

# WHERE ARE WE? SOME CLOSING THOUGHTS ON THE HISTORY OF SCIENCE AND TECHNOLOGY AT THE END OF THE MILLENNIUM\*

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## ABSTRACT

This paper attempts to examine the history and philosophy of science and technology as it enters the new millennium by playing on themes that were addressed in a 1959 lecture by Ernst Mayr, titled "Where Are We? After exploring the relationship between history and science, it charts some of the major trends in the historiography of science by following the issues of importance to subsequent generations of historians of science. It culminates with the "science wars" of the 1990's and suggests that the wars were an attempt by the humanities to resist a science and technology that leads to what Timothy Lenoir has described as a post-human condition; a condition that makes the humanities obsolete. A critique of this post-human condition is offered and a series of questions are offered as relevant for historians and philosophers of science as they encounter the science and technology of the new millennium.

**Key words:** historiography of science; "two cultures"; "science wars"; post-human condition; humanities.

## ONDE ESTAMOS? ALGUMAS REFLEXÕES DE ENCERRAMENTO SOBRE A HISTÓRIA DA CIÊNCIA E DA TECNOLOGIA NO FINAL DO MILÊNIO

Este artigo procura examinar a história e a filosofia da ciência, bem como a da tecnologia na entrada de um novo milênio, utilizando temas que foram discutidos por Ernst Mayr em sua conferência de 1959 intitulada "Where are we?". Após refletir sobre as relações entre a história e a ciência, o artigo mapeia algumas das grandes tendências na historiografia da ciência ao seguir os temas considerados importantes por gerações sucessivas de historiadores da ciência. A análise culmina com as chamadas "guerras da ciência" ("science wars") dos anos 90 e sugere que tais guerras representaram uma tentativa das humanidades em resistir a uma ciência e tecnologia que conduz ao que Timothy Lenoir descreve como condição pós-humana, uma condição que torna as humanidades em algo obsoleto. Uma crítica a

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esta condição pós-humana é apresentada e uma série de questões são sugeridas como relevantes para historiadores e filósofos da ciência, na medida em que eles se defrontem com a ciência e a tecnologia do novo milênio.

**Palavras-chave:** historiografia da ciência; “duas culturas”; “guerras da ciência”; condição pós-humana; humanidades.

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## WHERE ARE WE? CLOSING THOUGHTS ON THE HISTORY OF SCIENCE AT THE END OF THE MILLENNIUM

*Such an emphasis on history may be a wholesome counterweight to the exceedingly unhistorical attitude of the current age.*

Ernst Mayr, “Where Are We?”, 1959.

*Humankind is either on its way to the stars or hurtling out of a high-rise window to the street mumbling, “So far, so good.”*

Edward Tenner, *Why Things Bite Back. Technology and the Revenge of Unintended Consequences*, 1996.

Exactly forty years ago the evolutionary biologist Ernst Mayr delivered a historic address as the inaugural lecture at Cold Spring Harbor on the occasion of the 100th anniversary of the publication of Darwin's *On the Origin of Species*. Entitled “Where are we?” the address assessed the state of evolutionary biology as it had recently emerged from the evolutionary synthesis and as it faced the next one hundred years of its existence. The address was soon published and became one of the most well-known essays that Mayr has written, a classic widely cited by historians as marking Ernst Mayr's debut as a serious historian of science.<sup>1</sup> The title of this presentation plays on some of the themes introduced by Mayr the scientist and Mayr the historian forty years ago.

The year 1999 marks at least one other important anniversary: the 75th year of the History of Science Society, a society founded by George Sarton to support the scholarly and professional historical study of science. A special issue of *Isis*, the journal of the History of Science Society (HSS), was published just this month, and commemorates the founding of the society and the journal with retrospective essays, photographs, and other memorabilia.<sup>2</sup> What exactly does our field look like at 75

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<sup>1</sup>Ernst Mayr, “Where Are We?” *Cold Spring Harbor Symposium on Quantitative Biology*, 24 (1959): 409-440. Revised edition of paper published in Ernst Mayr, “Where Are We?” in *Evolution and the Diversity of Life. Selected Essays*, Cambridge, MA: The Belknap Press of Harvard University Press, p. 307-328.

<sup>2</sup>See Margaret Rossiter, ed. *Catching Up with the Vision. A Supplement to Isis*. Volume 90, 1999. See especially the essay by Michael M. Sokal, “The History of Science Society, 1970-1999: From Subscription Agency to Professional Society,” p. S135-S181.

years? Where has it come from and where is it going? As we enter the new millennium, it seems appropriate to reflect on what we have done and where we are going as historians of science.

