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THE PHILOSOPHER'S BEARD

Women and Gender in Science

Londa Schiebinger

> A woman who . . . engages in debates about the intricacies of mechanics, like the Marquise du Châtelet, might just as well have a beard; for that expresses in a more recognizable form the profundity for which she strives.
>
> Immanuel Kant, 1764

Kant's sentiments reiterated those of the great Carl Linnaeus, who taught in his lectures given at the University of Uppsala in the 1740s that "God gave men beards for ornaments and to distinguish them from women."[1] In the eighteenth century the presence or absence of a beard not only drew a sharp line between men and women but also served to differentiate the varieties of men. Women, black men (to a certain extent), and especially men of the Americas simply lacked that masculine "badge of honor" – the philosopher's beard. As Europe shifted from an estates society to a presumed democratic order, sexual characteristics took on new meaning in determining who would and who would not do science.

INSTITUTIONAL LANDSCAPES

The new sciences of the seventeenth and eighteenth centuries were fostered in a landscape – including universities, academies, princely courts, noble networks, and artisanal workshops – that was expansive enough to include a number of women. In the sustained negotiations over gender boundaries in early modern Europe, it was not at all obvious that women would be excluded from science.[2]

Universities have not been good institutions for women. From the found-

[1] Wilfred Blunt, *The Compleat Naturalist: A Life of Linnaeus* (London: William Collins, 1971), p. 157.
[2] Many of the materials in this essay are drawn from Londa Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (Cambridge, MA: Harvard University Press, 1989).

ing of universities in the twelfth century until late into the nineteenth century, women were proscribed from study. A few exceptional women, however, did study and teach at universities beginning in the thirteenth century, primarily in Italy. These women often flourished in fields, such as physics and mathematics, that today are thought especially resistant to them. The most exceptional woman in this regard was physicist Laura Bassi, who became the second woman in Europe to receive a university degree in 1732 (the first was the Venetian Elena Cornaro Piscopia in 1678) and the first woman to be awarded a university professorship. Celebrated for her work in mechanics, Bassi also became a member of the Istituto delle Scienze in Bologna (Figure 8.1). Like other members she presented annual papers ("On the compression of air," 1746; "On the bubbles observed in freely flowing fluid," 1747; "On bubbles of air that escape from fluids," 1748; and so forth) and received a small stipend. She also invented various devices for her experiments with electricity. The Englishman Charles Burney, who met Bassi during his tour of Italy, found her "though learned, and a genius, not at all masculine or assuming."[3]

The Milanese Maria Gaetana Agnesi, celebrated for her 1748 textbook on differential and integral calculus *Instituzioni analitiche,* was also offered a chair at the University of Bologna. She is often credited with formulating the *versiera,* the cubic curve that (through a mistranslation) has come to be known in English as the "witch of Agnesi."[4] In trying to persuade her to take up a chair of mathematics and natural philosophy, Pope Benedict XIV proclaimed, "From ancient times, Bologna has extended public positions to persons of your sex. It would seem appropriate to continue this honorable tradition."[5] Agnesi accepted this appointment only as an honorary one and, after her father's death in 1752, withdrew from the scientific world to devote herself to religious studies and to serving the poor and aged. By the 1750s, the University of Bologna had offered a position to a third woman, the wax modeler Anna Morandi Manzolini, famous for her anatomical figures showing the development of the fetus in the womb.[6]

[3] Charles Burney, *The Present State of Music in France and Italy* (1773), ed. Percy Scholes (London: Oxford University Press, 1959) pp. 159–60.

[4] The curve that bears Agnesi's name had already been described by Pierre de Fermat. Hubert Kennedy, "Maria Gaetana Agnesi," in Louise Grinstein and Paul Campbell (eds.), *Women of Mathematics: A Biobibliographic Sourcebook* (New York: Greenwood Press, 1987), pp. 1–5; Lynn Osen, *Women in Mathematics* (Cambridge, MA: MIT Press, 1974), pp. 33–48, especially 44–5; Edna Kramer, "Maria Gaetana Agnesi," *Dictionary of Scientific Biography,* I, 75–7.

[5] Benedict to Agnesi, September 1750, cited in Alphonse Rebiére, *Les Femmes dans la science,* 2nd ed. (Paris, 1897), p. 11.

[6] Morandi was employed by the university to dissect and prepare bodies in order to teach anatomy to students and curious amateurs. Marta Cavazza, "'Dottrici' e Lettrici dell'Università de Bologna nel settecento," *Annali di Storia delle Università Italiane,* 1 (1997), 120. Maria Dalle Donne held the post of director of the Scuola per levatrici (School of Midwives) from 1804 to 1842 and was, for many years, a member of the Istituto delle Scienze. I thank Dr. Marta Cavazza at the University of Bologna for this information.

Figure 8.1. Laura Bassi, professor of Newtonian physics and mathematics at the University of Bologna from 1732 to 1778. From Alphonse Rebière, *Les Femmes dans la science* (Paris, 1897), facing p. 28. By permission of the Schlesinger Library, Radcliffe College.

