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Author(s): Peter Pesic

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Proteus Rebound

Reconsidering the “Torture of Nature”

*By Peter Pesic**

ABSTRACT

Though Carolyn Merchant has agreed that Francis Bacon did not advocate the “torture of nature,” she still maintains that “the very essence of the experimental method arose out of human torture transferred onto nature.” Her arguments do not address serious problems of logic, context, and contrary evidence. Her particular insistence on the influence of the torture of witches ignores Bacon’s skepticism about witchcraft as superstitious or imaginary. Nor do the writings of his successors sustain her claim that they carried forward his supposed program to abuse nature. We should be wary of metaphorical generalizations that ignore the context of the metaphor, the larger intent of the writers, and the fundamental limitations of such metaphors as descriptions of science.

There are no scientific methods which alone lead to knowledge! We have to tackle things experimentally, now angry with them and now kind, and be successively just, passionate, and cold with them. One person addresses things as a policeman, a second as a father confessor, a third as an inquisitive wanderer. Something can be wrung from them now with sympathy, now with force; reverence for their secrets will take one person forwards, indiscretion and roguishness in revealing their secrets will do the same for another. We investigators are, like all conquerors, discoverers, seafarers, adventurers, of an audacious morality and must reconcile ourselves to being considered on the whole evil.

In this provocative aphorism, Friedrich Nietzsche describes modern science using a variety of images, each accenting different aspects of its nature and character, each reflecting basic presuppositions.¹ In general, such metaphorical devices are scarcely

* St. John’s College, 1160 Camino de la Cruz Blanca, Santa Fe, New Mexico 87505-4511; ppesic@sjcsf.edu. I would like to thank Gerald Holton for his advice; Stuart Clark, Bernard Lightman, and the *Isis* referees for their helpful comments; and the John Simon Guggenheim Memorial Foundation for its support.

¹ Friedrich Nietzsche, *Daybreak: Thoughts on the Prejudices of Morality*, trans. R. J. Hollingdale (Cambridge: Cambridge Univ. Press, 1982), p. 185. I thank Gerald Holton for drawing my attention to this quotation.

neutral; they rely on context and emotional implications, which in turn can influence public discourse in important ways. The recurrent image of science as the “torture of nature” has played an especially important part in such broader controversies, especially with regard to the role of science in the treatment of the environment. Works like Carolyn Merchant’s *The Death of Nature* rely on such imagery and accordingly need to be examined with special care to test the fidelity of their insights in terms of historical accuracy and the ways those images are then interpreted and deployed. In a recent forum in these pages, Merchant has responded to my work concerning the status and history of the so-called “torture of nature.”² I appreciate her serious and respectful response to my work; in reply, I wish to correct several significant errors of translation and interpretation, bring forward new material about Bacon’s views on witchcraft, and review how his successors did or did not address the “torture of nature.” These issues remain important because many writers have relied on Merchant as a principal authority on the nature of science flowing from Bacon.³ Thus, careful correction of the historical record here may have far-reaching implications for the way we read not only Bacon but a whole range of thinkers who reflect back on him as a seminal figure. In order to address this long and continuing engagement with Merchant’s views, this essay will especially try to point to writings and evidence of which she does not seem aware and to clarify larger considerations of context and intent she does not treat.

FRANCIS BACON’S ATTITUDE TOWARD NATURE

For centuries, many eminent scholars repeatedly claimed that Francis Bacon advocated that nature should be “tortured” or “put on the rack” in order to reveal her secrets, an image that became widely disseminated as a representation of experimental science.⁴ In 1999 I argued in the pages of this journal that, on the contrary, Bacon never advocated the “torture” of nature. Not only did he never use those phrases (as often as they were misattributed to him); instead, his writings describe experimental science using the imagery of wrestling with Proteus, the godlike Old Man of the Sea, depicting a kind of

² Carolyn Merchant, *The Death of Nature* (San Francisco: Harper & Row, 1980) (hereafter cited as **Merchant, *Death of Nature***), pp. 164–190 (the tenth-anniversary edition [1990] includes a new preface by the author but no changes in the text); and Merchant, “The Scientific Revolution and *The Death of Nature*,” *Isis*, 2006, 97:513–533 (hereafter cited as **Merchant, “Scientific Revolution”**).

³ For instance, Merchant is cited as an authority for the claim that Bacon advocated the “torture of nature” by Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven, Conn.: Yale Univ. Press, 1985), pp. 35–37; Sandra Harding, *The Science Question in Feminism* (Ithaca, N.Y.: Cornell Univ. Press, 1986), pp. 113, 237; Ann Blair, *The Theater of Nature: Jean Bodin and Renaissance Science* (Princeton, N.J.: Princeton Univ. Press, 1997), pp. 229–230; and Elizabeth Hanson, *Discovering the Subject in Renaissance England* (Cambridge: Cambridge Univ. Press, 1998), pp. 20, 25 n 6. Keller repeated her claim that Bacon advocated “putting nature on the rack” in her later collection *Secrets of Life, Secrets of Death* (New York: Routledge, 1992), p. 57. In her recent contribution to the retrospective look at Merchant’s book in these pages (“Focus: Getting Back to *The Death of Nature*: Rereading Carolyn Merchant,” *Isis*, 2006, 97:485–533), Katharine Park also praised Merchant’s “pointed—and in my view generally accurate—analysis of Francis Bacon’s description of the search for natural knowledge in terms of a physically coercive relationship between male inquirer and female nature, expressed in metaphors of marital discipline, inquisition, and rape”: Park, “Women, Gender, and Utopia: *The Death of Nature* and the Historiography of Early Modern Science,” *ibid.*, pp. 487–495, on p. 488.

⁴ I will cite only a few examples among moderate voices sympathetic to Bacon. Ernst Cassirer wrote that “Bacon sits as a judge over reality, questioning it as one examines the accused. Not infrequently he says that one must resort to force to obtain the answer desired, that nature must be ‘put to the rack’”: Cassirer, *The Platonic Renaissance in England*, trans. J. P. Pettegrove (Austin: Univ. Texas Press, 1953), p. 48. Likewise, Charles Webster wrote in *The Great Instauration* (London: Duckworth, 1975) that “nature would be ‘tortured’ into revealing her secrets” (p. 338); so too did Howard White in *Peace among the Willows* (The Hague: Nijhoff, 1968), p. 1.

heroic ordeal in which nature is “vexed” but not abused. In the spirit of Bacon’s famous argument that the worship of “idols” leads to “great infelicity” and “lasting and general agreement in error,” I concluded that because Bacon did not conceive experiment as torture, the time had come to dismiss this strangely prevalent idol.⁵

Accordingly, I welcome Merchant’s recent statement that “Bacon did not use the phrases ‘torture nature’ or ‘putting nature on the rack’ (nor did I claim in *The Death of Nature* that he did so).” Yet her final disclaimer seems odd given her explicit statements in that book that

much of the imagery [Bacon] used in delineating his new scientific objectives and methods derives from the courtroom, and, because it treats nature as a female to be tortured through mechanical inventions, strongly suggests the interrogations of the witch trials and the mechanical devices used to torture witches. . . . The interrogation of witches as symbol of the interrogation of nature, the courtroom as model for its inquisition, and torture through mechanical devices as a tool of the subjugation of disorder were fundamental to the scientific method as power.⁶

How else can these statements by Merchant (which she quotes directly in her recent article) be taken—except as insisting that torture, especially of witches, is explicitly “fundamental to the scientific method as power”? Despite admitting that Bacon never explicitly advocated the “torture of nature,” Merchant nevertheless wants to persuade us that he intended essentially that, as if his avoidance of those charged words was finally immaterial to his implicitly abusive program.