## TWO WORLDS: HISTORY AND SCIENCE

To begin with, the meaning of the term “history of science” seems to defy any clear definition. The set of meanings given to the word “science” in methodology and subject matter alone is manifold, as has the set of meanings given to the word “history.” The conjunction of the two as in “history of science” leads to an even greater possibility of meanings. Adding more difficulties is the fact that terms “history” and “science” usually represent two of the polar ends of C. P. Snow’s much hackneyed, but occasionally useful distinction between the sciences and the humanities, which is also known as the “two cultures” (assuming we reject the notion of history as a social science).<sup>3</sup> History, by definition deals with the past, while science—a transhistorical, progressive enterprise (if we believe the standard scientific viewpoint)—looks to the future; history is a humanistic, literary enterprise largely relying on subjective standards (if we ignore again the move to make it a social science) while science is frequently non-human (or as Timothy Lenoir and others have recently suggested a post-human activity):<sup>4</sup> quantitative, rigorous and relying on objective modes of analysis. In their domains of inquiry, history is preoccupied with nurture and culture, while science is usually preoccupied with nature.<sup>5</sup>

Even the physical location of most science departments is separated from and frequently located at the opposite ends of university campuses. Language, social conventions, training practices, and even something as trivial as dress style differ between the two areas. Even the way that work is presented separates historians from scientists: historians write enormous scholarly books, demonstrating their verbal acumen, and rely heavily on discursive footnotes at the bottom of each page, while scientists write succinct formulaic articles often with tables, graphs and illustrations, usually devoid of “too many words” with works cited or references tacked on at the end of the article. At conferences and professional meetings, historians always read

<sup>3</sup>C. P. Snow, *The Two Cultures and the Scientific Revolution*. Cambridge: Cambridge University Press, 1962. This small book was based on the Rede Lecture of 1959.

<sup>4</sup>Timothy Lenoir, “Science in the Matrix 2000,” paper delivered at the History of Science at the End of the Millennium Symposium in Porto Alegre, Brazil. See also Andrew Pickering, *The Mangle of Practice. Time, Agency, and Science*. Chicago, University of Chicago Press, 1995; and see Donna J. Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge Press, 1991.

<sup>5</sup>Jan Golinski makes some similar observations in exploring the “yoking together of the words ‘history’ and ‘science.’” Jan Golinski, *Making Natural Knowledge. Constructivism and the History of Science*. Cambridge: Cambridge University Press, 1998. Quotation on p.1.

their scholarly papers: it usually a sign of ill-preparedness to give a talk that appears to be “off the cuff,” while scientists never read their scholarly papers: relying on a text rather than one’s own walking-talking knowledge, is a sign of weakness or failure to remember what one has “discovered”. Students in one area find it difficult to move into the other without advanced and substantive re-training; and academic positions with standards of publication and for teaching accommodating both history and science are well-nigh non-existent. Coming up for tenure in the United States, or competing for grants and positions as a historian of science is frequently a confusing process that all too often has negative results.

Many of these distinctions were, of course, noted by Snow. His analysis of the two cultures actually included both intellectual differences in subject matter and cognitive style and in the kind of cultural differences familiar to anthropologists. For Snow, this widening rift was perilous for practical and political reasons, especially in the context of the cold war that defined his epoch. His well-known essay was intended to be a clarion call for educational reforms before humanity ran out of time. But even an alarmist like Snow, could not anticipate how wide the rift would become by the end of the century, nor ironically enough, that it would coincide with the end of the cold war. By the late 1980s, intellectuals making science their object of study generated a view of history and science that appeared fundamentally at odds with each other, if not downright incommensurable. As historians aligned themselves with the humanities, and as phrases like “blurred genres” began to describe the cultural or literary turn they were taking, they began to recognize a situational, embodied view of local knowledge and questioned the very notion of historical “objectivity”.<sup>6</sup> Terms like “discourse” and “culture” became part of the common vocabulary of historians as did terms like “context” and “disunity”. Undergoing a multicultural fracturation, historians—and many identified with post-modernist movements of varied ilk—thus rejected the view of universal transcendent knowledge, and abandoned the possibility of value-neutral claims to knowledge.<sup>7</sup> For these historians, science, with its universalizing, unifying, transcendent claims to value-neutrality, represented precisely the kind of practice that they were keen to subvert. Small wonder then, that many historians of science sympathetic to the literary turn and sympathetic to science, felt schizophrenic as they moved from their historical to their scientific worlds; both worlds were growing farther apart.

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<sup>6</sup>See Clifford Geertz, *Local Knowledge. Further Essays in Interpretive Anthropology*. New York: Basic Books, 1983; and see Clifford Geertz, *The Interpretation of Cultures. Selected Essays*. New York: Basic Books, 1973; and see Richard Rorty, *Philosophy and the Mirror of Nature*. Princeton: Princeton University Press, 1979. See also Peter Novick, *That Noble Dream*. Cambridge: Cambridge University Press, 1988.