The Italian model was not embraced across Europe. Germany experimented with higher education for women, conferring two degrees (at Halle and Göttingen) in the eighteenth century; no degrees were awarded in France or Great Britain. Outside Italy, no women were appointed professors; within Italy, the tradition of women professors did not continue. After about 1800, women were generally proscribed from European institutions of higher learning until the end of the nineteenth and in some cases until the twentieth century. Sofia Kovalevskaia was the next woman to become a professor (of mathematics) within Europe; she was appointed to the University of Stockholm in 1889.

Why did Italy accommodate learned women in ways that other European countries did not? Paula Findlen has suggested that Bassi served to bolster Bologna's flagging patriciate, becoming a "symbol of scientific and cultural regeneration." With Bassi, the city could boast a woman learned beyond any other in Europe. Beate Ceranski concurs that the traditions of Renaissance humanism, in which a woman could be admired for her learning, remained alive in the relatively small Italian city-states; no woman, however – no matter how great her learning – could hold such a position in the larger and more strongly centralized states of France or England, as the example of Gabrielle-Émilie le Tonnelier de Breteuil, Marquise du Châtelet, bears out.[7]

Historians have traditionally focused on the decline of universities and the founding of scientific academies as a key step in the emergence of modern science. Except for a few Italian academies (the Institute of Bologna mentioned earlier and the Accademia de' Ricovrati), the new scientific societies, like the universities, were closed to women. The Royal Society of London, founded in the 1660s and the oldest permanent scientific academy, did not admit the eccentric but erudite Margaret Cavendish, Duchess of Newcastle, although she was well qualified for that position (men above the rank of baron could become members without scientific qualifications). From its founding in 1660 until 1945, the only female member of the Royal Society was a skeleton in its anatomical collection.[8] The Académie Royale des Sciences in Paris, founded in 1666, refused to admit women; even the illustrious Marie Curie (1867–1934) was turned away. The first woman was elected to this academy in 1979. Nor did the Societas Regia Scientiarum in Berlin admit the well-known astronomer Maria Margaretha Winkelmann (1670–1720), who worked at the academy observatory first with her husband and later her son.

The prominence of universities and scientific academies today should not lead us to overemphasize their importance in the past. Several avenues into scientific work existed for women before the stringent formalization of science in the nineteenth century. In the early years of the scientific revolution, women of high rank were encouraged to know something about science. Along with gentlemen virtuosi, gentlewomen peered at the heavens through telescopes, inspecting the moon and stars; they looked through microscopes, analyzing insects and tapeworms. If we are to believe Bernard de Fontenelle,

[7] Paula Findlen, "Science as a Career in Enlightenment Italy: The Strategies of Laura Bassi," *Isis,* 84 (1993), 441–69, especially 449; Beate Ceranski, *"Und Sie Fürchtet sich vor Niemandem": Die Physikerin Laura Bassi, 1711–1778* (Frankfurt: Campus Verlag, 1996). See also Paula Findlen, "A Forgotten Newtonian: Women and Science in the Italian Provinces," in William Clark, Jan Golinski, and Simon Schaffer (eds.), *The Sciences in Enlightened Europe* (Chicago: University of Chicago Press, 1999), pp. 313–49.

[8] "A Catalogue of the Natural and Artificial Rarities belonging to the Royal Society, and preserved at Gresham College," in H. Curzon, *The Universal Library: Or, Compleat Summary of Science* (London, 1712), vol. 1, p. 439. Kathleen Lonsdale and Marjory Stephenson were elected to the Royal Society in 1945 (*Notes and Records of the Royal Society of London,* 4 (1946), 39–40). See also Joan Mason, "The Admission of the First Women to the Royal Society of London," *Notes and Records of the Royal Society of London,* 46 (1992), 279–300.

secretary of the Académie Royale des Sciences and *président* of Madame Lambert's salon, it was not unusual to see people in the street carrying around dried anatomical preparations. Especially in Paris, wealthy women were ready consumers of scientific curiosities, collecting everything from conches, stalactites, and petrified wood to insects, fossils, and agates to make their natural history cabinets "the epitome of the universe."[9] In what I have called "noble networks" – of natural philosophers, patrons, and illustrious consumers – well-born women were often able to exchange social prestige for access to scientific knowledge. The physicist Emilie du Châtelet, for example, was able to insinuate herself into networks of scientific men by exchanging patronage for the attention of men of lesser rank but of significant intellectual stature.[10]

Royal women also formed crucial links across Europe as patrons of science. In 1650 Descartes was commissioned by the audacious queen Christina of Sweden to draw up regulations for her scientific academy. Even the highest rank did not, however, insulate women from reproach and ridicule. Many people blamed Christina and the rigors of her philosophical schedule for Descartes's death. For her philosophical prowess, the queen was denounced as a hermaphrodite.[11]

