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## Once More into the Stirrups

Lynn White jr., *Medieval Technology and Social Change*

### ALEX ROLAND

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Lynn White's *Medieval Technology and Social Change*, first published by Oxford University Press in 1962, was brilliantly conceived and researched. It was informed by White's compelling vision of the Middle Ages as a coherent and ultimately rational age. It addressed large historical questions of continuing significance. It brought to bear ten languages and almost as many categories of evidence, from epigraphy and archaeology to anthropology and philology. And it sparkled with clarity, wit, and insight. Still, the strenuous criticism it attracted almost from the start, and the accumulation of four decades of subsequent scholarship, call into question its continuing viability.

While admitting that *Medieval Technology and Social Change* may be dangerous to their professional health, many historians of technology are loath to renounce it. Many still concur with Joseph Needham's assessment that it is "the most stimulating book of the century on the history of technology."<sup>1</sup> White demonstrated the importance of technology in an era widely perceived as technically stagnant. He focused on artifacts seldom studied by historians of technology: stirrups, ploughs, horse harnesses and shoes, cranks. He brought insight and imagination to a wide range of evidence. And, most important, he argued that technology sparked social change, that the history of technology mattered. But can these many

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1. *Isis* 54 (1963): 418–20, quote at 418.

virtues, can this utility for historians of technology, outweigh the most fundamental standards of the profession? Can historians of technology continue to read and assign a book that is, in the words of a recent critic, “shot through with over-simplification, with a progression of false connexions between cause and effect, and with evidence presented selectively to fit in with [White’s] own pre-conceived ideas”?<sup>2</sup>

The answer, I think, is yes, at least a qualified yes. But this requires more than a little explanation. Let me first review briefly what White claimed, what his critics have said, and then why I think the critics may be discounted. Then I will recommend an antidote to the allegedly fatal flaws of *Medieval Technology and Social Change*.

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## The Argument

White’s first and most controversial argument tied feudalism to the stirrup.<sup>3</sup> As with all three of the essays that make up the heart of *Medieval Technology and Social Change*, White built upon the work of a famous and distinguished predecessor—in this case, Heinrich Brunner. In 1887, Brunner had argued that Charles Martel returned from the battle of Poitiers in 732 convinced that he needed a mounted army to defeat the Muslims and other horse warriors.<sup>4</sup> He therefore confiscated Church land and distributed it to his followers. Income from the land would arm and equip the bondsmen to serve their lord on demand as mounted warriors. In other words, Martel, said Brunner, created vassalage; he invented feudalism. White embraced most of Brunner’s famous thesis, but he concluded from more recent scholarship that the battle of Poitiers had actually occurred in 733, not 732. It could not have moved Martel to the confiscation that clearly began the previous year. What, then, *did* inspire Martel to set in motion the steps that made the heavily armed and armored mounted knight the dominant force on the battlefields of Europe?

It was the stirrup, said White, that allowed the knight to engage in shock combat, to strike with his lance tucked under his arm without fear that the impact would unseat him. The stirrup, White showed, appeared in Europe early in the eighth century. Martel’s inspiration, then, was not the mobility and fighting power of the Muslims at Poitiers, but rather the realization that the stirrup could make the mounted warrior supreme. With character-

2. 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 (Amsterdam, 1998), 103–21, quote at 105.

3. A fair and lucid presentation of the controversy appears in Kelly DeVries, *Medieval Military Technology* (Lewiston, N.Y., 1992), 95–122.

4. Heinrich Brunner, “Der Reiterdienst und die Anfänge des Lehnwesens,” *Zeitschrift der Savigny-Stiftung für Rechtsgeschichte, Germanistische Abteilung* 8 (1887): 1–38.

istic flair and drama, White concluded: "Antiquity imagined the Centaur; the early Middle Ages made him the master of Europe."<sup>5</sup> The stirrup was an indispensable part of that achievement.

