CISTERCIAN EXPANSION AND INDUSTRIAL WATER MILL INFRASTRUCTURE IN TWELFTH-CENTURY FRANCE: AN UNRECOGNIZED DEPENDENCY

A Thesis

Presented to the Faculty

of the Department of History

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In Partial Fulfillment

Of the Requirements for the Degree of

Master of Arts

By

Christie Peters

May, 2016

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Christie Peters

APPROVED:

Sally Vaughn, Ph.D.
Committee Chair

Martin Melosi, Ph.D.

Nora Laos, Ph.D.
Hines College of Architecture and Design
University of Houston

Steven Craig, Ph.D.
Interim Dean, College of Liberal Arts and Social Sciences
Department of Economics

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ABSTRACT

Cistercians have long been linked with the development and use of industrial water mill technology, but current scholarship downplays this interrelationship. The argument presented here is that the success of the Cistercian Order in twelfth-century France and Europe depended upon the incorporation and use of industrial water mill infrastructure and technology that existed in France prior to the Order's foundation in 1098. Evidence for the presence of pre-existing hydraulic resources in France, the development of a Cistercian technological system centered on the incorporation and use of these resources, as well as an explanation of St. Bernard's role in perpetuating an architectural and technological model throughout the Order based upon his own monastery of Clairvaux that incorporated hydraulic infrastructure into its design will be presented here. Taken together, this evidence demonstrates the dependency of the Order on these pre-existing resources.

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Chapter 1: Introduction

> The chief glory of the later Middle Ages was not its cathedrals or its epics or its scholasticism: it was the building for the first time in history of a complex civilization which rested not on the backs of sweating slaves or coolies, but primarily on human power.[1] – Lynn White, Jr.

The recognition of medieval technology as a legitimate field of study owes much to the scholarship of Lynn White, Jr. White acknowledged that Hellenistic society had developed the cam and basic gearing mechanisms that are necessary for various types of milling, but thought that the *real* development of power sources like the water mill and windmill took place in the High Middle Ages due largely to the work of monks. Cistercian monks in particular, according to White, seem to have been leaders in the use of power.[2] We now know diverse milling technologies existed in later Antiquity, contrary to views of White and his peers in the early twentieth century, but the medieval attitude towards and contribution to milling technology and technology in general still demands clarification.

I argue that the existence of advanced industrial water mill technology in France prior to the foundation of the Cistercian Order in 1098 enabled its prolific expansion and economic growth in the twelfth century. This is not a claim that technology alone drove the expansion of the Order, simply recognition that it would have been incapable of growing at the rate that it did without the presence and systematic implementation of this pre-existing technology. This inverts the idea espoused by White and his peers that an already rapidly expanding and

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[1] Lynn White, Jr., "Technology and Invention in the Middle Ages," *Speculum* 15, no. 2 (1940): col. 613 D - 14 D.
[2] "Dynamo and virgin reconsidered," *The American Scholar* 27 (1958): 190.

technologically adept Cistercian Order initiated the revolutionary development and proliferation of water mill technology in the Middle Ages. It is in keeping, however, with White's assertion that the heart of the Western Middle Ages lay between the Loire and the Rhine.[3] The birth place and locus of the Cistercian Order lies squarely within this region. While my argument and White's are essentially at odds with one another, they both tie Cistercians to water mill technology and economic expansion in the Middle Ages. Our differences of opinion arguably lie in extensive research that has been done in the intervening years that disprove technological stagnation in Antiquity and discontinuity with the Middle Ages.

The historiography of water mill technology in twelfth-century France requires some preliminary explanation. In the last quarter of the twentieth century, a shift away from grand periodization and toward a more topically-focused approach took place in the study of medieval technology. While other areas of history of technology have seen grand narratives developed that refine earlier periodization or emphases, medieval technology has seen no new sweeping narratives since the 1970's. As such, contemporary medieval scholarship still uses those mid-century insights as their basis. A thorough historiography of medieval technology must therefore reach back to the works written in the middle third of the twentieth century to properly situate the topic. This does not mean that current literature is irrelevant. It simply means that the historic literature is more relevant to this discussion than if such a shift had not taken place. An effort will be made here to balance the old with the

[3] "Technological Progress in Western Middle Ages," in *Scientific change: historical studies in the intellectual, social, and technical conditions for scientific discovery and technical invention, from Antiquity to the present*, ed. A. C. Crombie, Symposium on the History of Science, University of Oxford 9-15 July 1961 (New York: Basic Books Inc., 1963), 280.

new. In addition, few historians of medieval technology have ever undertaken a historiography that attempts to apply theories of modern technology to medieval technology. This too will be explored.

According to White, medieval technology "exploded" as a topic in the 1930s,[4] but the groundwork for this development began as early as 1915 with the work of Sir Patrick Geddes. In *Cities in Evolution*, Geddes distinguished between the paleotechnic and later neotechnic phases of industrial civilization.[5] The *paleotechnic* phase, which introduced the mass production of goods through coal and iron-driven mechanized power, began after 1700 with the start of the modern industrial revolution, reached its pinnacle in the mid-nineteenth century with the first World Exposition at the Crystal Palace in Hyde Park, London in 1851 and ended around 1900. The science-based, electricity and alloy-driven *neotechnic* phase began with the perfection of the water turbine by Fourneyron in 1832 and still held sway in the early twentieth century. Significantly for the nascent field of medieval technology, Lewis Mumford later expanded upon the work of Geddes by preceding the paleotechnic with an even earlier *eotechnic* phase in *Technics and Civilization*.[6]

The wood and water-driven eotechnic phase stretched from approximately 1000 to 1750. Mumford considered this period to be one of slowly accelerating consolidations of invention and experimental adaptation, both of which were necessary precursors to the development of "the machine." The machine, according

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[4] *Medieval Religion and Technology* (Berkeley: University of California Press, 1978), Introduction, xv.
[5] Sir Patrick Geddes, *Cities in Evolution: an introduction to the town planning movement and to the study of civics* (London: Williams & Norgate, 1915), 60-83; Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace & World, 1962).
[6] *Technics and Civilization*, 107-50.

to Mumford, is defined as the entire technological complex, including tools, instruments, apparati, and machines, as well as the knowledge and skills derived from industry and incorporated into the new technics that define the modern industrial age.[7] Mumford claimed that if machinery be the criterion, the modern industrial revolution began in the twelfth century.[8] The principle benefit of water-power during the eotechnic period, according to Mumford, lay in the fact that it freed man from labor and allowed for the intellectual and physical development of subsequent phases of industrial civilization. When placed within Mumford's framework, the technological complex of the Cistercian Order comprised a machine. Unfortunately, Mumford does not account for the social aspect of such a complex.

Thomas Hughes believed technology to be socially constructed as well as society shaping and defined technology as the effort to organize the world for problem solving so that goods and services can be invented, developed, produced, and used. He defined technological systems as a combination of physical artifacts, organizations, legislative artifacts, scientific components and natural resources.[9] An examination of the technological system that comprised the Cistercian Order demonstrates the usefulness of this theory to the evaluation of medieval systems. The nascent Cistercian Order in twelfth-century France had to find a way to fulfill its strict mandate of self-sufficiency while still allowing monks to carry out their day-to-day monastic duties. When placed within Hughes' framework of technological

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[7] Ibid., 12.
[8] Ibid., 112.
[9] Thomas P. Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970* (Chicago: The University of Chicago Press, 2004), 6; "The Evolution of Large Technological Systems," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987).

systems, water mills can be categorized as *physical artifacts*; donations of resources, which often consisted of land and water mills, *system inputs*; and products generated by the Order to sustain itself, *system outputs*. The system inputs in this case speak to *technology transfer*, which is at the heart of the thesis presented here. This transfer occurred when Cistercians incorporated local, pre-existing water mill infrastructure and technology into their system. The substantial system outputs generated by the system resulted from the Order's masterful utilization of water power. This productive output played a significant role in the phenomenal success and growth of the Cistercian Order in the twelfth century. Bernard of Clairvaux provided the initial *momentum* of the system in the first half of the twelfth century. By the time of his death in 1153, the system had become self-sustaining through the spread of a Cistercian network of monasteries throughout Europe, although the *reverse salients* or set-backs encountered by the system increased significantly after Bernard's death.

Alex Roland defined technology as systematic, purposeful manipulation of the material world that is comprised of four components – materials, technique, power, and tools or machines.[10] He favored this definition because it is static, not addressing technological change. Roland's epochs of Western technological development fall into four categories, the Age of Materials (up to 1000 B.C.), the Age of Technique (1000 B.C. – 1453 A.D.), the Age of Power (1453 – 1871), and the Age of Machines (1871 – present). The Cistercian technological system falls within Roland's Age of Technique, which is defined as an age in which techniques for

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[10] Alex Roland, "Theories and Models of Technological Change: Semantics and Substance," *Science , Technology, & Human Values* 17, no. 1 (1992).

manipulating known and malleable materials through numerous means were employed and mastered. He convincingly argued that the differences between the various models of technological change described here are more semantic than substantive. That the Cistercian “machine” fits as well in Roland’s model as Hughes’ seems to substantiate this argument.

Marc Bloch and Lucien Febvre collaborated on a special issue of *Annales d’histoire économique et social: revue trimestrielle* in 1935 that was dedicated to the study of the history of technology. In his introductory essay, “Réflexions sur l’histoire des techniques,” Febvre outlined three separate, but related, areas of study that he considered the basis of the history of technology, including the role of science in technical invention, the technical history of technology, and the placement of technology into a social context.[11] Febvre bemoaned the fact that historians of technology tended to focus on only one of the three components, depending on their area of expertise, rather than considering their interplay. Over time, this resulted in a tendency to view technological development as episodic rather than as a gradual evolution. L.A. Moritz’s assertion almost twenty-five years later that technological progress is often more a matter of rapid advance after centuries of inaction than continuous development demonstrates how pervasive this idea has been through the years.[12]

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[11] Lucien Febvre, "Réflexions sur l'Histoire des techniques," *Annales d'Histoire Économique et Sociale* 7, no. 36 (1935).
[12] L.A. Moritz, *Grain-mills and flour in classical antiquity* (Oxford: Clarendon Press, 1958), 134.

While one may conceive of technology as the embodiment of science,[13] the role of science in technical innovation would not become a factor until the Renaissance. John Beer attributes the separation of science and technology in the Middle Ages to the class differentiation characteristic of the period, which served to separate those who produced society's goods, including artisans, from the educated elite who pursued knowledge for its own sake.[14] Whatever the case may be, original scientific discoveries in the medieval West did not begin to occur until the thirteenth century, and that science would more appropriately be categorized as natural philosophy than experimental method.[15]

The role of science in the history of technology aside, Febvre's thoughtful assessment still holds true for the study of medieval technology. There remains a tendency to consider technological development in the Middle Ages as episodic. This is certainly true in studies of water mill technology, which has left scant physical and literary evidence with which to track its gradual evolution. Most works tend to focus on either time period, such as Örjan Wikander's *Handbook of Ancient Water Technology*; or region, such as Richard Holt's *The Mills of Medieval England*.[16] Adam Lucas provides a rare comprehensive overview of the history of water mill technology in "Industrial Milling in the Ancient Medieval Worlds" and *Wind, Water,*

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[13] Michael Smithurst, "Do successes of technology evidence the truth of theories?," in *Philosophy and Technology*, ed. Roger Fellows (Cambridge: Cambridge University Press, 1995), 20.
[14] John J. Beer, "The Historical Relations of Science and Technology," *Technology and Culture* 6, no. 4 (1965): 547.
[15] Lynn White, Jr., "Medieval Roots of Modern Technology," in *Medieval Religion and Technology* (Berkeley: University of California Press, 1978), 85.
[16] Örjan Wikander, *Handbook of Ancient Water Technology* (Leiden: Brill, 2000); Richard Holt, *The Mills of Medieval England* (Oxford: Basil Blackwell, 1988).

Work: Ancient and Medieval Milling Technology, although his documentation on milling in France is not as robust as it could be, as this study highlights.[17]

Maurice Daumas expanded upon Febvre's ideas regarding the stages and episodic nature of technological development by providing an excellent discussion of the confusing vocabulary as related to this development.[18] In particular, he highlighted the distinction between the words 'invention' and 'innovation,' bemoaning the fact that historians use the term invention, which carelessly implies complete novelty. Innovation, on the other hand, takes into consideration the high probability that most technological development comes about through the enhancement of elements that already exist in some form. Daumas, like Febvre, focused on technology after 1750, but his discussion of the use of innovation and invention is useful in the context of this discussion. Appropriate use of the word innovation helps to mitigate the tendency to think of technological development in the Middle Ages as episodic, supporting instead the more likely scenario of a progression over time, at least in the case of the water mill.

David Edgerton's distinction between innovation-centric history of technology, which accurately describes the approach taken by historians of technology for much of the twentieth century, and use-centered history of technology is an important one.[19] In *Shock of the Old: Technology and Global History Since 1900,* Edgerton describes innovation-centric history as one that measures the success of an

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[17] Adam Robert Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology* (Leiden: Brill, 2006).
[18] Maurice Daumas, "The History of Technology: its aims, its limits, its methods," in *History of Technology*, ed. A. Rupert Hall and Norman Smith (London: Mansell, 1976).
[19] David Edgerton, *The Shock of the Old: Technology and Global History Since 1900* (Oxford: Oxford University Press, 2007).

invention or innovation by its future success. Use-centered history, on the other hand, examines technology within the context of its own time and place, not just the time and place when invention and innovation occurred. It does not measure the ‘success’ or ‘failure’ of an innovation or invention by its future success, but by how well if fits a given need at the time of its development. The evidence presented here demonstrates that invention, innovation and diffusion of water mill technology did occur in Antiquity, but this has only been discerned through the thoughtful use-centered examination of water mill technology in Antiquity from the 1980s onward.

Robert Friedel shifts the focus away from innovation to ‘improvement’ in *A Culture of Improvement.*[20] He characterizes improvement as contingent, possible at all levels of action, and not tied to future success. Friedel argues that societies are driven to improve how they do things as the need arises and that the success of a technological improvement must be assessed within its own context and not by some modern conception of future success. The rate of technological change depends upon whether or not a technology is ‘captured’ in a way that ensures it will be diffused throughout society. In the Middle Ages, according to Friedel, significant, widely shared value came to be attached to improvement that sustained its development, and methods of capture improved. The process of capture in Antiquity was affected by wide-spread illiteracy and the perception of the educated that technology was not suitable literary material.

Friedel does apply his ideas about improvement to some medieval topics, such as the plow and water mill, but he stops short of connecting these technological

[20] Robert Friedel, *A Culture of Improvement: Technology and the Western Millennium* (Cambridge, Massachusetts: The MIT Press, 2007).

developments to improvements made in Antiquity. The capture of technology no doubt increased significantly in the Middle Ages when documentation pertaining to property transfer increased, and the Cistercian Order can be said to have captured water mill technology by incorporating it so thoroughly into their lifestyle. The speed with which they then spread throughout Europe no doubt affected the rate of transfer of water mill technology in the twelfth century, which in turn led to their association with that technology in such a way that they were attributed with innovation more so than is warranted.

Assuming the role of historian in Febvre's framework, Marc Bloch explored the history and development of the water mill in "Avènement et Conquêtes du Moulin à Eau."[21] He suggested that the water mill appeared in the Mediterranean basin, likely as a tool to facilitate irrigation in times of drought. He believed that a glut of slave labor, however, prevented a power revolution in Antiquity the likes of which occurred in the Middle Ages due to the transition from animal and human to water-powered mills. The argument that slave labor inhibited the development of the water mill in Antiquity has proven particularly hard to shake. Aage Drachmann argued strongly against it as early as 1965, but only in the 1980s did archaeological evidence begin to lay it to rest.[22]

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[21] Marc Bloch, "Avènement et conquêtes du moulin à eau," *Annales d'histoire économique et sociale* 7, no. 36 (1935).

[22] Aage G. Drachmann, "Man Power, Animal Power and Water Power in Greek and Roman Antiquity," in *Actes du XIe Congrès de l'histoire des sciences III* (Varsovie-Torun-Kielce-Cracovie24-31 Août 1965); Örjan Wikander, "Exploitation of water-power or technological stagnation? A reapprisal of the productive forces of the Roman Empire," in *Scripta Minora. Regiae Societatis Humaniorum Litterarum Lundensis. Studier utgivna av Kungl. Humanistiska Vetenskapssamfundet i Lund 1983-1984*, ed. Berta Stjernquist (Lund: CWK Gleerup, 1984); M. I. Finley, "Technical innovation and economic progress in the ancient world," *The Economic History Review* 18, no. 1 (1965).

Bloch emphasized the importance of water power in the medieval countryside, but argued that the water mill did not find its way to France, which was distant from Mediterranean influences, in any significant way until the eleventh century. When water mill technology did finally make its way to Gaul, he believed its transmission to be due to the increasing influence of feudal society in the region.[23] Bloch supported this and other claims largely with evidence from scant literary sources, which served as the primary form of evidence for the distribution and development of the water mill until the last quarter of the twentieth century.[24] Unfortunately, no record like William the Conqueror's Domesday Book, which documents over 6,000 water mills in England shortly after the Conquest in 1066, exists for medieval France.[25]

In "Le Moulin à Eau*:* Une Révolution Technique Médiévale," Bertrand Gille expanded upon Bloch's work with a comprehensive summary of literary and archaeological evidence for ancient and medieval water mills, and described in detail the development of industrial milling. Industrial milling is defined here as milling involved in processes other than grinding grain. The industrial applications of water power for which Gille provided evidence include fulling, hemp, iron, and paper mills, as well as the hydraulic saw.[26] Due to the relative lack of archaeological evidence that existed in the first half of the twentieth century, however, Gille could point to the

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[23] Marc Bloch, *Feudal Society*, 2 vols. (Chicago: University of Chicago Press, 1964).
[24] "Avènement et conquêtes du moulin à eau."
[25] Margaret Hodgen, "Domesday Water Mills," *Antiquity* 13 (1939). Hodgen counted 5,632 mills in her study, but this number has been corrected to 6,082 by H.C. Darby, *Domesday England* (Cambridge: Cambridge University Press, 1977), 361.
[26] Bertrand Gille, "Le Moulin à Eau: Une Révolution Technique Médiévale," *Techniques et Civilisation* 3, no. 1 (1954): 10.

existence of no more than ten hydraulic wheels in sixth century Gaul. This lent credence to the idea that the water mill underwent a veritable explosion of development in the Middle Ages, as evidenced by the thousands of water mills that are documented in Domesday Book.

Gille held the common belief at the time that the Middle Ages, while lacking "industrial civilization," underwent a technological revolution that culminated in the twelfth and thirteenth centuries.[27] In regard to the role that Cistercians played in this revolution, he stated that "among the groups that contributed to the spread of technical progress, perhaps none was more effective than the Cistercian Order."[28] While he did not speak of "the machine" in terms of technological systems as Mumford did in 1915, he attributed this medieval industrial revolution to the medieval machine, as exemplified by the water mill.

Georges Duby underscored the importance of the water mill in rural development in *Rural Economy and Country Life in the Medieval West*. Duby reinforced Bloch's ideas about the important role that feudal society played in the distribution of mills throughout the countryside, and proposed a connection between water mills and the prolific economic development of the eleventh and twelfth centuries in the Occident.[29] Feudal lords, both lay and ecclesiastical, could significantly increase their revenue by forcing their serfs to bring their grain to the lord's mill. In his later work, *The Early Growth of the European Economy,* Duby

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[27] "The Medieval Age of the West (Fifth Century to 1350)," in *in A History of Technology and Invention: Progress Through the Ages*, ed. Maurice Daumas (New York: Crown Publishers, 1969), 424.
[28] Ibid., 559.
[29] Georges Duby, *Rural Economy and Country Life in the Medieval West*, trans. C. Postan (Philadelphia: University of Pennsylvania Press, 1968).

acknowledged the role of Cistercians in the promotion of economic growth in the twelfth century.[30]

As early as 1940, Lynn White Jr. disputed the idea of an abrupt disconnect between the Roman Empire and the medieval West during the "Dark Ages."[31] He also diverged somewhat from his predecessors in his focus on the significance of the transition from human to non-human sources of power. According to White, non-human sources of power, such as the water mill, developed in the Middle Ages due to the "implicit theological assumption of the infinite worth of even the most degraded human personality, by an instinctive repugnance towards subjecting any man to a monotonous drudgery which seems less than human in that it requires the exercise neither of intelligence nor of choice."[32] St. Benedict, according to White, changed the very nature of technological development in the West by exalting labor as a way to praise and serve God and by encouraging a tradition of learning among monks.[33] He achieved this monumental achievement by penning the Benedictine Rule, a set of guidelines to direct the religious life in Benedictine monasteries in the Middle Ages hundreds of years after his death. White considered St. Benedict of Nursia (d. 543) the first pivotal figure in the history of labor. Friedel acknowledged this emphasis on the value of human life as a significant impetus for improvement in the Middle Ages, and he mentioned the Cistercian Order in his discussion. He believed the Order's

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[30] *The Early Growth of the European Economy: Warriors and Peasants from the Seventh to Twelfth Centuries*, trans. Howard B. Clarke (Ithaca, NY: Cornell University Press, 1974), 220-21.
[31] White, "Technology and Invention in the Middle Ages."
[32] Ibid., 156.
[33] "Dynamo and virgin reconsidered." This was reiterated by George Ovitt Jr., *The Restoration of Perfection: Labor and Technology in Medieval Culture* (New Brunswick: Rutgers University Press, 1987), chapter 3: Labor and the Foundations of Monasticism.

success stemmed not from innovation, however, but from the systematic application of the best-known techniques at the time.[34]

According to White, the combination of technology and the Benedictine attitude toward labor and learning resulted in a social environment favorable to scientific and technological development, and ultimately to an industrial revolution in the Middle Ages. He agreed with his peers that the mill existed in Antiquity, but believed that a great deal of innovation of the water mill occurred in the Middle Ages due largely to the work of Cistercians who led the way in the use of power, water power in particular.[35] In *Technological Progress in the Western Middle Ages*, he went one step further and argued that Cistercians led in the application of water power to industrial processes.[36] The traditional argument espoused by White and his peers is that water-powered mills allowed medieval monks to fulfill the Benedictine mandates of manual labor and self-sufficiency, both of which were construed more literally [*ad litteram*] by Cistercians than their Benedictine neighbors. The utilization of water power required allowed more time to satisfy their obligations of study and prayer.

White remains closely associated with the concept of technological determinism more than fifty years after the publication of *Medieval Technology and Social Change*, a seminal work in which he established medieval technology as a legitimate field of study.[37] Technological determinism is the idea that technology is the prime driving force of history and can be construed as independent of other

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[34] Friedel, *A Culture of Improvement: Technology and the Western Millennium*, 21.
[35] White, "Dynamo and virgin reconsidered," 190.
[36] "Technological Progress in Western Middle Ages," 290.
[37] *Medieval Technology and Social Change* will subsequently be referred to in the text as *MTSC.*

factors.[38] His association of the introduction of the stirrup to Western Europe with the development of feudalism, or vassalage in exchange for benefices, is a classic example.[39] While it is undeniable that White had strongly deterministic opinions about the nature of technological development in the Middle Ages at that point in his career, it has become clear that they are not as one dimensional as scholars have claimed over the years.

Donald MacKenzie and Judy Wajcman cited White's theories regarding the influence of the stirrup on feudalism as a classic example of technological determinism in their introduction to *The Social Shaping of Society*, but they fail to note his arguments concerning the influence of Christianity on the development of technology in the Middle Ages.[40] This is a curious omission given that White's arguments foreshadow their own, by admitting to the possibility of a 'soft' technological determinism that considers political, economic, and cultural factors along with the technological.

Similarly, Peter Perdue argued that White used a 'single-factor' method of investigation when he singled out a number of individual technologies such as the heavy plough and stirrup as the primary drivers of historical change in Western Europe in the Middle Ages.[41] He acknowledged that White shifted towards cultural

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[38] Merritt Roe Smith and Leo Marx, *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, Massachusetts: The MIT Press, 1994), Introduction.
[39] Lynn White, Jr., *Medieval Technology and Social Change* (Oxford: Oxford University Press, 1962), chapter 1.
[40] *The Social Shaping of Technology*, ed. Donald Mackenzie and Judy Wajcman (Philadelphia: Open University Press, 1985).
[41] Peter C. Perdue, "Technological Determinism in Agrarian Societies," in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith and Leo Marx (Cambridge, Massachusetts: The MIT Press, 1994), 174-78.

determinism in his essays, later compiled in *MTSC*,[42] but questioned whether White's reliance on Christianity as a driving force for technological development was compatible with his earlier views. What Perdue failed to note is that *Medieval Religion and Technology* is a compilation of essays that White wrote early in his career. White argued in 1940 that the theological assumption of infinite worth that is due to even the lowest among us drove the development of labor saving power machines in the Occident in the later Middle Ages.[43]

Bert Hall contended that the long-standing confusion about White's arguments stems from the fact that he wrote *MTSC* while in the midst of a personal paradigm shift away from a framework that attempted to contextualize the history of technology through the lens of economic, social and political history to one that focused on attitudes and beliefs of technology through the lens of cultural history.[44] Pamela Long described a contextual methodology that seeks to place technologies within the context of other contemporary technological processes and devices that includes relevant social, political, and material circumstances.[45] *MTSC* can be viewed as an early attempt at such a contextual methodology before such a methodology was widely accepted or even well understood. White did look at both 'technology' and 'culture' as the contextual methodology suggests, but his focus on

[42] White, *Medieval Religion and Technology*.
[43] "Technology and Invention in the Middle Ages," 156. For further thoughts on this topic, see Susan J. White, *Christian Worship and Technological Change* (Nashville: Abingdon Press, 1994).
[44] Bert Hall, "Lynn White's *Medieval Technology and Social Change* After Thirty Years," in *Technological Change: Methods and Themes in the History of Technology*, ed. Robert Fox (Amsterdam: Harwood Academic Publishers, 1996), 94.
[45] Pamela O. Long, "The Craft of Premodern European History of Technology: Past and Future Practice," *Technology and Culture* 51, no. 3 (2010): 698.

culture tends to be overlooked due to his bold assertions regarding the relevance of technology on the development of history in the medieval West.

The intention here is not to apologize for the deterministic slant of White's arguments, but to point out that the strongly deterministic nature of *MTSC* has resulted over time in an obfuscation of the emphasis that White placed on the social construction of technology. White claimed in *MTSC* that "the historical record is replete with inventions which have remained dormant in a society until at last – usually for reasons which remain mysterious – they 'awaken' and become active elements in the shaping of a culture to which they are not entirely novel." Sawyer and Hilton argued shortly after the publication of *MTSC* that this claim weakened White's overall deterministic argument. They did not appreciate that it simply renders his arguments more complex than generally realized.[46] Roland has argued more recently that this statement highlights the largely unrecognized cultural determinism found within White's work.[47] Bert Hall agreed, stating in his review "*Medieval Technology and Social Change* after Thirty Years" that White was, if anything, a cultural determinist.[48] Perhaps nowhere is this cultural determinism demonstrated more clearly than in his work about the development of medieval power technology by monks.

Historians of technology for much of the twentieth century believed that individuals in the Mediterranean basin invented the basic rotary grain mill in

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[46] P. H. Sawyer and R. H. Hilton, "Technical Determinism: The Stirrup and the Plough," *Past and Present* 24 (1963): 91.
[47] Alex Roland, "Once More into the Stirrups: Lynn White Jr., "Medieval Technology and Social Change"," *Technology and Culture* 44, no. 3 (2003): 581.
[48] Hall, "Lynn White's *Medieval Technology and Social Change* After Thirty Years," 92.