<sup>7</sup>See for instance, Lynn Hunt, ed., *The New Cultural History*. Berkeley: Berkeley University Press, 1989.

## WHIGS AND PRIGS IN THE HISTORY OF SCIENCE

The divisions in history of science were not always so clearly demarcated. The first generation of historians of science were practicing scientists who reflected on the history of their disciplines often later in their careers, well after their research programs had been established.<sup>8</sup> Their historiography reflected their epistemic commitments to their science. Writing their histories, they at times simultaneously rewrote their science, and raising their predecessors to the mythical status of founding fathers—geniuses among the ordinary folk—they served to reify their own identities as truth-seekers. For them history would serve the interests of science; it would be the handmaiden of science.

In the history of biology Ernst Mayr—the “Darwin of the Twentieth Century”—as he was called in a *New York Times* article<sup>9</sup>—reflects this first generation of historians of science who rewrote the history of science in their image. No confusion for them: science was cumulative progressive truth-seeking activity and history was the non-introspective neutral account of that righteous path towards the truth. Mayr and his generation felt comfortable in their historiography. It took Mayr until 1982 to lay it down for the next generation of historians and philosophers of biology with the completion of his magnum opus, *The Growth of Biological Thought* in 1982.<sup>10</sup> So much of Mayr’s scientific beliefs made their way in this historical and philosophical account, that it became the perfect example of a historical document serving simultaneously as both a primary and a secondary historical source. It demonstrated beautifully the interplay between the historical writing of the science, its philosophical structure, and the content of science.

Ironically, just as Mayr, the biologist made his debut as a historian, Thomas Kuhn, a physicist was making his historical debut with the appearance of his *The Structure of Scientific Revolutions*;<sup>11</sup> the linkage between history of science was to begin to unravel with this book. For Kuhn, a physicist, history of physics was to play an important role in understanding the tempo and mode of scientific change. As he stated in the famous opening to what would become a revolutionary book “History, if viewed as a repository for more than anecdote or chronology, could produce a decisive transformation in the image of science by which we are now possessed.”<sup>12</sup> Kuhn

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<sup>8</sup>If we dug even deeper into the history of our field, or more correctly, the prehistory of our field, we might trace our origins to natural philosophers like August Comte and William Whewell who began the narrative of western science as they extended the Enlightenment project.

<sup>9</sup>Carol Kaesuk Yoon, “Long Evolution of ‘Darwin of 20th Century’”, *New York Times*, Tuesday (April 15, 1997).

<sup>10</sup>Ernst Mayr, *The Growth of Biological Thought*. Cambridge: Cambridge University Press, 1982.

<sup>11</sup>Thomas Kuhn, *The Structure of Scientific Revolutions*. 2nd edition. Chicago: University of Chicago Press, 1970. First published 1962.

<sup>12</sup>Kuhn, page 1.

took his own advice and looked to the history of his science. Wearing the eyeglasses of the gestalt school of psychologists popular in his day, Kuhn saw incommensurability between paradigmatic worlds, very much like the imagery in gestalt psychology; depending on the observer one could see a duck or a rabbit in the same picture. Without intending it, Kuhn's observations of the tempo and mode of scientific change, drew attention to the community of belief and practices, eventually opening the door to the sociology of science and "external" or social influences began to determine the "internal" components of the science. Putting history and science together after Kuhn, increasingly led to the possibility of dissonance of the union.

But this was not altogether bad, at least at first. On the institutional front things began to alter for historians of science. Academic positions for historians of science sometimes in history and sometimes in science departments began to increase in the 1960s. In some places entire university departments were organized around the history of science by the end of the decade.<sup>13</sup> Although it helped to fuel growth and interest in the history of science, the increasing professionalization of the history of science widened the rift between historians of science and scientists-turned historians of previous generations. Having viewed themselves as throwing off the yoke of the scientific disciplines, now free to write "objective" accounts of science and acting as historical critics of science where need be, younger professional historians and philosophers started to ignore more traditional histories of science. At their worst they began to deride naive accounts of the progression of great heroes (nearly all of whom were white males) embarked on an enterprise leading inexorably to truth. No longer the mere mnemonic devices, illegitimate children, or handmaidens to the scientific disciplines, professional historians of science effectively distanced themselves from their scientific objects of study. The occasion of the 300th anniversary of the publication of Newton's *Principia*, which should have been reason for pause and reflection if not celebration went by largely unnoticed by the leading American journal for the history of science, *Isis*. By 1987, the subtitle for *Isis* — an "international review devoted to the history of science and its cultural influences"<sup>14</sup> — weighed more and more in favor of the latter half of the phrase. Terms like "whiggish" history and "whig" became terms of derision used as historiographic slurs against histories of science especially popular with scientists who upheld progressive, cumulative, growth models

