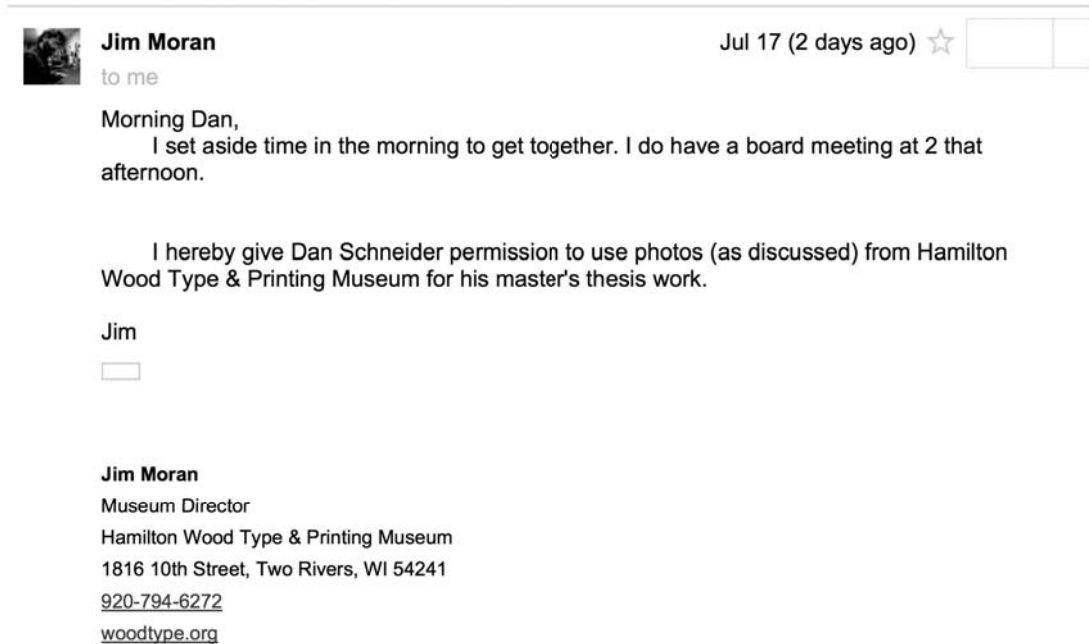
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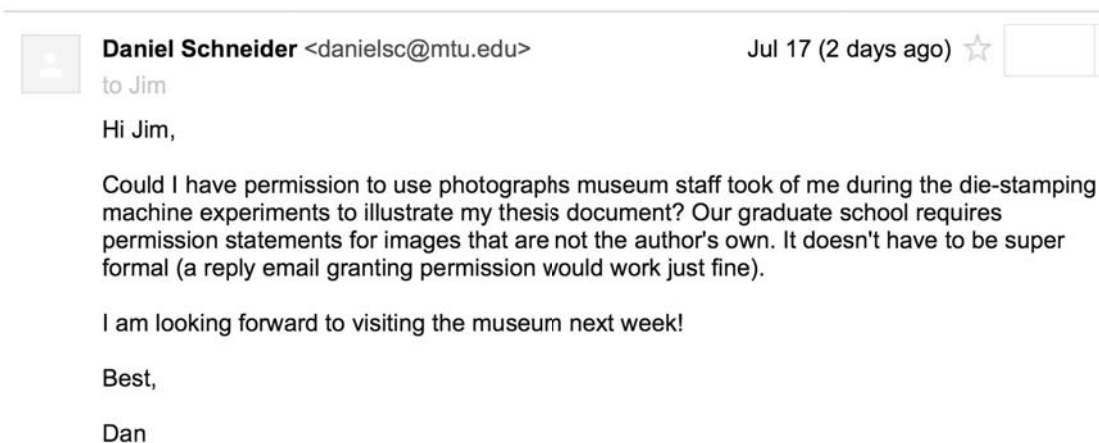
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to me ▾