Noble networks also flourished within salons, intellectual institutions or-

[9] P. Remy, *Catalogue d'une Collection de très belles Coquilles, Madrepores, Stalactiques . . . de Madame Bure* (Paris, 1763). On Fontenelle, see Jacques Roger, *Les Sciences de la vie dans la pensée Française du XVIII^e siècle* (Paris, 1963), pp. 165, 181–2; Nina Rattner Gelbart, "Introduction," in Bernard le Bovier de Fontenelle, *Conversations on the Plurality of Worlds,* trans. H. A. Hargreaves (Berkeley: University of California Press, 1990); Aileen Douglas, "Popular Science and the Representation of Women: Fontenelle and After," *Eighteenth-Century Life,* 18 (1994), 1–14; and Geoffrey Sutton, *Science for a Polite Society: Gender, Culture, and the Demonstration of Enlightenment* (Boulder, CO: Westview Press, 1995), chap. 5. Science for ladies remained popular throughout Europe in the eighteenth century. In Italy, the poet Francesco Algarotti published an introduction to Newtonian physics in 1737. In Germany, Johanna Charlotte Unzer published her *Outline of Philosophy for Ladies* (Grundriss einer Weltweisheit für Frauenzimmer) in 1761; in Russia, and from his post at the Academy of Science in St. Petersburg, Leonhard Euler wrote his *Letters to a German Princess on Diverse Points of Physics and Philosophy* in 1768. See also John Harris, *Astronomical Dialogues Between a Gentleman and a Lady* (London, 1719); James Ferguson, *Easy Introduction to Astronomy for Gentlemen and Ladies* (London, 1768); [Lorenz Suckow], *Briefe an das schöne Geschlecht über verschiedene Gegenstände aus dem Reiche der Nature* (Jena, 1770); Pierre Fromageot, *Cours d'études des jeunes demoiselles* (Paris, 1772–5); Jakob Weber, *Fragmente von der Physik für Frauenzimmer und Kinder* (Tübingen, 1779); Christoph Leppentin, *Naturlehre für Frauenzimmer* (Hamburg, 1781); August Batsch, *Botanik für Frauenzimmer* (Weimar, 1795); and Christian Steinberg, *Naturlehre für Frauenzimmer* (Breslau, 1796). See also Gerald Meyer's excellent *The Scientific Lady in England: 1650–1760* (Berkeley: University of California Press, 1955).

[10] For "noble networks," see Schiebinger, *The Mind Has No Sex?* chap. 2. For Châtelet, see René Taton's "Gabrielle-Émilie le Tonnelier de Breteuil, Marquise du Châtelet," *Dictionary of Scientific Biography,* III, 215–17, who provides primary and secondary bibliography; see also Carolyn Iltis, "Madame du Châtelet's Metaphysics and Mechanics," *Studies in History and Philosophy of Science,* 8 (1977), 29–48; Ira O. Wade, *Voltaire and Madame du Châtelet: An Essay on the Intellectual Activity at Cirey* (Princeton, NJ: Princeton University Press, 1941); Elizabeth Badinter, *Emilie, Emilie: L'Ambition féminine au XVIII^e siècle* (Paris, 1983); Linda Gardiner, "Women in Science," in Spencer (ed.), *French Women,* pp. 181–96; and Mary Terrall, "Emilie du Châtelet and the Gendering of Science," *History of Science,* 33 (1995), 283–310.

[11] *Carpenrariana or remarques . . . de M. Charpentier* (Paris, 1724), p. 316; Claude Clerselier, *Lettres de Mr. Descartes* (Paris, 1724), vol. 1, preface.

ganized and run by women. Like the French academies, salons created cohesion among elites, assimilating the rich and talented into the French aristocracy. Although these gatherings were primarily literary in character, science was fashionable at the salons of Madame Geoffrin, Madame Helvétius, and Madame Rochefoucauld; Madame Lavoisier received academicians at her home. There were, however, limits to this type of exchange. In the same way that privilege gave women only limited access to political power and the throne, high social standing gave them only limited access to the world of learning. Because women were barred from the centers of scientific culture – the Royal Society of London or the Académie Royale des Sciences of Paris – their relationship to knowledge was inevitably mediated through a man, whether that man was their husband, companion, or tutor.[12]

It should be noted that ridicule of "learned ladies" appeared in the late seventeenth century along with *virtuosae* themselves. Jean-Baptiste Molière's *Les Femmes Savantes* (1672) was much acclaimed for portraying Cartesian women running mad after philosophy and disrupting established social hierarchies by having no time for marriage or household duties. A husband whose dinner has been neglected rails against his science-minded wife for wanting "to know the motions of the moon, the pole star, Venus, Saturn, and Mars . . . while my food, which I need, is neglected."[13] Fears that learned ladies threatened to disrupt the status quo were justified: it was part of the political program of *salonières* of the seventeenth and eighteenth centuries to eschew traditional forms of marriage and motherhood. With books to read and lectures to attend, upper-class and even middle-class women had shifted the responsibilities of motherhood to wet nurses and governesses. These women's desires to engage, like men, in productive lives free of the cares of parenting came increasingly into conflict with the belief that public employ should be the preserve of men and that women could best serve the nation (and later the race) by producing healthy, and abundant, offspring.