To make her case, Merchant must demonstrate that other statements of Bacon effectively advocate the “torture of nature.” Unfortunately, her discussion of these other passages does not address their detailed context.⁷ For example, she holds that his use of the word “vexation” is synonymous with “torture,” despite extensive textual evidence demonstrating that, in the usage of Bacon and his contemporaries, “vexation” essentially differs from “torture.”⁸ Such evidence cannot be ignored, because it establishes the philological context crucial to understanding any text on its own terms, whereas Merchant’s conflation of “vexation” and “torture” presumes *our* contemporary understanding of these words.

Similarly, in her recent discussion of the term “hounding,” which Bacon also used to

⁵ Peter Pesic, “Wrestling with Proteus: Francis Bacon and the ‘Torture’ of Nature,” *Isis*, 1999, 90:81–94, on p. 94. See also Pesic, “Nature on the Rack: Leibniz’s Attitude towards Judicial Torture and the ‘Torture’ of Nature,” *Acta Leibnitiana*, 1998, 29:189–197; Pesic, “Proteus Unbound: Francis Bacon’s Successors and the Defense of Experiment,” *Studies in Philology*, 2001, 98:428–456; and Pesic, “Shapes of Proteus in Renaissance Art” (unpublished MS). I would especially like to draw attention to Alan Soble, “In Defense of Bacon,” *Philosophy of the Social Sciences*, 1995, 25:192–215, rpt. (with additions and corrections) in *A House Built on Sand*, ed. Noretta Koertge (New York: Oxford Univ. Press, 1998), pp. 195–214; Iddo Landau, “Feminist Criticism of Metaphors in Bacon’s Philosophy of Science,” *Philosophy*, 1998, 73:47–61; Nieves H. De Madariaga Mathews, “Francis Bacon, Slave-Driver or Servant of Nature? Is Bacon to Blame for the Evils of Our Polluted Age?” <http://itis.volta.alessandria.it/episteme/madar1.html>; and Perez Zagorin, *Francis Bacon* (Princeton, N.J.: Princeton Univ. Press, 1998), pp. 121–122. William E. Burns, “‘A Proverb of Versatile Mutability’: Proteus and Natural Knowledge in Early Modern Britain,” *Sixteenth Century Journal*, 2001, 32:969–980, gives further examples of the use of Proteus as an image of nature and agrees that Bacon treats “the struggle with Proteus as one from which both combatants emerge purified,” as opposed to the claim that there is “a hostile and domineering quality of the natural philosopher’s struggle with Proteus” (p. 974).

⁶ Merchant, “Scientific Revolution,” p. 518; and Merchant, *Death of Nature*, pp. 168, 172 (quoted in Merchant, “Scientific Revolution,” p. 518).

⁷ I treated this context in detail in the works cited in note 5, above; and in Peter Pesic, *Labyrinth: A Search for the Hidden Meaning of Science* (Cambridge, Mass.: MIT Press, 2000), to which Merchant does not refer.

⁸ See Pesic, “Wrestling with Proteus” (cit. n. 5), pp. 88–90.

describe experimentation, Merchant adduces “the English foxhunt (outlawed by the British Parliament in 2005 for its excessive cruelty to the hounded and tortured foxes)” to argue that Bacon meant by “hounding” something that she judges violent through its excessive cruelty.⁹ Though I personally agree with Merchant in opposing foxhunting, it would surely be quite anachronistic for us to substitute our opinion for the prevalent view in Bacon’s time that hunting was not “cruel.” Consequently, his use of the term “hounding” cannot be read to signify “using excessive cruelty.” In fact, long before Bacon, the hunt or *venatio* was a familiar metaphor quite lacking in negative connotations.¹⁰

Merchant also does not seem to be aware of the context of a passage she cites in which Bacon supposedly comes “leading to you Nature with all her children to bind her to your service and make her your slave,” for she does not notice that this comes from an early and unpublished manuscript by Bacon, who never wrote of “enslaving” nature in any of his published works. Further, as William Waterhouse pointed out in a letter to this journal, “Bacon said no such thing” in the Latin text of the passage in question, “which means merely ‘In fact, I am about to assign and transfer to you nature with her offspring.’”¹¹

Most troublingly, Merchant’s arguments to establish the abusive implications of Bacon’s language ignore his explicit intent. Let me begin by noting that she and I agree that, as she puts it, “Bacon’s goal was to use constraint and force to extract truths from nature.”¹² In interpreting this “constraint and force,” Bacon’s statement in his *Descriptio globi intellectualis* (1612) should guide us:

But if anyone gets annoyed because I call the arts the bonds of nature when they ought rather to be considered its liberators and champions in that in some cases they allow nature to achieve its ends by reducing obstacles to order, then I reply that I do not much care for such fancy ideas and pretty words; I intend and mean only that nature, like *Proteus*, is forced by art to do what would not have been done without it: and it does not matter whether you call this forcing and enchaining, or assisting and perfecting.¹³

This passage makes explicit both that nature is indeed being “forced by art” *and* that such arts are “liberators and champions,” hence not abusers, whether one uses the words “assisting and perfecting” or “forcing and enchaining” nature. Bacon here warns us about the way he uses metaphor, lest we misinterpret. As if anticipating the foibles of future readers, he disarms

⁹ Merchant, “Scientific Revolution,” p. 528.

¹⁰ See the quotation concerning the chase at note 15, below. See also Paolo Rossi, *Philosophy, Technology, and the Arts in the Early Modern Era*, trans. Salvator Attanasio (New York: Harper, 1970), p. 42; Keith Thomas, *Man and the Natural World: Changing Attitudes in England, 1500–1800* (New York: Oxford Univ. Press, 1983), pp. 29–30, 160–165; William Eamon, *Science and the Secrets of Nature* (Princeton, N.J.: Princeton Univ. Press, 1994), pp. 269–300; and Rossi, “Bacon’s Idea of Science,” in *The Cambridge Companion to Bacon*, ed. Markku Peltonen (Cambridge: Cambridge Univ. Press, 1996), pp. 25–46, esp. p. 31.

¹¹ Benjamin Farrington, *The Philosophy of Francis Bacon* (Liverpool: Liverpool Univ. Press, 1964), p. 62 (whose translation for this passage Merchant cites in *Death of Nature*, p. 170); and William Waterhouse, “Letter to the Editor,” *Isis*, 1999, 90:770–771 (see also my reply). The Latin text reads “Ego . . . revera naturam cum fetibus suis tibi addicturus et mancipaturus.” Waterhouse notes that “it is true that, in Roman law, ‘mancipatio’ can transfer ownership of a slave; but it is also used for land and cattle. They are much more likely to underlie the language here, as ‘fetibus’ is used for calves and crops but only exceptionally for human children.”

¹² Merchant, “Scientific Revolution,” p. 518.