White's second chapter took up an argument made by Marc Bloch in 1931.<sup>6</sup> The introduction of a heavy plough with vertical coulter, horizontal plowshare, and moldboard, Bloch had argued, allowed Northern Europeans beginning in the ninth century to eliminate cross plowing, to work their fields in patterns that lessened the impact of drought and flood, and to open up dense, rich, but previously untillable soils. The consequent rise in agricultural productivity resulted in food surpluses, increased population, specialization of labor, urbanization, and an expansion of leisure. White elaborated Bloch's theory by adding the use of horses as draft animals and three-field crop rotation. Horseshoes and the horse collar, said White, allowed the replacement of oxen for plowing with the more efficient horse. Three-field crop rotation allowed more and better crops to be produced with the same amount of land and labor, increasing not only the supply but the quality of food produced. To the effects Bloch had attributed to the new agriculture, White added "the rise in industrial production, the outreach of commerce, and the new exuberance of spirits which enlivened" Europe by the tenth century. He saw nothing less than an "agricultural revolution of the early Middle Ages" that explained "the change of the gravitational centre of Europe from south to north."<sup>7</sup>

White's third essay, the longest, most abstract, and until recently the least controversial, examined mechanical power and devices used to transmit it. He traced changes in the harnessing of water, wind, falling weight, and finally chemical power during the Middle Ages. Then he looked specifically at the machinery invented or adapted to transmit this power, focusing particular attention on the crank. White acknowledged Lewis Mumford's assertion that the crank is the single most important mechanical device next to the wheel, "the technical advance which characterizes specifically the modern age."<sup>8</sup> "Continuous rotary motion," said White, "is typical of inorganic matter, whereas reciprocating motion is the sole source of movement found in living things. The crank connects these two kinds of motion."<sup>9</sup> The obsession with harnessing power in new forms of machinery such as the crank led to a "medieval industrial revolution."<sup>10</sup> As in his

5. White, *Medieval Technology and Social Change* (London, 1968), 38. All page references to the book in this essay are to this paperback edition.

6. White cites Marc Bloch, *Les Caractères originaux de l'histoire rurale française* (Oslo, 1931).

7. White, 76, 78.

8. *Ibid.*, 103, 114, quoting Lewis Mumford, *Technics and Civilization* (New York, 1934), 80.

9. White, 115.

10. *Ibid.*, 89.

other essays, White here paid little attention to the social, political, and economic context of the technological developments he highlighted. It was not his purpose to challenge those traditional and well-developed categories of historical explanation, only to add technology to the mix.

## The Criticism

Initial reviews of *Medieval Technology and Social Change* focused on the book's strengths. Lynn Thorndike, writing in the *American Historical Review*, found the book "readable, epigrammatic, and humorous."<sup>11</sup> G. C. Homans found the "main lines" of the argument to be "sound," though he did note that White "indulges some unjustified speculations" and "tends to oversimplify the effects of technological and social change."<sup>12</sup> A. Rupert Hall called it an "admirable book."<sup>13</sup> Lewis Mumford wrote that "Professor White excels, not only in mastery of the documents and physical relics but in acute powers of interpreting this material."<sup>14</sup> Writing a long review in *Technology and Culture*, Joseph Strayer took exception to several of White's points, but concluded that the book was of "first importance." It was, said Strayer, "an almost perfect example of what work in the history of technology should be."<sup>15</sup> But these reviews provided the merest hint of the attacks that were to come. Those attacks targeted the three essays with varying intensity, with the most devastating onslaught falling upon the stirrup thesis.

Though many scholars challenged White on the thesis, none did so with more thoroughness or effect than Bernard S. Bachrach, whose 1970 article, "Charles Martel, Mounted Shock Combat, the Stirrup, and Feudalism," is viewed in many quarters as decisive.<sup>16</sup> Bachrach's argument moves on three fronts. First, he takes exception to several of White's readings of evidence. For example, Bachrach notes that "Marchfield" does not necessarily mean a muster in the month of March, as White claimed, following Brunner; it could also mean a military muster, a "field of Mars" at any time in the year. White's surmise, therefore, that the muster in 755 was moved from March to May to provide better forage for the horses does not necessarily follow. The criticisms in this first category are interesting but esoteric and inconclusive, "a subject of scholarly debate," as Bachrach dubbed one of them. More significantly, Bachrach argues at great length that the mounted warrior was not the "decisive element" of the armies of Charles Martel or his sons. Furthermore, he finds that "the stirrup was little appreciated and lit-

11. *American Historical Review* 68 (October 1962): 93.

12. *American Journal of Sociology* 68 (November 1962): 396.

13. *Nature* 198 (6 April 1963): 61.

14. *Endeavour* 22 (1963): 52.

15. *Technology and Culture* 4 (1963): 62–65.

16. Bernard S. Bachrach, "Charles Martel, Mounted Shock Combat, the Stirrup, and Feudalism," *Studies in Medieval and Renaissance History* 7 (1970): 49–75.