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<sup>13</sup>For a recent account of the institutionalization of the history of science see the special historical issue of *Isis*, note 2 above. See also the following retrospective essays on the history of the history of science: Arnold Thackray and Robert K. Merton, "On Discipline Building: The Paradoxes of George Sarton." *Isis* 63 (1972): 473-95; Arnold Thackray, "The History of Science Society: Five Phases of Prehistory, Depicted from Diverse Documents," *Isis* 66 (1975): 445-53; Arnold Thackray, "The Pre-History of an Academic Discipline: The Study of the History of Science in the United States, 1891-1941," *Minerva* 18 (1980): 448-73; see also Nathan Reingold, "History of Science Today, I. Uniformity as Hidden Diversity: History of Science in the United States, 1920-1940," *British Journal for the History of Science* 19 (1986): 243-62.

<sup>14</sup>This description is found on the journal's cover.

for the history and philosophy of science. No wonder then, that by the late 1980s, scientists interested in their history became watchful of how their work was represented. Growing weary of the move for more social, external, “constructivist” and overly critical approaches to science, they began to fight back historians’ charges of “whig” history with their own academic slur, “prig” history for the stuffy, self-important kind of history that “professional” historians were increasingly accepting as the only real history of science. The growing rift between scientists and “professional” historians was rendered visible for scientists with the appearance of a commentary on “whigs and prigs” and the history of science in no less a journal than *Nature* in 1987.<sup>15</sup>

### THE “SCIENCE WARS” OF THE 1990s

By the 1990s the relationship between history and science had visibly soured. As individuals like Paul Forman declared “independence, not transcendence for the historian of science,” in 1991 in the pages of *Isis*, the lines became indelibly drawn.<sup>16</sup> Individuals, extremists (oftentimes neither historian nor scientist), took advantage of the instability to garner attention with destructive claims. Individuals like Andrew Ross became entirely dismissive of the scientists’ perspective when he wrote a notorious dedication to a notorious critique of science: “This book is dedicated to all of the science teachers I never had. It could only have been written without them.”<sup>17</sup> Constructivists of varied ilks began to join the fray and taunt scientists with claims for the “social construction of reality.”<sup>18</sup> Scientists, in turn, lacked the patience to delve into a body of literature that became riddled with overly abstruse and arcane language; to them “science studies”—the buzz-phrase of the late 1980s that saw the refiguration of history, philosophy and sociology of science in places like the University of California, San Diego<sup>19</sup>—was a pathetic if not a bankrupt attempt to understand a body of knowledge and a set of practices that were incomprehensible to “outsiders”. Scientists grew even more incensed as science studies refigured into “cultural studies” and as the growing body of feminist critiques began taking on the giants of the

<sup>15</sup>E. Harrison, “Whigs and Prigs and Historians of Science,” *Science* 329 (1987): 213.

<sup>16</sup>Paul Forman, “Independence, Not Transcendence, for the Historian of Science,” *Isis* 82 (1991): 71-86.

<sup>17</sup>Andrew Ross, *Strange Weather: Culture, Science and Technology in the Age of Limits*. London: Verso, 1991.

<sup>18</sup>For a recent account of see Ian Hacking, *The Social Construction of What?* Cambridge: Harvard University Press, 1999. He states that the term social construction has the tendency to replicate itself much as cancer cells do.

<sup>19</sup>See Chris Raymond, “Scholars Take a New Approach in Studying the Institution of Science,” *Chronicle of Higher Education* 9 May 1990, p. A4-A7.

history of science like Isaac Newton and reducing them to masculine rapists of a feminized nature.<sup>20</sup> Social historians and sociologists of the “strong programme” did not help matters at all as they struggled with integrating the community into the body of beliefs called science.<sup>21</sup> Taking the sociological approach to the extreme some students of science study like Bruno Latour, eventually argued for a fundamentally ahistorical view of scientific knowledge.<sup>22</sup> Like all revolutions, this one began to consume some of its own children.

The Enlightenment project as a whole began to fragment as multiculturalists, post-modernists, post-structuralists *et.al.*, began to view the project as serving the totalizing motives of elite dead white males. Courses at Stanford in the “CIV” (cultures, ideas and values track) reflected this rebellion with course titles like “The Enlightenment and Its Victims” (Beccaria would have turned in his grave). Books and articles undergirded by a move to “subvert the system” through techniques of deconstruction flooded traditional branches of the humanities as identity politics replaced the notion of universal self-evident truths.