Artisanal workshops served as another avenue into science for eighteenth-century women. Edgar Zilsel was among the first to point to the importance of craft skills for the development of modern science in the West. What Zilsel did not point out, however, is that the new value attached to the traditional skills of the artisan also allowed for the participation of women in the sciences. Women were not newcomers to the workshop; it was in craft traditions that the fifteenth-century writer, Christine de Pizan, had located women's

[12] Carolyn Lougee, *Le Paradis des Femmes: Women, Salons, and Social Stratification in Seventeenth Century France* (Princeton, NJ: Princeton University Press, 1976), pp. 41–53; Alan Kors, *D'Holboch's Coterie* (Princeton, NJ: Princeton University Press, 1976); Charles C. Gillispie, *Science and Polity in France at the End of the Old Regime* (Princeton, NJ: Princeton University Press, 1980), pp. 7, 94; Dena Goodman, "Enlightenment Salons: The Convergence of Feminine and Philosophical Ambitions," *Eighteenth-Century Studies,* 22 (1989), 329–50; Schiebinger, *The Mind Has No Sex?* pp. 30–2; Paula Findlen, "Translating the New Science: Women and the Circulation of Knowledge in Enlightenment Italy," *Configurations,* 2 (1995), 167–206.

[13] Jean-Baptiste Molière, *Les Femmes savantes* (1672), Jean Cordier (ed.) (Paris, 1959), pp. 36–7.

greatest innovations in the arts and sciences: the spinning of wool, silk, and linen and "creating the general means of civilized existence."[14] In the workshop, women's (like men's) contributions depended less on book learning and more on practical innovations in illustrating, calculating, or observing.

Whereas in France women's contributions to the sciences came consistently from women of the aristocracy, in Germany some of the most interesting innovations came from craftswomen. The prominence of artisans in Germany accounts for the remarkable fact that between 1650 and 1710 some 14 percent of all German astronomers were women – a higher percentage even than is true in Germany today (Figure 8.2). Astronomy was not a guild; as I have argued elsewhere, however, the German astronomer of the early eighteenth century bore a close resemblance to the guild master or apprentice, and the craft organization of astronomy gave women a prominence in the field. Trained by their fathers and often observing alongside their husbands, women astronomers in this period worked primarily in family observatories – some built in the attic of the family house, others across the roofs of adjoining houses, still others on city walls. In these astronomical families, the labor of husband and wife did not divide along modern lines: he was not fully professional, working in an observatory outside the home; she was not fully a housewife, confined to hearth and home. Nor were they independent professionals, each holding a chair of astronomy. Instead, they worked as a team and on common problems. They took turns observing so that their observations followed night after night without interruption. At other times they observed together, dividing the work so that they could make observations that a single person could not make accurately. Guild traditions within science allowed women such as the astronomer Maria Margaretha Winkelmann and the celebrated entomologist Maria Sibylla Merian to strengthen the empirical base of science.[15]

A number of other women of lower estates also contributed to science. Midwives, long before the recent enthusiasm for women's health initiatives, took full charge of women's medicine. Wise women developed balms and cordials to prevent disease and cure ills. The eighteenth century was also the time when these aspects of women's traditional knowledges were under attack. In the best-known example, midwives were run out of business, first by those ungainly creatures called "man midwives" and eventually by gynecologists and obstetricians.[16]

[14] Christine de Pizan, *The Book of the City of Ladies* (1405), trans. Earl Jeffrey Richards (New York: Persea Books, 1982), pp. 70–80; Edgar Zilsel, "The Sociological Roots of Science," *American Journal of Sociology,* 47 (1942), 545–6; and Arthur Clegg, "Craftsmen and the Origin of Science," *Science and Society,* 43 (1979), 186–201.

[15] Schiebinger, *The Mind Has No Sex?* chap. 3. On Merian, see also Natalie Zemon Davis, *Women on the Margins: Three Seventeenth-Century Lives* (Cambridge, MA: Harvard University Press, 1995).

[16] Jean Donnison, *Midwives and Medical Men: A History of Inter-Professional Rivals and Women's Rights* (London: Heinemann, 1977); Schiebinger, *The Mind Has No Sex?* chap. 4; Ornella Moscucci, *The Science of Woman: Gynaecology and Gender in England, 1800–1929* (Cambridge University Press, 1990);