CLASSICS

REVISITED

tle used by the Carolingians during the eighth and ninth centuries.”<sup>17</sup> His evidence on this count is persuasive. In his third set of criticisms, Bachrach offers alternative explanations for the confiscation of Church lands, noting that such property had been redistributed often before 732 to reward followers for service.<sup>18</sup>

JULY

2003

VOL. 44

White’s theory of a medieval agricultural revolution attracted less attention and criticism, but similar indignation. In a scathing and dismissive review in *Past and Present*, R. H. Hilton questioned not only White’s evidence and his logic but also his integrity.<sup>19</sup> Relying primarily on evidence from English agricultural history, Hilton asserted that open-field communal agriculture existed long before the Danes, as White had argued, imported it from Francia in the ninth century. In Hilton’s view, White’s argument for a Carolingian agricultural revolution fails if its components can be located elsewhere in an earlier time. Hilton also took exception to White’s evidence that the three-field system produced superior crop yields and that Europeans added significant legumes to their diet in this period. He even challenged White’s claim that horses were then recognized as superior to oxen as draft animals for plowing.<sup>20</sup>

More troubling than the substance of Hilton’s argument was the tone of his review. He contrasted *Medieval Technology and Social Change* with Georges Duby’s *L’Economie rurale et la vie des campagnes dans l’occident médiéval* (1962), noting that Duby’s “handling of evidence conforms to scholarly standards.”<sup>21</sup> He accused White of “pretending” not to know that spring crops could be paired with fallow ground in a two-field system, which Hilton asserts, without explanation, that White did know. He claimed that White’s argument on the transformation of English agriculture “seems not only unproved but perverse.” Hilton asserted that White’s entire argument for an agricultural revolution was built on a “fragile evidential base” and that “secondary sources which fail to support the author’s *a priori* reasoning are conveniently ignored.” “The author’s theories,” con-

17. *Ibid.*, 53, 65.

18. See Susan Reynolds, *Fiefs and Vassals: The Medieval Evidence Reinterpreted* (New York, 1994), which casts doubt on the entire concept of feudalism. In 1974, Elizabeth A. R. Brown called feudalism “a tyrannical construct which must be declared once and for all deposed and its influence over students of the Middle Ages finally ended”; see “The Tyranny of a Construct: Feudalism and Historians of Medieval Europe,” *American Historical Review* 79 (1974): 1088.

19. P. H. Sawyer and R. H. Hilton, “Technical Determinism: The Stirrup and the Plough,” *Past and Present* 24 (1963): 90–100. Each author reviewed a separate chapter of White’s book.

20. On many of these points, Hilton’s evidence seems just as thin as White’s. He notes, for example, that “Carolingian evidence is minute” on crop yield and that conclusions on a shift in human diet from grains to legumes must be “deduced from later evidence.” *Ibid.*, 99.

21. *Ibid.*, 95.

cluded Hilton, “are produced in a speculative vacuum, . . . and with the aid of a card index of European periodicals, both well known and obscure, an apparatus to support the theories is built up.”<sup>22</sup>

By comparison, White’s essay on machinery and power in the Middle Ages provoked far less controversy. And it appears to have been used far more constructively by succeeding scholars to advance our understanding of the topic.<sup>23</sup> Though some medievalists have grumbled for decades about the claims for a medieval industrial revolution in the thirteenth and fourteenth centuries, few formal challenges appeared until recently. Adam Lucas cites numerous recent studies of medieval mills, supplemented by his own archival research, in arguing that “the claim for an industrial revolution based on water power in the middle ages is . . . wildly overblown.”<sup>24</sup> He credits White with popularizing this argument, even though he cites four other scholars, including Mumford and Bloch, who had advanced it in the 1930s. Still, it is a fair charge against White, and medievalists will have to weigh the new evidence for themselves.

The decades that elapsed before White’s third essay came under serious attack only serve to highlight the speed and severity of the assaults on the first two essays, relegating them to the category “destroyed.” It is these attacks that raise questions about the continued viability of Lynn White’s best-known book. Indeed, they raise the question of how a scholar whose major work was so thoroughly disparaged by his peers could within a decade be elected to the presidency of the Medieval Academy of America, the History of Science Society, and the American Historical Association. (He had already been elected to the presidency of the Society for the History of Technology before the book appeared.)

## A Resolution

The contrast between White’s towering reputation within the historical community at large and the savage reviews inflicted upon *Medieval Technology and Social Change* by his fellow medievalists is best explained by the different scholars’ varying perceptions of determinism. White’s critics interpreted his book, and especially the stirrup thesis, as an argument for technological determinism. P. H. Sawyer illustrates this interpretation in his joint review with R. H. Hilton in *Past and Present*, titled “Technical Deter-

22. *Ibid.*, 98–99, 96, 100.