¹³ Citations from Bacon not otherwise identified refer to volume and page numbers in *The Works of Francis Bacon*, ed. James Spedding (London: Longmans, 1857–1874; rpt., New York: Garrett, 1968); the first seven volumes include the *Works*, and the succeeding volumes comprise *The Letters and Life of Francis Bacon*. Where two citations are given for the same passage, the bracketed one refers to the Latin original. Here, then, the reference is 3.729 [5.506]—though in this case I have used the translation of the Oxford edition: Francis Bacon, *Philosophical Studies, c. 1611–c. 1619*, ed. Graham Rees (Oxford: Clarendon, 1996), Vol. 6, pp. 100–101.

their “annoyance” at his choice of metaphor by stating plainly that he does “not much care for such fancy ideas and pretty words,” if they are misunderstood in such a way as to obscure what he explicitly “intends and means”—namely, that nature is “forced by art to do what would not have been done without it.”

Merchant seems to take Bacon’s project of dominion over nature as “forced by art” to involve inherent abusiveness, whereas I read it more neutrally. Even “force” does not necessarily imply abuse; would someone forced to answer a question during a trial (say, by order of a judge) rightly be said to be abused? The matter rests on the legitimacy of the tribunal and the propriety of its question, just as the political term “dominion” raises the question of legitimacy. Everything hangs on how such legitimacy is understood, for I doubt that Merchant denies the possibility of *any* legitimate government or judicial questioning, hence of legitimate scientific “interrogation” of nature.

Here we cannot be simply guided by analogy to arguments that condemn the sexual harassment of a human being through “hounding,” “vexation,” and “pestering.” We cannot equate a metaphorical figure of Nature with a human female, the natural world being neither human nor female, unless we assume the literal truth of the traditional feminine image of Mother Nature.¹⁴ Indeed, the force of Merchant’s argument emerges most clearly in cases when animate beings are the subject of such interrogation, when the suffering of experimental animals or the horrors of environmental abuse cry out for redress. Yet it would be quite illogical to blame Bacon and science for abusive experiments and ecological disaster, fallaciously arguing that, because science and experiment *have* been abused, they *must* be intrinsically abusive. On the contrary, the very possibility of abuse logically rests on the possibility of legitimate use.

Merchant never mentions that Bacon himself warned against what he considered cruel or abusive experiments.¹⁵ Nor was his concern limited to animate beings: Bacon compared the alchemists’ excessive use of fire with Vulcan’s attempt to rape Minerva, which clearly shows that he condemned even an attempted “rape” of nature as both illegitimate and futile, contradicting those who have taxed him with such designs.¹⁶ Instead, his preferred images of experimental procedure are notably feminine and maternal, comparing the “handcuffs” of a properly controlled experimental apparatus to the natural warmth of the womb.¹⁷

¹⁴ Catharine Gimelli Martin has argued that Bacon’s “‘Nature’ is never securely masculine or feminine. Like his shape-shifting Proteus, natural realities are on the one hand passive matter awaiting conquest, and on the other supremely active gods or goddesses scheming to outwit the passive human mind. As a result, Bacon never securely represents the mind needed to ‘marry’ things themselves as either passive or active, feminine or masculine.” See Martin, “The Feminine Birth of the Mind: Regendering the Empirical Subject in Bacon and His Followers,” in *Francis Bacon and the Refiguring of Early Modern Thought: Essays to Commemorate The Advancement of Learning (1605–2005)*, ed. Julie Robin Solomon and Martin (Aldershot: Ashgate, 2005), pp. 69–88, on p. 70, which also refers to Evelyn Fox Keller, “Baconian Science: An Hermaphroditical Birth,” *Philosophical Forum*, 1980, 11:299–308. Susan Haack, *Defending Science—Within Reason: Between Scientism and Cynicism* (Amherst, N.Y.: Prometheus, 2003), advises that, “rather than disparaging a stereotyped science misperceived as embodying stereotypically masculine values, we need to rid ourselves of stereotypes, both of women and of science” (p. 316). Would it not be unfortunate if young women, told that science learned from the torture of female witches to abuse Mother Nature herself, concluded that they should have nothing to do with science?

¹⁵ He argued, e.g., that “to prosecute such inquiries concerning perfect animals by cutting out the fetus from the womb would be too inhuman, except when opportunities are afforded by abortions, the chase, and the like” (4.202 [1.316]). Note that this explicitly qualifies “the chase” (hunting) as not inhuman, following what he evidently considered common opinion (see note 10, above).

¹⁶ Both Vulcan and the alchemists, through “much vexing of bodies to force Nature,” got only “imperfect births and lame works” (6.736). See also Stanton J. Linden, “Francis Bacon and Alchemy: The Reformation of Vulcan,” *Journal of the History of Ideas*, 1974, 35:547–560. On the “rape of nature” see note 3, above, and note 34, below.

¹⁷ In his account of the “handcuffing” of Proteus in *De augmentis scientiarum*, Bacon notes that “the heat must

Bacon reminds us that, whatever metaphorical language we may choose, in the end we are at nature's mercy, for "you may deceive nature sooner than force her" (4.324). If, as he tells us, "nature to be conquered must be obeyed" (4.32), any attempt to exert "dominion" over nature must finally be an act of obedience to her far greater power. Far from advocating the "rape of the environment," this caution delineates a robust basis for ecological concern by conceding only appropriate and guarded power to human judgment.

BACON AND THE ISSUE OF WITCHCRAFT

Merchant has consistently used "the interrogation of witches as symbol of the interrogation of nature," a discussion she repeated and expanded in her recent article to include graphic accounts of torture with pictures of its instrumentalia. Much of this is really superfluous, for there has never been any doubt that King James advocated and supervised the torturous interrogation of witches. Despite her disclaimers, however, Merchant does not seem to recognize the many respects in which these monstrous proceedings cannot be extended to describe either Bacon's own beliefs or Baconian science.¹⁸ Lacking such proof, her extended narration of torture practices and implements, juxtaposed with passages from Bacon's writings, appears to condemn him merely by association with his royal master.

In fact, Merchant admits that "Bacon did not advocate the practice of torture or use of the rack on human beings," here agreeing with Nieves Mathews's exhaustive documentary demonstration that Bacon was no "rackmaster." We must then examine the substance of Merchant's claim about "the interrogation of witches as symbol of the interrogation of nature." I agree with her that Bacon "believed that witchcraft and sorcery could reveal useful information," for he does remark that "neither am I of opinion in this history of marvels, that superstitious narratives of sorceries, witchcrafts, charms, dreams, divinations, and the like, where this is an assurance and clear evidence of the fact, should be altogether excluded" (4.296). Citing this passage from *The Advancement of Learning* in parallel versions from English (1605; 3.330–331), Latin (1623; 1.496–498), and French (1624), Merchant wishes to show that Bacon's respect for the king's "own example," his supposed "entering and penetrating into these holes and corners [*antra*]," should be interpreted as alluding expressly to James's examination of sexual marks on witches, by extension imputing a similar character to Baconian science.¹⁹

Here Merchant has been misled by James Spedding's 1875 translation; as Waterhouse points out, "*antra*" is a poetic term for caverns or grottos, which, "in the context of witchcraft, most readers in the 1600s would associate . . . with the vast *antrum* where Aeneas met the Sibyl and found the way to the underworld."²⁰ This hardly suggests the kind of sexual transgression Merchant finds in the phrase "holes and corners." Nor does

be so regulated and varied, that there be no fracture of the vessels. For this operation is like that of the womb, where the heat works, and yet no part of the body is either emitted or separated" (4.420–421 [1.632]).