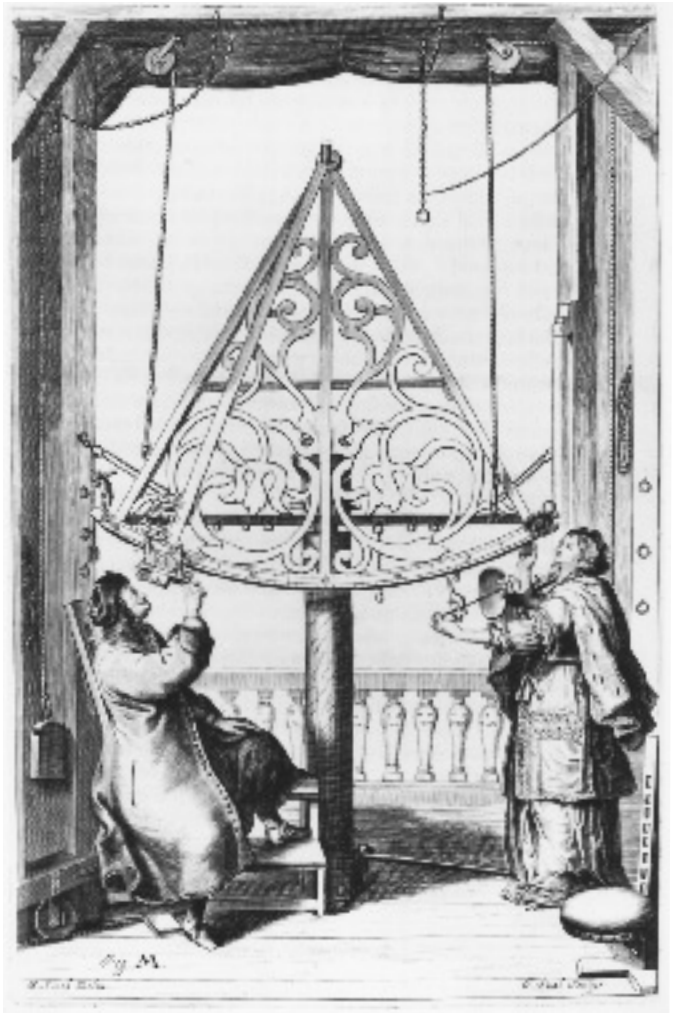

Figure 8.2. Astronomers Elisabetha and Johannes Hevelius working together with the sextant. From Hervelius's *Machinae coelestis* (Danzig, 1673), facing p. 222. By permission of Houghton Library, Harvard University.

Outside Europe, a number of women aided Europeans' forays into nature, preserving the health and well-being of foreign naturalists by preparing local foods and medicines. Women sometimes also served as local guides for European expeditions; much of the collecting and cataloging for Garcia da Orta's well-known 1563 *Coloquios dos simples e drogas . . . da India,* for example, was

Hilary Marland (ed.), *The Art of Midwifery: Early Modern Midwives in Europe* (London: Routledge, 1993); Adrian Wilson, *The Making of Man Midwifery* (Cambridge, MA: Harvard University Press, 1995); and Nina Rattner Gelbart, *The King's Midwife: A History and Mystery of Madame du Coudray* (Berkeley: University of California Press, 1998).

done by a Konkani slave girl known only as Antonia.[17] In a much celebrated instance, Lady Mary Wortley Montagu served as an international broker for women's knowledges. During her stay in Turkey as the wife of the British Ambassador at Constantinople, Lady Mary learned of an old Greek woman who – with her nutshell and needle – inoculated children against smallpox; Montagu along with her surgeon, Charles Maitland, introduced this practice into England. Montagu's role here may be more that of a mother than a scientist; her willingness to have her own children inoculated convinced many people of the safety of the procedure. Maitland tested the inoculation against smallpox on six prisoners and, by 1723, fifty-one other people, and he wrote several treatises concerning its safety.[18]

In the nineteenth century, the breakdown of the old order (the guild system of artisanal production and aristocratic privilege) closed to women what informal access to science they might have enjoyed. With the privatization of the family and the professionalization of science, women wanting to pursue a career in science had two options. They could attempt to follow the course of public instruction and certification through the universities, as did their male counterparts. Or they could continue to participate within the (now private) family sphere as increasingly invisible assistants to scientific husbands or brothers; this became the normal pattern for women in science in the nineteenth century.[19]

"LEARNED VENUSES," "AUSTERE MINERVAS," AND "HOMOSOCIAL BROTHERHOODS"

In 1985 Evelyn Fox Keller, rephrasing Georg Simmel, declared that science is "masculine," not only in the person of its practitioners but also in its ethos and substance.[20] The elusive and explosive question of the gendering of science, nature, men, and women has been tied for some people to the question of women's access to science, for others to the style of science, and for still others to the content and priorities of science and human knowledge more generally. In the study of conceptions of gender in science, three elements must be distinguished: how gender is defined; how the sex is understood; and how

[17] Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism: 1600–1860* (Cambridge University Press, 1995), p. 81.

[18] Charles Maitland, *Mr. Maitland's Account of Inoculating the Small Pox* (London, 1722). There was much discussion about who first introduced the smallpox vaccination into Western Europe. In his account, John Andrew claimed that Lady Montagu sent the first report in 1716. James Jurin reported that this type of inoculation had been practiced in Wales from "time out of mind." See Isobel Grundy, *Lady Mary Wortley Montagu: Comet of the Enlightenment* (Oxford: Oxford University Press, 1999).

[19] Pnina Abir-Am and Dorinda Outram (eds.), *Uneasy Careers and Intimate Lives: Women in Science 1789–1979* (New Brunswick, NJ: Rutgers University Press, 1987); Helena Pycior, Nancy Slack, and Pnina Abir-Am (eds.), *Creative Couples in Science* (New Brunswick, NJ: Rutgers University Press, 1996).

[20] The terms featured in the subtitle are Paula Findlen's, "Translating the New Science," p. 171. Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven, CT: Yale University Press, 1985).

actual men and women participated in science. Masculinity and femininity are not characteristics inherent to men or women that have universal meanings above and beyond historical contexts. These terms mean very different things at different times and in different places, and they often refer as much to the manners of a particular class or a particular people as to the characteristics of a particular sex. For the founders of the Royal Society, for example, the much-trumpeted "masculine philosophy" was to be distinctively English (not French), empirical (not speculative), and practical (not rhetorical).[21] "Masculinity" served in this case as a term of approbation and attached only tangentially to men (Figure 8.3).