Antiquity, but did not have the wherewithal and/or incentive to develop more advanced milling technology. M. I. Finley's bold statement that "it is commonplace that the Greeks and Romans together added little to the world's store of technical knowledge and equipment" is representative of the majority opinion.[49] Finley acknowledged that the first water mills are rightly attributed to societies in Antiquity, but argued that they used them sporadically with little overall effect on the ancient economy. In particular, he claimed that while invented in the first century, the water mill was not utilized for industrial applications until the end of the fourth and not widely utilized until the fifth or sixth centuries.[50] K.D. White held this view as late as 1984 in *Greek and Roman Technology*, but by that time archaeological evidence had begun to suggest otherwise. One notable exception is C. L. Sagui, who in 1948 documented the widespread development and use of water power in Antiquity.[51] Sagui may have diverged somewhat from popular opinion due to his early use-centered approach to water mill technology, which recognized the importance of agricultural mills in Antiquity. Agricultural mills were not considered to be as innovative as industrial mills by Sagui's contemporaries who followed a more innovation-centric approach to water mill technology, so they were likely disregarded when estimating the level technological proficiency and innovation in Antiquity.

Örjan Wikander began in the 1980s to successfully argue against the idea of technological stagnation and decline in Antiquity using an increasingly robust body of archaeological evidence. With the aid of archaeological evidence from 56 water

[49] Finley, "Technical innovation and economic progress in the ancient world," 29.
[50] Ibid., 35-36.
[51] C. L. Sagui, "La meunerie de Barbegal (France) et les roues hydrauliques chez les anciens et au moyen âge," *ISIS* 38, no. 3/4 (1948).

mill sites that date prior to 700 A.D., he argued that the critical breakthrough of the water mill occurred at the end of the second century A.D.,[52] a time period for which little literary evidence remains. When evidence from medieval charters is removed (a literary type not known in Antiquity), a comparison of medieval and ancient literary evidence supports this claim.[53] Through a careful and considered evaluation of the evidence, he demonstrated that mechanical grain mills were in more or less constant use in the Mediterranean during the time period that the early historians of technology claimed technological stagnation to be the greatest. To consider industrial developments in the ancient world a failure, according to Wikander, would be to consider our own world the climax and only natural aim of historical development.[54] This conclusion is in keeping with Edgerton's concept of use-centered history, which demands that water mill technology in Antiquity be evaluated within its local context, not judged in comparison to medieval usage. It contrasts, however, with the innovation-centric approach taken by scholars in the first half of the twentieth century.

Wikander also systematically addressed weaknesses in the most prevalent arguments cited above against the full development of water mills in Antiquity. For example, he has demonstrated that the greatest expansion of water mills in the Roman Empire corresponds to a period when slavery was ubiquitous in the region, invalidating the proposition that there is not a causal relationship between slave

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[52] Wikander, "Exploitation of water-power or technological stagnation? A reapprisal of the productive forces of the Roman Empire."; "The Water-Mill," in *Handbook of Ancient Water Technology*, ed. Örjan Wikander (Leiden: Brill, 2000), 372.

[53] "Exploitation of water-power or technological stagnation? A reapprisal of the productive forces of the Roman Empire," 22-23.

[54] Ibid., 40.

labor and the use of water mill technology at that time. He makes a similarly strong case against reliance on ancient literature for information on water mill use in Antiquity.

Many cities in the Mediterranean world of Antiquity were situated on high ground with little or no access to running water. This protected urban areas against spring floods, but made access to running water for mills difficult to come by.[55] Furthermore, the expense of operating a water mill that depended upon an aqueduct for its source of power would have been significant. It is therefore more likely that ancient water mills would have been built in rural areas than cities in the Mediterranean region. Ancient literature, however, tends to focus on town life, unlike medieval literature that has a more rural focus. Legal treatises, hagiography, and charters do not become common literary genres before late Antiquity. It is in these types of sources where the preponderance of references to medieval mills can be found.[56] As such, it is unsurprising that water mills appear in medieval documents more so than in ancient documents.

Kevin Greene, also an archaeologist, agrees with Wikander that technology transfer in Antiquity has been vastly underestimated, and berates Finley in particular for focusing on the causes of alleged stagnation rather than on apparent achievements in technology.[57] Greene highlighted that many medieval innovations, such as cranks, reciprocating machinery, and the windmill, were simply

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[55] Ibid., 20.
[56] Benoit and Rouillard also emphasize this point, but go further in highlighting how various medieval documents detail the use of hydraulic energy; Paul Benoit and Josephine Rouillard, "Medieval Hydraulics in France," in *Working with Water in Medieval Europe*, ed. Paulo Squatriti (Leiden: Brill, 2000).
[57] Kevin Greene, "Technological innovation and economic progress in the ancient world: M. I. Finley re-considered," *Economic History Review* 53, no. 1 (2000).

modifications or expansion of ideas rooted in Antiquity. In spite of this increasing body of work that documents a more technologically dynamic ancient world than previously realized, medieval historians who do not focus on technology continue to cling to the traditional views. As late as 2004, Elspeth Whitney suggested that while water wheels were well known in Antiquity, they were largely confined to grinding grain and irrigation.[58] Similarly, in 2009 Steven Epstein stated in his work on economic and social history in later medieval Europe that classical technologies were stagnant prior to the Middle Ages due to largely defunct theories that have already been mentioned, such as the presence of slave labor.[59] These recent examples demonstrate that much work remains to be done in dispelling long-held beliefs about the prevalence and development of technology in Antiquity.

Adam Lucas has provided a wealth of information on ancient and medieval milling, including the most detailed list of medieval industrial mills to date. This list includes industrial mills in France, but unfortunately Lucas focuses his discussion on milling in England and fails to adequately highlight significant differences that existed between milling in England and the continent, particularly in France.[60] Paul Benoit fills this gap with the most comprehensive study of French medieval water mills, particularly as developed and used by the Cistercian Order.[61] Benoit provides

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[58] Elspeth Whitney, *Medieval Science & Technology*, Greenwood Guides to Historic Events of the Medieval World (Westport, Connecticut: Greenwood Press, 2004), 116.
[59] Steven A. Epstein, *An Economic and Social History of Later Medieval Europe, 1000-1500* (New York: Cambridge University Press, 2009), 21.
[60] Adam Robert Lucas, "Industrial Milling in the Ancient and Medieval Worlds, a Survey of the Evidence for an Industrial Revolution in Medieval Europe," *Technology and Culture* 46, no. 1 (2005); *Wind, Water, Work: Ancient and Medieval Milling Technology*.
[61] Benoit and Rouillard, "Medieval Hydraulics in France."; Paul Benoit, "L'Industrie Cistercienne (XII^{ème} - Premiere Moitie du XIV^{ème} siècle)," in *Monachisme et Technologie dans la Société Médiévale du Xe au XIIIe Siècle*, Actes du Colloque Scientifique International, Cluny 4, 5 et 6 septembre 1991 (Cluny: Centre d'Enseignement et de Recherche de Cluny, 1991); Paul Benoit and Karine Berthier, "L'Innovation dans

demonstrable evidence for the reuse of old Roman infrastructure for the development and use of medieval mills in France. He points out, however, that it is difficult to connect the dots between technology in Antiquity and that in medieval France. He fills those gaps with details from Visigothic laws, monastic charters, and other types of documents that remain to us. In a call to action that brings to mind Febvre's criticism that scholars too often focus on their areas of specialization to the exclusion of all others, Benoit emphasizes the need for historians, art historians, archaeologists, hydraulic engineers, and ethnologists to work together to construct a comprehensive profile of the history of hydraulics in France.[62]

This brings us to the central topic of this thesis, the question of the development and use of water mill technology by the Cistercian Order in twelfth-century France. Cistercian abbeys generally had at least one milling complex on most of their agricultural granges, but many of these mills preceded Cistercian milling complexes. Constance Berman has identified the acquisition by Cistercians of over one hundred sites for mills in southern France alone. About two-thirds of these acquisitions were in locations with one or more mills already on site.[63] While capital and manpower would have been needed to repair or refit some of these pre-existing mills, she demonstrated that water mill technology often preceded acquisition by the Order.

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l'Exploitation de l'Énergie hydraulique d'Après le cas des monastères cisterciens de Bourgogne, Champagne et Franche-Comté," in *L'Innovation technique au Moyen Age*, ed. Patrice Beck, Actes du VIe Congrès International d'Archéologie Medieval (Paris: Éditions Errances, 1998).

[62] Benoit and Rouillard, "Medieval Hydraulics in France," 165.

[63] Constance Hoffman Berman, "Medieval Agriculture, the Southern French Countryside, and the Early Cistercians. A Study of Forty-Three Monasteries," *Transactions of the American Philosophical Society* 76, no. 5 (1986): 88.

Archaeological evidence now reveals that the discontinuity of ancient and medieval industrial water mill technology has been greatly overstated. This, then, largely disproved the existence of a medieval "industrial revolution."[64] Scholars now acknowledge that medieval monasteries made extensive use of existing technology without necessarily contributing significantly to its development. Cistercians do still appear, however, to have been pioneers in certain industrial applications of water mill technology, such as its use in the manufacture of iron.[65] Unfortunately, the gradual abandonment of the idea of a medieval industrial revolution has resulted in an unwarranted trend to overlook the symbiotic relationship between Cistercians and waterpower. That is the purpose of this study. Before undertaking a detailed exploration of the Cistercian use of water power, however, it is necessary to provide some background on the history of the water mill itself.

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[64] Wikander, "Exploitation of water-power or technological stagnation? A reapprisal of the productive forces of the Roman Empire."; Catherine Verna, *Les Mines et les Forges des Cisterciens en Champagne méridionale et en Bourgogne du Nord XIIe-XVe Siècle* (Paris: A. E. D. E. H., 1995).

[65] Adam Robert Lucas, "The role of monasteries in the development of medieval milling," in *Wind & Water: Fluid Technologies from Antiquity to the Rennaissance*, ed. Steven A. Walton (Tempe, Arizona: ACMRS, 2006), 106; Verna, *Les Mines et les Forges des Cisterciens en Champagne méridionale et en Bourgogne du Nord XIIe-XVe Siècle*.

Chapter 2: The Water Mill

> Cease from grinding, ye women who toil at the mill; sleep late, even if the crowing cocks announce the dawn. For Demeter has ordered the Nymphs to perform the work of your hands, and they, leaping down on top of the wheel, turn its axle which, with its revolving spokes, turns the heavy concave Nisyrian mill-stones. We taste again the joys of the primitive life, learning to feast on the products of Demeter without labour.[1] - Antipater

Antipater's poem *On a Water-Mill* is one of the earliest surviving descriptions of a grain mill, dating to just before the birth of Christ. Exact details of the invention and development of the water mill are shrouded in mystery due to scant remaining literary and archaeological evidence, but close examination of this evidence makes it possible to paint a rough picture. This chapter will begin with a technical overview of water mill technology. This will be followed by a survey of ancient literary evidence and an update on the state of archaeological research that is changing the way scholars view technological development in the Middle Ages. This evidence will demonstrate that ideas purporting technological stagnation in Antiquity and innovation of technology in the Middle Ages are becoming increasingly difficult to sustain. On the contrary, it supports the argument that water mill technology gradually spread from the Mediterranean region to France resulting in the presence of this technology in France prior to the foundation of the Cistercian Order at the end of the eleventh century.

Many types of water mills have been used throughout history, but the most important for this discussion are the horizontal and vertical water mill. The simplest configuration, a horizontal mill driven by a horizontal wheel, consists of a vertical

[1] Antipater of Thessalonica, "On a Water-mill," in *The Greek Anthology*, ed. G. P. Goold (London: William Heinemann Ltd., 1983).

shaft with a water-driven wheel at the bottom and horizontally-oriented millstones at the top (*Figure 1a*).[2] The horizontal mill is also referred to as the Greek or Byzantine mill, as well as the Norse mill.[3] This type of mill requires no specialized gearing and can be used for grinding grain into flour, but little else. An early passage by Apollonius of Perga (d. 190 B.C.) that dates to the early third century B.C. and exists only in translation provides evidence of a horizontal water-wheel-driven flute player. Based on this evidence, it is generally thought that the horizontal water wheel slightly preceded the vertical wheel.[4] Adam Lucas, however, argues that the more complex vertical mill preceded the horizontal mill due to the lack of definitive radio-carbon dating of commonly cited early horizontal mills.[5]

The vertical water mill is more complex than the horizontal mill. In this type of configuration, a vertical wheel is connected to millstones by means of a horizontal shaft equipped with a right-angled gearing mechanism that consists of a vertical cog wheel that rotates on the horizontal shaft of the vertical water wheel as it turns (*Figure 2*).[6] This cog wheel engages with a horizontal cog wheel that in turn rotates the horizontally-oriented mill stones. The speed of the mill stones in relation to the water wheel can be geared up or down, the need for which depends on the type of mill and speed of water flow, by manipulating the size of the two cog wheels in relation to each other. There are three basic types of vertical wheel that can be used

[2] Terry S. Reynolds, "Medieval Roots of the Industrial Revolution," *Scientific American* 251, no. 1 (1984): 124.
[3] Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*, 34.
[4] M. J. Lewis, *Millstone & Hammer: The Origins of Water Power* (Hull: Hull University Press, 1997), 49-57, 60.
[5] Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*, 38.
[6] Ibid., 29.

to power a vertical mill, the undershot (*Figure 1b*), overshot (*Figure 1c*), and the breast mill (*not shown*).[7]

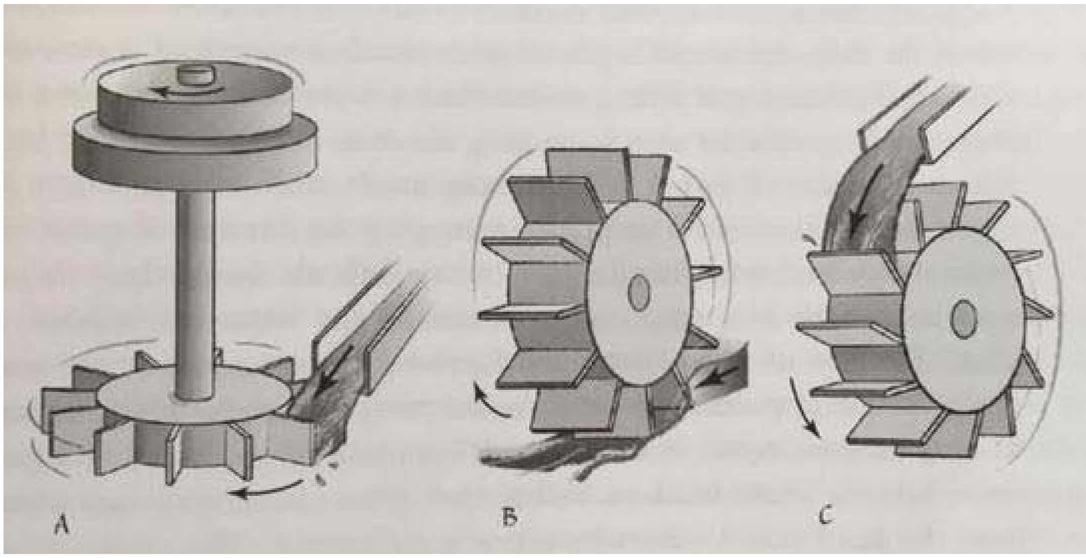

Figure 1: a) Horizontal, b) Vertical undershot, c) Vertical overshot

Overshot and undershot wheels drove most mills in medieval France.[8] The lower part of an undershot wheel is partially submerged in running water, the power of which drives the wheel, while the overshot wheel is powered through gravity by the weight of the water falling onto the wheel.[9] The breast wheel is a type of overshot wheel in which water is supplied near the center of the wheel, rather than over its top. In spite of the overshot wheel's higher efficiency (50-70%) as compared to that of the undershot wheel (20-30%),[10] the undershot wheel appears to have been more commonly used in France due to the country's topography. France does

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[7] Friedel, *A Culture of Improvement: Technology and the Western Millennium*, 33.
[8] Wikander, "The Water-Mill," 373-78.
[9] Terry S. Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel* (Baltimore, MD: The Johns Hopkins University Press, 2002).
[10] Frances Gies and Joseph Gies, *Cathedral, Forge, and Waterwheel* (New York: Harpers Collins Publishers, 1994), 35.

not have many naturally occurring waterfalls, and the engineering required to create artificial waterfalls may have been prohibitively expensive.

The vertical, undershot wheel, also known as the Vitruvian mill, is thought to have evolved from the water-bearing *noria* and is similarly powered.[11] The *noria* is an automatic, compartmentalized irrigation wheel that lifts water in buckets. Philo of Byzantium first documented the *noria* in his *Pneumatica* around the year 200 B.C. The original version of the *Pneumatica* has not survived, but evidence on an Egyptian papyrus that dates from the second century B.C. substantiates this early date.[12] There has been some speculation that Arab translators added the references to water power in the *Pneumatica* at a later date, but Michael Lewis has demonstrated through a detailed analysis of the various translations of the *Pneumatica* that Philo was, in fact, familiar with the *noria*, as well as the overshot waterwheel and a number of other water-powered devices.[13]

For the purposes of this discussion, water mills will be placed into one of two categories: agricultural mills that are solely dedicated to grinding grain, or industrial mills dedicated to all milling processes other than grinding grain. This definition of an industrial mill contrasts with Walter Horn's usage in 1975 in which he refers to industrial milling as intensive, large-scale agricultural milling operations.[14] The mechanical requirements of industrial mills are significantly different. Agricultural mills require the simple rotary motion of horizontal millstones and can be powered by

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[11] K. D. White, *Greek and Roman Technology* (London: Thames and Hudson, 1984), 55.
[12] Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel*; White, *Medieval Technology and Social Change*.
[13] Gies and Gies, *Cathedral, Forge, and Waterwheel*, 34; Lewis, *Millstone & Hammer: The Origins of Water Power*, 32.
[14] Walter Horn, "Water power and the Plan of St. Gall," *Journal of Medieval History* 1, no. 3 (1975).

either horizontal or vertical water wheels (*Figure 2*).[15] Industrial mills, on the other hand, require that the rotary motion of a water wheel be converted to reciprocating motion. Reciprocating motion is the up and down pounding motion that is necessary to accomplish tasks such as fulling cloth and hammering iron ore (*Figure 3*).[16]

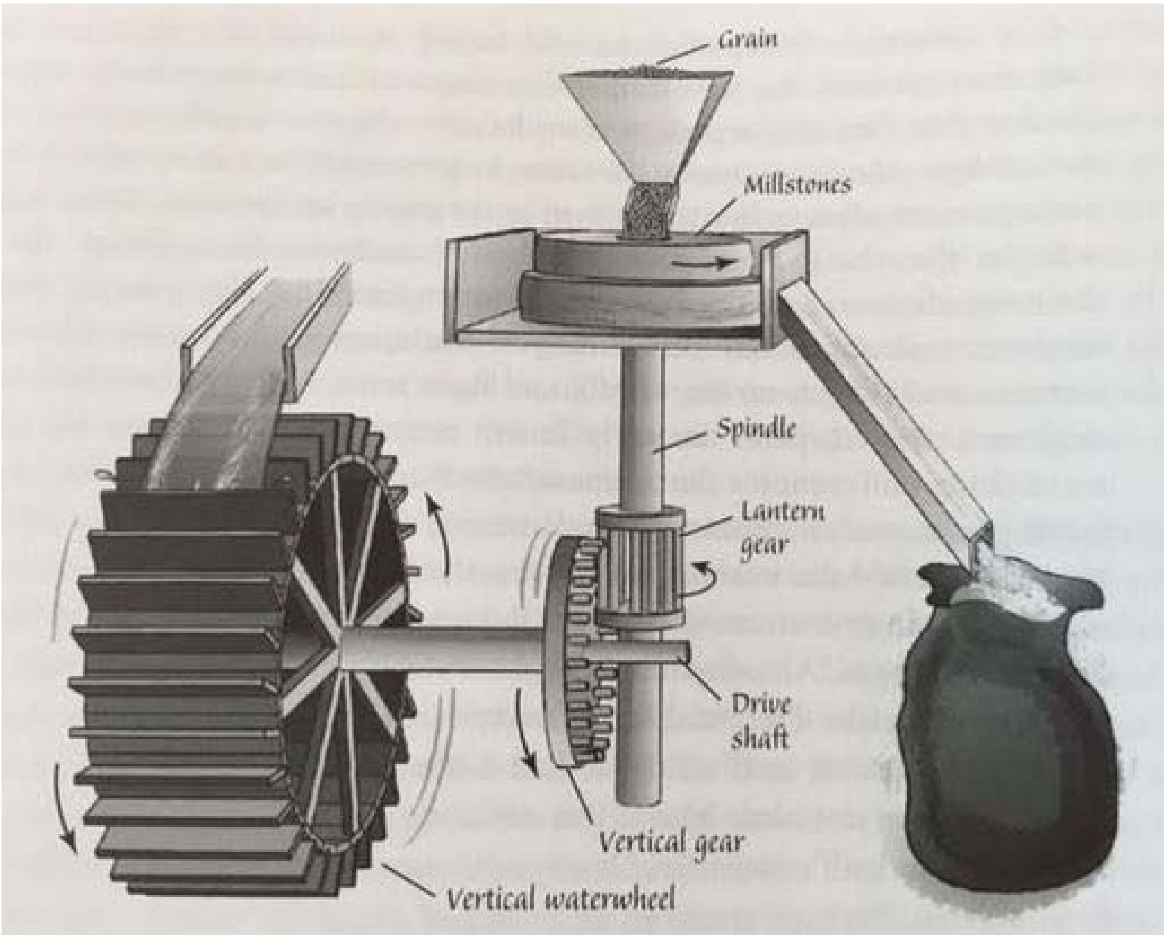

Figure 2: Mill powered by a vertical waterwheel

[15] Gies and Gies, *Cathedral, Forge, and Waterwheel*, 34. Image from Friedel, *A Culture of Improvement: Technology and the Western Millennium*, 36.
[16] Georgii Agricolae, "De re metallica," (Basileae1556), book VIII.

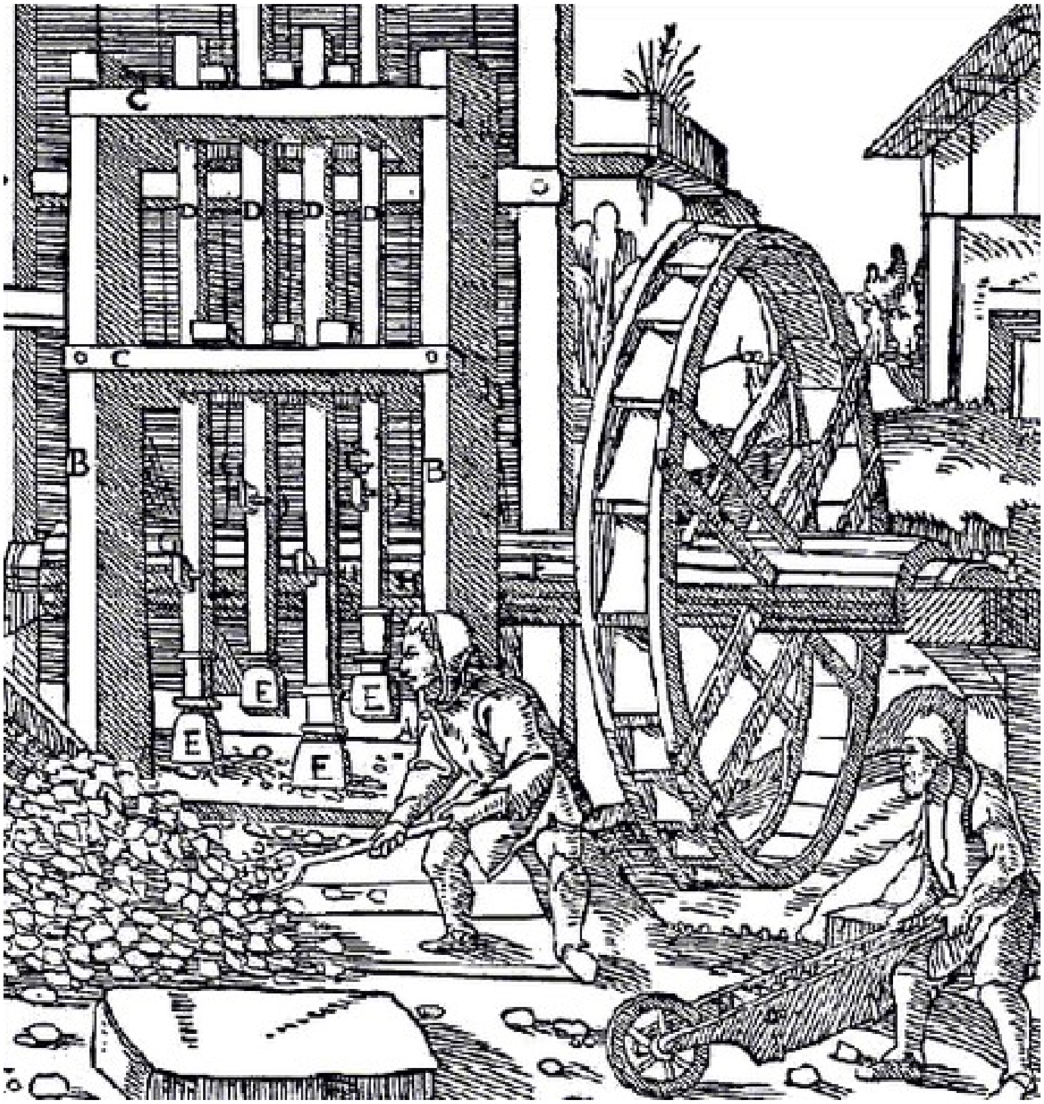

Figure 3: Rock crushing industrial mill

The conversion of rotary to reciprocating motion is accomplished with the aid of cams. A camshaft is a projection that is attached to the horizontal axle of a vertical waterwheel. As the wheel turns, these projections engage and disengage with similar projections on trip hammers causing them to rise and fall (*Figure 4*).[17] By holding the cams directly, the horizontal axle of the wheel does not require additional

[17] Gille, "The Medieval Age of the West (Fifth Century to 1350)," 455. Figure from Friedel, *A Culture of Improvement: Technology and the Western Millennium*, 44.

gears that could reduce the amount of energy available for the process or cause undue mechanical problems.[18]

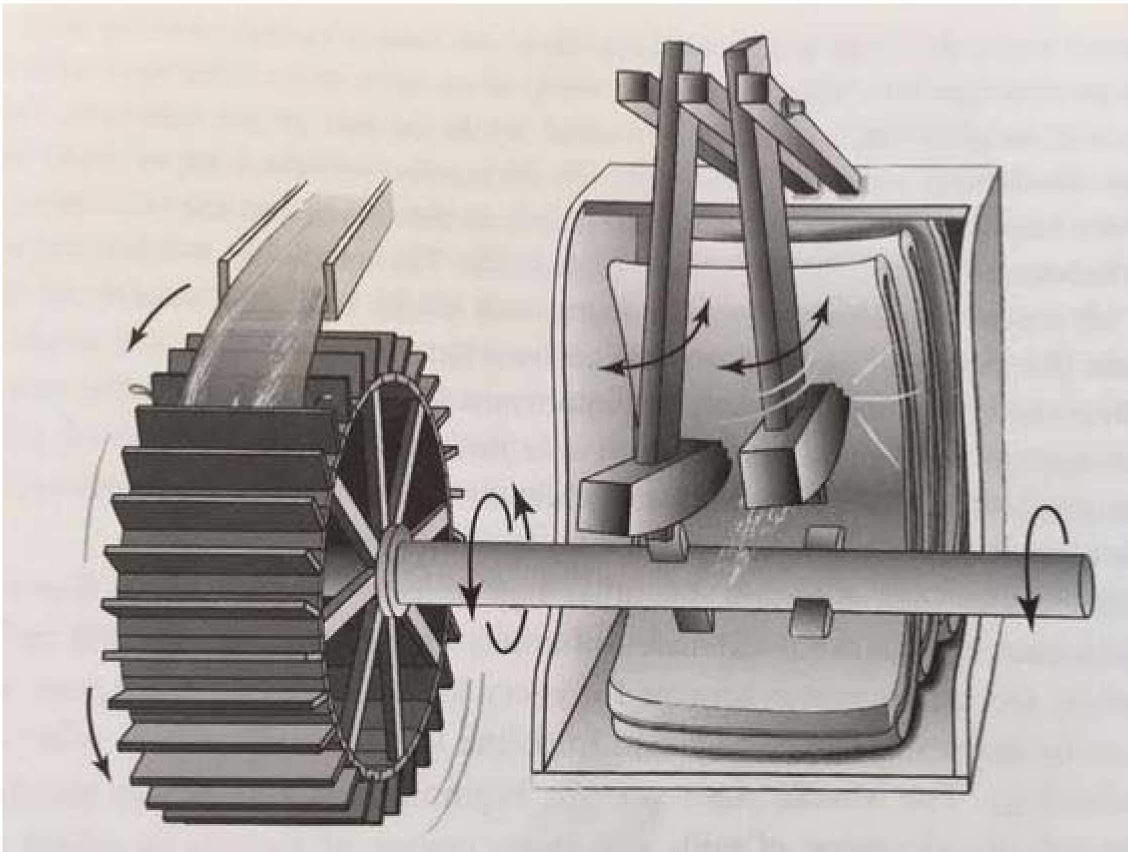

Figure 4: Cam mechanisms for a fulling mill

Walter Horn first suggested in 1975 that water-powered recumbent trip-hammers drove the pestles (*pilae*) or grain pounding mechanism in the mortar house of the Plan of St. Gall (*Figure 5*).[19] This Plan includes both a mill (27) and mortar house (28) clearly demonstrating that the person who drew the plan differentiated between the two tasks, and both houses are situated on the southern-most side of the plan, which provides access to a flowing course of water. Horn considered the

[18] Benoit and Rouillard, "Medieval Hydraulics in France," 204.
[19] Lorna Price, *The Plan of St. Gall in Brief* (Berkeley: University of California Press, 1982), 19.