No wonder that what was happening in the humanities garnered the attention of self appointed “science watchdogs” who rushed to defend the boundaries of science and the Enlightenment project. As a result, the middle 1990s saw the most uncomfortable, embarrassing, and divisive period for historians of science. “Science wars” became the buzz-phrase to denote the conflict between scientists and critical students of the study of science. Some, like Paul Gross and Norman Levitt, made things easy for themselves by creating an artificial category of the “academic left”—a veritable “bestiary” of post-modernists, feminists, multiculturalist, and constructivists who threatened to breach “the wall between science and culture.”<sup>23</sup> Higher

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<sup>20</sup>For an introduction to cultural studies see Joseph Rouse, “What Are Cultural Studies of Scientific Knowledge,” *Configurations* 1(1993): 1-22. For an introduction to the general area see L. Grossberg, C. Nelson and P. Treichler, eds., *Cultural Studies*. New York: Routledge, 1992; and see Fred Inglis, “Cultural Studies,” *Times Literary Supplement*, 27 May, 1994. Sandra Harding built on the work of Carolyn Merchant to argue that Newton’s *Principia* functioned like a “rape manual”. See Carolyn Merchant, *The Death of Nature. Women, Ecology, and the Scientific Revolution*. San Francisco: Harper and Row, 1980; see Sandra Harding, *The Science Question in Feminism*. Ithaca: Cornell University Press, 1986; and Sandra Harding, *Whose Science? Whose Knowledge? Thinking from Women’s Lives*. Ithaca: Cornell University Press, 1991.

<sup>21</sup>For a successful attempt to do this see: Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*. Princeton: Princeton University Press, 1985.

<sup>22</sup>See Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*. 2nd edition. Princeton: Princeton University Press, 1986. Bruno Latour and Steve Woolgar, *Laboratory Life: The Social Construction of Scientific Facts*. Beverly Hills: Sage, 1979; and see Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge: Harvard University Press, 1987.

<sup>23</sup>Paul R. Gross and Norman Levitt, *Higher Superstition. The Academic Left and Its Quarrels with Science*. Baltimore: Johns Hopkins University Press, 1994. The quotation is from Paul Forman’s review of Paul R. Gross, Norman Levitt and Martin Lewis eds. *The Flight from Science and Reason*. *New York: New York Academy of Sciences, 1996 in Science* 276 (1997) 750-752.



Superstition—the title of their book on the subject gained the curious subtitle *The Academic Left and Its Quarrel with Science*. Others sought to fortify the walls of science so that it could withstand the assault that came not just from outside the walls of the academy but from within. Buying a full page advertisement in the leading American journal of science, *Science*, the newly formed National Association of Scholars dedicated “to combat the irrationality and politicization now thriving in university life” alarmed American scientists with a bold headline: “Science is Under Attack!”<sup>24</sup> Such attacks were “dangerous” they declared because they “undermine public confidence; alter directions of research; affect funding” and most importantly they “subvert the standards of reason and proof.” Conferences under the auspices of august scientific institutions were organized just on this subject, and then big fat volumes with titles like *The Flight from Science and Reason* were produced.<sup>25</sup> Historians of science like Paul Forman returned fire in the pages of *Science* with a blistering review of this book—and others—that drew so much negative attention that the long-standing book review editor of *Science* was castigated for encouraging such anti-science perspectives to appear in an establishment journal like *Science*. As part of the accelerating pattern of academic violence, she, and the prominent book reviews covering the new literature from the history of science, were “retired” at the prestigious journal.

But none of these accounts matched the destruction that followed after the “Sokal Affair”, also known as the Sokal incident or the Sokal hoax that physicist Alan Sokal managed to pull off at the peak of the science wars. In 1996 Alan Sokal submitted a bogus article oozing with post-modernist gobbledeygook, the kind of language that frequently concealed nonsensical claims, and sprinkled liberally with citations to the likes of Continental theorists like Derrida, Serres, and Irigaray and icons of critical science studies like Keller, Haraway, Aronowitz and Harding, to *Social Text*, a journal favored by individuals like Andrew Ross. The title tells us much: “Transgressing the Boundaries: The Transformative Hermeneutics of Quantum Gravity”.<sup>26</sup> It was promptly published, following routine “rigorous” peer review. Sokal did not stop there: he exposed the hoax as an “experiment done by a physicist on cultural studies” in the popular journal for academics, *Lingua Franca*.<sup>27</sup> The hoax quickly made its way to wider American culture demonstrating exactly how low the

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<sup>24</sup>See the unusual call of alarm in the full-page notice for the National Association of Scholars: “Science is Under Attack,” *Science* 265 (1994):1508. The bottom of the page had included a quotation stating “for reasoned scholarship in a free society.”

<sup>25</sup>See note 23 above.

<sup>26</sup>Alan Sokal, “Transgressing the Boundaries: The Transformative Hermeneutics of Quantum Gravity,” *Social Text*, 46/47(1996): 217-252.