¹⁸ Karen Green and John Bigelow, "Does Science Persecute Women? The Case of the Sixteenth–Seventeenth Century Witch-Hunts," *Philosophy*, 1998, 73:195–217, argues that, rather than being "early scientists," "the witch-hunters were practising bad science" because their "methods were unreliable" (pp. 200, 198, 204). On King James and the torture of witches see, e.g., Wallace Notestein, *A History of Witchcraft in England from 1558 to 1718* (New York: Crowell, 1968), pp. 93–145. Stuart Clark notes in a personal communication to me that in Scotland James's Privy Council moved quickly to intervene when prosecutions got out of hand, while in England the judiciary was notably reluctant to prosecute the 1603 statute against witches.

¹⁹ Merchant, "Scientific Revolution," pp. 524, 526, Table 1; Nieves Mathews, *Francis Bacon: The Story of a Character Assassination* (New Haven, Conn.: Yale Univ. Press, 1996); and Mathews, "Francis Bacon, Slave-Driver or Servant of Nature?" (cit. n. 5).

²⁰ See Waterhouse letter (cit. n. 11). Bacon's Latin text reads "Neque certe haesitandum de ingressu et

her connection of “nature as female” with the interrogation of witches square with her own acknowledgment that witches could be men as well as women.²¹ This, in turn, undermines her connection between the torture of specifically *female* witches and the Baconian interrogation of (female) nature.²²

If we are to judge his relation to witchcraft, Bacon’s attitude needs more clarification than Merchant or I have previously given. In the passage we have been discussing, Bacon’s allusion to James’s activities as witch hunter is remarkably evasive and diplomatic, especially given the more extreme aspects of the king’s opinions on the subject.²³ Certainly Bacon does not praise the king’s activities as torturer, which would have been inconsistent with Bacon’s disavowal of torture, already acknowledged by Merchant. Nor does he in any way express agreement with the king’s opinions about the dangers of witches; he merely states that “superstitious narrations of sorceries, witchcrafts, dreams, divinations, and the like” are not to “be altogether excluded. For it is not yet known in what cases, and how far, effects attributed to superstition do participate of natural causes; and therefore howsoever the practice of such things is to be condemned, yet from the speculation and consideration of them light may be taken, not only for the discerning of the offences, but for the further disclosing of nature” (3.330–331 [4.296]).²⁴

Here, Bacon clearly indicates that he considers most narrations of witchcraft to be “superstitious,” a daringly frank word, given the king’s well-known beliefs and public activities to the contrary. Bacon only allows guardedly that “the speculation and consideration” of such “effects attributed to superstition” conceivably could “participate of natural causes.” It is hard to imagine how more coldly he could receive the king’s beliefs nor indicate his own contrary sense that witchcraft was mere superstition, though he

penetratione intra hujusmodi antra et recessus”; for the Sybil’s cave, “horrendaeque procul secreta Sibyllae, / antrum immane,” see Virgil, *Aeneid* 6.10–11.

²¹ Merchant refers to male witches in “Scientific Revolution,” p. 525. Many other references confirm that men could be considered witches or to conduct witchcraft; see Hugh Trevor-Roper, *The European Witch-Craze of the Seventeenth Century and Other Essays* (New York: Harper & Row, 1969), pp. 156–157. See the evidence collected in R. Briggs, “Women as Victims? Witches, Judges, and the Community,” *French History*, 1991, 5:438–450; and Stuart Clark, *Thinking with Demons: The Idea of Witchcraft in Early Modern Europe* (Oxford: Clarendon, 1997): “men made up a significant minority or even a substantial portion of those accused” (p. 129). Note that King James the First, *Dæmonologie* (1597) and *Newes from Scotland* (1591) (New York: Barnes & Noble, 1966), divides the “unlawfull artes” into two parts, “whereof the one is called *Magie* or *Necromancie*, the other *Sorcerie* or *Witch-craft*” (p. 7), implying that he considered “sorcery” and “witchcraft” to be synonymous. Further, James’s character Epistemon asserts that “where the Deuill findes greatest ignorance and barbaritie, there assayles he grosseliest, as I gaue you the reason wherefore there was moe Witches of women kinde nor men” (p. 69). *Newes from Scotland* describes how King James caused “Doctor Fian, alias Iohn Cunningham,” to be brutally tortured and executed for “his witchcrafte” (p. 19).

²² Nor is it logical for Merchant to dismiss Soble’s point (“In Defense of Bacon” [cit. n. 5], p. 205) that the masculinity of Proteus indicates that it is not only a feminine nature that science seeks to interrogate; Bacon’s inclusion of a female nature and a male Proteus in the same sentence (4.298) undermines Merchant’s attempt to argue that “Bacon’s treatment of nature as female legitimated the control of nature through science and technology”: Merchant, “Scientific Revolution,” pp. 518–519; for the dismissal of Soble’s point see p. 529.

²³ Stuart Clark reads this passage in Bacon *not* as regarding the use of torture on witches but, rather, as pertaining to the king’s primary inquiry, which sought to determine of witchcraft and sorcery—as James put it—“what kinde of things are possible to be performed in these arts, & by what naturall causes they may be”: King James the First, *Dæmonologie* (cit. n. 21), p. xii. See Clark, “The Scientific Status of Demonology,” in *Occult and Scientific Mentalities in the Renaissance*, ed. Brian Vickers (Cambridge: Cambridge Univ. Press, 1984), pp. 351–374, esp. p. 363.

²⁴ In allowing that natural phenomena or possibly “a tacit operation of malign spirits” (2.658) might be involved, Bacon shows himself to occupy the “vast middle ground occupied by hundreds of texts where genuine attempts are made to discriminate between what is to be accepted and what rejected”: Clark, “Scientific Status of Demonology,” p. 358. See also D. P. Walker’s comment about demonology as “an aspect of early modern science that has not yet . . . been investigated”: Walker, *Unclean Spirits: Possession and Exorcism in France and England in the Late Sixteenth and Early Seventeenth Centuries* (London: Scholar, 1981), p. 13.

agrees “that the practice of such things is to be condemned”—as how could he not? Characteristically, Bacon takes the opportunity to urge “the further disclosing of nature” as the justifiable response to this and other putative natural phenomena.

Bacon openly dismisses such common reports of witches as were the basis for their interrogation under torture.²⁵ He notes that “in all times, in the opinion of the multitude, witches and old women and imposters have had a competition with physicians. And what followeth? Even this, that physicians say to themselves, as Salomon expresseth it upon an higher occasion: *If it befall to me as befalleth to the fools, why should I labour to be more wise?*” (3.372). How more clearly could Bacon imply that those who believe in witchcraft are fools, without openly mocking the king? By coupling “witches and superstitious persons” (2.656), Bacon indicates his opinion of their probity.²⁶ Instead, he attributes the powers of witches to the imagination of the credulous, not to any “immaterial virtue.”²⁷ Nor should the king fear witchcraft, “for it is hard for a witch or sorcerer to put on a belief that they can hurt such persons” if they do not give it credence (6.642).²⁸ Indeed, as Merchant notes, James’s opinions later changed, so that he “came to believe that many witches were either deluded or prevaricators.” Yet in light of the king’s earlier vehemence, we should recognize Bacon’s courage in going as far as he did. If, as Hugh Trevor-Roper argued, the “new philosophy” of Bacon and Descartes “ultimately destroyed the witch-

²⁵ This is also the conclusion drawn by Notestein, *History of Witchcraft* (cit. n. 18), pp. 246–247. When Bacon recounts that “the ointment that witches use is reported to be made of the fat of children digged out of their grave,” he immediately adds: “but I suppose that the soporiferous medicines are likeliest to do it; which are henbane, hemlock, mandrake, moonshade, tobacco, opium, saffron, poplar-leaves, &c.” (2.664). Clearly, he thinks that such sleep-inducing drugs can induce the illusions superstitiously attributed to witches’ gruesome potions.