Plan of St. Gall the earliest evidence of this type industrial technology in Western Europe. He categorized this process as industrial based on the reciprocating action that it required, even though the process was ultimately applied to grain. Terry Reynolds agreed with Horn's assessment of the Plan as late as 1984.[20] Horn has drawn an excellent interpretation of the mill and mortar house in the Plan of St. Gall that depicts them as they may have looked when equipped with mills (*Figure 6*).[21] Evidence for the incorporation of industrial water power in the Plan of St. Gall is important to the argument presented here, for it clearly demonstrates that advanced water mill technology existed in the West prior to the birth of the Cistercian Order.[22]

The exact date of the 'invention' of the water mill is difficult to ascertain, a problem that is compounded by the fact that classical Latin did not semantically differentiate between different types of mills. This makes a meaningful translation of the few surviving texts difficult.[23] Michael Lewis has argued that the origin of the vertical water mill can be found through reassessment of the accepted translation of Apollonius' description of the waterwheel by Arabic translators.[24] The passage in question has long been translated "a wheel like that of the Byzantine mill or the newly invented vertical mill on the axle that is called *abdar,"* abdar being a meaningless word as far as scholars can tell. According to Lewis, this should be translated "a wheel like that of the Byzantine mill or the newly invented vertical mill of

[20] Reynolds, "Medieval Roots of the Industrial Revolution."
[21] Price, *The Plan of St. Gall in Brief*.
[22] Horn, "Water power and the Plan of St. Gall," 237.
[23] Paolo Squatriti, "'Advent and Conquests' of the Water Mill in Italy," in *Technology and Resource Use in Medieval Europe: Cathedrals, Mills, and MInes*, ed. Elizabeth Bradford Smith and Michael Wolfe (Aldershot: Ashgate, 1997), 128.
[24] Lewis, *Millstone & Hammer: The Origins of Water Power*, 60.

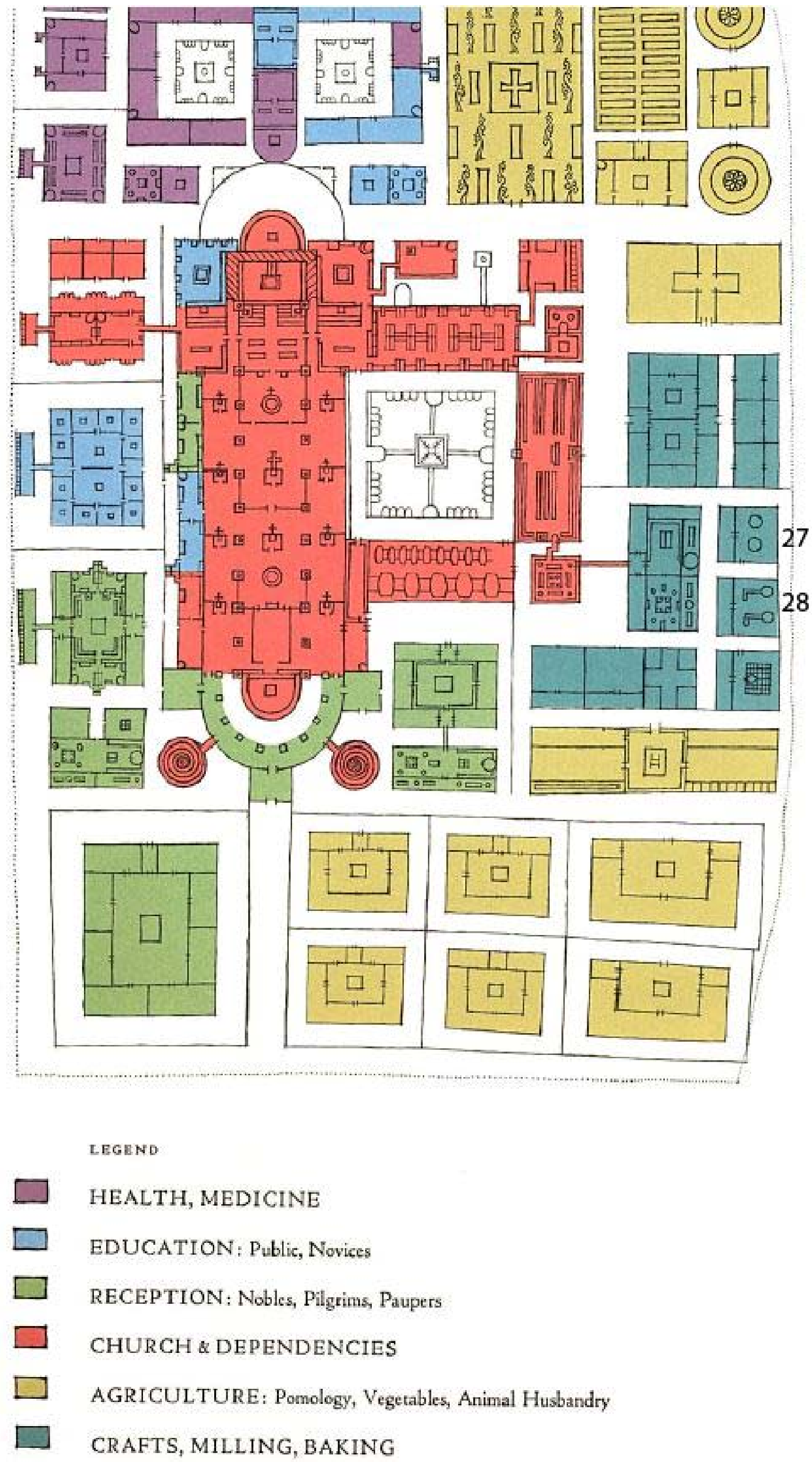

Figure 5: Color-coded Plan of St. Gall

Abdaraxos.” Abdaraxos is known to have carried out a program of mechanical work, largely as an academic exercise, at the museum in Alexandria. The museum served as a research institute for the arts and sciences that flourished under Ptolemy II and III during the third century B.C. This date and location is plausible given the evidence that does remain.

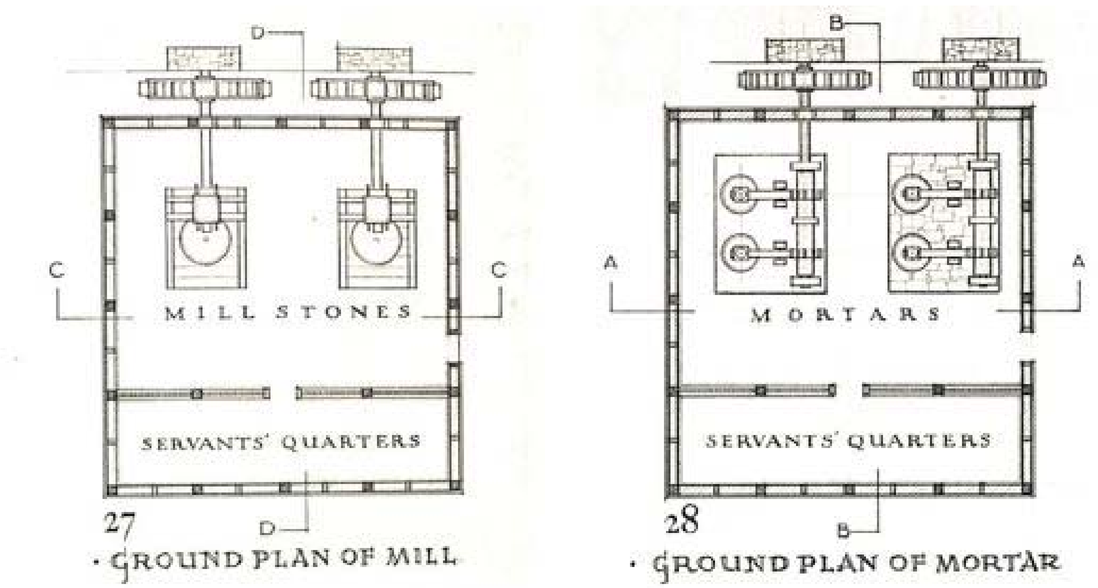

Figure 6: Mill and Mortar house from Plan of St. Gall

In approximately 24 B.C., Vitruvius described four different water-lifting machines – the water-drum, tread-wheel with buckets, bucket-chain with tread-wheel, and wheel with buckets and paddles, with the latter device being powered by a paddle-wheel submerged in a flowing river.[25] According to Vitruvius,

> Water-mills are turned on the same principle, and are in all respects similar, except that at one end of the axis they are provided with a drum-wheel, toothed and framed fast to the said axis; this being placed vertically on the edge turns round with the wheel. Corresponding with the drum-wheel a larger horizontal toothed wheel is placed, working on an axis whose upper head is in the form of a dovetail, and is inserted into the mill-stone. Thus the teeth of the drum-wheel which is made fast to the axis acting on the teeth of the horizontal wheel, produce the revolution of the mill-stones, and in the engine a

[25] Drachmann, "Man Power, Animal Power and Water Power in Greek and Roman Antiquity."

> suspended hopper supplying them with grain, in the same revolution the flour is produced."[26]

He described the mill as a machine that is rarely employed, which could speak to its relative novelty at the time.[27] This is the first explicit written evidence that we have of a water mill. Shortly thereafter, in approximately 18 B.C., the geographer Strabo documented a water-driven grain mill in the palace of Mithridates, King of Pontus, at Kabeira in the Pontus, an ancient kingdom located on the southern coast of the Black Sea in what is today Turkey.[28] This site has been dated to 120-63 B.C. Roughly contemporary with Strabo, Antipater wrote of water nymphs who liberated mankind from the drudgery of hard labor by grinding corn through water power.[29] Collectively, the three early references from Vitruvius, Antipater, and Strabo are thought to date from between 25 B.C. and the birth of Christ. To summarize, both the horizontal and vertical water wheel are thought to have been invented in the third century B.C. in Byzantium and Alexandria respectively, the horizontal wheel slightly preceding its vertical counterpart.

In the first century A.D., Pliny the Elder (d. 79 A.D.) described water mills on Italian rivers in his *Naturalis Historia*, and it is in Italy where the earliest surviving archaeological evidence of an undershot water wheel has been found at Venafro

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[26] Vitruvius Pollio and G.H.G.E. Aberdeen, *The Ten Books of Vitruvius Translated from the Latin by Joseph Gwilt ... to which is Prefixed an Inquiry Into the Principles of Beauty in Grecian Architecture by George, Earl of Aberdeen*, trans. Joseph Gwilt (London: Crosby, Lockwood & Company, no later than 1894), 244; L.A. Moritz, "Vitruvius' Water-Mill," *The Classical Review* 6, no. 3/4 (1956).
[27] Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel*, 30.
[28] Bloch, "Avènement et conquêtes du moulin à eau," 538; J. G. Landels, *Engineering in the Ancient World* (Berkeley: University of California Press, 1978), 17; White, *Medieval Technology and Social Change*, 80.
[29] See note 1, chapter 2.

near Pompeii.[30] This wheel is evidenced by the imprint that it left in lava, which dates it to the eruption of Vesuvius in 79 A.D. Perhaps the most impressive archaeological evidence of a water mill complex from Antiquity is the milling complex at Barbegal located in the Valley of Arcs near Arles in southern France. Dated to the beginning of the second century A.D., the Barbegal milling complex consisted of sixteen mills powered by the Baux aqueduct that divided above the complex in such a way that eight mills were staggered down each branch of the aqueduct on terraced land. This allowed for an overshot mill to be placed on each tier, at a slope of about 30^{o}, for a total fall of 61 feet.[31] Calculations of the power generated by the force of the water running through the aqueduct and that consumed by the 16 wheels in the complex, suggest that the 16 water wheels of Barbegal could power 32 millstones resulting in an estimated overall capacity of 28 tons of flour in one ten hour day.[32]

Evidence from a number of important and previously overlooked textual references to water mills further weakens the case that this technology was not heavily utilized in Antiquity. The *Talmud* specifies penalties for grinding grain with water on the Sabbath; Diocletian’s *Edict of Prices* (301 A.D.) assessed taxes on water mills; and the *Theodosian Code* (312 A.D.), a compilation of Roman law, frequently referred to water mills.[33] Written and archaeological evidence both suggest that the water mill can be dated to the last centuries B.C. and was generally

[30] Wikander, "Exploitation of water-power or technological stagnation? A reapprisal of the productive forces of the Roman Empire."; Bloch, "Avènement et conquêtes du moulin à eau."; Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel*.
[31] Fernand Benoit, "L'Usine de Meunerie Hydraulique de Barbegal (Arles)," *Revue Archéologique* 15 (1940); Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel*, 39.
[32] Sagui, "La meunerie de Barbegal (France) et les roues hydrauliques chez les anciens et au moyen âge," 227.
[33] Squatriti, "'Advent and Conquests' of the Water Mill in Italy," 129.

adopted over the following centuries in the Mediterranean Basin and Asia Minor. The inaccessibility of potential archaeological sites in Asia Minor is unfortunate given the likelihood that physical evidence for water mills is there waiting to be found. This inaccessibility may at least partially explain the lack of evidence for expansion and diffusion of the water mill in Antiquity.

The scarcity of literary evidence for industrial applications of water power led to the widespread assumption in the twentieth century that the development of industrial water power should rightly be attributed to developments in the Middle Ages. The earliest known reference to the industrial application of water power can be found in Ausonius' *Mosella*, a poem about life along the Moselle River in France, dated to the fourth century A.D. The *Mosella* documents a Roman, water-powered, saw mill in the river basin. The excerpt reads, "Thee swift Celbis, thee Erubris, famed for marble, hasten full eagerly to approach with their attendant waters: renouwned is Celbis for glorious fish, and that other, as he turns his mill-stones in furious revolutions and drives the shrieking saws through smooth blocks of marble, hears from either bank a ceaseless din."[34]

Historians long thought the *Mosella* to be a tenth century apocryphal work falsely attributed to Ausonius.[35] *S*ubstantial evidence surfaced in the 1980s, however, that lends credence to the *Mosella's* fourth century attribution.[36] There is also evidence for the presence of water-powered saw mills in Hierapolois in the

[34] Ausonius, *Ausonius. Volume 1, Books 1-17*, trans. Hugh G. Evelyn-White, Loeb Classical Library 96 (Cambridge, MA: Harvard University Press, 1919).
[35] White, *Medieval Technology and Social Change*, 83.
[36] Örjan Wikander, "The Use of Water-power in Classical Antiquity," *Opuscula Romana* 13 (1981): 99-100; D. L. Simms, "Water-driven saws, Ausonius and the authenticity of the Mosella," *Technology and Culture* 24 (1983).

second half of the third century A.D. and in the city of Ephesus in the seventh century, both in present-day Turkey, confirming the development of industrial saw mills in Antiquity.[37] These findings put to rest the long-held belief that only in the thirteenth century does a reference to a definitive water-powered saw mill appear in Villard de Honnecourt's sketchbook.[38]

Wikander provides additional evidence for the presence of industrial milling technology in Antiquity through a reassessment of Vitruvius' description of a water-powered grain mill that he claims has been mistranslated over the years. Rather than a grain mill, Wikander believes that *subigitur* in the line *et eadem versatione subigitur farina* should read "kneaded" rather than "ground," thus indicating a dough-kneading, rather than grain-grinding, water-driven process.[39] Similarly, a new translation of Pliny's first century A.D. reference to a water mill in Italy alludes to water-powered pestles that supplemented the grain mill,[40] and evidence for milling in China is well-documented as early as the second century A.D., particularly in relation to the pounding of rice.[41]

The conclusions drawn from the re-evaluation of literary evidence are substantiated by a wealth of archaeological evidence that reveals the practice of water-powered metallurgy in Antiquity in locations ranging from Spain to Wales.[42] In

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[37] Wikander, "Industrial Applications of Water-Power."; Andrew Wilson, "Machines, Power and the Ancient Economy," *The Journal of Roman Studies* 92 (2002): 11; Tullia Ritti, Klaus Grewe, and Paul Kessener, "A Relief of a Water-Powered Stone Saw Mill on a Sarcophagus at Hierapolis and It's Implications," *Journal of Roman Archaeology* 20 (2007).
[38] Theodore Bowie, ed. *The sketchbook of Villard de Honnecourt* (Bloomington: Indiana University Press, 1959).
[39] Moritz, "Vitruvius' Water-Mill."; Wikander, "Industrial Applications of Water-Power."
[40] Lewis, *Millstone & Hammer: The Origins of Water Power*, 101-02.
[41] Joseph Needham and Wang Ling, *Heavenly Clockwork: The Great Astronoical Clocks of Medieval China*, Second ed. (Cambridge: Cambridge University Press, 1986), 104.
[42] Wikander, "Industrial Applications of Water-Power."

addition, there is circumstantial evidence for industrial water power, such as documentation for a fuller's canal in Syria dating to the first century A.D. that would have supplied too much water to human-powered fulling mills. Mounting evidence for widespread use of industrial water power in Antiquity makes the inclusion of industrial water power in the St. Gall Plan appear less groundbreaking than long thought. [43]

While evidence now substantiates wide-spread use of water mill technology in Antiquity, it appears as if the water mill did not become common in the Mediterranean Basin until the fourth century A.D., diffusing gradually thereafter. Terry Reynolds downplayed the importance of industrial milling prior to the High Middle Ages, but he failed to recognize that this diffusion took place. Evidence suggests that this occurred primarily through the Frankish Empire in the eighth and ninth centuries due to the relative peace and stability in the region at that time.[44] André Guillerme provides extensive documentation for the development of a hydraulic network in northern France very near the heart of the Cistercian Order during the time period immediately preceding its foundation, which lends credence to this idea.[45] Guillerme's ideas concerning the development and utilization of water power in France will be discussed in more detail below. The presence of this technology, in conjunction with the growing movement of monastic reform that had

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[43] D. Feissel, "Deux listes des quartiers d'Antioche astreints au creusement d'un canal (73-74 après J.-C.)," *Syria* 62 (1985).
[44] Reynolds, *Stronger Than a Hundred Men: A History of the Vertical Water Wheel*, 49.
[45] Andre Guillerme, *The Age of Water: The Urban Environment in the North of France, A.D. 300 to 1800*, Environmental History Series, 9 (College Station, Texas: Texas A&M University Press, 1988).

built to a fevered pitch by the end of the eleventh century, set the stage for the prolific expansion of the Cistercian Order in the eleventh century.

Chapter 3: Monastic Reform and the Foundation of the Cistercian Order

> Listen carefully, my son, to the teachings of a master and incline the ear of your heart. Gladly accept and effectively fulfill the admonition of a loving father so that through the work of obedience you may return to him from whom you had withdrawn through the sloth of disobedience. To you, therefore, my word is now directed – to whoever, renouncing his own will in order to fight for the Lord Christ, the true king, takes up the brilliant and mighty weapons of obedience.[1] – St. Benedict of Nursia

So begins the prologue of the Rule of St. Benedict. The Benedictine Rule outlines the governance of a completely self-sufficient monastery that answered to no exterior authority and largely shaped both monastic and non-monastic life in Western Europe in the Middle Ages.[2] In this Rule, St. Benedict proclaimed idleness the enemy of the soul and directed brothers to be occupied at set times in manual labor.[3] Adherence to the Rule lay at the heart of the monastic reform movement of the eleventh and twelfth centuries, but the founders of the Cistercian Order were committed to living a more literal expression of the Rule than their medieval predecessors. This chapter will trace the evolution of monastic reform back to the time of St. Benedict, which will help to situate the Cistercian Order in the monastic reform movement of the eleventh and twelfth centuries. This will be followed by a discussion of the development of the Cistercian Order, including details on the lay brotherhood. It was the lay brotherhood that managed Cistercian granges or farms

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[1]Benedict of Nursia and Bruce L. Venarde, eds., *The Rule of St. Benedict*, Dumbarton Oaks Medieval Library (Cambridge, MA: Harvard University Press, 2011).

[2] David Knowles, *From Pachomius to Ignatius: A Study in the Constitutional History of the Religious Orders*, The Sarum Lectures 1964-5 (Oxford: Clarendon Press, 1966), 6.

[3] Otiositas inimica est animae et ideo certis temporibus occupari debent fratres in labore manum. Benedict of Nursia and Venarde, *The Rule of St. Benedict*, chapter 48:160-61.

and therefore the water mills and associated agricultural work and crafts necessary for the Order to remain self-sufficient.

According to Pope Gregory I (r. 590-604) who provides the earliest account of the life of St. Benedict (d. 543), Benedict established twelve monasteries before finally establishing the monastery at Monte Cassino where he is thought to have written his Rule around the year 535.[4] Benedictine life as dictated by the Rule revolves around three basic activities: performance of the *Opus Dei* or vocal, liturgical adoration of God through community prayer; the *lectio divina,* reading of scriptures and meditation; and manual labor. A number of notable rules preceded and influenced that of St. Benedict. Pachomius (d. 346), Basil of Caesarea (d. 379), Augustine of Hippo (d. 430), and John Cassian (d. 435) all penned rules for coenobitic life. Coenobitism refers to a common or communal monastic life. This contrasts with the eremitical or solitary life of the desert fathers.

While some monasteries are known to have adhered to various tenets of the Rule after the destruction of the monastery of Monte Cassino by the Lombards in the sixth century, none fully embraced the Rule until its acceptance by Carolingian Rulers in the ninth century.[5] Gregory greatly influenced the spread of the Benedictine Rule in the West when in 595 he sent a Benedictine, St. Augustine, to evangelize the Germanic tribes of England, Frisia and Germany.[6] The influence of the Rule continued to spread and firmly became the basis of monastic life in the

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[4] Pope Gregory I, "The Second Book: Of the Life and Miracles of St. Bennet," in *The Dialogues of Saint Gregory, surnamed the Great; pope of Rome & the first of that name. Divided into four books, wherin he enteateth of the lives and miracles of the saints in Italy and of the eternity of men's souls* (London: P. L. Warner, 1911), 68.
[5] Knowles, *From Pachomius to Ignatius: A Study in the Constitutional History of the Religious Orders*, 7.
[6] Bede K. Lackner, *The Eleventh-Century Background of Cîteaux*, Cistercian Studies Series (Washington, D.C.: Cistercian Publications Consortium Press, 1972), ix.

West at the synod of Aachen in 817 when Benedict of Aniane (d. 821), with the support of Louis the Pius (r. 814-840), proposed the *capitulare monasticum* for uniform monastic observance. The *capitulare* includes eighty cannons that define matters not regulated or specified in the Rule.[7] Benedict of Aniane arguably initiated the process of monastic reform in the Middle Ages.

A number of controversial practices in the tenth and eleventh centuries, all of which stemmed from the privatization of churches, became commonplace among secular church leaders. The most prominent of these include investitures, the practice of lay leaders appointing church officials; simony, the buying and selling of church positions; and nicolaitism, clerical marriage. A growing sense of discontent with these practices among various religious communities, both monastic and clerical, led to the reform movement of the eleventh century. This reform movement is often called the Gregorian Reform, although that is something of a misnomer. Pope Gregory VII (r. 1073-1085) did work diligently to separate church and state, and he effectively used the reform movement as a means of enhancing papal power, but the movement began with local bishops, abbots, and lay leaders outside of Rome and was initially taken up by the papacy by Pope Leo IX (r. 1049-1054).[8]

Monastic reform in the Middle Ages truly began with foundation of Cluny by Duke William I of Aquitaine in 909. The Cluniac reform differed significantly from that of most monasteries in England and Germany in that William initially granted and the papacy confirmed exemptions from local lay and episcopal control. Popes and French rulers confirmed these exemptions no less than three times over the course

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[7] Ibid., 8-11.

[8] F. Donald Logan, *History of the Church in the Middle Ages*, 2nd ed. (London: Taylor and Francis, 2012), 99.

of the tenth century.[9] This *libertas Romana* or freedom from lay control and subsequent freedom from the spiritual jurisdiction of local bishops allowed Cluny the freedom to evolve that was without precedence at the time.

Cluny served as a transition from the conservative feudal, proprietary monastic system of the tenth and eleventh centuries to the more radical reform of the twelfth and thirteenth. The divergence of Cluny from the typical monastic practices of the day can be attributed to Odilo (r. 994-1049), Cluny's fourth abbot, who consolidated the Order and expanded the number of houses from five to sixty.[10] Hugh the Great (r. 1049-1109) continued this trend adding more than a thousand houses to Cluny's fold during his reign. The true distinction of Cluny lay in the priory system developed by Odilo that established the abbot of Cluny as head of all of its monasteries. The abbot of Cluny personally appointed the superiors of these daughter houses. While distinctively feudal in nature, this direct oversight allowed Cluny to extend its papal protection to all of the houses in its direct line. Cluny did not have a legislative structure with constitutional elements or a general council or legislative body that gave equal status to all members until late in the twelfth century, well after the establishment and rise of the Cistercian Order.[11]

Poverty, eremitism, and apostolic life are the guiding principles associated with monastic reform in the eleventh and twelfth centuries.[12] While a reformed monastery, Cluny had acquired a level of wealth by the eleventh century that reformers deemed unseemly and not in keeping with the strictures of the Rule.

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[9] H. E. J. Cowdrey, *The Cluniacs and the Gregorian Reform* (Oxford: Clarendon Press, 1970), 16.
[10] Knowles, *From Pachomius to Ignatius: A Study in the Constitutional History of the Religious Orders*, 10-15.
[11] Ibid.
[12] Louis J. Lekai, *The Cistercians: Ideals and Reality* (Kent State University Press, 1977), 5.