Scholars have explained the gendering of science in different ways. In her classic 1980 *Death of Nature,* Carolyn Merchant revealed how the rise of a mechanistic worldview entailed the "death of nature." Notions of nature as matter in motion served to weaken moral restrictions embedded in older cosmologies that had forbidden untoward incursions into the belly of "Mother Nature." Merchant focused attention on the rhetorical violence of Francis Bacon's new mechanical (and "masculine") philosophy, which purported to unlock the "secrets . . . in Nature's bosom," to bind "Nature with all her children to [its] service and make her [its] slave."[22] Merchant and much subsequent ecofeminism have emphasized that the newly virile science held devastating consequences for women and for nature, both seen as subordinate females. Although roundly criticized for reinforcing the traditional notion that women belong to nature in ways that men do not, Merchant rightly called attention to the adamant gendering of nature as female in both ancient and modern science traditions.

Others have explained the gendering of science in terms of sexual divisions in physical and intellectual labor. According to this view, science was part of the territory that fell to the masculine party in the broader cultural restructurings of the early modern period. Because science, like any other profession, came to inhabit the public realm, where women (or femininity) dared not tread, science came to be seen as decidedly masculine. As science increasingly lost its amateur status and became a paid vocation, its ties to the public sphere strengthened. Ideologues of the day taught that the public sphere of government and commerce, science and scholarship was founded on the principles of reasoned impartiality – qualities increasingly associated with masculinity. At the same time, the rise of the sentimental family increasingly put the ideal mother in charge of child rearing and moral rectitude. The norms of femininity developed in the late eighteenth century portrayed womanliness as a virtue in the spheres of motherhood and the home but as a handicap in

[21] Schiebinger, *The Mind Has No Sex?* chap. 5.

[22] Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (San Francisco: Harper and Row, 1980), pp. 168–72; and Brian Easlea, *Witch-Hunting, Magic, and the New Philosophy* (Hassocks, Sussex: Harvester Press, 1980), pp. 126–9.

Figure 8.3. "Academy of Sciences, Arts, and Trades," the frontispiece to Diderot and d'Alembert's *Encyclopédie.* In early modern Europe, two allegories vied for power of representation: the feminine "scientia," female muses and otherwordly consorts to the predominantly male practitioners of the sciences; and the new ideal of a "masculine" philosophy, explicitly championed by the Royal Society of London. In this well-known frontispiece, Truth, Reason, Philosophy, Physics, Optics, Botany, and Chemistry are all represented in female form. By permission of the Department of Special Collections and University Archives, Stanford University Libraries.

the world of science.[23] Early modern science thus built the exclusion of actual women, as well as cultural practices and ideals deemed feminine, into what could count as truth.

Yet another well-established tradition fostered the gendering of early modern science: homosociability. David Noble has shown how, following well-established traditions, the presence of learned Venuses or even austere Minervas threatened to disrupt the homosocial bonding that fired many a male intellect. Ancient Hebrew traditions (at least in the interpretation given them by the *Encyclopédie*) held that by virtue of contact with women, men lost the power of prophecy. In Christian traditions of medieval Europe, monastic life – important to the life of the mind – was a celibate one. These traditions continued in universities. Professors at the universities of Oxford and Cambridge were not allowed to marry; until late into the nineteenth century, celibacy was required of all faculty. The perceived dangers of women to the life of the mind – both the threat of carnal desires and the banality of daily bodily maintenance – was so great that a number of philosophers (among them Bacon, Locke, Boyle, Newton, Hobbes, Hume, and Kant) never married. Francis Bacon clearly considered wife and children impediments to great enterprises; Pierre Bayle declared the marriage of a learned woman a waste of national resources. Even Mary Wollstonecraft agreed that unmarried men and women proved the most creative thinkers.[24]

Other scholars have located the gendering of science in the new scientific societies. Steven Shapin has argued that in seventeenth-century England, women, under *covert* first of their fathers and then of their husbands, lacked standing within the economy of civility, the crucial social element that guaranteed truth in the new experimental science. Robert Boyle, an independent gentleman of honor, became the ideal "modest witness" – a faithful and unobtrusive scribe – to natural facts. Women's all-essential modesty, by contrast, was modesty of the opaque and epistemologically polluting body; as Elizabeth Potter has pointed out, women's names never appeared among those attesting to the veracity of experiments, whether or not they were present in cabinets of natural philosophy.[25]

Mary Terrall has similarly focused on the academies, where scientists forged

[23] See Maurice Bloch and Jean Bloch, "Women and the Dialectics of Nature in Eighteenth-Century French Thought," in Carol P. MacCormack and Marilyn Strathern (eds.), *Nature, Culture, and Gender* (Cambridge University Press, 1980), pp. 25–41; Joan Landes, *Women and the Public Sphere in the Age of the French Revolution* (Ithaca, NY: Cornell University Press, 1988); Schiebinger, *The Mind Has No Sex?;* and Geneviève Fraisse, *Reason's Muse: Sexual Difference and the Birth of Democracy,* trans. Jane Marie Todd (Chicago: University of Chicago Press, 1994).