²⁶ To complete the list of Bacon’s references to witchcraft, let me also note his very brief mention that “in Zant it is very ordinary to make men impotent to accompany with their wives”; he asserts that “the mothers themselves do it, by way of prevention; because thereby they hinder other charms, and can undo their own. It is a thing the civil law taketh knowledge of; and therefore is of no light regard” (2.634). On the same page, he mentions “that amongst the Leucadians, in ancient time, upon a superstition, they did use to precipitate a man from a high cliff into the sea; tying about him with strings, at some distance, many great fowls; and fixing unto his body divers feathers,” which he takes as an invitation for “further extension of this experiment,” not as a demonstration of the powers of witchcraft.

²⁷ Bacon notes that “if there be any power in imagination, it is less credible that it should be so incorporeal and immaterial a virtue, as to work at great distances” but, rather, is “conveyed from man to man, as fame is; as if a witch by imagination should hurt any afar off, it cannot be naturally, but by working upon the spirit of some that cometh to the witch; and from that party upon the imagination of another” (2.657). Thus, “boys and young people” are more susceptible to “what hath been used in magic (if there be in those practices any thing that is purely natural); as vestments; characters; words, seals; some parts of plants, or living creatures; stones; choice of the hour; gestures and motions; also incenses and odours; choice of society, which increaseth imagination,” as well as “Scripture words,” “images of wax, and the like; or some other things burying in muck, that should putrefy by little and little” (2.656–657). Even the “hammer of witches”—Heinrich Kramer and James Sprenger, *The Malleus Maleficarum*, trans. Montague Summers (New York: Dover, 1971)—notes the effects of imagination on alleged occurrences of witchcraft, for “sometimes persons only think that they are molested by an Incubus when they are not so actually; and this is more apt to be the case with women than with men, for they are more timid and liable to imagine extraordinary things” (p. 167). For a helpful discussion of Bacon’s use of imagination see Katharine Park, “Bacon’s ‘Enchanted Glass,’” *Isis*, 1984, 75:290–302.

²⁸ In this Bacon may have been influenced by Pietro Pomponazzi, who had argued that “apparitions were natural phenomena and that ‘men possessed by the devil’ were melancholic”; see Trevor-Roper, *European Witch-Craze* (cit. n. 21), pp. 131–132. For Bacon’s relation to Pomponazzi see Sachiko Kusukawa, “Bacon’s Classification of Knowledge,” in *Cambridge Companion to Bacon*, ed. Peltonen (cit. n. 10), pp. 47–74, esp. pp. 55–56; and Ian Maclean, “White Crows, Graying Hair, and Eyelashes: Problems for Natural Historians in the Reception of Aristotelian Logic from Pomponazzi to Bacon,” in *Historia: Empiricism and Erudition in Early Modern Europe*, ed. Gianna Pomata and Nancy G. Siraisi (Cambridge, Mass.: MIT Press, 2005), pp. 147–180. For Pomponazzi’s critique of witchcraft see Clark, *Thinking with Demons* (cit. n. 21), p. 243.

craze, on an intellectual level,” it would be especially unjust to accuse Bacon of advocating a “witch-hunt” on nature.²⁹

Approaching these questions quite differently than Trevor-Roper, Stuart Clark has analyzed in detail how “witchcraft (and allied) beliefs made whatever sense they did during their period of maximum appeal to intellectuals,” including Bacon,

who gave not only one of the most effective fresh defenses of the study of preternature but, by placing it at the centre of his *Instauratio magna*, one of the most influential as well. At the same time, his discussion signals a crucial stage in the absorption of natural marvels by a more expansive *scientia naturalis*, a shift in the balance of categories that underlies many of the changes in early modern scientific thought.

Beyond Bacon’s well-attested interest in natural magic, “demonology’s chief explanatory rival,” Clark further hypothesizes that “the real intellectual distance between a figure like Bacon and the world of demonology may not after all be as great as might be assumed,” though also noting that Bacon “talked as though it was a personified nature itself that erred, not a nature acted on by demonic forces.”³⁰ Here nuances of tone become important. Clark’s wide reading of various “misgivings about the right attribution of phenomena” expressed by different writers leads him to conclude that these doubts came both “from demonology itself, as well as from the opponents of witch trials.”³¹ The question here is whether Bacon’s guarded, critical language, cited above, situates him not far from “the world of demonology” (as Clark suggests) or whether, instead, his tone should be read as politic, ironic, and ultimately distant from witchcraft (as I have argued here).

Nevertheless, even if one were to assume hypothetically that Bacon sincerely considered demonology an important subject, Clark nowhere indicates that Bacon advocated pursuing such investigations through torture—either of witches or of nature in general. In general, Clark treats demonology as a cool theoretical *scientia*, though commenting occasionally on the issue of torture, its legal difficulties, abuses, and critics, noting that “we should beware of thinking of it solely in secular and ultimately negative terms as simply a piece of sadistic barbarism. Revelation is not, after all, falsifiable.”³² Yet even as Clark argues that we should reconsider our presumptions about torture and witchcraft, he recognizes that “tying demonism to ultimately natural causes had the necessary consequence of tying orthodox demonology to a particular natural philosophy—that of late

²⁹ Merchant, “Scientific Revolution,” p. 525; and Trevor-Roper, *European Witch-Craze*, p. 180. The *Malleus Maleficarum* asserted that “people who hold that witches do not exist are to be regarded as notorious heretics”: Kramer and Sprenger, *Malleus Maleficarum*, trans. Summers (cit. n. 27), pp. 8–11, on p. 8. Bacon knew the case of Johann Weyer, whose *De praestigiis demonum* (1563), arguing that the activities of witches were illusions, so incensed King James that he ordered his books to be burned and wrote that Weyer “plainly bewrayes himself to haue bene one of that profession”: King James the First, *Dæmonologie* (cit. n. 21), p. xii. For Weyer’s critique in relation to his own beliefs about witchcraft see Clark, *Thinking with Demons*, pp. 198–205. Trevor-Roper notes that through the seventeenth century, “lenient judges were denounced as enemies of the people of God, drowsy guardians of the beleaguered citadel. Perhaps these ‘patrons of witches’ were witches themselves”: Trevor-Roper, *European Witch-Craze*, pp. 96–97. Along with the cases of imposture that increasingly troubled James, Bacon’s skepticism may also have moved the king to change his position.

³⁰ Clark, *Thinking with Demons*, pp. 683, 252, 194, 256. On p. 184 Clark locates all preternatural phenomena (*mira*) “somewhere on a grid with four reference points: the demonic; the non-demonic; the true; the false.”

³¹ *Ibid.*, p. 195.

³² *Ibid.*, pp. 591–593, on p. 592; torture is also discussed on pp. 141, 198, 205–208, 518–519, 550, 581. On p. 591 Clark notes that “when the accused were actually beaten with heavy candles it becomes difficult to say just what was going on—whether a torture, an exorcism, or an ordeal”; am I wrong to hear a certain note of humor?

medieval and early modern scholasticism, with its Christianised Aristotle and animistic physics and cosmology.”³³ Insofar as Bacon was important in overturning just this natural philosophy, the direction of his thought ultimately pointed away from demonology and any putative “witch-hunt upon nature.”