Cluny's monks practiced a fully coenobitic form of monasticism quite unlike the eremitical monasticism of the desert fathers, and the abbey was too firmly embedded in the feudalistic society of the day to claim an apostolic lifestyle. The later reform movements, on the other hand, sought to disentangle themselves from feudal society, embraced poverty, and combined eremitic, solitary monasticism with the coenobitic, community-based monasticism common in Western Europe in the eleventh century. Giles Constable termed this unique merger of eremitic and coenobitic lifestyles eremitical coenobitism.[13]

Eremitical movements began in Italy in 1012 with St. Ramuald of Ravenna (d. 1027) who founded Sacro Eremo of Camaldoli, the first of what would become many Camaldoli communities, in the Apennine Mountains of northern Italy.[14] The Camaldoli lived an austere lifestyle based upon strict observance of the coenobitic Rule of St. Benedict. Ramuald did not write down the strictures of his interpretation of the Rule, so Blessed Rudolph wrote down the rules of the Order in 1080 after his death and lessened the severity of Ramuald's oral tradition. These were the first rules written down for a group of hermits in the West.[15] Peter Damian (d. 1072), prior of the hermitic community of Fonte Avellana in Italy, wrote *De ordine eremitarum et facultatibus eremi Fontis Avellani* and *De suae congregationis institutis*, both works that served to reform his hermitic community.[16] Through his work, writings, and

[13] Giles Constable, "Eremitical Forms of Monastic Life," in *Istituzioni monastiche e istituzioni canonicali in occidente, 1123-1215: Atti della settima Settimana internazionale di studio (Mendola, 28 agosto - 3 settembre 1977)* (Milan: Vita e pensiero, 1980), 239-64.
[14] Lackner, *The Eleventh-Century Background of Cîteaux*, 167-76; Emilia Jamroziak, *The Cistercian Order in Medieval Europe 1090-1500* (New York: Routledge, 2013), 6.
[15] Knowles, *From Pachomius to Ignatius: A Study in the Constitutional History of the Religious Orders*, 18.
[16] Lackner, *The Eleventh-Century Background of Cîteaux*, 180-81.

relationships with church leaders, Damian greatly influenced the eleventh-century reform movement. Both Ramuald and Damian favored extremely severe interpretations of the Benedictine Rule and envisioned coenobitic monastic life simply as a stepping stone to the eremitical lifestyles they preferred.

John Gualbert (d. 1073), a contemporary of Peter Damian, similarly established the community of Vallombrosa, which followed a strict observance of the Rule. Gualbert contributed particularly to the reform of simony in Florence and established a centralized government for his monasteries that Pope Urban II sanctioned. In addition, and significantly for the future Cistercian Order, Gualbert established a non-clerical class of *conversi* or laybrothers who helped keep the monks of Vallombrosa free from distraction by assuming responsibility for physical activities that diverted the monks' focus from their religious obligations.[17] Somewhat later in the twelfth century, Stephen of Thiers (d. 1124) acquired followers while leading an eremitic lifestyle in Muret near Grandmont in the diocese of Limoges.[18] This led him to establish the community of Grandmont. Rather than adhering to a single rule like his Italian predecessors, Stephen espoused the teaching of all the desert fathers and the Holy Gospel itself and left no written rule of his own. In spite of this, the Grammontensians numbered sixty houses in France and England by 1174.

Robert of Molesme (d. 1111), influenced by these contemporary eremitical movements and the spirit of reform in the eleventh century, initiated a movement

[17] Ibid., 195-96; Knowles, *From Pachomius to Ignatius: A Study in the Constitutional History of the Religious Orders*, 18.
[18] Lackner, *The Eleventh-Century Background of Cîteaux*, 196-203.

that would develop into the Cistercian Order when he founded the monastery of Molesme in 1075. Robert began his monastic career at the abbey of Montier-la-Celle at Troyes, a monastery that followed Cluniac practices, and rose to the position of abbot around the year 1050.[19] While there, he helped to found a group of hermits in Colan, but found it impossible to implement the monastic reform about which he was so passionate within the monastery itself. As a result, he left and spent time at a number of different abbeys, always leaving unhappy with his inability to effect reform.[20]

In 1075, Robert and a number of like-minded companions left Montier-la-Celle to establish what he hoped would be a truly reformed monastery at Molesme. The community spent their first five years in abject poverty, often having to beg for food and clothing, but became quite wealthy and influential by the end of the eleventh century due to an influx of clerics, feudal lords, and knights. Alberic and Stephen Harding, both of whom played a significant role in the establishment of Cîteaux, the first house of the Cistercian Order, are notable recruits of Molesme. In spite of Robert's determination to effect reform, the organization of Molesme resembled Cluny too much for true reform to take place.[21] It included amongst its ranks lay brothers who were classified as monks and accepted oblates, children to be raised as monks. It permitted acceptance of *praebendarii* or individuals whom they allowed to live with the monks without taking up the vocation in exchange for a donation. Molesme, like Cluny, also regularly served as a site for feudal gatherings called by

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[19] Jean-Baptiste Van Damme ocso, *The Three Founders of Cîteaux*, trans. Nicholas Groves and Christian Carribid. (Kalamazoo, MI: Cistercian Publications, 1998), 10.
[20] Lekai, *The Cistercians: Ideals and Reality*, 11.
[21] Lackner, *The Eleventh-Century Background of Cîteaux*, 229-30.

local lords, which effectively put the monks in the service of local lay authority. Practices like these led to an influx of generous donations, but made it difficult to stay true to the principles of reform upon which the abbey was founded.

Finding himself frustrated yet again with his failure to establish a truly reformed monastery, Robert went to live with a community of men living an eremitic life at Aux near Riel-les-Eaux from approximately 1090-1093.[22] In 1098, in order to avoid continued conflict at Molesme and sanctioned by the papal legate, Hugh of Lyons, Robert left Molesme with a number of monks to establish a monastery at Cîteaux with the aim of following a stricter observance of the Rule.[23] Orderic Vitalis relates that Robert spoke to the monks at Molesme prior to his departure saying, “My dear brethren, we have made our profession according to the Rule of St. Benedict, but it appears to me that we do not observe it in its integrity. We follow many practices which are not found there, and we negligently omit many which it has enjoined.”[24] Philip of Harvengt, a twelfth-century Premonstratensian and abbot of Bonne-Espérance, recognized the importance of Cîteaux to the movement of monastic reform in the twelfth century when he noted that through Cîteaux, the monastic order “formerly dead, was revived; there the old ashes were poked; it was

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[22] Ibid., 233.

[23] “Vobis ergo tunc praesentibus Roberto abbati, fratribus quoque Alberico, Odoni, Johanni, Stephano, Letaldo et Petro, sed et omnibus quos regulariter et communi consilio vobis sociare decreveritis, hoc sanctum propositum servare et tunc consuluimus, et ut in hoc perseveretis praecipimus, et auctoritate apostolica per sigilli nostri impressionem in perpetuum confirmamus,” Jean de la Croix Bouton and Jean-Baptiste Van Damme, eds., *Les Plus Anciens Textes de Cîteaux: sources, textes et notes historiques*, Cîteaux, studia et documenta 2 (Achel: Abbaye cistercienne, 1974), 58-60.

[24] Nos, fratres charissimi, secundum Normam sancti Patris Benedicti professionem fecimus. Sed, ut mihi videtur, non eam ex integro tenemus. Multa, quae ibi non recipiuntur, observamus, et de mandatis ejus plura negligentes intermittimus. Ordericus Vitalis, "Historia Ecclesiastica," *Patrologia Latina* 188: 637.

reformed by the grace of novelty, and by zeal it recovered its proper state… and the Rule of Benedict recovered in our times the truth of the letter."[25]

Robert and his companions founded the monastery of Cîteaux, *Cistercium* in Latin, in the diocese of Châlons-sur-Saône. Organizationally, Cîteaux differed in significant ways from Molesme and Cluny. First and foremost, it aimed to follow a literal observance of the Rule, not the greatly modified usages of Benedict of Aniane. The abbot of Cîteaux did not have absolute power, as did the abbot of Cluny; Cîteaux did not accept oblates, requiring novices to be at least sixteen years of age; nor did it host gatherings of feudal lords, which helped the nascent monastery distance itself from feudal obligations that conflicted with its mission.[26] It also rejected its own role as ecclesiastical feudal lord by vowing not to collect tithes or revenues from monastery property, although it encountered difficulties living up to this self-imposed regulation very early in the Order's history.[27] Cîteaux did eventually allow for the inclusion of lay brothers who carried out much of the manual labor of the Order, but unlike the lay brothers at Molesme and Cluny, they did not take monastic vows.

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[25] Illic, inquam, monachicus ordo pridem mortuus, suscitatur; illic, pulso vetusto cinere, novitatis gratia reformatur; illic in statum debitum lima et studio revocatur, dum caeteris acceptam monachis delicatam teneritudinem exsecratur, et laborem, pauperiem, luctum, silentium, insatiabiliter amplexatur... De hoc autem coenobio quod Cystercium nominatur, in quo nostris temporibus regula Benedicti ad veritatem litterae revocatur, insignis illa felici partu Claravallis procedit, quae caetera ejusdem ordinis coenobia claritate famae et nominis antecedit. Giles Constable, "Renewal and Reform in Religious Life: Concepts and Realities," in *Renaissance and Renewal in the Twelfth Century*, ed. Robert L. Benson and Giles Constable (Toronto: University of Toronto Press, 1991), 836 B, 37 A. Translation by ibid., 43.

[26] David H. Williams, *The Cistercians in the Early Middle Ages: Written to Commemorate the Nine Hundredth Anniversary of Foundation of the Order of Cîteaux in 1098* (Trowbridge, Wiltshire: Cromwell Press, 1998).

[27] Constance Brittain Bouchard, *Holy Entrepreneurs: Cistercians, Knights, and Economic Exchange in Twelfth-Century Burgundy* (Ithaca: Cornell University Press, 1991), 95-128.

Shortly after Robert and his companions established Cîteaux, the monks of Molesme, angry at Robert's desertion, appealed to Pope Urban II to force his return. Urban agreed. Upon his departure, the monks of Cîteaux elected Alberic (r. 1100-1108) to serve as their new abbot. The accomplishment for which Alberic is most remembered is his acquisition of a bull of papal protection from Pope Paschal II. This bull, also known as the Roman Privilege, confirmed Cîteaux's foundation and independence from the overtly hostile Molesme. Stephen Harding (r. 1109-1133) succeeded Alberic as abbot and oversaw the foundation of the Order's four primary daughter houses, La Ferté (1113), Pontigny (1114), Clairvaux (1115), and Morimond (1115). The Cistercian Order began to coalesce under Stephen's leadership as he worked to standardize Cistercian practice and legislative documents. Stephen garnered a second papal bull from Pope Callistus II in 1119 that confirmed the nascent Order and its founding documents. After this second papal confirmation, the charters and pancartes of Cîteaux stopped employing the term *novum monasterium* and begin using the term Cistercium.[28]

If traditional dating of the Cistercian legislative documents is correct, Stephen oversaw the writing of the *Carta Caritatis,* a legislative document that established the constitutional organization of the Cistercian Order. He did this in conjunction with the founding of La Ferté, the first daughter house of Cîteaux, in 1113. From that point on, the Cistercian Order became a federation of abbeys bound to each other by the Rule, but equal amongst themselves. All abbeys in the Order depended upon Cîteaux or one of her four primary daughter houses, but all had a voice in the

[28] Jean Marilier, "Le vocable Novum Monasterium dans les premiers documents cisterciens," *Cistercienser Chronik* 57 (1950).

governing of the Order through the annual meeting of the General Chapter. No other monastic organization at the time, reform or otherwise, had this type of constitutional structure. If one considers such a structure an essential component for a monastic order, as does Mario Sensi, Cîteaux became the first true monastic Order in the Middle Ages.[29]

The Cistercian legislative documents consist of the *Exordium parvum*, *Carta Caritatis* (Charter of Charity), *Exordium Cistercii*, and *capitula*. The *Exordium parvum* includes the original Cistercian narrative; the *Carta Caritatis*, the Cistercian constitution; the *Exordium Cistercii,* an earlier history; and the *capitula*, a set of twenty paragraphs that lay out practical regulations of the Order in accordance with details in the previous documents. Extant versions of the *Carta Caritatis* include the *Summa cartae caritatis*, the *Carta caritatis prior*, and the *Carta caritatis posterior*. The *Carta caritatis posterior* is the final version of the constitution that emerged between 1165 and 1190.[30] The *Instituta generalis capituli* (Institutes of the General Chapter), published in 1152, document annual meetings of the General Chapter from 1119 to 1151. The *Instituta*, along with the *Consuetudines* (Book of Customs), lay out the directives of the Cistercian Order. The *Consuetudines* is comprised of two works, the *Ecclesiastica officia* that deals with liturgical matters, and the *Usus conversorum* that specifies appropriate conduct for the lay brotherhood. The dating of these documents has long been a matter of controversy.

[29] Mario Sensi, "Cistercians, the *Commenda* System, and the Period of the Congregations," in *The Cistercian Arts from the 12th to the 21st Century*, ed. Terryl N. Kinder and Roberto Cassanelli (London: McGill-Queen's Press, 2014), 310. However, many scholars consider Cluny, with the first network of dependent abbeys, as the first monastic order.
[30] Lekai, *The Cistercians: Ideals and Reality*, 28.

Louis Lekai is a proponent of the traditional and still widely accepted view that an early version of the *Carta Caritatis, Exordium Cistercii*, and some of the *capitula* were presented to pope Calixtus II in 1119 by Stephen Harding when he requested the second papal bull.[31] Constance Berman, however, argues that the 1119 confirmation is a forgery, that the legislative documents were written much later than originally thought, and that the Order did not truly emerge as such until the second half of the twelfth century, well after the death of St. Bernard. The *Carta Caritatis*, according to Berman, did not receive papal approval until the 1160s when Alexander III issued the papal bull *Sacrosancta*.[32] Berman contends that the documents were written later and post-dated in an effort to curb increasing laxity in the Rule by the time of Bernard's death in 1153. Regardless of their date, there is no doubt that discrepancies between ideals as specified in these documents and practice emerged early on in the Order's history.

As with many aspects of the Rule, Cistercians took the mandate of self-sufficiency more literally than their monastic predecessors.[33] They specified in their legislative documents, for example, that the Order possess *only for its own use* streams, woodland, vineyards, meadows, and lands far removed from secular dwellings and animals.[34] This goes beyond the specification in the Rule that simply

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[31] Ibid., 26.

[32] Constance Hoffman Berman, *The Cistercian Evolution: The Invention of a Religious Order in Twelfth-Century Europe* (Philadelphia: University of Pennsylvania Press, 2000), Chapter 2.

[33] Caput LXVI. *De ostiariis monasterii*. Monasterium autem, si potest fieri, ita debet constitui, ut omnia necessaria, id est, aqua, molendinum, hortus, pistrinum, vel artes diversae, intra monasterium exerceantur, ut non sit necessitas monachis vagandi foras, quia omnino non expedit animabus eorum. "Evaluation of a library outreach program to research labs," *Med Ref Serv Q* 29, no. 3: col. 900.

[34] Unde licet nobis possidere ad proprios usus aquas, silvas, vineas, prata, terras a saecularium hominum habitatione semotas et animalia… Bouton and Van Damme, *Les Plus Anciens Textes de Cîteaux: sources, textes et notes historiques*, 123.

requires the presence of water and a mill inside the monastic compound so that monks do not have to roam outside its walls.[35] As will be seen in Chapter 5, the complexity of land acquisition in medieval France made strict adherence to this mandate impossible.

Likewise, Cistercian tradition dictates that new monasteries should be placed on previously unclaimed and uncleared land, but previous settlements often preceded Cistercian houses and granges. This is evidenced in part by the lack of documentation regarding reclamation efforts in donations and other types of land acquisitions, and is logical given the scarcity of suitable, un-cleared land in France in the eleventh century.[36] The Rule does not prohibit commerce as long as the monks take care not to be overcome with avarice and offer a fair price for their goods, but Cistercian documents strictly prohibit revenues from milling and restrict the Order's development of surplus capacity.[37] In spite of this, the Order began to realize a profit on its surplus almost immediately. If Berman's later dating of the early legislative documents is accepted, it indicates an order trying to correct course as a result of its sudden and unexpected economic success. Her claims in this regard, however, remain quite controversial.[38] Regardless, it is clear that the Cistercian Order, in its

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[35] Monasterium autem, si possit fieri, ita debet constitui ut omnia necessaria, id est, aqua, molendinum, hortum, vel artes diversas intra monasterium exerceantur, ut non sit necessitas monaschis vagandi foris, quia omnino non expedit animabus eorum. Benedict of Nursia and Venarde, *The Rule of St. Benedict*, 66.6, 215.

[36] Berman, "Medieval Agriculture, the Southern French Countryside, and the Early Cistercians. A Study of Forty-Three Monasteries," 11, 44.

[37] Caput LVII. *De artificibus monasterii.* Si quid vero ex operibus artificum venundandum est, videant ipsi per quorum manus transigenda sunt: ne aliquam fraudem monasterio facere praesumant. …In ipsis autem pretiis non subripiat avaritiae malum: sed semper aliquantulum vilius detur quam ab aliis saecularibus datur, ut in omnibus glorificetur Deus. Brandenburg, Doss, and Frederick, "Evaluation of a library outreach program to research labs," col. 801.

[38] For the most widely accepted argument against Berman's claims regarding the dating of the early Cistercian documents, see Chrysogonus Waddell, ed. *Cistercian Lay Brothers: Twelfth-Century Usages with Related Texts*, Studia et Documenta (Cîteaux: Commentarii cistercienses, 2000).

determination to effect reform, made it practically impossible to live up to its own standards.

In the early years of the Order, choir monks carried out a great deal of manual labor as specified by the Rule. They quickly found it difficult, however, to live up to the strictures of the Rule and properly manage their agrarian economy, which required working on granges and engaging in commerce outside of the monastic complex. The inclusion of lay brothers allowed for a level of self-sufficiency that would have been impossible to attain otherwise. Over the course of the twelfth century, manual labor became the sole domain of the lay brotherhood. Evidence for the lay brotherhood does not appear until about 20 years after the foundation of Cîteaux in the *Usus Conversorum*, which Stephen presented to Callistus II in 1119 for his approval.

The *Usus* documents the roles and responsibilities of the Cistercian lay brotherhood and specifies that lay brothers cannnot not become monks once they complete their novitiate and make their profession. This sets them apart from lay brothers at Molesme and Cluny who were simply a different class of monk.[39] A common misconception about lay brothers is that they replaced all other hired help for the Order, but lesser known *oblate,* laymen who professed obedience to the monastery in exchange for support; *familiari,* individuals with a status between that

[39] This is based on the argument that Cistercians actually wrote the *Exordium Parvum,* originally dated 1119 and attributed to monks who followed Robert of Molesme when he left for Cîteaux, as late as 1151 in response to controversies surrounding the Order at that time. This stands in contrast to earlier views that the lay brotherhood existed from the Order's initial foundation, see James Donnelly, *The decline of the medieval Cistercian laybrotherhood* (New York: Fordham University Press, 1949); Jacques Dubois, "The Laybrothers' life in the 12th century: A form of lay monasticism," *Cistercian Studies Quarterly* 7 (1972).

of workman and lay brother; *mercenarii,* hired laborers; and *servi*, general servants all assisted lay brothers with their various tasks from the Order's inception.[40]

Lay brothers have been referred to as 'villeins in monastic dress,' but the opportunity to join a monastic order in a non-monastic role provided men from lower classes who did not possess the necessary educational background access to the monastic profession.[41] The strict regulations that are set out in the *Usus* have resulted over time in the view that lay brothers were simple-minded, humble, servile, deferential, and dutiful,[42] but Cistercian lay brothers served as grange masters and on more than one occasion witnessed charters.[43] In 1145, two members of a four-man Cistercian delegation convened to resolve a land dispute between Pontigny and the Benedictine abbey of St. Germain of Auxerre were lay brothers.[44]

There are also notable early examples of educated men choosing the life of a lay brother over that of a monk. Pons of Léras, a former knight and something of a brigand in his life prior to joining the Order, established and affiliated with Cîteaux the house Silvanès on a grant of land from a fellow nobleman in 1132. Pons chose to remain a lay brother rather than become a proper monk.[45] Cistercian lay brothers were often sought out for their exceptional skill. Emperor Frederick II, for example, sought out Cistercian building experts in 1221 to assist with the construction of his

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[40] Lekai, *The Cistercians: Ideals and Reality*, 341.
[41] Richard Roehl, "Plan and Reality in a Medieval Monastic Economy: The Cistercians," in *Studies in Medieval and Renaissance History*, ed. Howard L. Adelson (Lincoln: University of Nebraska Press, 1972), 87-91.
[42] Brian Noell, "Expectation and unrest among Cistercian lay brothers in the twelfth and thirteenth centuries," *Journal of Medieval History* 32 (2006): 261.
[43] Ibid., 255.
[44] Martine Garrigues, *Le premier cartulaire de l'Abbaye cistercienne de Pontigny (XIIe-XIIIe siecles)*, Collection de documents inedits sur l'histoire de France (Paris: Bibliothèque Nationale, 1981), no. 44.
[45] *Vita* translated by Beverly Mayne Kienzle, "The conversion of Pons of Léras and the true account of the beginning of the monastery at Silvanès: analysis and translation of the Latin text in Dijon, Bibliothèqe Municipale, Ms. 611," *Cistercian Studies Quarterly* 30 (1995).

palace.[46] These accomplishments when taken together demonstrate that lay brothers were not always illiterate or otherwise unqualified to enter the Order as a monk,[47] although by 1188 individuals seeking entry to the Order who were deemed useful as monks were expected to enter as a monk and not a lay brother.[48] This injunction served to prevent nobles, knights and others who were qualified for the monastic profession from becoming a lay brother without truly understanding what the life entailed and then acting out against it once committed.[49]

It does appear that lay brothers became increasingly insubordinate and resentful of their lesser status over time.[50] They may have felt alienated from monks who forced them to wear beards and remain separate from the monks within the church and other monastic buildings.[51] The layout of an ideal Cistercian monastery differs from that of traditional Benedictine monasteries in that it carefully separates choir monks from lay brothers at all times (*Figure 7*).[52] In the plan, the lay brother's refectory (28) and cellar (27), which was the lay brothers' responsibility, are on the western side of the complex, while the monks' common room (17) and the room for novices (18) are on the eastern end. Similarly, in the church, the choir monks stood in the first choir (3) and the lay brothers in the second (6). Monks entered the church

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[46] Williams, *The Cistercians in the Early Middle Ages: Written to Commemorate the Nine Hundredth Anniversary of Foundation of the Order of Cîteaux in 1098*, 197.
[47] Dubois, "The Laybrothers' life in the 12th century: A form of lay monasticism."
[48] Roehl, "Plan and Reality in a Medieval Monastic Economy: The Cistercians," 87.
[49] Chrysogonus Waddell, "The Place and Meaning of the Work of God," *Cistercian Studies Quarterly* 23 (1988).
[50] Donnelly, *The decline of the medieval Cistercian laybrotherhood*, 28-32, 65-67; Lekai, *The Cistercians: Ideals and Reality*, 341.
[51] Jean Leclercq, "Comment vivaient les frères convers'," *Analecta Cisterciensia* 21 (1965).
[52] Maximilian Sternberg, *Cistercian Architecture and Medieval Society*, Brill's Studies on Art, Art History, and Intellectual History, Volume 5 (Brill, 2013), 41. Image from Wolfgang Braunfels, *Monasteries of Western Europe: The Architecture of the Orders* (London: Thames and Hudson, 1972), 75.

from the eastern side of the cloister and the lay brothers from the west. Monks were never to see or hear the lay brothers.[53]

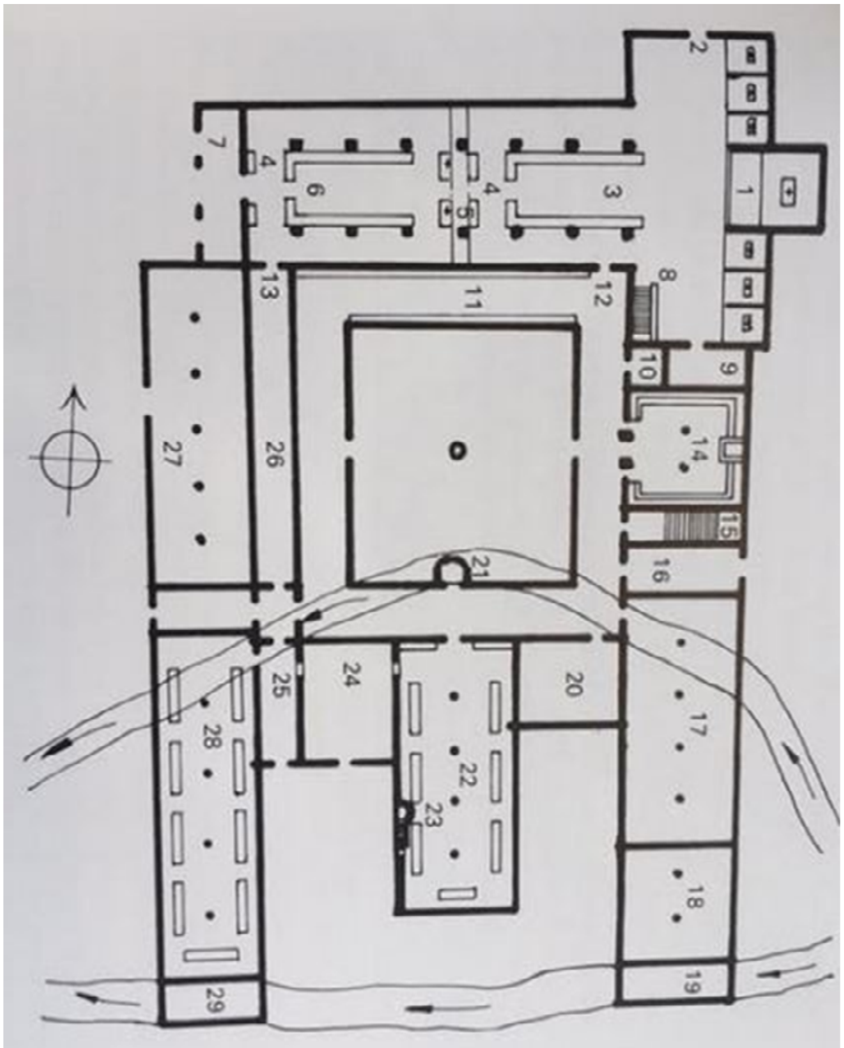

Figure 7: Plan for the ideal Cistercian monastery

One possible explanation for the growing discontent among the lay brotherhood lies in the increasing necessity over time for Cistercians to convert tenants who were located on land the Order acquired by various means into lay brothers. This allowed tenants to remain on and continue to work the land for the

[53] *Monasteries of Western Europe: The Architecture of the Orders*, 76.

Order without the feudal ties that such an arrangement would have otherwise entailed, but circumvented the Order's original intent for lay brothers to seek entrance to the Order out of a true desire to serve. Over time, this became the primary way in which the Order recruited lay brothers. The heightened awareness of separation between lay brothers and monks in all aspects of Cistercian life must have increased the frustration of those who did not want to be in the Order in the first place. In 1150, three years prior to the death of St. Bernard, Clairvaux had 300 lay brothers and 200 monks.[54] This disproportion likely contributed to the tensions between monks and lay brothers at some monasteries. True unrest among the lay brotherhood began in earnest later in the twelfth century.

The *Usus* establishes the grange as the primary domain and area of responsibility for lay brothers who carried out a diverse array of tasks, such as milling and baking, shoemaking, leather working, animal husbandry, and metal work.[55] As with the lay brotherhood, the grange system existed in Europe prior to the foundation of the Cistercian Order, but the Order's unique management of this system contributed greatly to the Order's success in the twelfth century.[56] Cistercians acquired and consolidated disparate, pre-existing granges into cohesive, well-managed units in a process known as 'compacting.' This required a great deal of planning, patience, and skill at negotiation. A donation to Pontigny in 1188, for example, conveys the right to allow herds to graze on either side of the river

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[54] Marcel Aubert, *L'Architecture Cistercienne en France*, 2 vols., vol. 1 (Paris: Vanoest, 1947), 54.
[55] Chrysogonus Waddell, ed. *Narrative and Legislative Texts from Early Cîteaux: Latin Text in Dual Edition with English Translation and Notes*, Studia et Documenta, vol. 9 (Cîteaux: Comentarii Cistercienses, 1999), 65, 72.
[56] Berman, "Medieval Agriculture, the Southern French Countryside, and the Early Cistercians. A Study of Forty-Three Monasteries."