<sup>27</sup>Alan Sokal, “A Physicist Experiments with Cultural Studies,” *Lingua Franca*, May/June(1996): 62-64. See also Alan Sokal, “Transgressing the Boundaries—An Afterward.” *Dissent*, Fall(1996): 93-99; and see Alan Sokal, “A Plea for Reason, Evidence, and Logic.” *New Politics* 6(1997): 126-129.

standards had dropped in humanistic circles. Shortly after the hoax was revealed, a soaring defense was mounted on behalf of the humanities by one of the most visible literary theories, Stanley Fish. It appeared in *The New York Times*.<sup>28</sup> Sokal, receiving more than the requisite fifteen minutes of fame, proceeded to write an entire book on the subject titled *Fashionable Nonsense. Postmodern Intellectuals' Abuse of Science*, which was first published in France (no doubt where it would be read by the Continental theorists he was so fond of) under the title *Impostures Intellectuelles* (no translation needed here).<sup>29</sup> Not to be outdone, Norman Levitt, of Gross and Levitt fame, also published another provocative book about the science wars titled *Prometheus Bedeviled. Science and the Contradictions of Contemporary Culture*.<sup>30</sup> Adding further to what had become an industry of bashing and exposure was Noretta Koertge's edited volume with yet another revelatory title: *A House Built on Sand: Exposing Postmodernist Myths About Science*.<sup>31</sup>

In his earlier presentation, Ian Hacking stated how much he regretted the science wars, and how it brought out the worst in some very sane people;<sup>32</sup> he was right. While he was combing Shakespeare for appropriate plague curses to hurl at both houses—history and science—historians of science like Timothy Lenoir and his cohort of warriors were fighting the battles against detractors of science and cultural studies, and getting badly bruised in the process. No one was spared. It was especially bad for the new kids on the block who had the misfortune to enter the profession in the midst of a war: we found ourselves in a minefield of conflicting points of view. Many of us did not survive, losing tenure bids, or failing to secure academic positions, while others had lesser damage to contend with like failed grant applications or severed academic relationships.

But the sociopolitical-turned-personal divisions in the history of science in the mid-1990s positively paled in comparison with the intellectual dissonance. Historians of biology probably had it as bad, if not worse than anyone else. The historical progeny of Ernst Mayr, the "architect" of the evolutionary synthesis and the dominant historian and philosopher of biology, had to simultaneously contend with the likes of Donna Haraway, the deconstructor of the same event and the icon of feminist cultural

<sup>28</sup>Stanley Fish, "Professor Sokal's Bad Joke," *New York Times*, May 21, 1996.

<sup>29</sup>Alan Sokal and Jean Bricmont, *Fashionable Nonsense. Postmodern Intellectual's Abuse of Science*. New York: Picador, 1998. First published as *Impostures Intellectuelles*. Paris: Editions Odile Jacob, 1997.

<sup>30</sup>Norman Levitt, *Prometheus Bedeviled. Science and the Contradictions of Contemporary Culture*. New Brunswick: Rutgers University Press, 1999.

<sup>31</sup>Noretta Koertge, *A House Built on Sand: Exposing Postmodernist Myths About Science*. New York: Oxford University Press, 1998.

<sup>32</sup>Ian Hacking, "Afterthoughts on Construction," paper delivered at the History of Science at the End of the Millennium Symposium in Porto Alegre, Brazil. See also Ian Hacking, *The Social Construction of What?* Cambridge: Harvard University Press, 1999.

studies of science. Not only did I understand and respect their positions, but I had sympathies for both.<sup>33</sup>

### THE LAST GASP OF THE HUMANITIES?

At the time of science wars, no one was quite sure exactly what was happening in the profession, or why it was happening. Even with a bit of historical hindsight (let us hope that the wars are finally over), it is still hard to gain a clear perspective: was this controversy a case of temporary or transient insanity brought on by the careless actions of a few self-serving, noisy individuals? It seems fairly certain that more than a few of the major players profited by the lavish attention they received (their citation indices alone increased astronomically); or was this just a phase in an inevitable process that historians of science had to undergo as they became professionalized and integrated with something called "mainstream" history, the kind of history that is written in predominantly in history departments? In his preceding talk, Ian Hacking spoke of the science wars as "growing pains" for historians of science.<sup>34</sup> Could the science wars be seen as the equivalent of an especially stormy adolescence? Or is there some other explanation for the turmoil?

My own sense that there is much to Hacking's suggestion that this was part of the maturation of the history of science (though it also flushed out some very noisy and egocentric individuals in the process). It was bound to become a contested site by virtue of its dual allegiance to history and science. As historians turned to their post-modernist critiques and to other approaches, some of which with the benefit of historical hindsight seem now as "fashions" driven by political action programs, they inevitably took on science, the most powerful practice with traditional claims to value-neutrality. The dominance of science, and especially technology in the latter half of the twentieth century is now so much a fact of everyday life that even the popular American magazine called *Time* recently designated Albert Einstein as the "Person of the Century." The very success of science and its extension into everyday life perhaps sets it up for criticism from a diverse set of perspectives or interests. In this sense, perhaps, we would probably not be far off to think that science may have become a victim of its own success.