23. Bert Hall, “Lynn White’s *Medieval Technology and Social Change* after Thirty Years,” in Fox (n. 2 above), 85–101, esp. 99–100.

24. Adam Lucas, “Industrial Milling in the Ancient and Medieval Worlds: A Survey of the Evidence for a Technological Revolution in the Middle Ages,” 11 May 2003 (copy in possession of the author), 45. I am indebted to Dr. Lucas for a collegial and illuminating exchange of correspondence on the subject of White’s culpability.

minism: The Stirrup and the Plough.” Sawyer quotes two telling and critical passages from White’s essay on the stirrup, both of which warrant close scrutiny. From White’s concluding paragraph, Sawyer drew this excerpt:

JULY  
2003  
VOL. 44

Few inventions have been so simple as the stirrup, but few have had so catalytic an influence on history. The requirements of the new mode of warfare which it made possible found expression in a new form of western European society dominated by an aristocracy of warriors endowed with land so that they might fight in a new and highly specialized way. Inevitably this nobility developed cultural forms and patterns of thought and emotion in harmony with its style of mounted shock combat and its social posture.<sup>25</sup>

White made a serious mistake in this paragraph, which Sawyer caught, but he also circumscribed his argument in two ways that Sawyer missed. White’s use of “inevitably” lends credence to the charges of determinism that rained down on this thesis. Sawyer responds by noting that “the stirrup made new methods possible, not inevitable.” White surely agreed. Indeed, earlier in the paragraph he took great pains, which Sawyer overlooked, to note that the stirrup had a “catalytic . . . influence on history” and that it made a new mode of warfare “possible.” His use of “inevitably” applied only to the nobility’s cultural transformation to suit the form of warfare that the stirrup had made possible. The complete sentence, which Sawyer truncated, was: “Inevitably this nobility developed cultural forms and patterns of thought and emotion in harmony with its style of mounted shock combat and its social posture; as Denholm-Young has said: ‘it is impossible to be chivalrous without a horse.’” Chastened by the epistemological black holes that have gobbled up scholars making claims for historical inevitability, prudent historians now eschew the word entirely. But White was making a modest, cultural claim for inevitability, not a claim that the stirrup made either the mounted knight or the feudal system inevitable. The stirrup to him was a catalyst that made mounted shock combat and feudalism possible.

Remarkably, Sawyer went on to quote another passage from White that makes this disclaimer even more clearly. White said:

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 shaping a culture to which they are not entirely novel. . . . As our understanding of the history of technology increases it becomes clear that a new device merely opens a door; it does not compel one to enter. The acceptance or rejection of an invention, or the extent to which its

25. Sawyer and Hilton (n. 19 above); White, 38.



implications are realized if it is accepted, depends quite as much upon the condition of a society, and upon the imagination of its leaders, as upon the nature of the technological item itself.<sup>26</sup>

A believer in the social construction of technology could hardly have stated the case better today, forty years after White penned it, perhaps replacing “invention” with “artifact or process.” In 1963, however, Sawyer insisted that this passage “undermines [White’s] main thesis.” Convinced that White was a technological determinist, Sawyer and many other critics refuted arguments that White did not make, inferred motives that White did not manifest, and accused him of views he did not hold. If anything, Lynn White was a cultural determinist, not a technological determinist.<sup>27</sup> But that is not the way his critics read *Medieval Technology and Social Change*. Concerns about technological determinism ran high in the 1960s, and many scholars worried that confirmation of the phenomenon in history would only add to its impetus in contemporary life, when the nuclear arms race and other perils of modernity seemed rife.