Armançon that passed through the donor's land, to divert that river for use on their grange at Crécy, and leaves open the possibility of additional land acquisition in the future.[57]

The Order initially established granges near monasteries, no more than a day's march away (15-20 km), to serve their immediate needs. This distance limitation became impossible to adhere to later in the century, however, as monasteries expanded. Foigny, an abbey established by St. Bernard in 1121, had fourteen granges that covered over 29,000 acres of land.[58] Upon these fourteen granges were located fourteen grain mills, a fulling mill, three furnaces, three forges, a brewery, three wine presses, and a glassworks. Many of the granges acquired and pieced together by the Order were established in areas where granges already existed, and these sites often came with much of the necessary accoutrement, e.g. sheds, mills, stables, barns, sheep pens, a dormitory and an inn for visitors, a kitchen and refectory, an oratory. This extensive network of granges required considerable man-power to manage. The lay brotherhood enabled the Order to acquire and piece together these complex grange systems and remain true to the Rule.

By the time Robert founded Cîteaux in 1098, monastic reform in Europe was well underway, but had yet to achieve its full zeal. Under the leadership of Robert, Alberic, and Stephen Harding, the organization of the Cistercian Order took shape over the course of the next seventeen years. The next pivotal step in the development of the Order occurred in 1115, when Stephen Harding sent Bernard

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[57] Garrigues, *Le premier cartulaire de l'Abbaye cistercienne de Pontigny (XIIe-XIIIe siecles)*, 131.
[58] Marcel Aubert, *L'Architecture cistercienne en France*, 2 vols., vol. 2 (Paris: Vanoest, 1947), 161.

and twelve companions to establish the monastery of Clairvaux. The legislative documents mentioned above caution against *superfluitas* in the architecture of some buildings, but do not actually define an architectural ideal.[59] Bernard set the architectural and technological standard of the Order and played a pivotal role in the propagation of this archetype, as we shall see in Chapter 4, to which we turn.

[59] Sternberg, *Cistercian Architecture and Medieval Society*, 32.

Chapter 4: Clairvaux – Architectural Archetype

> But the river does not give up here. It is the turn of the fullers working next to the mill to call upon it. Having concerned itself with preparing nourishment for the monks it now thinks of their clothing. It never refuses to do what is asked of it. It raises and lowers in turn the heavy pounders, hammers, or to put it another way, the wooden feet, thus sparing the brothers much heavy labor… Next it enters the tannery, where it prepares the leather needed for the brothers' footwear. It is both hard-working and energetic.[1]

This description of the milling complex of Clairvaux, fueled by the river Aube, demonstrates the awe in which the complex was held shortly after its construction, as well as the complexity, efficiency, and productivity of this systematic use of the river's flow. We are fortunate to have such a description, as technological matters were not typically considered worthy of mention by most medieval authors. The word *engineer*, according to White, first appeared in Catalonia in the eleventh century and became widely used by the end of the twelfth.[2] Prior to the Renaissance, however, terminology did not distinguish between architect and engineer, one being part and parcel of the other.[3] The Cistercian Order's influence in the realm of both architecture and technology in the twelfth century reflects this truth. Its mandate of self-sufficiency necessitated a monastic complex with advanced machinery that could meet all of the abbey's needs, both physical and spiritual.

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[1] Eum enim ad se fullones invitant, qui sunt molendino confines, rationis jure exigentes, ut sicut in molendino sollicitus est, quo fratres vescantur, ita apud eos paret, quo et vestiantur. Ille autem non contradicit, nec quidquam eorum negat quae petuntur: sed graves illos, sive pistillos, sive malleos dicere mavis, vel certe pedes ligneos (nam hoc nomen saltuoso fullonum negotio magis videtur congruere) alternatim elevans atque deponens, gravi labore fullones absolvit: et si joculare quidpiam licet interserere seriis, peccati eorum poenas absolvit… Excipitur dehinc a domo coriaria, ubi conficiendis his quae ad fratrum calceamenta sunt necessaria, operosam exhibit sedulitatem. "Descriptio positionis seu situationis monasterii Clarae-Vallensis," *Patrologia Latina* 185: 570 C- 71 B. Translation from Jean-Francois Leroux-Dhuys, *Cistercian Abbeys: History and Architecture* (Koln: Konemann, 1998), 48.

[2] Lynn White, Jr., "Medieval Engineering and the Sociology of Knowledge," *Pacific Historical Review* 44, no. 1 (1975): 10.

[3] Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (New Haven: Yale University Press, 2007), 485-87.

This chapter will begin with an introduction to St. Bernard and his role in the foundation of Clairvaux in 1115. This will be followed by details surrounding the transfer of the original abbey in 1135 to a spot further upstream that could supply adequate water power for the monastery's new industrial milling complex. Details of what has come to be known as 'Bernadine' architecture will ensue, along with a discussion of Bernard's influence in setting an architectural standard for the Order through the propagation of a model based upon Clairvaux. Bernard's commitment to living a literal interpretation of the Rule is reflected in his influence on Cistercian architecture, technological development, and even details like textual illumination.

Born in 1090 to a family of military nobility in Fontaine-lès-Dijon, the region in which Robert founded Cîteaux, and destined for a religious life from birth, Bernard of Clairvaux (r. 1115-1153) and a number of family members entered Cîteaux in 1113.[4] Shortly thereafter, in 1115, Stephen Harding sent Bernard and twelve companions to found the monastery of Clairvaux. Bernard chose to found Clairvaux in his homeland of Champagne, on the banks of the Aube, in the diocese of Langres. The apparent influence that he had in the location of the monastery indicates that he had already achieved some influence in the Order prior to Clairvaux's foundation at the young age of twenty five. A close examination of the relationship between Clairvaux and Cîteaux during Bernard's abbacy reveals that Cîteaux and her daughter houses adapted themselves to Clairvaux rather than Clairvaux to Cîteaux.[5]

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[4] William of Saint-Thierry, "Liber Primus. Auctore Guillelmo olim Sancti Theoderici Prope Remos Abbate, Tunc Monacho Signiacensi," *Patrologia Latina* 185: 237. Bredero has shown the common claim that Bernard entered Cîteaux with 30 companions to be exaggerated by William of Saint-Thierry. While Bernard did enter Cîteaux with a number of family members, they were only part of a group of 30 men who entered the monastery from 1108-1115.

[5] Adriaan H. Bredero, *Bernard of Clairvaux: Between Cult and History* (Edinburgh: T&T Clark, 1996).

When Stephen abdicated the abbacy of Cîteaux in 1133 due to health reasons, Bernard's influence had grown significantly. The monks of Cîteaux elected Guy of Trois-Fontaines to replace Stephen, likely with his assent. Shortly following Stephen's death in 1134, however, and only months after Guy had assumed the abbacy of Cîteaux, he was replaced by Rainald de Bar (1133-1150). Rainald hailed from Clairvaux and is thought to have been one of Bernard's companions upon entering Cîteaux.[6] All four of Cîteaux's principal daughter houses ended up with abbots who were close companions of Bernard.

By the time of Bernard's death, Clairvaux had significantly more daughter houses (167) than Cîteaux (57) and her other principal daughter houses, La Ferté (8), Pontigny (26), and Morimond (87).[7] If one looks at filiations in the direct line of these monasteries and excludes the line of Savigny, which was incorporated into the Order in the line of Clairvaux, the number remains striking – Clairvaux (66-67), Cîteaux (16), La Ferté (3), Pontigny (13), and Morimond (22).[8] These numbers clearly reflect Bernard's influence in the growth of the Order. This is further substantiated by the largely unrecognized fact that Morimond, which was founded on the same day as Clairvaux, remained subordinate to Clairvaux until after Bernard's death in 1153.[9]

Bernard strove throughout his abbatial career to hold Clairvaux and the Order more broadly to the highest standard in all respects. The Cistercian legislative

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[6] Ibid.
[7] Anselme Dimier, "Le monde claravallien à la mort de saint Bernard," in *Mélange Anselme Dimier*, ed. Benoît Chauvin (1987).
[8] Ibid.
[9] Bredero, *Bernard of Clairvaux: Between Cult and History*.

documents do not specify a literal translation of the Rule, but St. Bernard clearly indicated his desire that this be so. In *De praecepto et dispensation* (1141-1145), Bernard responded to an inquiry from two monks from the monastery of St. Pierre in Chartres about proper adherence to the Rule. Bernard responded that it was not for most monks to live the Rule to the last detail [*ad unguem*], but he considered Cistercians an exception. They were expected to follow the Rule *ad litteram.*[10] Bernard was ever vigilant in maintaining this standard. He insisted, for example, that the monks of Mores sell a recently built oven because "our brothers cannot receive income in this manner."[11] During Bernard's lifetime, in spite of his strong influence over the Order, Clairvaux was the only Cistercian monastery to steadfastly refuse all gifts that would generate revenue.[12]

Bernard's influence on Cistercian architecture can be traced to the relocation of Clairvaux to a more suitable site in 1135. Its original site, *Monasterium Vetus,* is denoted Clairvaux I in the annotated version of Dom Milley's 1708 Plan of Clairvaux below (*Figure 8*).[13] As can be seen in Milley's plan, *Monasterium Vetus* is not well-situated to make full use of the river Aube. In 1133, Bernard's cousin, Geoffrey – Prior of Clairvaux, future Bishop of Langres, and a "wise and constant man,"

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[10] Exceptis proinde Cisterciensibus, et qui illorum forte ritu non tam vivere secundum Regulam quam ipsam ex integro pure ad litteram, uti se sane professos esse putant, tenere curant, de cetero neminem oboedienter degentem regularis moveat sollemnisque professio, in qua non fit de tota Regula promissio, in his dumtaxat monasteriis, in quibus ordo et disciplina servatur cum bonis consuetudinibus. Bernard of Clairvaux, "De Praecepto et Dispensatione," in *Sancti Bernardi Opera: Tractatus et Opuscula*, ed. J. Leclercq and H. M. Rochais (Rome: Editiones Cistercienses, 1963), 16.49, 286.

[11] *Sancti Bernardi Opera, letter 419*, ed. J. Leclercq, C. H. Talbot, and H. M. Rochais, vol. 8 (Rome: Editiones Cistercienses, 1957-1998), vol. 8, 403-04

[12] Bouchard, *Holy Entrepreneurs: Cistercians, Knights, and Economic Exchange in Twelfth-Century Burgundy*, 96-97.

[13] Watkin Williams, *Saint Bernard of Clairvaux* (Westminster, Maryland: The Newman Press, 1952), 396.

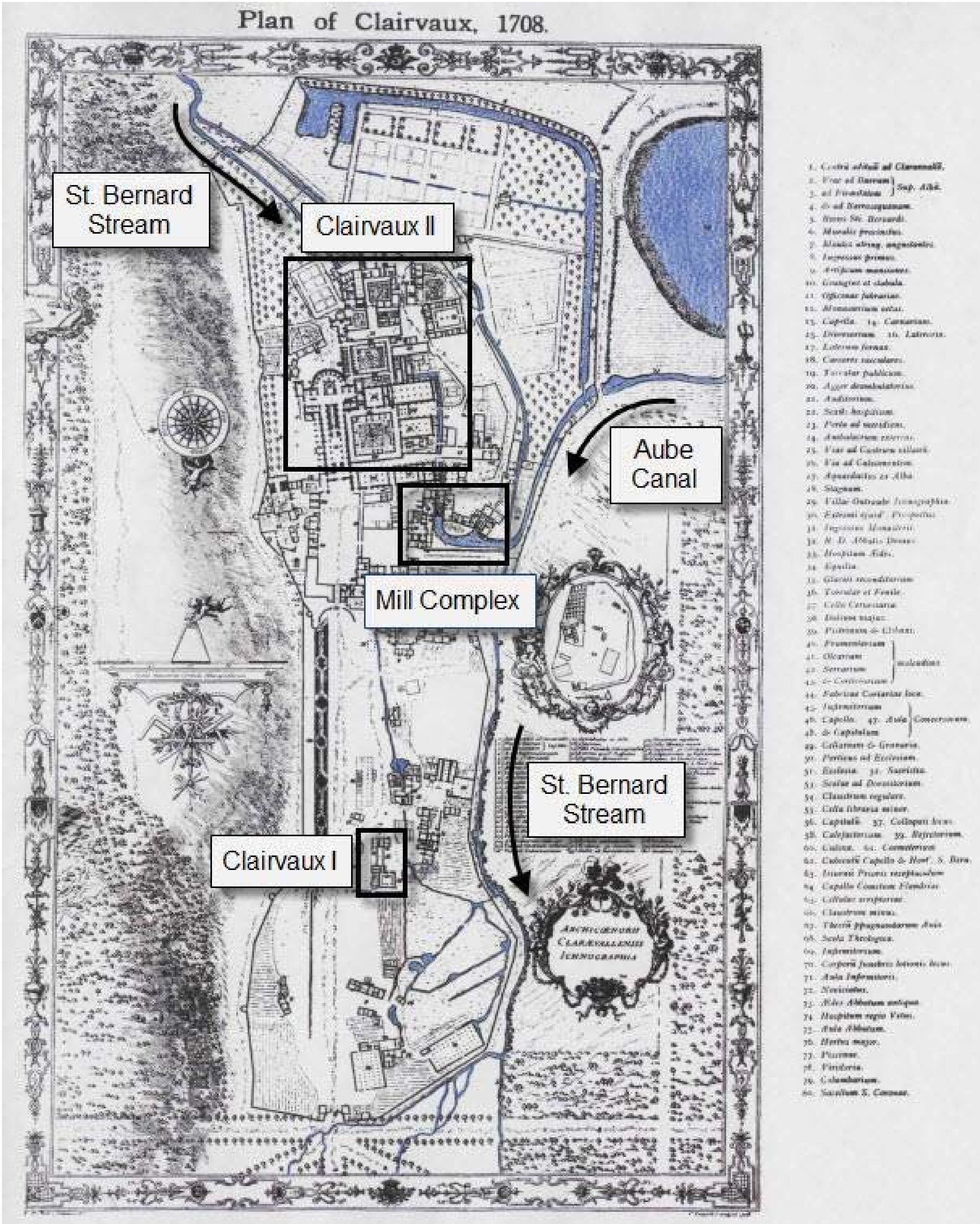

Figure 8: Plan of Clairvaux by Dom Milley, 1708

appealed to Bernard to relocate and expand the monastic complex further upstream to allow the monastery to make better use of the river for the utility of the rapidly expanding community. Cistercian abbeys did sometimes relocate after their initial foundation due to a number of unforeseen circumstances, including uncomfortably close proximity to civilization, the inability of the abbey to expand to accommodate growth, and inadequate proximity to water.[14] It appears that Geoffrey presented Bernard with a plan for the new complex when he made his entreaty.[15]

Geoffrey argued that the monastery "had settled in a narrow and inconvenient place which was not capable of so great a multitude [of tasks]; and with the daily increase in the number of arriving crowds, they could not be received within the structures of the factory and the *oratorium solis* barely [held] enough monks." Instead, Geoffrey "considered a way appropriate to the plain below, and that lower place can make use of the river." That place would be "spacious to all of the monastery's needs: meadows, colonies, shrubs, and vines, and if it were seen that the forest enclosure were wanting [videatur deesse; to be seen to be wanting], walls of stone would be easy [to construct], for there was a vast [supply of stone] there for replacements."[16]

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[14] Aubert, *L'Architecture Cistercienne en France*, 1; Benoit, "L'Industrie Cistercienne (XIIème - Premiere Moitie du XIVème siècle)."

[15] Peter J. Fergusson, "The Builders of Cistercian Monasteries in Twelfth Century England," in *Studies in Cistercian Art and Architecture*, ed. Meredith Parsons Lillich, Cistercian Studies Series (Kalamazoo: Cistercian Publications Inc., 1984), 16.

[16] Hic ergo atque alii plures viri provide, et de communi utilitate solliciti, Virum Dei, cujus conversatio in coelis erat, aliquando descendere compellebant, et indicabant ei quae domus necessitas exigebat. Insinuant itaque ei locum angustum et incommodum in quo consederant, nec capacem tantae multitudinis; et cum quotidie catervatim adventantium numerus augeretur, non posse eos intra constructas recipi officinas, et vix oratorium solis sufficere monachis. Addunt etiam se considerasse inferius aptam planitiem, et opportunitatem fluminis quod infra illabitur, ibique locum esse spatiosum ad omnes monasterii necessitates, ad prata, ad colonias, ad virgulta et vineas: et si silvae videatur deesse clausura, facile hoc parietibus lapideis, quorum ingens ibi copia

Initially Bernard resisted, complaining of the expense. Geoffrey and the monks of Clairvaux persevered, however, arguing that they would be doing a disservice to the ever-growing flock of new monks being led by God to Clairvaux if they could not adequately provide for their stay and future journeys.[17] In the end Bernard agreed to Geoffrey's request. In 1135, the monks of Clairvaux began the arduous process of relocating their monastic complex upstream to a more favorable location denoted Clairvaux II in Milley's plan.[18] This relocation appears warranted based on the number of inhabitants residing at Clairvaux in 1148. Just fifteen years after its relocation, Clairvaux housed 700 individuals, a number that includes 90-100 novices.[19]

Bernard later sent Geoffrey d'Ainai to instruct monks at the new abbey of Fountains in the ways of the Order. Similarly, he sent Achard, his own brother and Clairvaux's novice-master, to supervise the construction of a number of Cistercian abbeys throughout Europe. Both Geoffrey and Archad contributed to the construction of Clairvaux II.[20] Bernard's practice of sending monks from Clairvaux to

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est, posse suppleri, Charles du Fresne Du Cange *et al*, "Glossarium mediae et infirmae latinitatis," ed. Léopold Favre (Niort: Favre, 1883-1887), 284 D - 85 A. Translation by Steven Walton.

[17] Ad haec fratres respondent: "Si consummates lis quae ad monasterium pertinent, habitatores cessasset mittere Deus, stare posset sentential, et cessandum ab operibus rationabilis esset censura. Nunc vero cum quotidie gregem suum Deus multiplicet, aut repellendi sunt quos mittit, aut providenda mansio in qua suscipiantur. Nec dubium est, qui parat mansores, quin praeparet mansiones. Absit autem ut pro diffidentia sumptuum confusionis hujus incurramus discrimina!" Audiens haec Abbas, fide et charitate eorum delectatus est, et aliquando tandem consiliis acquievit; plurimis tamen prius super hoc ad Deum precibus fusis, nonnullis quoque revelationibus praeostensis. Gavisi sunt fratres, ubi effusum est verbum in publicum. Ibid., 285 B - 85 C.

[18] Leroux-Dhuys, *Cistercian Abbeys: History and Architecture*, 37.

[19] Aubert, *L'Architecture Cistercienne en France*, 1, 15.

[20] Williams, *The Cistercians in the Early Middle Ages: Written to Commemorate the Nine Hundredth Anniversary of Foundation of the Order of Cîteaux in 1098*, 198.

supervise the foundation and building of other abbeys is one way that he came to establish an architectural norm for the Order.

All orders in the Middle Ages enjoyed the benefits of water power, but those that preceded the Cistercian Order were not tied to a river location like the Cistercian Order. Cistercians personally managed most of their own agricultural and industrial mills, and the craft associated with those mills, in order to remain self-sufficient as the Rule requires. The relocation of Clairvaux II to a position a few hundred meters up the St. Bernard stream allowed for the construction of a 3.5 km millrace from the river Aube that provided adequate power for the compound's new milling facility.[21] This millrace is labeled the Aube Canal in Milley's plan. While true of the Order very broadly, Jean-Baptiste Auberger has pointed out that Clairvaux and her daughter houses had more of a tendency than Cîteaux and the other principal daughter houses and their early filiations to settle in river locations, yet another indicator of Clairvaux's role in setting an architectural standard for the Order that fully incorporated water power.[22]

Arnold of Bonneval, correspondent and biographer of St. Bernard, recorded an enthusiastic description of Clairvaux II's hydraulic system during a visit in 1136.

> They spared no expenses, and hiring employees quickly, they set down all the work for the brothers. Some cut down trees, some squared up [*conquadrabant*] stones, some built walls, some divided up limits of the river [*diffuses limitibus partiebantur fluvium*: dammed and channeled], and helped the forest's water to the mill. But fullers, bakers, tanners, smiths, and various other artificers, appropriately adapted its activities [to] engines as it issued

[21] Roberto Cassanelli, "Saint Bernard, a builder? The problem with the "Bernadine Plan"," in *The Cistercian Arts: From the 12th to the 21st Century*, ed. Terryl N. Kinder and Roberto Cassanelli (London: McGill-Queen's University Press, 2014), 76.
[22] Jean-Baptise Auberger, "L'Unanimite cistercienne primitive: Mythe ou realite?," in *Cîteaux: Commentarii Cistercienses*, Studia et Documenta, vol. 3 (Achel: 1986).

> and came forth. Wherever appropriate the underground stream was escorted, rushing [*ebulliens*], in channels to every home.[23]

Arnold mentions these industrial activities in a manner that seems to take them for granted suggesting that he was familiar with industrial milling prior to that time. Arnold's description provides the earliest documented evidence of Cistercian industrial milling. The site of Clairvaux is now inaccessible due to the presence of Clairvaux Prison, but archaeological evidence confirms these early reports.[24] The planning and implementation of such an advanced hydraulic system clearly demonstrates that Cistercians felt comfortable integrating water power into their monastic complex. The claim here is not that Bernard fully understood the mechanics or even the true significance of water power to the Order's future success. Bernard's significance lies in his propagation of Clairvaux as a model Cistercian monastery, a model that included extensive hydraulic infrastructure and technology.

Bernard's influence on art and architecture in the Middle Ages is now so widely accepted that the term Bernardine architecture has become commonplace.[25] The 'Bernadine Plan' applies ratios and modularity to the Early Christian T-plan of a Roman basilica, e.g. the church of Old St. Peter's in Rome (*Figure 9*).[26] This

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[23] Abundantibus sumptibus, conductis festinanter operariis, ipsi fratres per omnia incumbebant operibus. Alii caedebant ligna, alii lapides conquadrabant, alii muros struebant, alii diffusis limitibus partiebantur fluvium, et extollebant saltus aquarum ad molas. Sed et fullones, et pistores, et coriarii, et fabri, aliique artifices, congruas aptabant suis operibus machinas, ut scaturiret et prodiret, ubicunque opportunum esset, in omni domo subterraneis canalibus deductus rivus ultro ebulliens, Du Cange *et al*, "Glossarium mediae et infirmae latinitatis," col 285 C-D.

[24] Benoit, "L'Industrie Cistercienne (XIIème - Premiere Moitie du XIVème siècle)," 70.

[25] Otto von Simson, "The Cistercian Contribution," in *Monasticism and the Arts*, ed. Timothy Gregory Verdon (New York: Syracuse University Press, 1984).

[26] Walter Horn, "Survival, Revival, Transformation: The Dialectic of Development in Architecture and Other Arts," in *Renaissance and Renewal in the Twelfth Century*, ed. Robert L. Benson and Giles Constable (Toronto:

ultimately resulted in a plan with a cruciform layout with a nave flanked by single side aisles, a transept with one or more rectilinear chapels on the eastern side of each arm, and a projecting modest-sized choir with a flat apse.[27] While Bernard is noted for his eschewal of the Romanesque aesthetic of Cluny, Bernadine architecture did borrow some proto-gothic features from Cluny III, such as the ogive or pointed arch. The abbot Hugh initiated the construction of Cluny III in 1088 (*Figure 10*). Such an arch can be seen in the barrel vault of the nave of Fontenay's abbey church (*Figure 11*).[28]

The Bernadine plan is also modular. The Plan of St. Gall formally introduced modular design to medieval architecture. There is no direct indication that Bernard knew of the Plan of St. Gall, but Benedictine monasteries began to incorporate various aspects of its design into their plans after its creation, which provides circumstantial evidence of widespread knowledge of the Plan across Europe. Maximillian Sternberg asserts that the Cistercian Order firmly belonged to the 'cosmopolitan tradition' of the Plan of St. Gall that was inspired by the Carolingian monastic reforms of the ninth century. This tradition is reflected, in part, by the many permeable boundaries that Cistercians borrowed from the Plan of St. Gall via earlier

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University of Toronto Press, 1991), 712. The figure can be found in *Old St. Peter's, Rome*, ed. Rosamond McKitterick, et al. (Cambridge: Cambridge University Press, 2013), Introduction, 18.

[27] Terryl N. Kinder, *Cistercian Europe: Architecture of Contemplation* (Kalamazoo, MI: Cistercian Publications, 2002); Sternberg, *Cistercian Architecture and Medieval Society*, 44.

[28] Meyer Shapiro, "On the Aesthetic Attitude in Romanesque Art," in *Romanesque Art*, ed. Meyer Shapiro (New York: George Braziller, 1977); Xavier Barral i Altet, "Early Cistercian Architecture: Originality and Functionality of a Building Model," in *The Cistercian Arts From the 12th to the 21st Century*, ed. Terryl Kinder and Roberto Cassanelli (London: McGill-Queen's University Press, 2014), 70; Eric Fernie, *Romanesque Architecture: the First Style of the European Age* (New Haven: Yale University Press, 2014), 127. Image from Pierre-André Burton, ""Deformed Beauty" or "Beautiful Deformity": The Aesthetics of the Cross as a Mystical Ethic of Beauty in Bernard of Clairvaux," in *The Cistercian Arts From the 12th to the 21st Century*, ed. Terryl N. Kinder and Roberto Cassanelli (London: McGill-Queen's University Press, 2014), 37.

Benedictine plans to enable interaction between Cistercians and society, e.g. the gatehouse, narthex, and screens.[29]

The modular plan incorporated into Clairvaux's design would have satisfied Bernard's great admiration of St. Augustine (d. 430) who considered architecture and music sisters in their similar relation to numbers and ratios.[30] St. Augustine wrote of the perfection of music and modulation in *De Musica*. Villard de Honnecourt's drawing of a simple Latin cross Cistercian church that is composed of square and double-square bays is reminiscent of the church in the Plan of St. Gall (*Figure 5*).[31] This plan reflects the ratios of 1:1 (ratio of unison), 2:1 (octave ratio), 2:3 (the musical fifth), 3:4 (musical fourth), and 4:5 (musical third) in the crossing of the nave and transept, the ratio of the nave to side aisles, the length of the transept in relation to the length of the church, the ratio of the presbytery, and the ratio of the width of the church to the length of the nave respectively (*Figure 12*).[32] Villard's plan differs from earlier Cistercian churches that follow the Bernadine plan, which have a T shape with a flat-ended apse, but its use of ratios reflects that used in earlier Cistercian church plans. The first church of Clairvaux (*Figure 8*) consisted of two circumscribed squares that reflect the 1:1 ratio,[33] and the first Cistercian churches constructed after Clairvaux II appear to have been based upon these harmonic ratios, as evidenced by the remains of Fontenay and Eberbach.[34]

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[29] Sternberg, *Cistercian Architecture and Medieval Society*, 114.
[30] Simson, "The Cistercian Contribution," 129.
[31] Bowie, *The sketchbook of Villard de Honnecourt*, 92-93.
[32] E. de Bruyne, *Études d'Esthétique médiévale*, vol. 97-99 (Brugge: De Temple, 1946); Simson, "The Cistercian Contribution," 130.
[33] Cassanelli, "Saint Bernard, a builder? The problem with the "Bernadine Plan"," 78.
[34] Simson, "The Cistercian Contribution," 129.