But there is another aspect to the science wars that has hitherto gained little public exposure. It is an aspect that I considered in the early 1990s just as the declaration of independence was announced by historians like Paul Forman. Timothy Lenoir's

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<sup>33</sup>It took some five years for this historian, to find a middle ground. See the author's preoccupation with contradictory elements in Vassiliki Betty Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology*. Princeton: Princeton University Press, 1996.

<sup>34</sup>Ian Hacking, "Afterthoughts on Construction," paper delivered at the History of Science at the End of the Millennium Symposium in Porto Alegre, Brazil.

provocative demonstration titled "Science in the Matrix 2000" sadly brings to relief what have been for me largely unarticulated fears.<sup>35</sup> His demonstration leads students of science into troubling—and disturbing—terrain. To be sure, there are wondrous advances in the computerized world we now inhabit, which he describes so vividly—e.g., virtual surgery (i.e., surgery through computerized interventions that connect surgeon to the body via computerized technology), or the training of professionals like surgeons and airline pilots through efficient use of virtual reality generated by computer.

His presentation also tells us much about areas of the life sciences or biology that have become hot topics: bioinformatics, for one, which permanently converts the student of life into a kind of new-age engineer more conversant in computer methods and algorithms than in organismic bodies or in organic processes. Bioinformatics also radically alters the epistemic foundations of biology as a science: as Lenoir has pointed out, the automated science data is generated before theory. As a result we are witnessing the "disappearance of theory", and as he has noted, students of bioinformatics have "no time for theory". They would much rather "get on" with what is instead "economically effective."

To Lenoir, all these technologies, in turn fuel a cultural transformation or event on the scale of "another Renaissance": one that sees "seamlessly articulated intelligent machines" diminish the distinction between human and machine. Technoscience—the body of practices that he explores—leads ultimately to a shift in material reality, one that may change the "way that we think about ourselves." The invention of "smart devices" that alter and extend the human sensorium lead also to a redefinition of human identity: it is now an entity that is "tied-up with a commitment to these technologies". This post-human condition thus replaces the very notion of humanity as it has emerged from Renaissance culture. Lenoir adds that we should make no mistake about the onset of this post-human condition and the redefinition of our humanity in terms of our technologies. "Science fiction is not so far off", he notes, we are in fact not much farther away from the dizzying epistemology popularized by the hit American movie *The Matrix*.

Lenoir's vision of "Science in the Matrix" is well formed and many of his insights may prove to be prophetic (if they are not already confirmed). They may, as he notes, lead to wondrous advances that improve our ability to manipulate life and living processes to our advantage; and he has painted a richly textured picture of the new "technology of life", or even what we may view as the biology of the next millennium (after all the human genome project is rapidly approaching completion, even as I write). But little has been said of the other consequences from this technology.

For one thing, the virtual techniques that are employed for surgical intervention in the human body, were recently applied to the very real techniques of modern

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<sup>35</sup>Timothy Lenoir, "Science in the Matrix 2000," paper delivered at the History of Science at the End of the Millenium Symposium in Porto Alegre, Brazil.

warfare: the so-called “surgical strikes” by US-dominated NATO forces against purported or real targets in the Kosovo uprising last year was anything but surgical: hundreds of lives were lost in the supposedly bloodless warfare now fought and made terrifyingly efficient through computer mediated techno-warfare. The same training procedures used for surgical interventions and for the training of airline pilots, is also used to train police forces, and to teach mercenaries how to kill with terrifying precision. So too, the same computerized “killing games” have led to a generation of children taught to injure and kill their cohorts with the same bloodless and clean precision. The technology that mediates between us and reality may train us to perform amazing feats at a distance, but in so doing, entrains us to distance ourselves from the bloody suffering that our actions engender. They permit us to take life without remorse or empathy. “Bombs at a distance” cause just as much injury as bombs we throw by hand. This reality is disturbing indeed; the flip side of the technology of life may also be the technology of killing, the technology of death. Stanley Kubrick’s film of Arthur C. Clarke’s classic of science fiction 2001: A Space Odyssey makes a similar point. The opening shot of a family of proto-hominds quietly feasting on the bones of recent prey suddenly shifts to the proto-hominids at war with a strange new family that has encroached on their turf. The same hand which brought down the prey and held the bone for consumption turned it into an instrument for killing; it became a weapon. Homo technos is born at the same time as Homo sapiens; technology was equated with wisdom and the power to transform the environment, at the same time that it could become the weapon to extinguish others.