BACON'S SUCCESSORS

Bacon's opinions need careful comparison with those of later scientists, for we cannot assume that his successors simply echoed him. Merchant concludes “The Scientific Revolution and *The Death of Nature*” by reviewing the ways in which “Bacon's words and work influenced the growth of scientific societies and experimentation in the early modern period.” As in *The Death of Nature*, she continues to argue that “Bacon's efforts to define the experimental method were buttressed by his rhetoric and that the very essence of the experimental method arose out of techniques of human torture transferred onto nature.”³⁴ Having refuted this claim in the case of Bacon himself, I turn to the larger question of whether it applies to his successors, for Merchant argues that “these philosophers certainly interpreted him that way. To them, the rack exemplified the constraint of nature in a closed, controlled system, responding to questions posed by an inquisitor before witnesses—the very core of experimentation itself.”³⁵ I do not object to the notion of experiment as “the constraint of nature in a closed, controlled system,” except for the odious and abusive overtones of the metaphor of torture as a description of “the very core of experimentation itself.”

Merchant argues that so many others could not have followed Bacon had he not given them warrant, but she neglects the way a common claim may come to be repeated without question as to whether it is true—especially if that claim is rhetorically vivid. Merchant's own writings are a case in point, for though she asserts that she never claimed that Bacon used “the phrase ‘torture nature’ or ‘putting nature on the rack,’” many other authors have cited her as a principal authority to make this claim themselves, indicating (following her argument just given) that they interpreted her as having made that claim, despite her disclaimer.³⁶ Ironically, in her new paper, Merchant now cites as authorities some of the very people who cited *her* as their principal source!³⁷ Surely this curious circularity constitutes no argument at all but, rather, a testimony to the human weakness of scholars, of which Merchant gives an unintentional example by citing Thomas Kuhn on “experiments Bacon himself described as ‘twisting the lion's tail.’” This is surely a memorable turn of phrase—but Bacon never used it anywhere in his works.³⁸ Here Kuhn was probably repeating something he read elsewhere, without real-

³³ *Ibid.*, p. 153. Clark noted in a personal communication to me that we should also bear in mind the overlap between the older natural philosophy and the traditions of natural magic, which continued to interest Bacon. Clark's work has situated questions about demonology precisely in this overlapping territory.

³⁴ Merchant, “Scientific Revolution,” pp. 530, 532. In her recent writings she has continued to assert that Bacon's arguments “subtly turned into sanctions for exploiting and ‘raping’ nature for human good”: Carolyn Merchant, *Radical Ecology: The Search for a Livable World*, 2nd ed. (New York: Routledge, 2005), pp. 45–46.

³⁵ Merchant, “Scientific Revolution,” p. 528.

³⁶ See the examples cited in note 3, above.

³⁷ Merchant, “Scientific Revolution,” p. 527 n 36, cites Fritjof Capra's use of “the torture chamber to illustrate the torture of nature under mechanistic science,” whereas Capra himself specifically cites Merchant as *his* source in *The Turning Point: Science, Society, and the Rising Culture* (New York: Bantam, 1982), p. 56 nn 5, 6. The late Nieves Mathews pointed out this misreading of Bacon to Capra, who acknowledged her point but refused to correct his widely read text: N. H. Mathews to Peter Pesic, private communication.

³⁸ Merchant, “Scientific Revolution,” p. 531; note also the title of Lesley B. Cormack's essay “‘Twisting the Lion's Tail’: Practice and Theory in the Court of Henry, Prince of Wales,” in *Patronage and Institutions*:

izing the misattribution, nor Merchant likewise. Compassion for human frailty and the difficulty of the scholar's lot ought not lead us to enshrine such errors as established truth, however often they might be repeated.

Beyond avoiding such mistakes, we need also to seek full understanding of context and intent. Merchant notes that Leibniz may have been the first, in 1696, to write of "the art of inquiry into nature itself and of putting it on the rack—the art of experiment which Lord Bacon began so ably."³⁹ One does wonder why, if indeed Bacon had so clearly set the new science on the path of torturing nature, this phrase was not used in writing until almost a century later. The obvious inference is that, on the contrary, no one took Baconian science to imply any such thing. The greater irony is that neither did Leibniz himself, even as he used this vivid image for (perhaps) the first time. In fact, he detested the examination through torture of those accused of witchcraft, which he thought had "been pernicious to many innocent persons." By the time he wrote, torture had already been banned by the enlightened Elector of Mayence, whom Leibniz knew and respected.⁴⁰ Leibniz's references to torture thus were not so much concerned with the application of a procedure that was already on the way out, abolished in most European states within the next decades; instead, he used the topic to represent metaphorically the legal quest for the greatest possible *certainty* in important cases where any doubt remains.⁴¹

To gauge the tone and context of Leibniz's remarks, we must bear in mind that he (like Bacon) was an eminent legal scholar.⁴² In this capacity, Leibniz was concerned that, though Roman-canon law required *two* eyewitnesses to establish guilt, this might not be enough to achieve sufficient certainty in capital crimes, because "without doubt the reliability of two witnesses in a case of such moment varies to a great extent. . . . And from

Science, Technology, and Medicine at the European Court, 1500–1750, ed. Bruce T. Moran (Woodbridge, Suffolk: Boydell, 1991), pp. 67–84. The *Oxford English Dictionary* glosses this phrase as first appearing in 1895 (s.v. twist, v.) in American usage, "twisting the tail" of the (Brittanic) lion, meaning "to provoke the resentment of the British people," later extended more generally to mean "to annoy, to coerce (someone)." For the political context see John Moser, *Twisting the Lion's Tail: American Anglophobia between the World Wars* (New York: New York Univ. Press, 1998).

³⁹ Merchant, "Scientific Revolution," p. 526. This phrase comes from a letter Leibniz wrote to Gabriel Wagner concerning the value of logic; see Gottfried Wilhelm Leibniz, *Philosophical Papers and Letters*, 2nd ed., ed. Leroy E. Loemker (Dordrecht: Reidel, 1958), p. 456. For a detailed discussion of Leibniz's position see Pesic, "Nature on the Rack" (cit. n. 5), which Merchant quotes on this matter.

⁴⁰ This quotation comes from a letter dated 13 Aug. 1696; see G. W. Leibniz, *Textes inédits*, ed. Gaston Grua (Paris: Presses Univ. France, 1948), Vol. 2, p. 851. The elector had been moved by the Jesuit Friedrich Spee (1591–1635), who had pointed out the abuses of torture in his *Cautio criminalis* (1631). The elector confided to Leibniz that "of the enormous number of presumed criminals which the good Father [Spee] had accompanied to the stake as a confessor, about which he had tried in every way to discover the truth, he could not say that he had found a single one whom he truly believed to be a sorcerer." The elector was so convinced by this testimony that "as soon as he became bishop he caused these procedures to cease, which had been only too common in Franconia." *Ibid.*, Vol. 1, pp. 104–105; this also contains Leibniz's praise of Spee. For Spee's critique in relation to Weyer and other skeptics' beliefs about witchcraft see Clark, *Thinking with Demons* (cit. n. 21), pp. 205–213.

⁴¹ See John H. Langbein, *Torture and the Law of Proof* (Chicago: Univ. Chicago Press, 1977), pp. 8–12, 61–69; the beginning of the campaign to end torture is sometimes identified with Christian Thomasius's dissertation *Über die Folter* (1705), to whose legal work Leibniz refers in his *Textes inédits*, ed. Grua, Vol. 2, p. 658.