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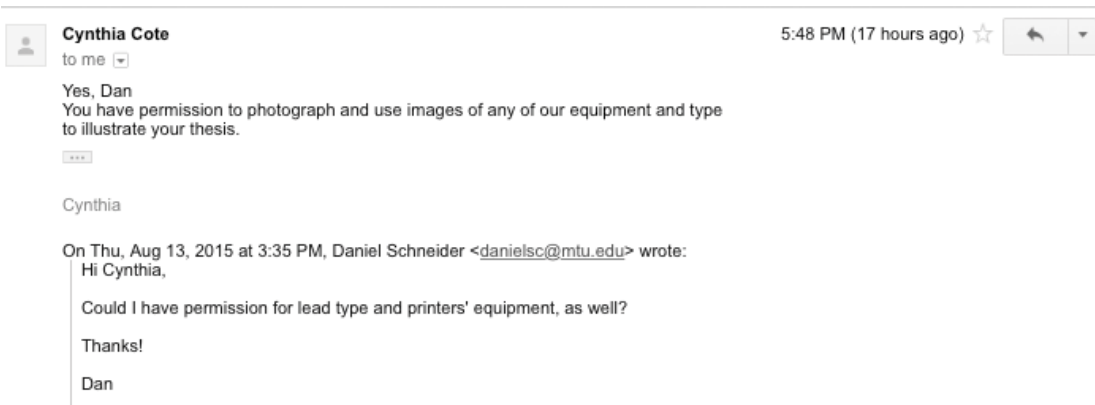
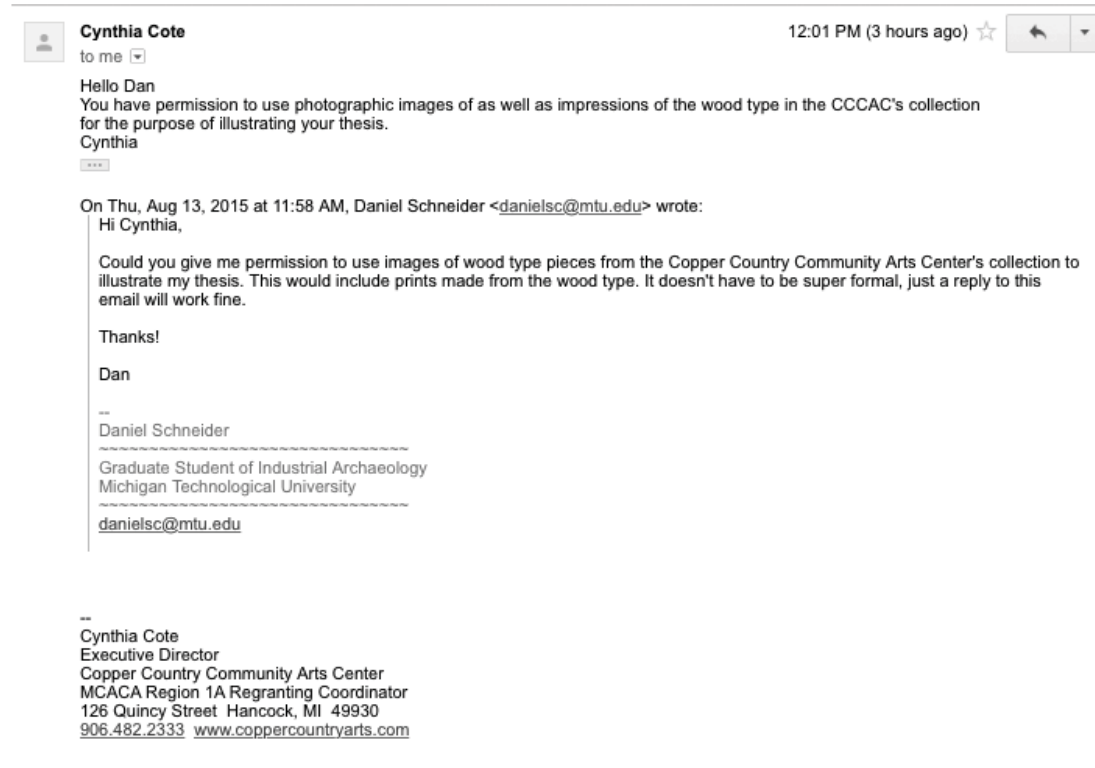
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