Bernard Bachrach also appears to have attacked White for views he neither held nor asserted. Bachrach’s most powerful argument was that the “stirrup was little appreciated and little used by the Carolingians during the eighth and ninth centuries” and that “heavily armed horsemen engaging in mounted shock combat were not the decisive arm of Charles Martel’s post-733 armies and those of his sons.”<sup>28</sup> But most of this statement refutes a claim that White did not make. Bachrach said that White argued for “a revolution in military tactics” created by Charles Martel. White actually claimed a “social revolution” that led eventually to Frankish development and propagation of mounted shock combat.<sup>29</sup> White had not contended that Martel or his sons—indeed that any of the Carolingians—relied primarily on mounted shock combat. The “crucial problem,” White said, was Martel’s confiscation of Church property.<sup>30</sup> That was the first step in the sequence of events that led to feudalism based on the vassalage of mounted knights. White wrote that “It was the Franks alone—*presumably* led by Charles Martel’s genius—who fully grasped the possibilities inherent in the stirrup and created in terms of it a new type of warfare supported by a novel structure of society which we call feudalism.”<sup>31</sup> White had also anticipated the argument by Bachrach and others that there were precedents and other explanations for Martel’s confiscation of Church property; it had already been leveled at Brunner’s thesis.<sup>32</sup>

26. *Ibid.*, 28.

27. Hall, “After Thirty Years,” 92.

28. Bachrach, “Charles Martel” (n. 16 above), 65–66.

29. White, 13.

30. *Ibid.*, 11.

31. *Ibid.*, 28; my italics.

32. *Ibid.*, 10.

JULY  
2003  
VOL. 44

White's only claim is that the stirrup helps to explain Martel's confiscation of Church property and the subsequent rise of feudalism.

It must be admitted that White flirted with claiming more. Indeed, his essay can be construed to imply that Martel and his sons actually created a feudal military system built around the mounted knight. He mentions, for example, "the feudality which the Carolingians had deliberately created . . . to be the backbone of their army."<sup>33</sup> This does not say, however, that it actually *became* the backbone of their army. White claimed that Martel and his immediate successors intended to do this, but that the fully evolved feudal military system did not appear in France until later, perhaps in the tenth century. But the social revolution in property holding, and the concept of holding that property in return for mounted military service, "presumably" began with Martel. White ended his essay by saying that "the Man on Horseback, *as we have known him during the past millennium*, was made possible by the stirrup, which joined man and steed into a fighting organism."<sup>34</sup> Writing in 1962, White claimed only that the system envisioned and launched by Charles Martel in 732 had come to fruition by 962.

Bachrach and White's other critics of the stirrup thesis clearly scored some hits. For example, Bachrach demolishes White's assertion that the Frankish battle-ax and barbed javelin disappeared in the eighth century, replaced by long swords and wing-spears better suited to mounted combat. White almost falls into a trap of his own making by asserting that "the generalization of the wing-spear in itself is evidence that under Charles Martel and his sons the meaning of the stirrup for shock combat was being realized."<sup>35</sup> He stopped short of asserting that Charles Martel and his sons instituted a military system built around shock combat, only that they began moving in that direction. Still, a hasty reading of White, here and elsewhere, can easily create the wrong impression.

Some of blame for his critics' misreading of *Medieval Technology and Social Change* no doubt attaches to White himself. His chapters were first delivered as lectures, a genre that lends itself to reductionism and overstatement. White did not claim what his critics inferred, but he may have implied it. He laid on his documentation pretty heavily: multiple footnotes on every page, supplemented by forty-three pages of endnotes, all in small type—verging perhaps on padding. He favored evidence that supported his argument, apparently overlooking some, though not all, to the contrary. He concentrated on the technology without developing fully the contextual information needed to understand the social and political dimensions of feudalism, the economics and demographics of agricultural expansion in the Middle Ages, and the nontechnical facets of what Jean Gimpel has

33. *Ibid.*, 30.

34. *Ibid.*, 38; my italics.

35. *Ibid.*, 28.

called “the first industrial revolution.”<sup>36</sup> And he wrote with impish mischievousness, a teasing provocation. He conjured marvelous images, such as the knight as centaur, which stretched his evidence to the breaking point and implied claims that he carefully avoided making explicit. Small wonder, then, that the community of medieval historians, a guild seldom extolled for its levity or insouciance, was not amused.

CLASSICS

REVISITED

## An Answer

What, then, is to be done with this exceptional book? Its appeal to historians of technology undoubtedly flows from its accessibility, its engaging arguments, its ringing validation of the importance of technology, and the sheer fun of its language and imagination. The charges of its critics may be discounted somewhat, but they cannot be dismissed. Some of the book’s arguments have been refuted, others overtaken by subsequent scholarship. Perhaps age and revisionism must finally trump brilliance and originality. Maybe books this provocative always hasten their own demise by challenging the scholarly community so thoroughly.