⁴² Though Leibniz was not a practicing magistrate, he was trying to bring the law of his time into some rational order; see Georges Kalinowski, "La logique juridique de Leibniz," *Studia Leibnitiana*, 1977, 9:168–189. For general accounts of Leibniz's juridical writings see Patrick Riley, *Leibniz' Universal Jurisprudence* (Cambridge, Mass.: Harvard Univ. Press, 1996); and Gaston Grua, *La justice humaine selon Leibniz* (Paris: Presses Univ. France, 1956). See also Gottfried Wilhelm Leibniz, "Meditation on the Common Concept of Justice" (ca. 1702–1703), trans. in Leibniz, *Political Writings*, 2nd ed., ed. Riley (Cambridge: Cambridge Univ. Press, 1988), pp. 45–64; and Leibniz, "Bedenkenswertes Bemerkungen über die Jurisprudenz" (1676), in Leibniz, *Politische Schriften* (Frankfurt: Europäische Verlagsanstalt, 1967), Vol. 2, pp. 94–103.

this beginning it is agreed that so much perjury and the condemnation of innocent persons recently arose in England,” whose common law was satisfied with the far lesser standard of proof “beyond a reasonable doubt” in the eyes of a jury composed of laymen, not jurists. Hence Leibniz argued that “proof, however, must be more than half strength (and, if it is allowed to speak thus, to exceed three-quarters).”⁴³ The legal context of Leibniz’s words shows that, in using the metaphor of torture with regard to science, Leibniz meant that Baconian experiment aims to understand nature at the highest level of certainty, not just through probable or circumstantial evidence that leaves some doubt. He emphatically did *not* mean that Bacon is to be praised for torturing nature in the abusive, cruel sense Leibniz explicitly disavowed.

Merchant also does not seem aware of substantial evidence that does not support her claim that, for those who followed Bacon, “the very essence of the experimental method arose out of techniques of human torture transferred onto nature.” On the contrary, Samuel Hartlib (1630) used the image of torture in a negative sense to characterize the *old* science, not the new.⁴⁴ Two prominent early members of the Royal Society, John Evelyn (1664) and Joseph Glanvill (1668), characterized experimentation with the charged term “evisceration,” but they used it in a clearly positive sense, to express the depth and exhaustiveness of experiment.⁴⁵ Though Merchant quotes Thomas Sprat’s *History of the Royal Society* (1667) for its accounts of some animal experimentation that Bacon would have found too cruel, she does not notice that Sprat himself used the image of torture to depict the fallacious proceedings of solitary thinkers *before* the advent of the new philosophy.⁴⁶ Among the poets, Abraham Cowley transformed Proteus into a female figure caught up in an intense intimacy with the scientist, their intercourse no scene of rape but, rather, of mystery jointly disclosed.⁴⁷ John Milton evoked “Proteus unbound” to compare alchemical wrestling with matter to the natural alchemy of the “Arch-chimic Sun.”⁴⁸ Among

⁴³ Leibniz, *Textes inédits*, ed. Grua, Vol. 2, p. 882 (cit. n. 40); and Gottfried Wilhelm Leibniz, *Nova methodus discendae docendaeque jurisprudentiae* (1667), in Leibniz, *Sämtliche Schriften und Briefe* (Berlin: Akademie-Verlag, 1966), Vol. 6, Pt. 1, pp. 311–312.

⁴⁴ Merchant, “Scientific Revolution,” p. 532. Pesic, “Proteus Unbound” (cit. n. 5), to which Merchant does not refer, gives the full evidence summarized in this paragraph, including quotations from the sources and the philological context needed to judge the contemporary meaning and connotations of crucial terms like “evisceration” and “ripping up.” The Hartlib letter cited is Samuel Hartlib to John Dury, 13 Sept. 1630, rpt. in *Samuel Hartlib and the Advancement of Learning*, ed. Charles Webster (Cambridge: Cambridge Univ. Press, 1970), p. 77.

⁴⁵ John Evelyn, *Sylva; or, A Discourse of Forest-Trees*, 3rd ed. (London: John Martyn, 1679), Preface to Reader; and Joseph Glanvill, *Plus Ultra: or, The Progress and Advancement of Knowledge since the Days of Aristotle* (Gainesville, Fla.: Scholars’ Facsimiles & Reprints, 1958), p. 11. For a careful reading of Evelyn’s *Sylva* in relation to Baconianism see William T. Lynch, *Solomon’s Child: Method in the Early Royal Society of London* (Stanford, Calif.: Stanford Univ. Press, 2001), pp. 34–69. Merchant herself praises Evelyn as a prophet of ecology in *Death of Nature*, pp. 236–242.

⁴⁶ Thomas Sprat, *History of the Royal Society* (London, 1667), ed. Jackson I. Cope and Harold Whitmore Jones (Saint Louis, Mo.: Washington Univ. Press, 1958), pp. 102–103. See also Lynch, *Solomon’s Child*, pp. 157–196.

⁴⁷ See Abraham Cowley, “Ode upon Dr. Harvey” (1663), in *The Complete Works in Verse and Prose of Abraham Cowley* (New York: AMS Press, 1967). Martin, “Feminine Birth of the Mind” (cit. n. 14), also reads Cowley as “disrupting the logocentric masculinism of earlier tradition” because “the sensuous feminine mind can now be used to symbolize a prudential civic pragmatism capable of adapting the wilderness of male ‘wit’ to the practical uses of society.” By ending “that truly artificial divide” between mechanical work and science, “Bacon did more than insure the possibility of scientific progress: he helped assure the future progress of women. His similarly rhetorical reconciliation of feminine with masculine powers pointed the way toward more real cooperation between the sexes and less rigid divisions of labor in marriage” (pp. 86–87).

⁴⁸ Milton invokes and changes the image of Proteus as Satan lands on the Sun in *Paradise Lost*, Bk. 3, ll. 599–605. Martin, “Feminine Birth of the Mind,” connects Bacon’s “analysis and its characteristic tropes” to Milton, including Eve’s “natural bent toward empirical inquiry” in *Paradise Lost*; she also argues that Milton’s “radical new paradigm” of marriage and divorce “agrees with Bacon that the essence of marriage is equal and

eminent practitioners of the new philosophy, Robert Hooke echoed Bacon's sentiments closely, but chose even milder metaphors.⁴⁹ Robert Boyle's unpublished writings clarify his rejection of cruelty and torture, though he undertook vivisections Bacon would have rejected.⁵⁰ Finally, Isaac Newton treats experiment as a "trial" that needs no metaphoric justification because of its mathematical purity.⁵¹

I do agree with Merchant that some cruel experiments were performed on animals, but textual evidence shows that some contemporary scientists (including Boyle) found them disturbing, not simply necessitated by the "torture of nature." Merchant does not comment on a number of troubling moral issues. After describing abhorrent experiments in which "a dog was injected with opium, then whipped and beaten to keep it alive," she immediately turns to early blood transfusion experiments, first animal-to-animal, then animal-to-human, as if such trials should be considered equally monstrous. Though I too am disturbed by the suffering of these animals and humans, I am less sure than she seems to be that the development of blood transfusion should be represented as a horror of the "torture of nature" by abusive science, given how many lives have been saved by transfusions. We cannot ignore such crucial and difficult moral issues.⁵²