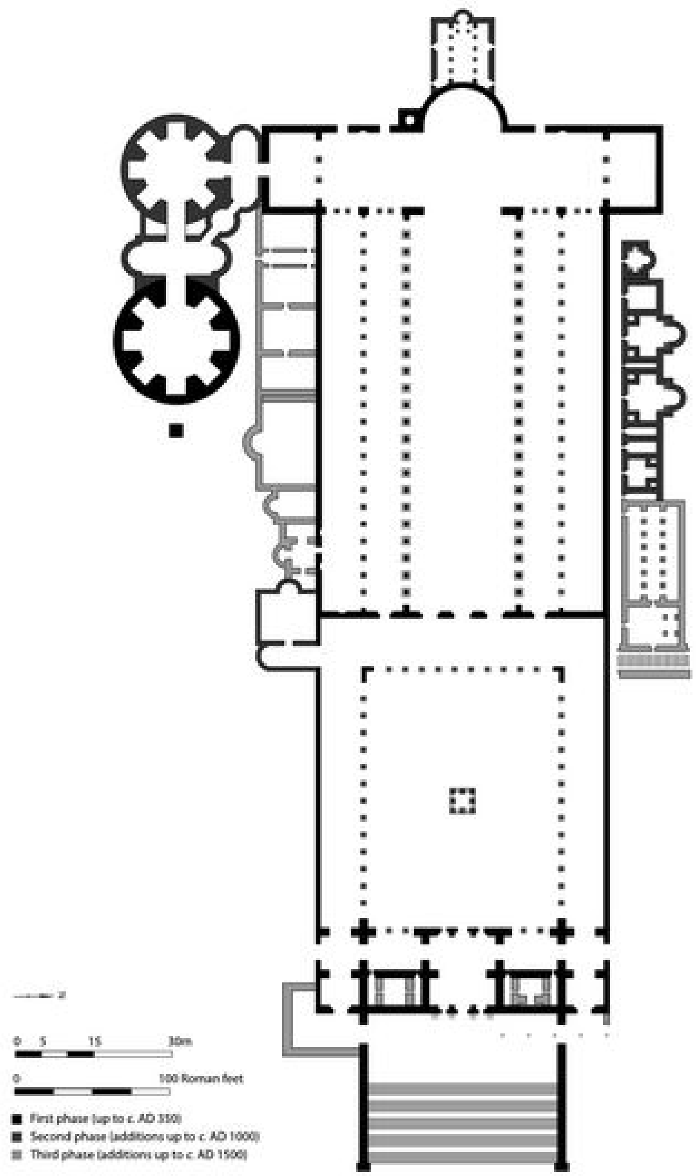

Figure 9: Plan of Old St. Peter's in Rome

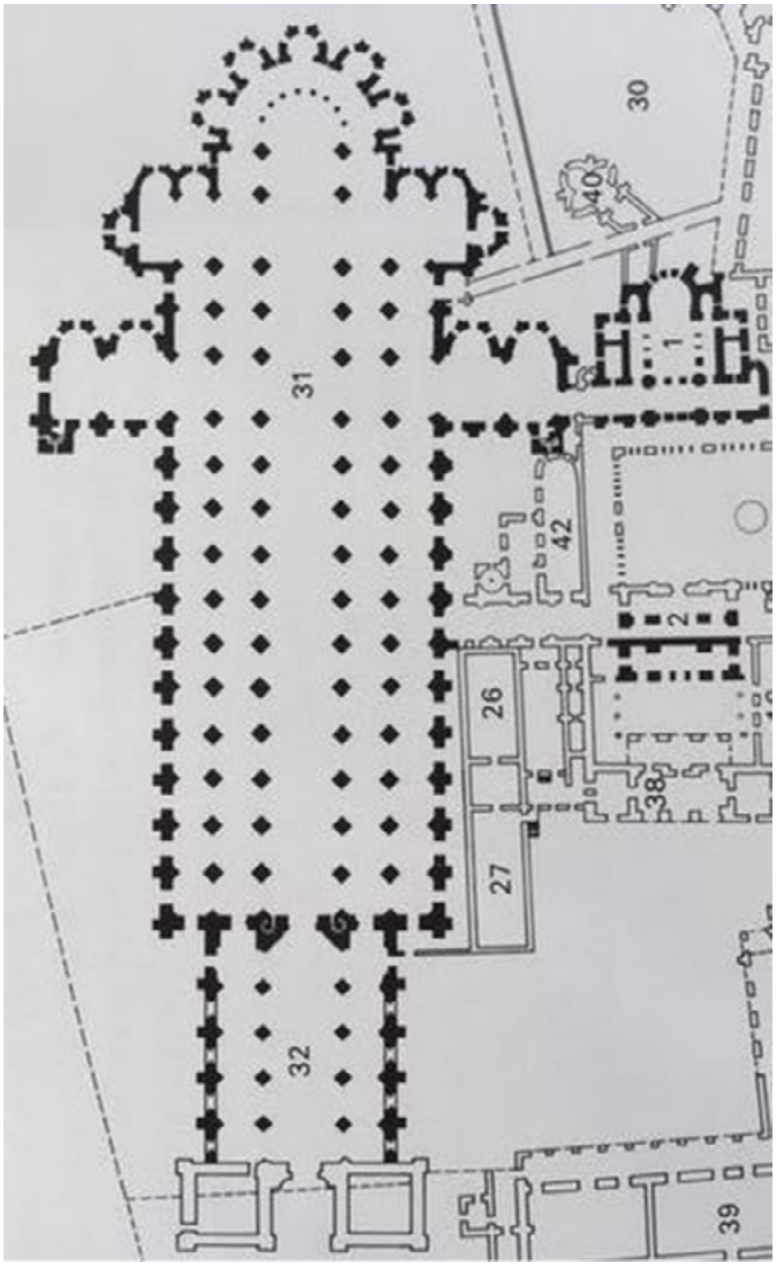

Figure 10: Cluny III church plan

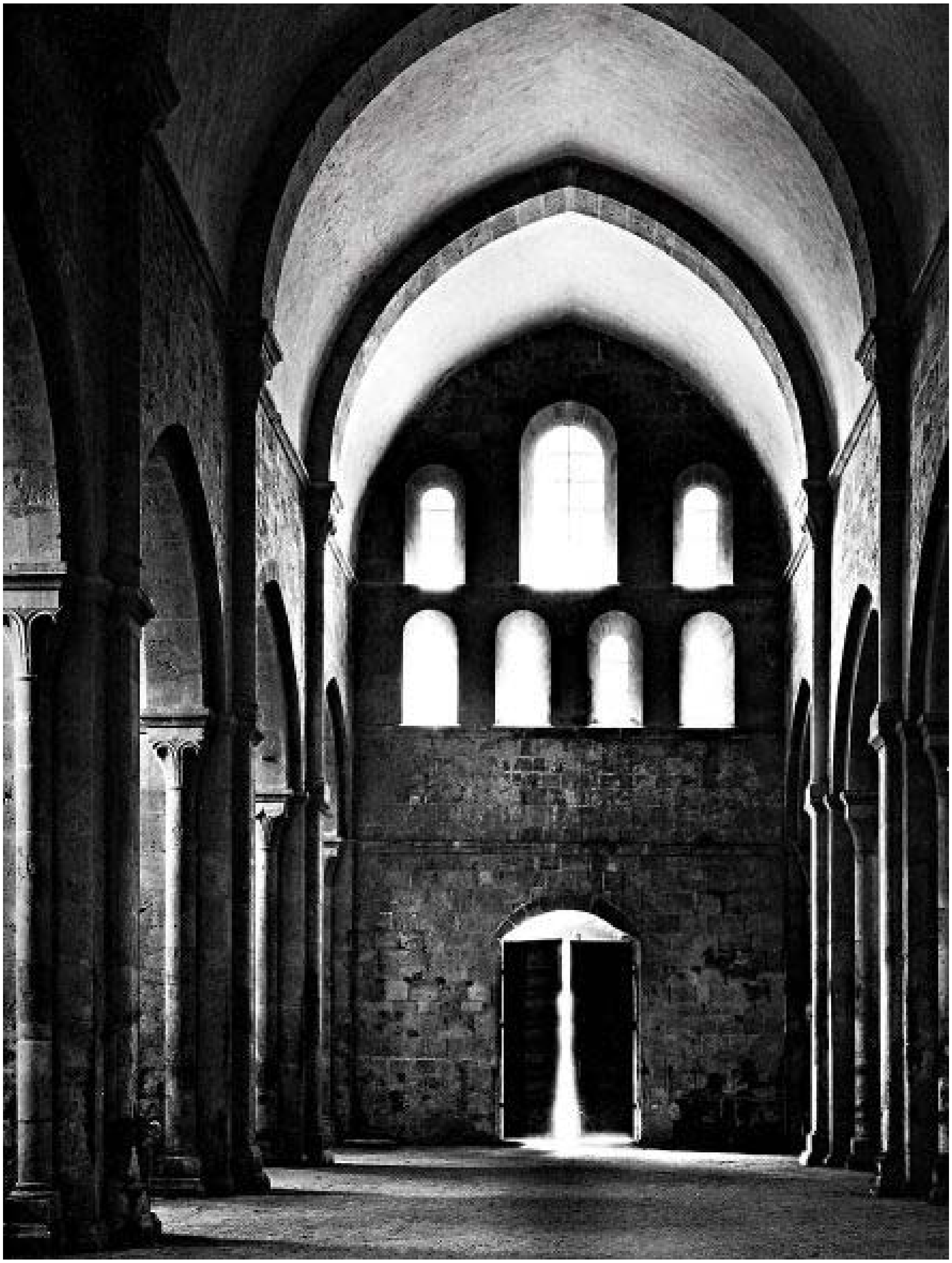

Figure 11: Nave of Fontenay's abbey church

A rectangular apse, such as that seen on the eastern end of the church in the plan of Clairvaux II (a) (*Figure 13*), is characteristic of the Bernadine plan. Later Cistercian churches, as represented by Clairvaux II (b), have a chevet with apse, ambulatory, and radiating chapels that is more reminiscent of Cluny III's design. After Bernard's death in 1153, Cistercian abbey churches increasingly incorporated a chevet into their church plans. This is evidenced in the church plans of Clairvaux II (b), and Pontigny (c), each of which had a rectangular apse in its first permanent church (*Figures 13-15*). Pontigny (b), which began construction in 1140, just five years after Clairvaux II (a) is the first example of the use of ribbed groin vaulting in Burgundy.[35] Only Cîteaux (c) retained the rectangular apse form, albeit considerably enlarged, in her third renovation later in the century. It has recently been suggested that Bernard approved the plans for Clairvaux II (b), which included a polygonal chevet, prior to his death, but this has yet to be proven.[36]

All 69 of Clairvaux's daughter houses that were constructed prior to the death of St. Bernard in 1153 conformed to the programmatic principles of Clairvaux. This can be seen in a comparison of the church plan of Fontenay, one of the first daughter houses of Clairvaux, with that of Clairvaux II (a) (*Figure 16*). Construction on Fontenay began just four years after Bernard approved the construction on Clairvaux II (a). While smaller, the plans are quite similar with the exception that Fontenay's church is missing a western aisle in the transept. More significantly, the monks of Cîteaux used Clairvaux's plan for the permanent church, Cîteaux (b),

[35] Janet Burton and Julie Kerr, *The Cistercians in the Middle Ages* (Woodbridge: The Boydell Press, 2011), 79.
[36] Sternberg, *Cistercian Architecture and Medieval Society*, 34.

which did not begin construction until the relocation and building of Clairvaux II had been initiated.[37]

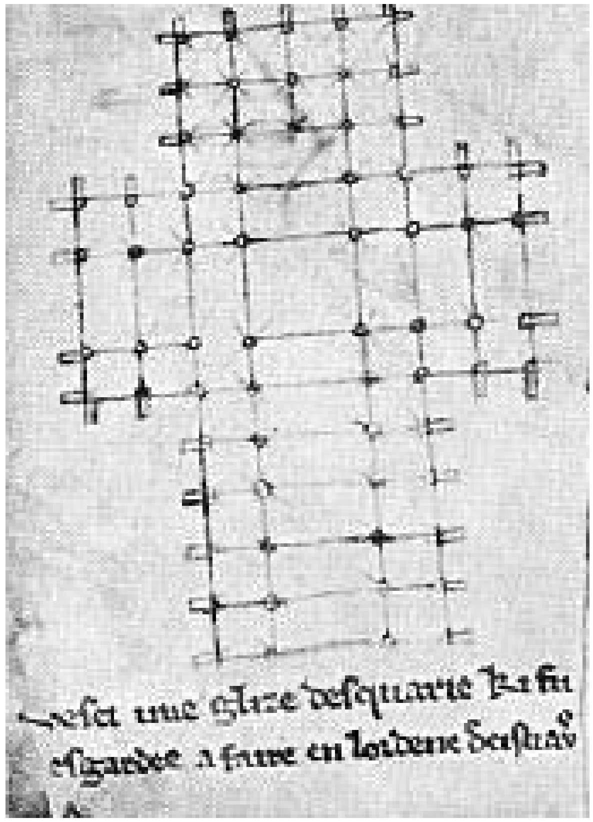

Figure 12: Villard de Honnecourt's plan of a squared Cistercian church

The church of Alcobaça, the first Cistercian monastery to be founded in Portugal in honor of St. Bernard just prior to his death in 1153, is modeled on the plan of Clairvaux II (b) and began construction just after its completion.[38] It is also the first and largest early gothic building in Portugal, demonstrating that while maintaining a strict aesthetic, Cistercian architecture was quite progressive.[39] While slightly smaller, the plans for the two churches are closely aligned (*Figure 17*). The

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[37] Anselme Dimier, *Recueil de plans d'Églises cisterciennes* (Grignan, Drôme: Abbaye Notre-Dame D'Aiguebelle, 1949), Clairvaux, Pl. 82-84; Citeaux, P. 78-80; Pontigny, Pl. 235-37.
[38] Paulo Pereira, *Monastery of Alcobaça* (Scala Publishers, 2007).
[39] Burton and Kerr, *The Cistercians in the Middle Ages*, 79.

nave of Alcobaça (*Figure 18*) when compared to that of Fontenay (*Figure 11*) demonstrates the transformation that Cistercian architecture took over the course of just fifty years while still retaining the austere beauty for which it is so well known. According to Maximilian Sternberg, the Cistercian aesthetic served as a physical representation of Cistercian reform and a means of communicating that reform to Christendom.[40] The following passage from the *Exordium Parvum* describes the Order's commitment to this aesthetic.

> They resolved to retain no crosses of gold or silver, but only painted wooden ones; no candelabra except a single one of iron; no thuribles except of copper and iron; no chasuble except of plain cloth or linen, and without silk, gold, and silver… They did, however, retain chalices, not of gold, but of silver, and, if possible, gilded… As for altar cloths, they explicitly decreed that they be of linen, without pictorial ornamentation, and that the wine cruets be without gold or silver.[41]

Cistercian architecture is now considered too complex to attribute to one man alone, even one as influential Bernard, but even the staunchest critics acknowledge his influence on its early phases in the first half of the twelfth century.

What is significant about the Bernadine Plan for the argument presented here is that it included a hydraulic network that allowed Cistercians to provide for all of their needs. Cistercians used water for liturgical, domestic, and industrial activities.[42] Some of the liturgical uses of water included holy water, ablutions, and footwashing; domestic uses included food preparation, latrines, irrigation, fishponds, and water for animals; and industrial uses included power for mills, forges, and associated crafts. Terryl Kinder further divides the water usage of a Cistercian monastery into "internal"

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[40] Sternberg, *Cistercian Architecture and Medieval Society*, 5.

[41] Waddell, *Narrative and Legislative Texts from Early Cîteaux: Latin Text in Dual Edition with English Translation and Notes*, chapter XVII, 438.

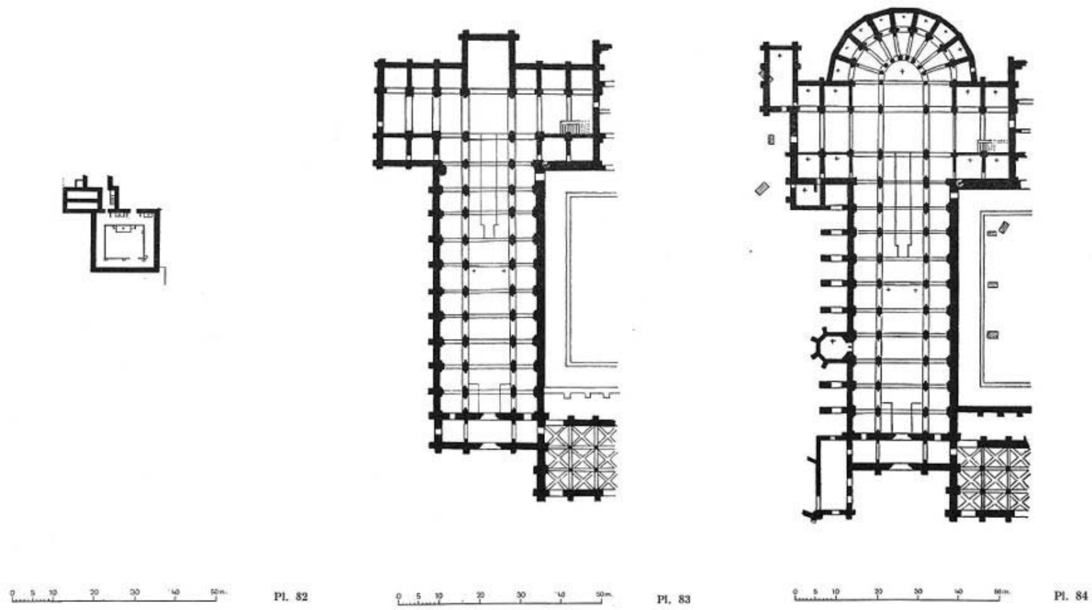
[42] Kinder, *Cistercian Europe: Architecture of Contemplation*, 86.

and "external" usage. The monasteries' internal needs were often provided for by water piped in from an uphill stream through sophisticated plumbing systems.[43] These systems were generally located underneath the monastery and are impossible to discern from site plans, although one visible point of egress was the *labatorium*, a fountain located within the cloister from which monks washed their hands and faces at designated times of the day.[44] The source of this water that served domestic and ritually important purposes had to be separate from that serving the abbey's external needs due to the contamination inherent in the latter.

External water needs were generally met by harnessing the power of an adjacent or nearby river. This often entailed damming the river and creating millraces, such as the Aube Canal, a 2.5 kilometer millrace that provided water to the milling complex of Clairvaux (*Figure 8*). At the time of Milley's rendering of the monastic complex of Clairvaux in 1708, this milling complex included a grain mill [45 - Frumentarium], with an attached bakery oven [44 – Pistrinum & Clibani], an olive crushing mill [46 - Olearium], a saw mill [47 - Serrarium], and a bark mill [48 - Corticiarium] (*Figure 19*).[45] Associated with this complex were buildings associated with the various crafts supported by these mills, including a number of buildings designated for fabric and tanning work [49 - Fabricae Coriariae loca].

That Bernard gave a great deal of thought to matters of art and architecture is evident in some of his correspondence prior to the relocation and expansion of Clairvaux II. At the request of William of Saint-Thierry, Bernard agreed to write a

[43] Ibid.
[44] Roberta Magnusson, *Water Technology in the Middle Ages: Cities, Monasteries, and Waterworks after the Roman Empire* (Baltimore: The Johns Hopkins University Press, 2001), 22.
[45] Braunfels, *Monasteries of Western Europe: The Architecture of the Orders*, 81.

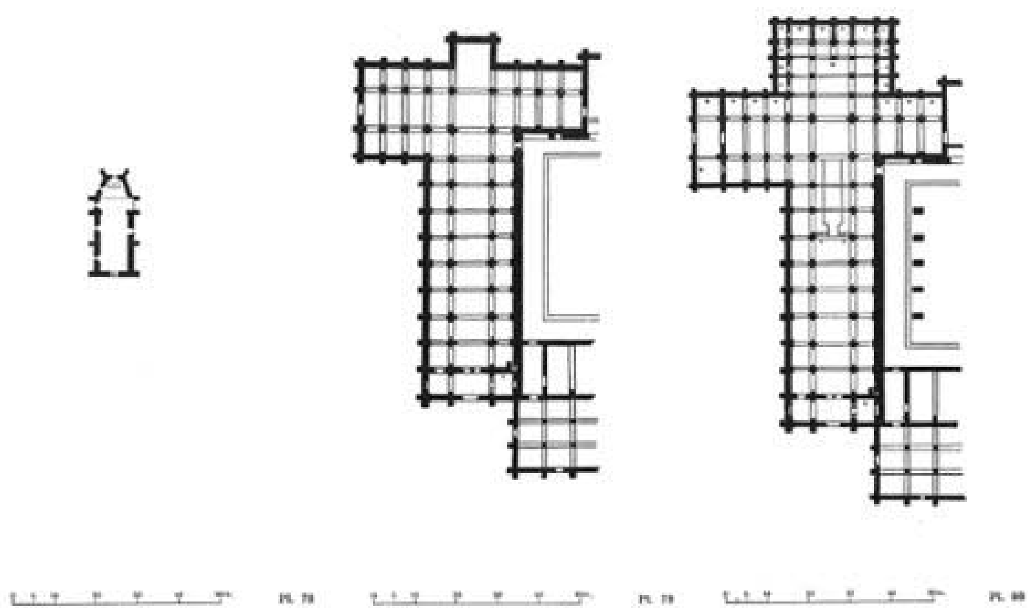


Clairvaux I
1115

Clairvaux II (a)
1135 -1145

Clairvaux II (b)
1154 -1174

Figure 13: Plans of the abbey church of Clairvaux



Cîteaux (a)
Cons. 1106

Cîteaux (b)
1140-1150

Cîteaux (c)
Cons. 1193

Figure 14: Plans of the abbey church of Cîteaux

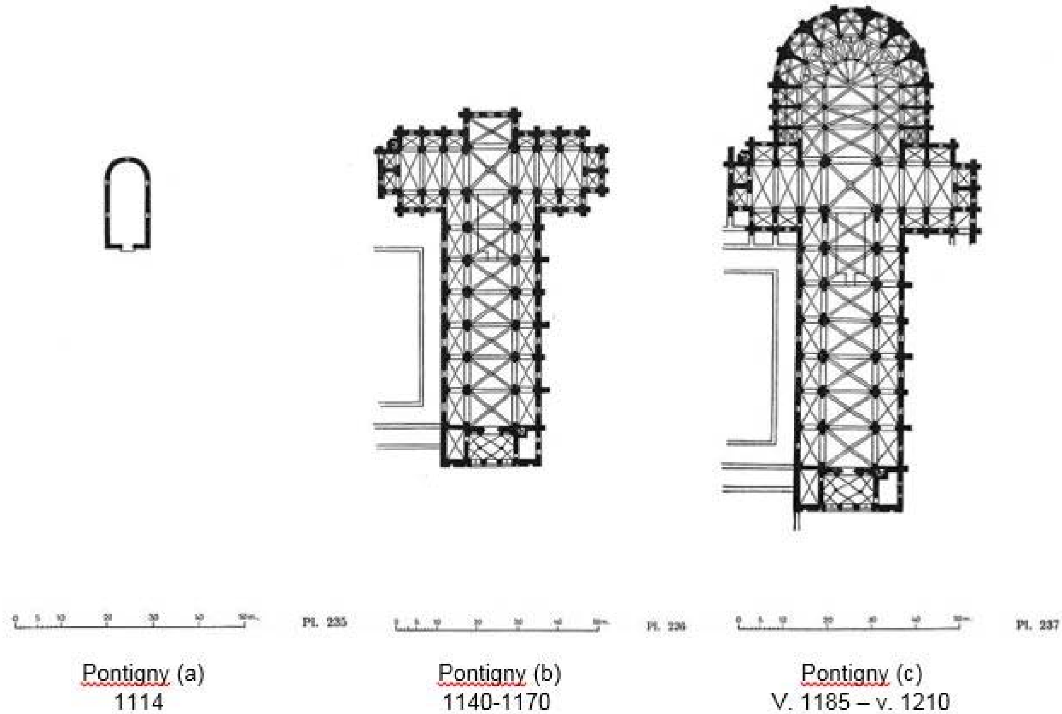


Figure 15: Plans of the abbey church of Pontigny

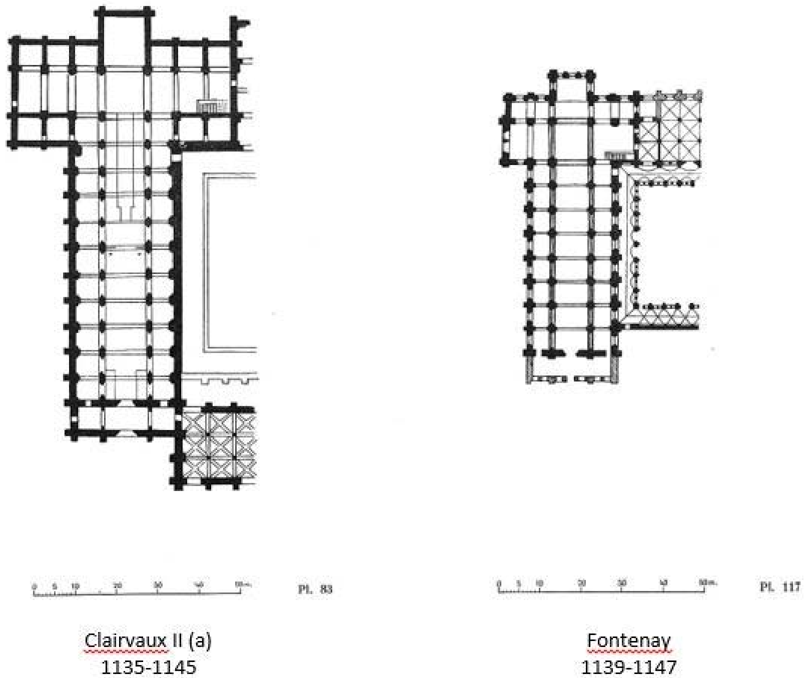


Figure 16: Comparison of Clairvaux II & Fontenay church plans

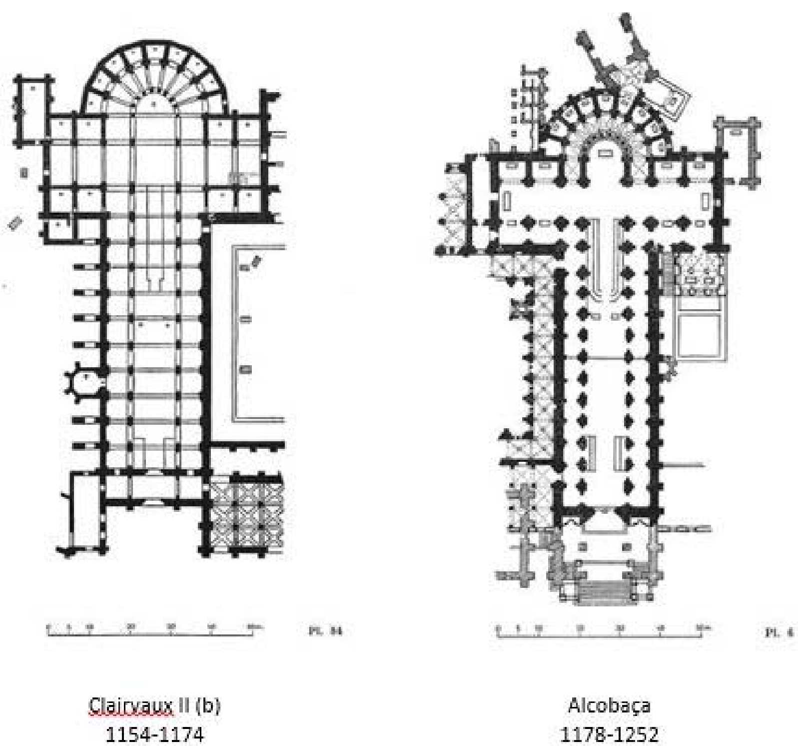


Figure 17: Comparison of Clairvaux II (b) & Alcobaça church plans

Figure 18: Nave of Alcobaça's abbey church

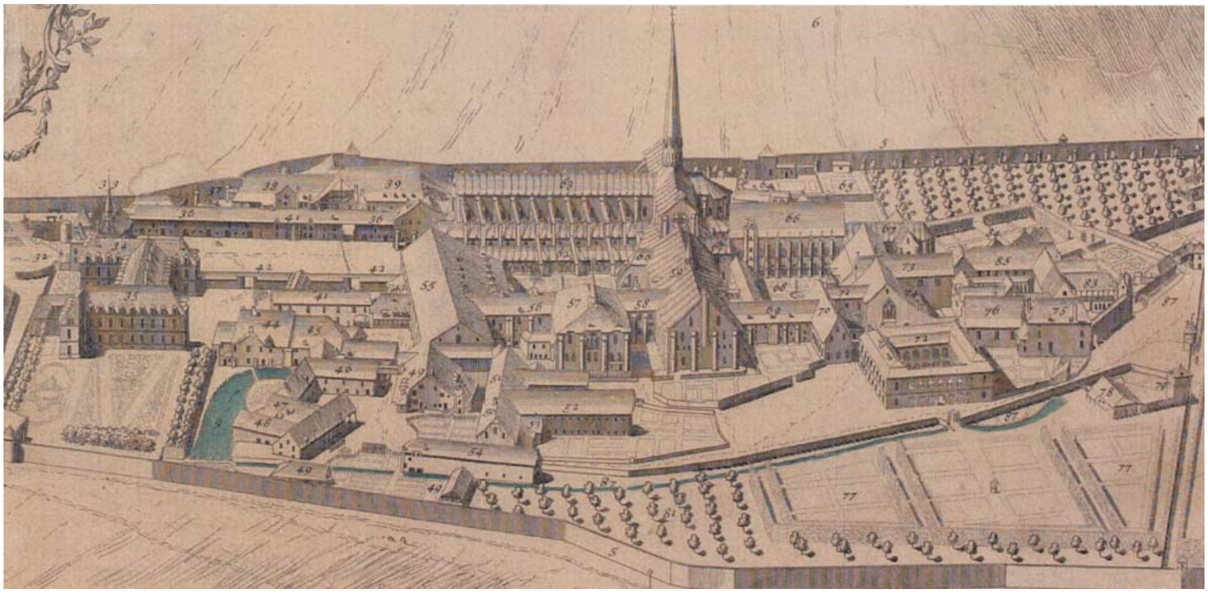


Figure 19: Bird's Eye View of Clairvaux

response to the forced abdication of the reform-minded Pons (r. 1109-1122), seventh abbot of Cluny.[46] In the *Apologia ad Guillelmum abatem* (1123-24), Bernard wrote,

> O vanity of vanities, vanity even more senseless than it is vain! The walls of the church glitter with a display of riches, and the poor lack everything; its stones are covered with gilt, and the children go unclothed; the goods of the poor pay for embellishments to charm the eyes of the rich; the dilettante can satisfy his curiosity in church, but the poor find nothing there to sustain them in their wretchedness.[47]

Scholars have long thought this to be a vitriolic response against the excess of Cluny, although Adriaan Bredero suggests that Peter the Venerable intentionally skewed public perception of the *Apologia* so that it would appear as a general

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[46] Bredero, *Bernard of Clairvaux: Between Cult and History*, 218-27.