My vote, however, is to keep using it until something better comes along. Medievalists may well delve into the accumulating anomalies in White’s arguments, but the broad outlines of his paradigms still stand. The Carolingians may have failed to implement the grand scheme that White attributed to Charles Martel, but the dominance of the mounted warrior pursuing shock combat did come to pass in Western Europe, and the stirrup was part of the formula. White believed that a complex soup of social, political, military, and economic forces existed in Francia in the eighth century, and that the addition of the stirrup precipitated out feudalism. Maybe it did not happen exactly when he said it did, but it did happen. And his account retains just the virtue he claimed for it. It shows how the stirrup opened a door through which the Franks, and then others, eventually passed. Philippe Contamine, author of the best current survey of medieval warfare, eschews the most extreme criticism of the stirrup thesis, stressing the slowness of the evolution toward the dominance of the mounted warrior, which he dates to Charlemagne. He concludes that “the military originality of the Middle Ages in the West, if compared with Antiquity, Byzantium, or Modern times, lies in the overwhelming preponderance of a very experienced heavy cavalry, possessing costly mounts, stirrups, complete armour and very firm, enveloping saddles.”<sup>37</sup> This is entirely consistent with White’s argument.<sup>38</sup>

36. Jean Gimpel, *The Medieval Machine: The Industrial Revolution of the Middle Ages* (New York, 1976).

37. Philippe Contamine, *War in the Middle Ages*, trans. Michael Jones (Cambridge, Mass., 1984; reprint, 1990), 179–84, 303.

38. Furthermore, it circumscribes the current debate over the dominance of mount-

JULY

2003

VOL. 44

So too with White's agricultural revolution. Parts of his argument are no doubt defective. It is even possible, as R. H. Hilton suggested, that the argument could be reversed. Maybe White's agricultural revolution did not stimulate an increase in population; maybe increased population sparked a transformation of agriculture. But until the issue is settled, White's provocative extension of Marc Bloch's theory provides a stimulating framework for thinking about the problem. And it addresses key technologies—horse collar, horseshoes, the moldboard plow, and crop rotation—that appear likely to be parts of any new paradigm.

White's essay on power and machinery in the Middle Ages has, at least until recently, proved less controversial. It appears vulnerable on the claim for a medieval industrial revolution, but the history of the water mill, on which the current criticism is based, occupied only a small part of a chapter divided equally between "sources of power" and "the development of machine design." Most of White's argument stands, and the rest has sparked useful lines of research. The stirrup thesis and the argument for an agricultural revolution might have had the same salutary effect had they not so incensed their critics. Instead of building upon these arguments, most criticism has focused on discrediting them.

So *Medieval Technology and Social Change*, for all its weaknesses, appears to have some life left in it. For one thing, it remains in print forty years after publication, apparently holding the appeal for the nonspecialist that it demonstrated in its first reviews. So, what antidote should be issued with it when recommending it to students, lay readers, and scholars with neither the time nor background to plumb the literature of medieval history thoroughly? Two warning labels seem in order. First should be an explanation of the controversy surrounding the book. The most thorough and judicious may well be Bert Hall's "Lynn White's *Medieval Technology and Social Change* after Thirty Years."<sup>39</sup> Here, a prudent and seasoned medievalist, and one of White's own students, offers a balanced and insightful appreciation of his mentor's contribution, explaining with clarity and sympathy why White's critics were so exercised. Second, *caveat lector*. All students should be taught early in their reading careers that the better the writer, the more the reader must be on guard. All good writers will exercise the maximum rhetorical suasion of which they are capable to bend

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ed combat in the Middle Ages. The canonical account is represented in works such as Charles Oman's *A History of the Art of War in the Middle Ages*, 2d ed., 2 vols. (London, 1924). The new interpretation, reducing the centrality of the mounted warrior, may be found in Nicholas Hooper and Matthew Bennett, eds., *The Cambridge Illustrated Atlas of Warfare: The Middle Ages* (New York, 1996), 154–55.

39. See note 23 above. See also Hall's eulogy for White in *Technology and Culture* 30 (1989): 194–213, which includes a complete bibliography of White's publications as well as a list of thirty-one reviews of *Medieval Technology and Social Change*.

readers to their views. Some critics have said or implied that White used his considerable rhetorical powers to intentionally mislead the reader. This is a charge that seems entirely inconsistent with the tone of the book, the sheer depth and breadth of the scholarship, the personality of Lynn White, and the stature he enjoyed within the historical community at large. But he was a provocateur, and he did provoke. This is what good books do. *Medieval Technology and Social Change* is still a good book. We should keep reading and recommending it until another grand synthesis provides a more compelling view of its topic.

CLASSICS

REVISITED