[24] David Noble, *A World Without Women: The Christian Clerical Culture of Western Science* (New York: Knopf, 1992); Mario Biagioli, "Knowledge, Freedom, and Brotherly Love: Homosociability and the Accademia dei Lincei," *Configurations,* 2 (1995), 139–66; and Schiebinger, *The Mind Has No Sex?* pp. 151–2.

[25] Steven Shapin, *A Social History of Truth, Civility and Science in Seventeenth-Century England* (Chicago: University of Chicago Press, 1994); Potter in Donna Haraway, *Modest_Witness@Second_Millennium:FemaleMan©_Meets_OncoMouse™* (New York: Routledge, 1997), pp. 26–33.

a masculine identity (as much in France as in England) not only in the absence of women but also as a foil to prominent feminine forms of intellectual activity, and especially to the world of salons. Members of the prestigious Parisian Académie Royale des Sciences, as Terrall has argued, portrayed their labors as a heroic quest for truth requiring strength of mind and also often of body. Although this image was designed to play to influential female audiences, it also reinforced the exclusion of women; the "doing" of science became increasingly distinct from the "consuming" of science.[26] Outside the Académie, Jean-Jacques Rousseau contrasted what he identified as the womanly style of the powerful salons, where "reason is clothed in gallantry," to a properly vigorous style that was inappropriate for women. Men among themselves would not "humor" one another in dispute; rather, each, feeling himself attacked by all the forces of his adversary, would feel obliged to use "all his own force to defend himself."[27] Only through this combative process did Rousseau believe that the mind gains precision and vigor.

Did the ardent gendering of scientific culture channel eighteenth-century women into what we today call the "soft" sciences (the life sciences and natural history) or the "hard" sciences (the physical sciences)? Surprising to modern eyes, women were as prominent among physicists and mathematicians in the eighteenth century as among other scientists, except perhaps for botanists. Of all the sciences recommended for women, botany became the feminine science *par excellence.* By the nineteenth century, botany's reputation as "unmanly" – an ornamental branch suitable only for "ladies and effeminate youths" – was such that it was questioned whether able-bodied young men should pursue it at all. Hegel even compared the mind of woman to a plant because, in his view, both were essentially placid. It is not surprising that botany was thought appropriate for women. Plants had long belonged to women's domains: peasants and aristocrats alike had worked as healers and wise women, gathering and cultivating the plants required for domestic medicines. Furthermore, an appreciation of botany posed no threat to orthodoxies concerning women's nature: a rose was said to mirror the beauty of its devotee, exotic plants were said to flourish under a nurturing female hand, and the female herself was thought to prosper from the rational pleasures botany afforded. Although after Linnaeus the study of plants seemed to require more of a focus on sexuality than might seem suitable to ladies, botany continued to be advocated (especially in England) as the science leading to the greatest appreciation of God and his universe.[28]

[26] Mary Terrall, "Gendered Spaces, Gendered Audiences: Inside and Outside the Paris Academy of Sciences," *Configurations,* 2 (1995), 207–32.

[27] Jean-Jacques Rousseau, *Lettre à M d'Alembert sur les spectacles* (1758), L. Brunel (ed.) (Paris, 1896), p. 157.

[28] Hegel compared the male mind to an animal that acquires knowledge only through much struggle and technical exertion. The female mind, by contrast, does not (cannot) rise above its plant-like existence and remains rooted in its *an sich* existence (*Grundlinien der Philosophie des Rechts,* 1821) in *Werke,* ed. Eva Moldenhauer and Karl Michel, 20 vols. (Frankfurt am Main: Suhrkamp, 1969–71),

THE SCIENCE OF WOMAN

At the birth of modern science, the noble networks and artisanal workshops gave women (limited) access to science. Their incursion into serious intellectual endeavor was supported ideologically by the Cartesian wedge driven between mind and body, giving voice to the notion that "the mind has no sex."[29] The expansive mood of the Enlightenment – the feeling that all men are by nature equal – gave women renewed hope that they, too, might begin to share the privileges heretofore reserved for men.

As it emerged toward the end of the eighteenth century, however, the participation of women in normal science was not to be. The exclusion of women from public life required new justifications, based on scientific, and not Biblical, authority. Within the framework of Enlightenment thought, an appeal to natural rights could be countered only by proof of natural inequalities. An individual's place in the *polis* increasingly depended on his or her property holdings and also on sexual and racial characteristics. Science, with its promise of a "neutral" and privileged viewpoint above and beyond the rough-and-tumble of political life, came to mediate between the laws of "nature" and the laws of legislatures. For many, scientists did not have to take a stand in questions of social equalities because "the body spoke for itself."[30]

In this political climate, the eighteenth century witnessed a revolution in "sexual science," the exact study of sexual difference.[31] The revolution was first and foremost a rupture in methodology: Aristotelian and Galenic science had understood divergent sexual temperaments as driven by cosmic principles reduplicating the macrocosm within the microcosm of the individual body.[32] Eighteenth-century science deployed empirical methods to weigh and measure sexual differences in the body. The revolution in sexual science was also marked by what Thomas Laqueur has described as a shift from a one-sex to a two-sex model of difference. The older, one-sex model, favored by Galen

vol. 7, pp. 319–20. See also J. F. A. Adams, "Is Botany a Suitable Study for Young Men?" *Science,* 9 (1887), 117–18; Emmanuel Rudolph, "How It Developed That Botany Was the Science Thought Most Suitable for Victorian Young Ladies," *Children's Literature,* 2 (1973), 92–7; and Ann Shteir, *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England 1760–1860* (Baltimore, MD: Johns Hopkins University, 1996). Lisbet Koerner argues that Linnaeus's new system of botany accommodated women and other lesser-educated folks because, even though it was in Latin, it was useful and simple ("Women and Utility in Enlightenment Science," *Configurations,* 2 (1995), 233–55).