[47] O vanitas vanitatum, sed non vanior quam insanior! Fulget ecclesia in parietibus, et in pauperibus eget. Suos lapides induit auro, et suos filios nudos deserit. De sumptibus egenorum servitur oculis divitum. Inveniunt curiosi quo delectentur, et non inveniunt miseri quo sustententur. Bernard of Clairvaux, "Apologia ad Guillelmum Sancti Theoderici Abbatem," *Patrologia Latina* 182 (1123-24): 182: 915 C. Translation from Lucien Hervé, *Architecture of Truth* (New York: George Braziller, 1957).

diatribe against the Cluniac lifestyle, rather than attempted interference in Cluniac affairs.[48]

Bernard may have had multiple audiences in mind when writing the *Apologia.* In the following passage, he asks,

> But apart from this, in the cloisters, before the eyes of the brothers while they read – what is that ridiculous monstrosity doing, an amazing kind of deformed beauty and yet a beautiful deformity? What are the filthy apes doing there? The fierce lions? The monstrous centaurs? The creatures, part man and part beast?... In short, everywhere so plentiful and astonishing a variety of contradictory forms is seen that one would rather read in the marble than in books, and spend the whole day wondering at every single one of them than in meditating on the law of God.[49]

This criticism overtly refers to the decorative sculptures of Cluny and other contemporary Benedictine monasteries, but the passage may also be construed as criticism of early Cistercian practices. A good example is the elaborate illumination of manuscripts for which Cîteaux had become quite well known under the direction of Stephan Harding.[50] The four volumes of Stephen's Bible that date to c. 1109 and Gregory the Great's *Moralia in Job* completed on Christmas Eve in 1111 are exemplars of Cistercian illumination prior to Bernard's interference. The initial of Book 23 in the *Moralia in Job* depicts a dragon devouring a tonsured monk in the form of a centaur, a figure directly mentioned in the passage from the *Apologia* above (*Figure 20*). This image allegedly represents the struggle between the forces

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[48] Bredero, *Bernard of Clairvaux: Between Cult and History*, 226.
[49] Caeterum in claustris coram legentibus fratribus quid facit illa ridicula monstruositas, mira quaedam deformis formositas, ac formosa deformitas?... Tam multa denique, tamque mira diversarum formarum ubique varietas apparet, ut magis legere libeat in marmoribus quam in codicibus, totumque diem occupare singula ista mirando, quam in lege Dei meditando. Proh Deo! si non pudet ineptiarum, cur vel non piget expensarum? Bernard of Clairvaux, "Apologia ad Guillelmum Sancti Theoderici Abbatem," 182: 916 A-B. Translation from Hervé, *Architecture of Truth*.
[50] Bredero, *Bernard of Clairvaux: Between Cult and History*, 204-05.

of evil and the hybrid conditions of fallen man.[51] Under Bernard's leadership, inclusion of this type of ornate illumination in texts produced by the Order ended.

Bernard did not propose to relocate and expand the monastery of Clairvaux in 1135, but he acknowledged the need when confronted by Geoffrey and acquiesced. The importance of Bernard's influence in the development of a Cistercian architectural archetype for this discussion lies in the fact that Clairvaux incorporated a well-developed hydraulic system and industrial milling technology that could support the craft needed to provide the bulk of the Order's material goods. Propagation of this model throughout Europe as the Order spread led to the widespread and mistaken attribution of significant innovation of water mill technology to the Cistercian Order.

The *Summa Carta Caritatis* states that "no abbot shall be sent to a new place without at least twelve monks and… without such places as an oratory, a refectory, a dormitory, a guest house, and a gate keepers cell, so that the monks may immediately serve God and live in religious discipline."[52] Peter Fergusson suggests that this initial construction would have been undertaken by the patron of the new foundation in collaboration with the motherhouse.[53] If this is the case, Cistercians were accustomed to working with and receiving the assistance of outside laborers on the construction of their facilities from the earliest days of the Order, an

[51] James France, "Images of Saint Bernard and Cistercians in Medieval Art," in *The Cistercian Arts From the 12th to the 21st Century*, ed. Terryl Kinder and Roberto Cassanelli (London: McGille-Queen's University Press, 2014), 299.
[52] Non mittendum esse abbatem novum in locum novellum sine monachis ad minus XII nec sine libris istis psalterio, hymnario, collectaneo, oratorio, refrectorio, dormitorio, cella hospitum, et portarii, quantinus ibi statim et Deo servire et regulariter vivere possint. Bouton and Van Damme, *Les Plus Anciens Textes de Cîteaux: sources, textes et notes historiques*, 121. Translation by Lekai, *The Cistercians: Ideals and Reality*, 448.
[53] Fergusson, "The Builders of Cistercian Monasteries in Twelfth Century England."

interaction that would have facilitated the exchange of ideas and knowledge about hydraulic infrastructure and technology. Evidence suggests that this knowledge and infrastructure did, in fact, exist in France prior to the foundation of the Order.[54]

[54] Guillerme, *The Age of Water: The Urban Environment in the North of France, A.D. 300 to 1800*; Magnusson, *Water Technology in the Middle Ages: Cities, Monasteries, and Waterworks after the Roman Empire*.

Figure 20: Moralia in Job: Initial of book 23

Chapter 5: Cistercian Milling in the Context of 12th Century France

> Give the Cluniacs today a tract of land covered with marvelous buildings, endow them with ample revenues and enrich the place with vast possessions: before you can turn round it will all be ruined and reduced to poverty. On the other hand, settle the Cistercians in some barren retreat which is hidden away in an overgrown forest: a year or two later you will find splendid churches there and fine monastic buildings, with a great amount of property and all the wealth you can imagine.[1]

This enthusiastic observation of Cistercian abbeys by Gerald of Wales in the twelfth century reflects the high esteem in which the Cistercian Order was held and the managerial prowess already associated with the Order in the second half of the twelfth century, but it does not reflect the hard work that Cistercians put into transforming "barren" land into complex granges that provided the wealth he mentions. That Cistercians were able to achieve such a rapid transformation is attributable to the Order's situation in France where hydraulic resources were plentiful at the time of its foundation.

The pervasive idea that technological development in general, and the use of the water mill in particular, stagnated in Antiquity has been greatly overestimated, and we now know that water mill technology diffused from the Mediterranean to Europe at least in part via France. Now it is time to connect the dots and explain the importance of the Cistercian Order's situation in France to the success of the economic model for which it is so renowned. This chapter will begin with evidence for the presence of hydraulic infrastructure and technology in France prior to the foundation of the Cistercian Order in 1098, which will demonstrate that Cistercians had access to these resources. This will be followed by a detailed examination of the

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[1] Gerald of Wales, *Journey Through Wales*, trans. L. Thorpe (Harmondsworth,1978).

Cistercian use of industrial water mill technology in France in the twelfth century and evidence that current lists of French industrial mills do not include well-known Cistercian mills. Lastly, the failure of historians to adequately account for the use of French industrial milling technology, which evidence shows differs from that outside of France, when propounding theories on the development of industrial milling in the Middle Ages and the role of the Cistercian Order in that development will be addressed.

Adjacent to the Mediterranean Sea and Italy, surrounded by water on three sides, and endowed with a number of significant rivers including the Seine, Loire, Rhône, and Garonne, it is unsurprising that France played a significant, if underappreciated, role in the diffusion of water mill technology from its birthplace in the Mediterranean to Western Europe. In *Medieval Hydraulics in France*, Paul Benoit and Josephine Rouillard document a number of locations where Roman infrastructure and aqueducts were repaired and used to support the burgeoning population in Paris, Le Mans, Béziers, and Pézenas well into the Middle Ages.[2] There is also evidence that mills existed in Gaul from the very beginning of the Christian era. A mill from the first century A.D. has been revealed on the Yèvre river,[3] as has the aforementioned milling complex in Barbegal that dates to the second century A.D.

Literary references, such as Ausonius' mention of a saw mill in the *Mosella,* also point to the transmission of water power into France during the alleged period of

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[2] Benoit and Rouillard, "Medieval Hydraulics in France," 167.

[3] Frédéric Champagne, Ferdière Alain, and Rialland Yannick, "Re-découverte d'un moulin à eau augustéen sur l'Yèvre," *Revue Archéologique du Centre de la France* 36 (1997).

technological dormancy between Antiquity to the Middle Ages. These references are substantiated by additional evidence that is found in various barbarian laws. Visigothic law, for example, specifies a fine for the destruction of a mill, Alamanic law threatens destruction of any mill or lock that caused harm to anyone, and Frankish law specifies a penalty for theft of a mill.[4] The quantity of mills in France certainly increased significantly in the Middle Ages, but there can be no doubt that hydraulic infrastructure and technology existed in that region prior to the twelfth century.

André Guillerme has defined several periods of urbanization that help place Cistercian milling into the context of urban France in the twelfth century.[5] The first medieval hydraulic networks were developed during a period of 'proto-urbanization' that lasted from 870-950 A.D. During this period, defensive moats at Senlis, Chartres, and Noyon were created for use by Carolingian rulers. The 'first period of urbanization' took place between 950-1050 A.D. and corresponds to the construction of the region's first network of canals. These canals allowed for the development of water-related activities, such as milling and crafts, which were crucial for the sustainability and growth of new urban centers. During this period, the fortification of four cities occurred, the previously Roman cities of Châlons-sur-Marne and Beauvais, and the medieval cities of Etampes and Caen.

The 'second period of urbanization' occurred at the end of the eleventh century and corresponds to the period of monastic reform described above. Marshes were increasingly drained during this period to assist with the burgeoning milling needs of the city. The city of Caen represents the culmination of this second phase

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[4] Benoit and Rouillard, "Medieval Hydraulics in France," 169-73.

[5] Guillerme, *The Age of Water: The Urban Environment in the North of France, A.D. 300 to 1800*, 23-50.

of urbanization. William the Conqueror (d. 1087) worked with Lanfranc, abbot of Saint-Etienne, to create a complex network of canals that branched off of the Odon River. William's son, Robert Courteheuse (d. 1134), continued this work so that by the end of his reign in 1106, just eight years after the foundation of Cîteaux, more than three kilometers of canals and waterways had been laid around the city.[6] These waterways serviced the castle and abbey, supplied millraces for the abbey, improved access to the harbor, and supported the crafts for which the city was well known at the time.

Guillerme has identified seven cities that distinguished themselves by their number of mills during the 'first period of urbanization.' These include Rouen, Châlons, Etampes, Beauvais, Amiens, Reims, and Caen.[7] Of the 82 mills that were constructed in northern France during this period, 63 were built in one of these seven cities. Châlons, Rheims, Rouen, and Beauvais were episcopal cities located in northwest France, as were Cîteaux and her four principal daughter houses (*Figure 21*).[8] The birth of the Cistercian Order fell in between the first and second periods of urbanization when France experienced a lull in the urban construction of mills in the north due to the impact of the Conquest and the move of William's court to England. It is clear from this evidence, however, that extensive hydraulic and milling infrastructure existed prior to the Order's foundation, and that lay and episcopal leaders actively worked together to improve this infrastructure to meet the demands of a growing population. The proximity of the heart of the Cistercian Order to these

[6] Ibid., 54-56.
[7] Ibid., 83.
[8] Martha G. Newman, *The Boundaries of Charity: Cistercian Culture and Ecclesiastical Reform 1098-1180* (Stanford: Stanford University Press, 1996).

urban centers undoubtedly influenced the rapidity with which Cistercians incorporated hydraulic infrastructure and water mill technology into their lifestyle.

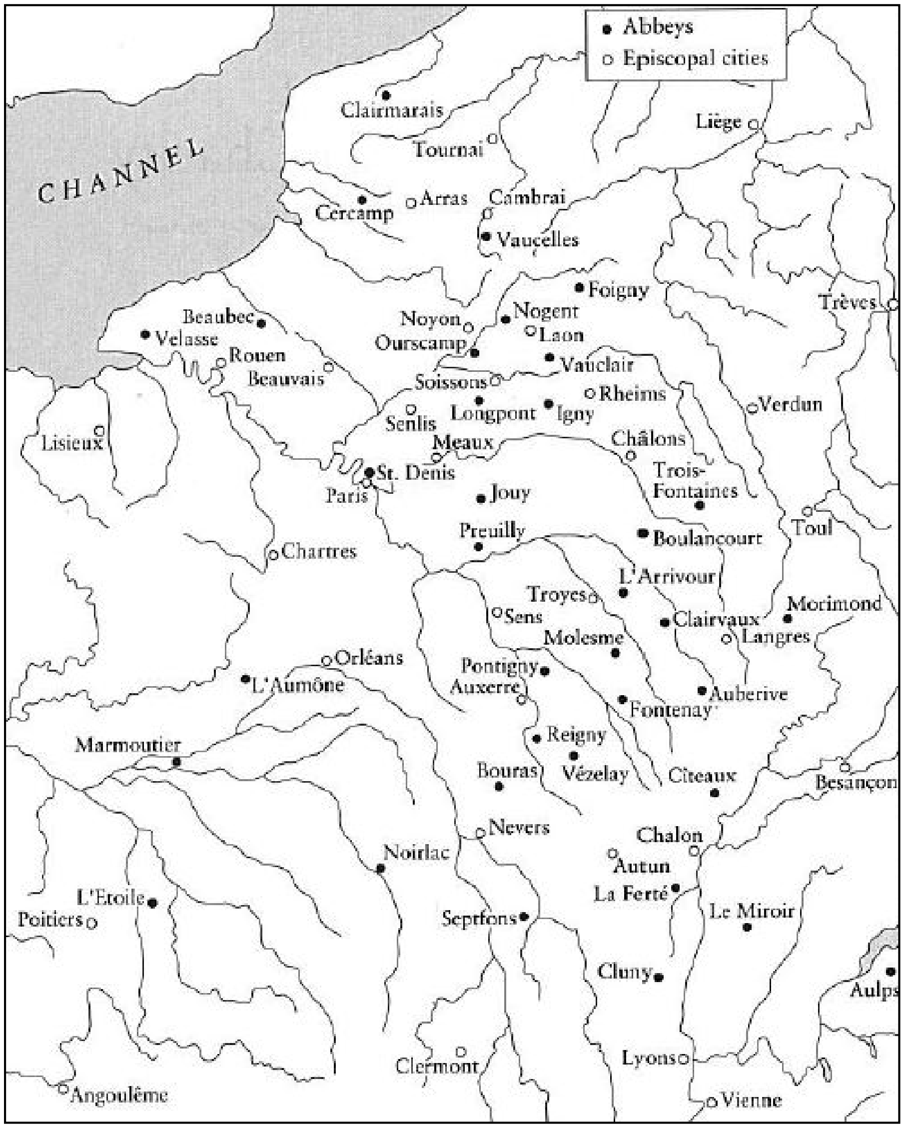

Figure 21: Ecclesiastical institutions in northwest France, c. 1150

White and his contemporaries argued that the concept of *caritas* or charity drove Benedictine and Cistercian Orders to develop an attitude toward labor that favored technology as a way to ease the burden of man. The preponderance of evidence, however, points to labor-saving devices such as the water mill being utilized by Cistercians for the express purpose of fulfilling the Order's mandate of self-sufficiency. The means by which they accomplished this self-sufficiency in the twelfth century set them apart from other orders and their secular neighbors.

Constance Berman attributes the Cistercian Order's success and expansion in southern France to "managerial prowess, interdependent agriculture and pastoralism, direct cultivation of newly created granges, land acquisition tied to the recruitment of *conversi* or lay brothers as laborers, the availability of markets in neighboring cities for surplus products… and exemption from ecclesiastical ties."[9] The argument presented here underpins Berman's claim. I contend that the Order demonstrated managerial prowess in regard to agriculture and pastoralism on their extensive system of granges by taking advantage of the extensive pre-existing hydraulic infrastructure and knowledge of water mill technology described above. That this infrastructure existed in locations where Cistercians established monasteries and granges has been well documented.

In 1135, under the direction of Bernard, Clairvaux established the daughter house of Buzay near Nantes, France. The 'innovation' of the Cistercians who founded Buzay lay in their acquisition of eight pre-existing locks on tributaries of the Loire that controlled water in the area and their systematic reclamation of the surrounding land by draining marshes. This reclamation effort provided more usable pasturage throughout the year. Evidence suggests that these locks were equipped with mills.[10] The example of Buzay demonstrates that while Bernard may have set

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[9] Berman, "Medieval Agriculture, the Southern French Countryside, and the Early Cistercians. A Study of Forty-Three Monasteries," 10.

[10] J. Sarrazin, "Les Cisterciens de Buzat et l'Amenagement de l'Estuaire de la Loire au Moyen Age (XIIe-XVe siècles)," *Memoires de la Société d'Histoire et d'Archéologie de Bretagne* 65 (1988).

the technological standard of the Order, an understanding of hydraulic infrastructure and water mill technology existed within the Order prior to that time. Berman has similarly demonstrated that Cistercians in the south of France acquired land that included mills, mill-ponds, and weirs that were often in a state of disrepair.[11] The majority of Cistercian mills were acquired by various means and not built by the monks themselves.[12] Only those mills in immediate proximity to the monastery were a regular exception, and they were built for the most part using existing technology without any significant innovative Cistercian contribution.[13]

Cistercian land and water management, which differed so significantly from contemporary monastic practice in twelfth-century France, certainly contributed to the Order's success. Its role in the innovation of the water mill, however, still asks for clarification. Most medieval mills, including those owned and operated by Cistercians, were agricultural mills dedicated to grinding grain. All but two of the mills at Cîteaux and fourteen of fifteen at La Bussière were grain mills.[14] The Rule of St. Benedict called for one weighed pound of bread per day to each monk, a significant demand for burgeoning monasteries.[15] For the Order to remain self-sufficient, Cistercians had to supply the grain, mills, and manpower necessary to bake this bread. In 1148, a mere thirty-three years after its foundation, Clairvaux housed

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[11] Berman, "Medieval Agriculture, the Southern French Countryside, and the Early Cistercians. A Study of Forty-Three Monasteries," 24.

[12] Benoit and Berthier, "L'Innovation dans l'Exploitation de l'Énergie hydraulique d'Après le cas des monastères cisterciens de Bourgogne, Champagne et Franche-Comté," 59. Evidence indicates that only 3 of 11 mills at Pontigny, 3 of 17 at Boulancourt, 1 of 17 at Morimond, 1 of 4 at Auberive were built by Cistercians.

[13] Benoit, "L'Industrie Cistercienne (XII^{ème} - Premiere Moitie du XIV^{ème} siècle)," 76.

[14] Karine Berthier and Josephine Rouillard, "Nouvelles Recherches sur l'Hydraulique Cistercienne en Bourgogne, Champagne et Franche-Comte," *Archéologie Médiévale* 28 (1999): 142.

[15] Panis libra una propensa sufficiat in die, sive una sit refection, sive prandii et coenae. Quod si coenaturi sunt, de eadem libra tertia pars a cellerario reservetur reddenda coenaturis, Brandenburg, Doss, and Frederick, "Evaluation of a library outreach program to research labs."

approximately 700 individuals, a number that included both novices and lay brothers.[16] That translates into a requirement of almost 20,000 pounds of bread per month for Clairvaux alone. It is a testimony to the Order's efficiency that monasteries regularly produced a surplus of grain that they sold at market.[17] As astounding as this agricultural capacity seems, it was the industrial milling capacity of Clairvaux that Bernard's contemporaries described in their writings.

In order to remain self-sufficient and still have time to meet their other monastic demands, Cistercians had to produce necessities like shoes, clothing, and tools using industrial water mill technology.[18] As such, it is no surprise that Cistercians have been associated with industrial milling to an extent that their contemporaries have not given that other orders could simply outsource this work. A short-coming of literature that addresses Cistercian technology is its failure to situate the Order within the technological context of eleventh and twelfth-century France. Guillerme contends that an 'artisanal revolution' based on river craft industrialization in northern France constitutes the originality of the second phase of urbanization. This phase began just prior to the foundation of the Cistercian Order.[19] The interchange of ideas between monastic, ecclesiastical, and lay authorities is well documented, so the timing could not have been more serendipitous. This exchange of ideas would have included technical knowledge, as evidenced by Lanfranc's work at Caen. If the Cistercian Order did make use of the current and most cutting edge

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[16] Aubert, *L'Architecture Cistercienne en France*, 1, 15.
[17] Bouchard, *Holy Entrepreneurs: Cistercians, Knights, and Economic Exchange in Twelfth-Century Burgundy*, 105.
[18] Lucas, "Industrial Milling in the Ancient and Medieval Worlds, a Survey of the Evidence for an Industrial Revolution in Medieval Europe," 6.
[19] Guillerme, *The Age of Water: The Urban Environment in the North of France, A.D. 300 to 1800*, 79.

technology of the day through collaborations such as this, they were no less innovative than long thought. Such collaborations lie at the heart of their innovation.

By the end of the twelfth century, Cistercians were acquiring industrial mills in numbers that resulted in a production capacity far exceeding the needs of their monastic communities resulting in engagement in commercial exchange in spite of the Order's self-imposed restrictions. A 1218 reference to the activities of Brother Ancher, a monk responsible for selling the excess products of Clairvaux and acquiring those products that the abbey could not produce, demonstrates this point.[20] When one considers this commercial activity in conjunction with the Order's targeted exploitation of granges by the middle of the thirteenth century, it becomes clear that Cistercians were purchasing mills specifically for their income-generating potential by this time.[21]

Fulling and forge mills are the first industrial mills for which we have documented evidence in France and the applications for which we have the most documentary and archaeological evidence.[22] The preparation of cloth in the Middle Ages required four steps.[23] Wool had to be carded or combed by hand, then spun into yarn on a rock or distaff. That yarn was then woven into cloth on a loom. The final process involved fulling the cloth, a process in which the newly made cloth was beaten or compressed in water. Fulling was necessary for a number of reasons. It

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[20] M. H. D'Arbois, *Études sur l'État Intérieur des Abbayes Cistercienne, et Principalement de Clairvaux, au XIIe et au XIIIe Siècle* (Hildesheim: Strauss & Cramer, 1858), 240.
[21] Benoit, "L'Industrie Cistercienne (XII^{ème} - Premiere Moitie du XIV^{ème} siècle)," 74; François Blary, "Les établissements agricoles et industriels de l'Abbaye cistercienne de Chaalis (Oise)," in *Les Abbayes Cistercienne et Leurs Granges*, ed. G. Duby (Paris: Ligue Urbaine et Rurale, 1991), 42.
[22] Bradford Blaine, "The application of water-power to industry during the Middle Ages" (UCLA, 1966).
[23] Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*, 243.

shrank the cloth, making it more resistant to wear; it felted the cloth, which further strengthened and soften the cloth; and lastly, it cleansed the cloth of impurities. Prior to the development of fulling mills, this process generally required fullers to pound the cloth with their feet. It is easy to see how that would be insufficient for the needs of monasteries as large as Clairvaux.

Fulling mills automated the processes described above. The first water-powered fulling mill is documented in Italy in 962, and the first record of a fulling mill to appear outside of Italy is in France.[24] A charter dated to 1080 documents the transfer of tithes from a fulling mill to the abbey of St. Wandrille in the diocese of Rouen, and Anne-Marie Bautier documents a water-powered fulling mill located in Annebecq, Normandy in 1086.[25] The earliest evidence of an industrial mill to appear in a Cistercian charter is the 1133 agreement between Pontigny and the Benedictine monastery of Saint-Germain d'Auxerre regarding the Espillard mill, a fulling mill in Revisy.[26] Pontigny and Saint-Germain agreed to share the expenses and profits of this mill, while Pontigny retained the exclusive right to fish and fisheries within the defined boundaries, as well as the right to choose the miller. This charter clearly

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[24] Benoit and Rouillard, "Medieval Hydraulics in France," 193.

[25] Anne-Marie Bautier, "Les plus anciennes mentions de moulins hydrauliques industriels et de moulins à vent," *Bulletin Philologique et Historique* (1960): 150.

[26] Successorum memoriae presenti scripto commendare studuimus, inter nos scilicet aecclesiam Sancti Germani Autisiodorensis et Beatae Mariae Pontiniacensis, agentibus abbatibus Gervasio atque Hugone, de molendino quod est in alodio Revisiaci, nomine Espaillardo, taliter convenisse. Utrumque siquidem laudavit capitulum ut expensas molendini communiter mitterent et reditus omnes aequali portione inter se dividerent. Aecclesia tamen Pontiniacensis ad quam proprie molendini sedes et aqua pertinebat, omnes ejusdem aquae pisces atque piscationes infra terminus aquae suae sibi specialiter retinuit. Ad eamdem quoque pertinebit aecclesiam molendinarium eligere, mittere atque mutare subque jure suo quantum dumtaxat ad molendinum pertinent, specialiter habere. Ipse vero molendinarius utrique aecclesie de parte sua fidelitatem faciet atque de communibus molendini reditibus modium annonae pro mercede recipient cum certeris exacturis quae ad hujus modi mercennarios universali consuetudine pertinere noscuntur. Garrigues, *Le premier cartulaire de l'Abbaye cistercienne de Pontigny (XIIe-XIIIe siecles)*, 171.

indicates that the miller of the Espillard mill was expected to be secular through its provision for his payment in grain, an interesting arrangement given the charter's early date. This provides clear evidence that Cistercian abbeys were struggling to balance their mandate of self-sufficiency with the reality of life in medieval France quite early in the Order's history.