Merchant may be so eager to save Mother Nature from abuse that her arguments too sweepingly condemn all the interventions of science, as if all of them equally acted to despoil the environment. For every use of scientific knowledge to pollute, others can act to undo such damage or even to improve the condition of the environment. Merchant herself recognizes that "obviously Bacon cannot be held individually responsible for the positive or negative implications or applications of his ideas," which perforce applies to subsequent scientists.⁵³ This clearly implies that the abuse of science by human greed cannot be charged against science itself, especially if such abuse was never part of the scientific program. Human overreaching always grasps whatever it finds at its disposal, whether that means seizing a stick to beat its enemies or misusing the powers of modern science and technology. But those powers can also be used positively, to remedy the harm

delightful 'conversation'" (pp. 82–86; the quotation is from p. 83). See also Catharine Gimelli Martin, *The Ruins of Allegory: "Paradise Lost" and the Metamorphosis of Epic Convention* (Durham, N.C.: Duke Univ. Press, 1998); Karen Edward, *Milton and the Natural World* (Cambridge: Cambridge Univ. Press, 2000); and Martin, "What If the Sun Be Centre to the World?" Milton's Epistemology, Cosmology, and Paradise of Fools Reconsidered," *Modern Philology*, 2001, 99:231–265.

⁴⁹ See Robert Hooke, *Micrographia* (London, 1665; New York: Dover, 1961), pp. 3 [of the Preface], 1, 186; see also Hooke's manuscript "A General Scheme, or Idea of the present state of Natural Philosophy, and how its defects may be remedied by a Methodical Proceeding in the Making of Experiments and collecting Observations, whereby to compile a Natural History as the Solid Basis for the Superstructure of True Philosophy" (1666), in *The Posthumous Works of Robert Hooke*, ed. Richard Waller (London, 1705; Hildesheim: Olms, 1970), pp. 6–7, 28–29, 34–35. For Hooke's use of Baconian analogy see Lynch, *Solomon's Child* (cit. n. 45), pp. 70–115.

⁵⁰ In an early manuscript (probably written in 1647–1648, when he was about twenty years old, and first published in 1989), Boyle argues that "God gaue [men] Authority indeed to employ Beasts in their Occasions, but not to torture them." This manuscript is cited in Malcolm R. Oster, "The 'Beame of Diuinity': Animal Suffering in the Early Thought of Robert Boyle," *British Journal for the History of Science*, 1989, 22:151–180; he argues that, for Boyle, "wanton cruelty towards animals was correspondingly perceived as a blasphemy against the moral order" (p. 153).

⁵¹ Though he never mentions Bacon, Newton begins his *Principia* on a Baconian note—"philosophers have hitherto made trial of nature in vain"—indicating that his principles lead to a proper "trial." Isaac Newton, *The Principia: Mathematical Principles of Natural Philosophy*, trans. I. Bernard Cohen and Anne Whitman (Berkeley: Univ. California Press, 1999), p. 383.

⁵² Merchant, "Scientific Revolution," p. 531. On Bacon and the use of science to relieve human suffering see Haack, *Defending Science—Within Reason* (cit. n. 14), pp. 317–320.

⁵³ Merchant, "Scientific Revolution," p. 533.

wrought by human folly. We may be impeded from taking such positive steps if we mistakenly think that science, “torturing nature,” is inherently abusive and abhorrent.

In her distress over Bacon’s project of dominion over nature, Merchant seems to ignore the pressing need to relieve human suffering. As Perez Zagorin notes, “those who criticize the aim of mastering nature to which Bacon’s science aspired either forget or are ignorant of what his world was like. In that world, human beings were extremely liable to disease, physical suffering, and early death.” Where human suffering remains acute, the help of science is urgently needed; where our world is different and better, it may have Bacon to thank. Like it or not, human dominion over nature is now an unalterable fact we cannot wish away but must strive to address responsibly, for (Zagorin continues) “should the world succeed in coping with its present environmental problems, it will do so, not by opposition to or rejection of science, but by the intelligent and humane use of science coupled with the existence of a public and governments capable of making sensible decisions about the application of science and its limits.”⁵⁴

Bacon’s provocative imagery implies that we must continue to interrogate science itself, though surely not with the prejudgment that it is inherently abusive and hence bad.⁵⁵ Taking up Bacon’s language, Nietzsche cautioned that “we investigators are, like all conquerors, discoverers, seafarers, adventurers, of an audacious morality and must reconcile ourselves to being considered on the whole evil,” calling that censorious judgment into question by his mordant tone.⁵⁶ Nietzsche’s irony suggests that those who overreact to metaphors about science may have mistaken literary conceits for the fuller realities beyond them.⁵⁷ With that caution, if we are free to be “successively just, passionate, and cold,” we may better discern the responsibilities, dangers, and possibilities of such inquiries. Under such searching interrogation, Merchant’s contention that “the very essence of the experimental method arose out of human torture transferred onto nature” is not sustained.

⁵⁴ Zagorin, *Francis Bacon* (cit. n. 5), pp. 122, 123. For additional perspective on Bacon’s reception and significance see Graham Rees, “Reflections on the Reputation of Francis Bacon’s Philosophy,” *Huntington Library Quarterly*, 2003, 65:379–394.

⁵⁵ If anything, Bacon anticipated that science will torment the *scientist*, not nature, as in his portrayals of Prometheus (6.745–753), Orpheus (6.762–764), and the Sphinx (6.755–758). These portrayals are treated in Peter Pesic, “Desire, Science, and Polity: Francis Bacon’s Account of Eros,” *Interpretation*, 1999, 26:333–352; and Pesic, *Labyrinth* (cit. n. 7), pp. 31–55. Denis Desroches agrees that “if we seek to constrain and vex nature, we must first constrain and vex *ourselves* according to the methodological edicts that Bacon’s new conceptions of method and experiment imply”: Desroches, *Francis Bacon and the Limits of Scientific Knowledge* (London: Continuum, 2006), pp. 133–138, on p. 135. Nietzsche perceptively called Bacon a “self-animal-tormentor [*Selbstthierquäler*],” taking up the image of “torturing nature” (with overtones of animal experimentation) popularized by Goethe as part of his anti-Newtonian polemic. See Friedrich Nietzsche, *Ecce Homo*, “Why I Am So Clever,” aphorism 4, *On the Genealogy of Morals and Ecce Homo*, trans. Walter Kaufmann (New York: Vintage, 1967), p. 246. The close connection between Bacon and Nietzsche has been particularly remarked by Lawrence Lampert, *Nietzsche and Modern Times: A Study of Bacon, Descartes, and Nietzsche* (New Haven, Conn.: Yale Univ. Press, 1993), pp. 17, 20, 410–420.

⁵⁶ Nietzsche also refers to this issue in aphorism 4 of *Ecce Homo*, directing further ironic attention to the “evil” imputed to science by the Goethean critique by provocatively praising the Promethean aspects of science’s “crime,” which Nietzsche finds not criminal but admirable.

⁵⁷ For a trenchant discussion of the problems encountered in literary approaches to these texts see Brian Vickers, “Bacon among the Literati: Science and Language,” *Comparative Criticism*, 1991, 13:249–271. Vickers addresses Merchant and Katharine Park in “Francis Bacon, Feminist Historiography, and the Dominion of Nature,” *J. Hist. Ideas*, 2008, 69:117–141; this piece is followed by responses from Park (pp. 143–146) and Merchant (pp. 147–162).