Troubling as well, are other “unintended consequences” of such new technologies. As Edward Tenner has argued in his astute book with the well-chosen title: *Why Things Bite Back. Technology and the Revenge of Unintended Consequences*,<sup>36</sup> the history of technology tells us that it is well-nigh inevitable that technology—a human invention if ever there was one—has the uncanny ability of “biting back” (a stunning metaphor). Like a “form of life” that is capable of self-replication, technology has taken a life of its own, complete with anthropomorphic attitudes like what Tenner describes as “revenge effects” (not to be confused with side-effects he points out). Just as we think we have solved one problem with a new technology, it bites back in a fashion that is the exact opposite of what the technology was intended to do: cures for one cancer that lead to other cancers is a good example of such revenge affects. Kubrick’s vision of Clarke’s novel ends with just this kind of scenario: “Hal” the computer, converts to a digital Frankenstein as “he” seeks to control the humans that have invented him. Will there be similar “revenge effects” that will materialize with the new computer technologies?

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<sup>36</sup>Edward Tenner, *Why Things Bite Back. Technology and the Revenge of Unintended Consequences*. New York: Alfred A. Knopf. 1996.

And who exactly will gain access to this technology? In a global culture that is seeing the widening of the rift between the haves and the have-nots, will access to the latest technology create an elite group of technocrats, predominantly in institutions that can afford the latest technology? And how exactly will developing nations like Brazil, for instance, as Vera Vidal pointed out,<sup>37</sup> gain access to such technology or compete on the global economic markets increasingly dependent on these technologies? Will the entire planet become beholden to, or enslaved by, a handful of wealthy “technonations” au courant with the new technologies?

And what role would the humanities play in a world that is post-human? or in a world where technology sets the standards or becomes template for our humanity? Were the science wars of the 1990s in fact an attempt to resist just this? Were the science wars in fact, the last gasp of the humanities as they became suffocated by the self-replicating machines? What does science look like in a world without theory, without an overarching unified framework? What kinds of sciences would there be? What would a biology devoid of organisms be like? Would there be any room at all for a science like evolutionary biology, an organismic science defined by the unifying power that its theoretical framework exercises?<sup>38</sup> Where would the next generation—the progeny—of Ernst Mayr fit into such a world? Would there be any room at all for a historian of science in a world without either?

If Lenoir has given us “the shape of things to come”, then where do we find the meaning of life: in the technology of death? How do we exercise agency? Is there room for emotion or aesthetic sensibility in such a world? Ian Hacking sides with the great thinker Pascal on this: he reminds us that the human comes before the machine.<sup>39</sup> He takes comfort in the thoughts—and words—of Renaissance thinkers who first encountered the “mechanization of the world-picture” yet managed to preserve their humanity and arguably even generated the rich corpus of humanistic perspectives in response to threats from the machine. But will reading Pascal really permit us to withstand the hurricane-force technological winds that have engulfed us and that have swept away our very humanity? And what about philosophy? Ian Hacking tells us that like all humanists we should continue to “wonder”. In this, of course, he echoes the ancient Greek philosophers who serve as the founders of the history and philosophy of science and of the western intellectual tradition: “thia tou thaumazon eirxanto filosofhein,” the Greeks said, “For the love of wondering, they philosophized.” This and this alone should give us reason to be; but who in the world of *The Matrix* is left to wonder, the machines? Is it possible that we have reached the end of this

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<sup>37</sup>Vera Vidal, comments made at the History of Science at the End of the Millenium Symposium in Porto Alegre, Brazil.

<sup>38</sup>For one recent example of this see, Edward O. Wilson, *Consilience. The Unity of Knowledge*. New York: Alfred Knopf, 1998.

<sup>39</sup>Ian Hacking, “Afterthoughts on Construction,” paper delivered at the History of Science at the End of the Millenium Symposium in Porto Alegre, Brazil.

intellectual tradition? I will close this essay with the suggestion that these are the kinds of questions that historians and philosophers of science must ask as we enter the next millennium. I will also take comfort in the thoughts of another thinker, Paul Valéry who wrote the following in the midst of the turmoil of the second world war:

Unpredictability in every field is the result of the conquest of the whole of the present world by scientific power. This invasion by active knowledge tends to transform man's environment and man himself— to what extent, with what risks, what deviations from the basic conditions of existence and of the preservation of life we simply do not know. Life has become, in short, the object of an experiment of which we can say only one thing—that it tends to estrange us more and more from what we were, or what we think we are, and that it is leading us ... we do not know and can by no means imagine where.<sup>40</sup>

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<sup>40</sup>Paul Valéry, “Unpredictability,” in *History and Politics*. Translated by Denise Folliot and Jackson Matthews. New York: Pantheon Press, 1962, p. 71. As cited in Edward Tenner, *Why Things Bite Back*, p.x.

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