In *Wind, Water, Work: Ancient and Medieval Milling Technology*, Adam Lucas argues that Benedictine and Cistercian application of water mills to industrial processes appears to have been overstated by historians of technology.[27] He supports this assertion with a compiled list of approximately 400 documented references to ancient and medieval industrial mills that date from 700 to 1600 A.D. For documentation of French mills, Lucas relies heavily upon Bautier's 1960 study *Les Plus Anciennes Mentions de Moulins Hydrauliques Industriels et de Moulins à Vent*. More than fifty years after its publication, this work remains the most comprehensive source of information regarding French industrial mills that existed from 1086-1200. Unfortunately, Bautier relied heavily upon documentation found within Du Cange, an extensive Latin reference work first compiled in France in 1678.[28] While the Du Cange is an immensely useful historical resource, it does not include most known Cistercian mills. Louis Dubois identified fifteen to twenty fulling mills associated with the Cistercian abbey of Morimond. This is an impressive number of fulling mills to be associated with a single abbey given that just over seventy such mills have been identified in the entirety of England and Wales, the

[27] Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*, 224.
[28] Du Cange *et al*, "Glossarium mediae et infirmae latinitatis."

first not being documented until 1185 and that owned and operated by the Templars.[29] None of Morimond's mills appear on Bautier's list.

It is possible that Morimond required such a large number of fulling mills due to the monastery's unusual practice of establishing granges in areas where future daughter houses were envisioned.[30] The surplus cloth generated by the mills owned by Morimond and other Cistercian abbeys may have provided a source of income for needs not met by the various granges, as well as for the purchase of more land and funds to establish new abbeys. It is easy to see how the drive to establish daughter houses could have innocently resulted in the generation of income above and beyond what Cistercian abbeys needed to sustain themselves and contributed to the rapid proliferation of the Order in the twelfth and thirteenth centuries. The fact that so many well-documented Cistercian mills are not listed in Lucas' work brings his argument that the Cistercian application of industrial water mill technology has been overblown into question and highlights the need for an updated, comprehensive list of French industrial mills.

Georges Duby proclaimed that the Cistercian Order built its forges with as much majesty as its sanctuaries,[31] and evidence does indicate that Cistercians made a significant technological contribution to the industrial application of iron production. As with fulling, water-powered iron production works by applying a cam

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[29] Louis Dubois, *Histoire de l'Abbaye de Morimond: Quatrième Fille de Cîteaux*, 3rd ed. (Dijon: Imprimerie Darantiere, 1879), 158; C. James Bond, "Cistercian Mills in England and Wales: A Preliminary Survey," in *L'espace Cistercien*, ed. Léon Pressouyre (Paris: Comité des travaux historique et scientifiques, 1994), 372; E. M. Carus-Wilson, "An Industrial Revolution of the Thirteenth-Century," *The Economic History Review* 11, no. 1 (1941): 44.

[30] Jean Salmon, "Morimond et ses Granges," in *Actes du 38e Congrès de l'Association Bourguignonne des Sociétés Savantes* (Langres: Société historique et archéologique, 1969), 124.

[31] Georges Duby, *Saint Bernard: L'art Cistercien* (Paris: Arts et metiers graphiques, 1976), 116.

system to the hammer function traditionally used by iron workers. This allows for the utilization of heavy hammers that do not tire resulting in higher output (*Figure 22)*.[32] Paul Benoit has shown that 85 percent of the references to metallurgy in French cartularies are Cistercian in origin and suggests that Cistercians could well have invented the water-powered hammer utilized for iron production.[33]

Figure 22: Hammer & anvil from Fontenay iron mill

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[32] Benoit and Rouillard, "Medieval Hydraulics in France," 194. Image from Denis Cailleaux, "Cistercian Metallurgy," in *The Cistercian Arts From the 12th to the 21st Century*, ed. Terryl N. Kinder and Roberto Cassanelli (London: McGill-Queen's University Press, 2014), 294.

[33] Benoit, "L'Industrie Cistercienne (XII^{ème} - Premiere Moitie du XIV^{ème} siècle)."; Benoit and Rouillard, "Medieval Hydraulics in France," 195.

Centered largely in Champagne and Burgundy at the very heart of the Cistercian Order in France, Cistercian iron production was often associated with granges dedicated to pasturage.[34] This provided a source of income that helped to compensate for the less productive, heavily wooded granges where iron ore with iron content as high as 32-45% was often found.[35] In Champagne, centers of iron production were located in the heart of the forests of Othe, Wassy, and La Chaume.[36] Cîteaux and Clairvaux, along with their daughter houses Vauluisant, Pontigny, La Crête, Longuay, Auberive, Fontenay, and LaBussière, were all active in the production of iron in this region.[37] An 1168 charter of Clairvaux documents an unusually detailed donation related to the production of iron by Walter, bishop of Langres.[38] This charter gave the abbey the exclusive right to extract iron from the land in the forest of La Chaume, to build a forge upon that land, and to use wood from the forest as needed for the forge.

The industry in Burgundy, located primarily in Gissey-on-Ouche, Montbard, and Cussey-les-Forge, developed somewhat later. The monasteries associated with these sites included Cîteaux, Fontenay, La Bussiere, and Auberive.[39] Cistercians

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[34] Benoit, "L'Industrie Cistercienne (XII[ème] - Premiere Moitie du XIV[ème] siècle)," 82; Verna, *Les Mines et les Forges des Cisterciens en Champagne méridionale et en Bourgogne du Nord XIIe-XVe Siècle*, 45.
[35] *Les Mines et les Forges des Cisterciens en Champagne méridionale et en Bourgogne du Nord XIIe-XVe Siècle*, 208.
[36] Ibid., 15.
[37] Ibid., 7.
[38] Ego Galterus, Dei gratia Lingonensis episcopus, notum esse volo presentibus et futuris me dedisse et concessisse in elemosinam domui Clarevallensi et fratribus ejusdem monasterii ut in finagio ville nostre de Chalma mineriam ferri extrahant et acceptam deferant libere sine contradiction, et si voluerint in eodem territorio de Chalma fabricam habeant et quod necessarium fuerit ad necessitate et utilitatem prefate domus habeant et exerceant mineriam prout utile sibi fratres idem judicaverint ad proprios usus Clarevallensis ecclesie cunctis diebus. Jean Waquet, ed. *Recueil des chartes de l'abbaye de Clairvaux, XIIe siecle*, 2 vols., vol. 2 (Troyes: Archives Départementales de l'Aube, 1950-1982), 141.
[39] Verna, *Les Mines et les Forges des Cisterciens en Champagne méridionale et en Bourgogne du Nord XIIe-XVe Siècle*, 30-31.

appear to have produced iron for internal needs alone until the middle of the twelfth century, a time that corresponds with an increasing demand for iron products in the west.[40] With few competitors prior to the early thirteenth century and exemptions still in place that resulted in a greater than average market value for their goods, the Order had much to gain by exploiting this market. By the thirteenth century, Cistercians were enthusiastically producing a surplus of iron to meet the internal needs of the abbey, as well as the needs of local communities.

Cistercian iron industry did not develop in earnest until the middle of the twelfth century, but the description of Clairvaux II by Arnold of Bonneval clearly documents a water-driven hydraulic forge at the time of the newly relocated monastery's construction.[41] Additionally, twenty nine lay and ecclesiastical acts associate Clairvaux with mines and forges.[42] A map of Clairvaux with granges and sites where forges were located demonstrates how central that industry was to the monastery (*Figure 23*).[43] Founded in 1118 by St. Bernard, Fontenay, which is situated at the confluence of two valleys, the Ru de Fontenay and Combe Saint-Bernard, yields the most evidence for water usage in relation to the Cistercian iron industry (*Figure 24*).[44] Its transition to a paper mill after the Revolution almost certainly saved it from destruction. Due to the marshy nature of its location and to provide an adequate water supply for the milling complex two dams were built before the erection of the abbey to control water flow into the area. Using archaeological

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[40] Ibid., 50.
[41] This mill is not identified on Dom Milley's drawings, see Figure 19.
[42] Catherine Verna and Paul Benoit, "La Siderurgie de Clairvaux au Moyen Age (XIIe-XVe Siecles)," in *Actes du Colloque Histoire de Clairvaux* (Bar-sur-Aube, 1991), 91.
[43] Ibid.
[44] Benoit and Rouillard, "Medieval Hydraulics in France," 186.

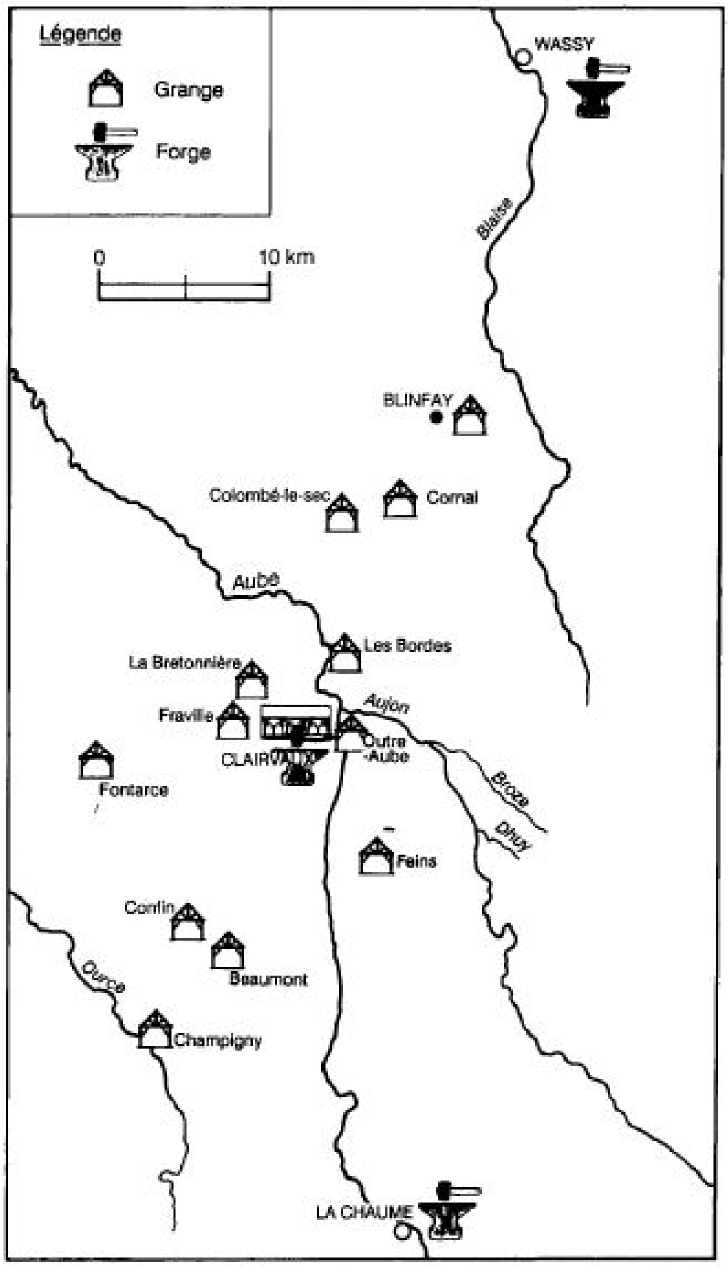

Figure 23: Forge Sites Associated with Clairvaux

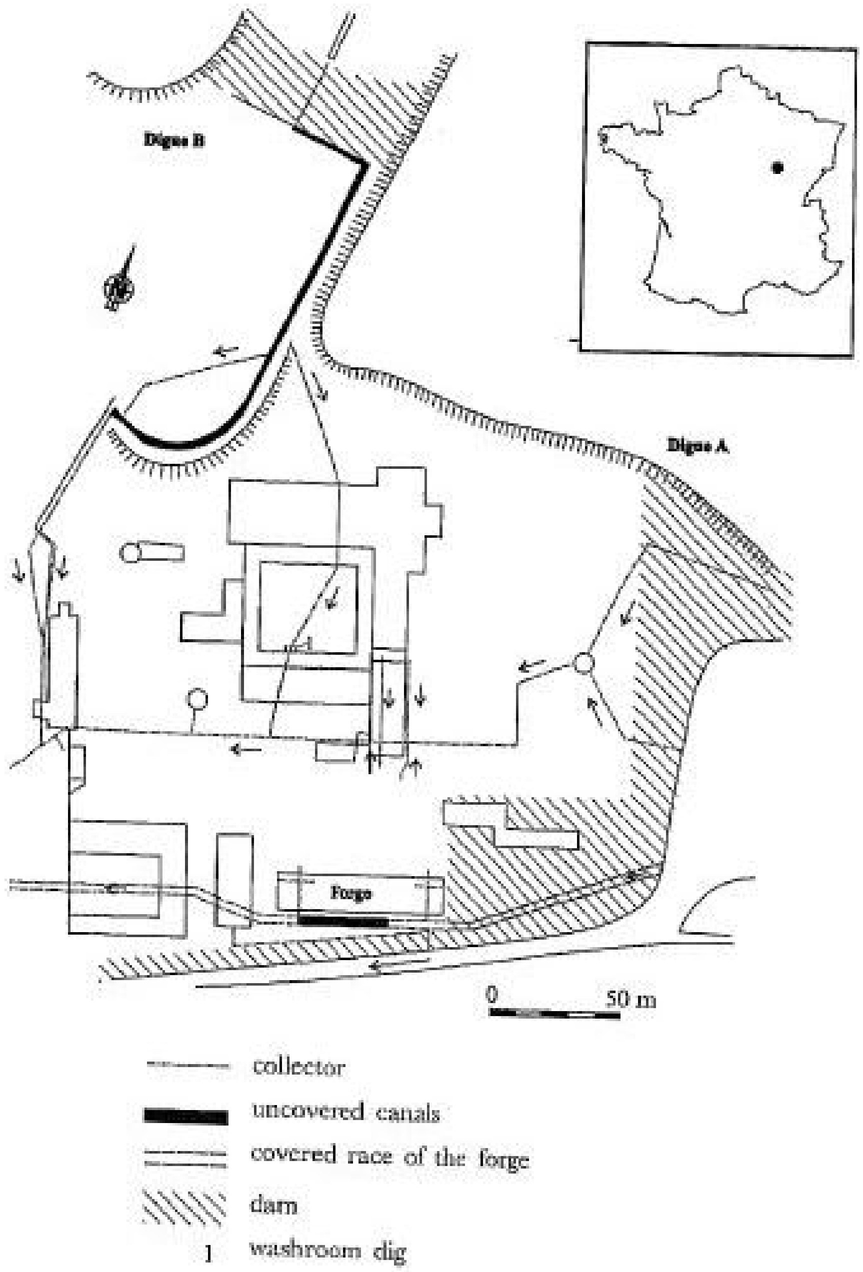

Figure 24: Fontenay Hydraulic System

evidence, Benoit dates the hydraulic system associated with the forge of Fontenay to a time period between 1130 and 1150, during its first phase of construction.[45] Nearby deposits of slag, a byproduct of the metallurgy process, provide additional evidence that Fontenay had an early water-driven forge equipped with a hydraulic hammer.[46] This evidence clearly points to early industrial metallurgy activity.

Similar evidence has been cited for the mill of Cérilly that belonged to the abbey of Vauluisant.[47] In Germany, Cistercian forge mills powered bellows that enabled temperatures high enough to liquefy metal in blast furnaces.[48] Physical and documentary evidence indicate that Cistercians were active in the iron industry quite early in the Order's history and that water power was used for this purpose when feasible.

Even with the significant omission of documented Cistercian mills from Lucas' list, 47 percent of the industrial mills listed in his compilation were located in France. His list also reveals more diversity of French industrial mills than industrial mills in other countries. Fulling mills appear to have comprised the majority of industrial mills outside of France, but fewer than 50 percent of the industrial mills in France were fulling mills. Malt mills, which Lucas argues are industrial rather than agricultural mills, tanning mills, tool-sharpening mills, hemp mills, and sawmills are associated

[45] Paul Benoit, "Un site industriel médiéval, l'Abbaye de Fontenay," *Mémoires de la Commission des antiquités du département de la Côte-d'Or* (1988).
[46] "L'Industrie Cistercienne (XII^ème - Premiere Moitie du XIV^ème siècle)," 89.
[47] Ibid.
[48] Albrecht Hoffmann, "The Management of Water Power by the Medieval Monasteries in Central Europe," in *Actas do simpósio internacional hydráulica monástica medieval e moderna*, ed. José Manuel P. B. de Mascarenhas, Maria Helena Abecasis, and Virgolino Ferreira Jorge, Convento da Arrábida, 15-17 de Novembro de 1993 (Lisboa: Fundação Oriente, 1996), 146. For the later furnace revolution, see Brian G. Awty, "The Development and Dissemination of the Walloon Method of Ironworking," *Technology and Culture* 48, no. 4 (2007).

with France in numbers that far exceed these types of mills in other countries. In addition, 75 percent of the fulling mills and the only tanning mills on Lucas' list that date to a time prior to the foundation of the Cistercian Order were located in France.[49] All of these observations reinforce the increasingly strong argument that France led the way in the application of industrial water mill technology well before and quite apart from the foundation of the Cistercian Order.

According to Richard Holt, many of England's medieval mills were incorporated into the demesne sector by English lords who were concerned first and foremost with profit.[50] Because fulling mills in England were much less profitable than agricultural mills, a preference developed for grain mills in areas of England where there was an abundance of water. This resulted in a conservative policy toward water mill acquisition and development in that country.[51] Holt broadly concluded from this geographically isolated fact that "the medieval application of water-power to a limited range of industrial processes has been exaggerated by historians of technology because, excited by the novelty of it all, they have failed to see how little economic impact it had."[52] Between the tenth and the twelfth centuries, however, ownership of mills in northern France shifted from lay and Episcopal authorities to chapter houses and suburban abbeys.[53] The intentional break of

[49] These numbers were obtained through examination of the tables provided in the following publications: Bautier, "Les plus anciennes mentions de moulins hydrauliques industriels et de moulins à vent."; Lucas, *Wind, Water, Work: Ancient and Medieval Milling Technology*.
[50] Richard Holt, "the Medieval Mill: A Productivity Breakthrough," *History Today* 39, no. 7 (1989): 31.
[51] "Whose Were the Profits of Corn Milling? An Aspect of the Changing Relationship Between the Abbots of Glastonbury and Their Tenents 1086-1350," *Past and Present* 116 (1987): 7-11, 13-22; John Langdon, "Was England a Technological Backwater in the Middle Ages?," in *Medieval Farming and Technology: the Impact of Agricultural Change in Northwest Europe*, ed. Grenville G. Astill and John Langdon (Leiden: Brill, 1997), 285.
[52] Holt, "the Medieval Mill: A Productivity Breakthrough," 31.
[53] Guillerme, *The Age of Water: The Urban Environment in the North of France, A.D. 300 to 1800*, 94.

Cistercians with feudal land management practices and their commitment to self-sufficiency led to a more liberal, open-minded approach to milling than that of their English neighbors, an approach surely encouraged by the pre-existence of a robust hydraulic infrastructure and industrial milling industry in France. This in conjunction with the economic influence of tithe exemptions resulted in a profitable industrial milling scenario for Cistercians in France and other parts of Europe from the twelfth century on. Evidence from both France and Italy has shown that fulling mills in those areas earned as much, if not more, than grain mills in some parts of Europe.[54]

Scholarship on medieval water mills that has been published in the English language, as evidenced by the work of Holt and Lucas, has focused predominately on English water mills. As can be seen from this examination, however, water mill development and usage in England differed significantly from that in the rest of Europe. Holt acknowledges that industrial mills may have had a more significant impact on the economy in other countries, but he claims that there is insufficient evidence to make such an assertion.[55] The evidence presented here belies that argument and proves that generalizations about the economic impact of industrial milling on the Cistercian Order that are based on English regional studies alone should not be made.

Evidence clearly shows significant development of hydraulic infrastructure and milling technology in France preceding the foundation of the Cistercian Order. This was particularly true in northern France where Cîteaux and her first daughter

[54] John Muendel, "The distribution of mills in the Florentine countryside during the late Middle Ages," in *Pathways to Medieval Peasants*, ed. J. A. Raftis (Toronto: Pontifical Institute of Medieval Studies, 1981), 89-95.
[55] Richard Holt, "Medieval Technology and the Historians: The Evidence for the Mill," in *Technological Change: Methods and Themes in the History of Technology*, ed. Robert Fox (New York: Routledge, 1996), 111.

houses were located, as evidenced by the vast hydraulic network developed around Caen in the eleventh century. The extensive use of industrial milling by Cistercians in the twelfth century corresponded to an artisanal revolution taking place in France at the same time. Arguments that downplay the influence of Cistercians to water mill technology have been both misinformed and too narrowly focused. They have been misinformed in that the most comprehensive lists of French mills to date, those of Bautier (1960) and Lucas (2006), fail to include well-documented Cistercian mills. They have been too narrowly focused in their definition of ‘innovation.’ It is true that Cistercians did not contribute greatly to water mill technology itself, with the likely exception of water-powered metallurgy. They did, however, develop a completely novel form of land and water management that required expertise in the development and maintenance of hydraulic infrastructure and industrial water mill technology.

As has been seen here, that expertise existed in northern France well before the Order was founded. The combination of existing infrastructure, technology and local expertise with the Cistercian system of land management allowed the Order to be phenomenally successful in spite of its strict mandate of self-sufficiency. The acquisition and management of locks at Buzay, the numerous fulling mills of Morimond, and the evidence for water-powered metallurgy mills associated with Clairvaux and Fontenay clearly demonstrate that Cistercians made great use of this knowledge and infrastructure. When considered in relation to the Order’s masterful and unique method of land management, this technology enabled the prolific expansion of the Order in twelfth-century France and Europe.

Chapter 6: Conclusion

That the Cistercian Order expanded at a phenomenal rate in twelfth-century Europe is indisputable. By the time of Bernard's death in 1153, just fifty-five years after the foundation of the Order, Cîteaux and her four principle daughter houses had established some three hundred and fifty monasteries in France, England, Ireland, Scotland, Germany, Spain, Italy, Switzerland, Belgium, Austria, Portugal, Hungary, Bohemia, Poland, Denmark, Sweden, and Norway. A full forty-nine percent of Cistercian houses were established during Bernard's lifetime.[1] The Cistercian Order's commitment to live according to the Rule of St. Benedict necessitated that it produce all of the food and material goods required to survive. Utilization of water power is the only way the Order could hope to produce the variety and volume of goods needed to expand as it did in the twelfth century. The evidence presented here demonstrates that the hydraulic infrastructure, technology, and expertise that the Order needed to create the complex Cistercian technological system described above existed in France prior to the foundation of Cîteaux in 1098.

A detailed description of water mill technology generally used to power both agricultural and industrial mills in twelfth-century France, namely the over and undershot vertical water mill, provided the technical basis for this discussion. This was accompanied by a brief history of the water mill as gleaned from surviving literary and archaeological evidence. Re-evaluation of this evidence suggests that the water mill, which can now be confidently dated to the third century B.C., was used more extensively and in more varied ways in Antiquity than previously realized.

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[1] Jamroziak, *The Cistercian Order in Medieval Europe 1090-1500,* 69.

Contrary to popular belief for much of the twentieth century, industrial mills did exist in Antiquity, and the diffusion of technology from the Mediterranean in Antiquity to Western Europe in the Middle Ages did occur, at least in part, through France. Unfortunately, while this evidence has correctly downplayed the idea of an industrial revolution in the Middle Ages, it has also led to the incorrect assumption that there is little more to be said about the relationship between Cistercians and water power.

An overview of monastic reform in the eleventh and twelfth centuries provided historical context for the birth of the Cistercian Order, and an early history of the Order laid the groundwork for close examination of its use of water power. This history necessarily focuses on the role of St. Bernard in the development and propagation of an architectural and technological archetype based on his own monastery of Clairvaux, an archetype that included extensive hydraulic infrastructure and milling technology as evidenced by the milling complex of Clairvaux. Dom Milley's drawings of Clairvaux in 1708 reveal a complex with the requisite grain mill, as well as an olive-crushing mill, a saw mill, and a bark mill. Eye witness accounts of the complex shortly after its construction in 1135 also point to the hydraulic system of Clairvaux powering metallurgy and tanning operations, industrial activities that would have also been critical for the success of the Order.

Bernard's influence over all aspects of Cistercian life in the first half of the twelfth century ensured the propagation of the archetype described above as the Order expanded throughout Europe. His influence can be seen in the widespread use of the Bernadine plan in the abbey churches of Cistercian monasteries that were built during his lifetime and the incorporation of similar hydraulic systems, such as that used to power a forge mill at Fontenay, into the monastic complex. That the propagation of an archetype was Bernard's express intention can be seen in his habit of sending building experts from Clairvaux to help establish new monasteries.

The physical situation of France and the pre-existence of large-scale hydraulic networks in northern France were essential to the success of the Cistercian Order, given its mandate to produce all necessary material goods internally as directed by the Benedictine Rule. Lay, ecclesiastical, and secular rulers had been working together to develop this infrastructure for as much as a century prior to the foundation of the Order, as evidenced by the work at Caen, which led to an artisanal revolution in the north of France in the eleventh century. This confluence of hydraulic resources enabled the Order to become self-sufficient with great rapidity and in a way that would simply not have been possible otherwise.

The Cistercian Order's visible success, as evidenced by its rapid proliferation in the twelfth century, resulted in the long-standing, but mistaken impression that it played an exaggerated role in technological development in the Middle Ages. This is no longer thought to be the case, but it would be a mistake to downplay the importance of this technology to the Order's success. Thomas Hughes' theory of technological systems provides a useful way to examine the Cistercian technological system, an open system in which many of the primary artifacts, e.g. hydraulic infrastructure and industrial mills were constructed by system builders who preceded the foundation of the Order. Application of this system model helps to highlight the importance of these pre-existing resources to the Order's success, as well as the importance of Bernard's role in the propagation of an architectural and technological archetype that incorporated these resources into the very fabric of Cistercian life.

The promulgation of this archetype, in conjunction with the economic success that the Order experienced due to its unique method of 'compacting' and managing previously disparate granges with the assistance of the Cistercian lay brotherhood, helps to explain the long-standing connection between Cistercians and water power. The Cistercian Order may not have contributed greatly to the innovation of the industrial water mill in the Middle Ages, but its masterful use of water mills certainly played an important role in its success and economic growth in twelfth-century Europe. Unfortunately, when scholars dispelled the idea of an industrial revolution in the Middle Ages at the end of the twentieth century, a general sense of disillusionment with the technological prowess of the Order and a subsequent tendency to overlook the complex, interwoven relationship that Cistercians had with their local environment and water power pervaded the literature.

Hughes' theory of technological systems provided a useful framework with which to conceptualize the Order's use of technology. His model helps to underscore the Cistercian dependency upon the extensive hydraulic infrastructure and industrial milling technology that existed in France prior to the foundation of Cîteaux in 1098. Robert established the monastery of Cîteaux in the right place at the right time. The monks of Clairvaux drew upon these resources and local knowledge when planning Clairvaux II (a), and Bernard ensured that the architectural and technological archetype of Clairvaux served as the model for new Cistercian foundations during his lifetime. This ensured the phenomenal success and growth of the Cistercian Order in the twelfth century.

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