[29] François Poullain de la Barre, *De l'Égalité des deux sexes: discours physique et moral* (Paris, 1673). See also Erica Harth, *Cartesian Women: Versions and Subversions of Rational Discourse in the Old Regime* (Ithaca, NY: Cornell University Press, 1992).

[30] Samuel Thomas von Soemmerring, *Über die körperliche Verschiedenheit des Negers vom Europäer* (Frankfurt and Mainz, 1785), preface.

[31] Cynthia Russett, *Sexual Science: The Victorian Construction of Womanhood* (Cambridge, MA: Harvard University Press, 1989). See also Ludmilla Jordanova, *Sexual Visions: Images of Gender in Science and Medicine between the Eighteenth and Twentieth Centuries* (Madison: University of Wisconsin Press, 1989).

[32] Joan Cadden, *Meanings of Sex Difference in the Middle Ages: Medicine, Science, and Culture* (Cambridge University Press, 1993); and Lesley Dean-Jones, *Women's Bodies in Classical Greek Science* (Oxford: Oxford University Press, 1994).

and others, saw male and female genitalia as the same in kind: "All parts that men have, women have too" (including a "spermatical vessel") with the exception that women's are inverted and contained inside the body.[33] Sexual difference was one of degree: woman simply lacked the heat to perfect her organs and thrust them outward from her body. The new "two-sex" model sharply distinguished male and female genitalia; the uterus was no longer configured an inadequate penis but instead was celebrated as a perfect instrument for producing future citizens of the state.[34]

The reevaluation of women's reproductive organs was only one element in a much broader revolution. Sexuality was no longer to be seen as residing exclusively in a "single organ" but, the French physician Pierre Roussel explained in 1775, as extending "through more or less perceptible nuances" into every part of the human body.[35] The first representations of distinctively female skeletons in Western anatomy epitomized this broader revolution (Figure 8.4). The materialism of the age led anatomists to look to the skeleton; as the hardest part of the body it was said to provide a "ground plan" for the body and to give a "certain and natural" direction to the muscles and other parts of the body attached to it.[36] If sex differences could be found in the skeleton, then sexual identity would no longer depend on differing degrees of heat (as the ancients had taught), nor would it be a matter of sex organs appended to a neutral human body (as Vesalius had thought). Instead, sexuality would be seen as penetrating every muscle, vein, nerve, and organ attached to and molded by the skeleton. Although the female skeleton was drawn from nature with painstaking exactitude, great debate erupted over its distinctive features. Political circumstances drew immediate attention to depictions of the skull as a measure of intelligence and the pelvis as a measure of womanliness. The woman's narrow cranium seemed to explain nicely her lesser achievement in science.[37]

By the 1790s, European anatomists presented male and female bodies as

[33] Galen, *On the Usefulness of the Parts of the Body,* trans. Margaret May (Ithaca, NY: Cornell University Press, 1968), vol. 2, pp. 628–9.

[34] Thomas Laqueur, *Making Sex: Body and Gender from the Greeks to Freud* (Cambridge, MA: Harvard University Press, 1990). See also the critical evaluation of Laqueur's work by Katharine Park and Robert Nye, "Destiny Is Anatomy," *The New Republic,* February 18, 1991, 53–7; and Cadden, *Meanings of Sex Differences in the Middle Ages.*

[35] Pierre Roussel, *Système physique et moral de la femme, ou Tableau philosophique de la constitution, de l'état organique, du tempérament, des moeurs, & des fonctions propres au sexe* (Paris, 1775), p. 2. Carl Klose also argued that it is not the uterus that makes woman what she is. Even women from whom the uterus has been removed, he stressed, retain feminine characteristics. See his *Über den Einfluß des Geschlects-Unterschiedes auf Ausbildung und Heilung von Krankheiten* (Stendal, 1829), pp. 28–30. See also Edmond Thomas Moreau, *Quaestio medica: An praeter genitalia sexus inter se discrepent?* (Paris, 1750).

[36] Bernard Albinus, *Table of the skeleton and muscles of the human body* (London, 1749), "Account of the Work."

[37] Schiebinger, *The Mind Has No Sex?* chap. 7; Elizabeth Fee, "Nineteenth-Century Craniology: The Study of the Female Skull," *Bulletin of the History of Medicine,* 53 (1979), 415–33; Stephen Jay Gould, *The Panda's Thumb: More Reflections in Natural History* (New York: W. W. Norton, 1980), chap. 14.

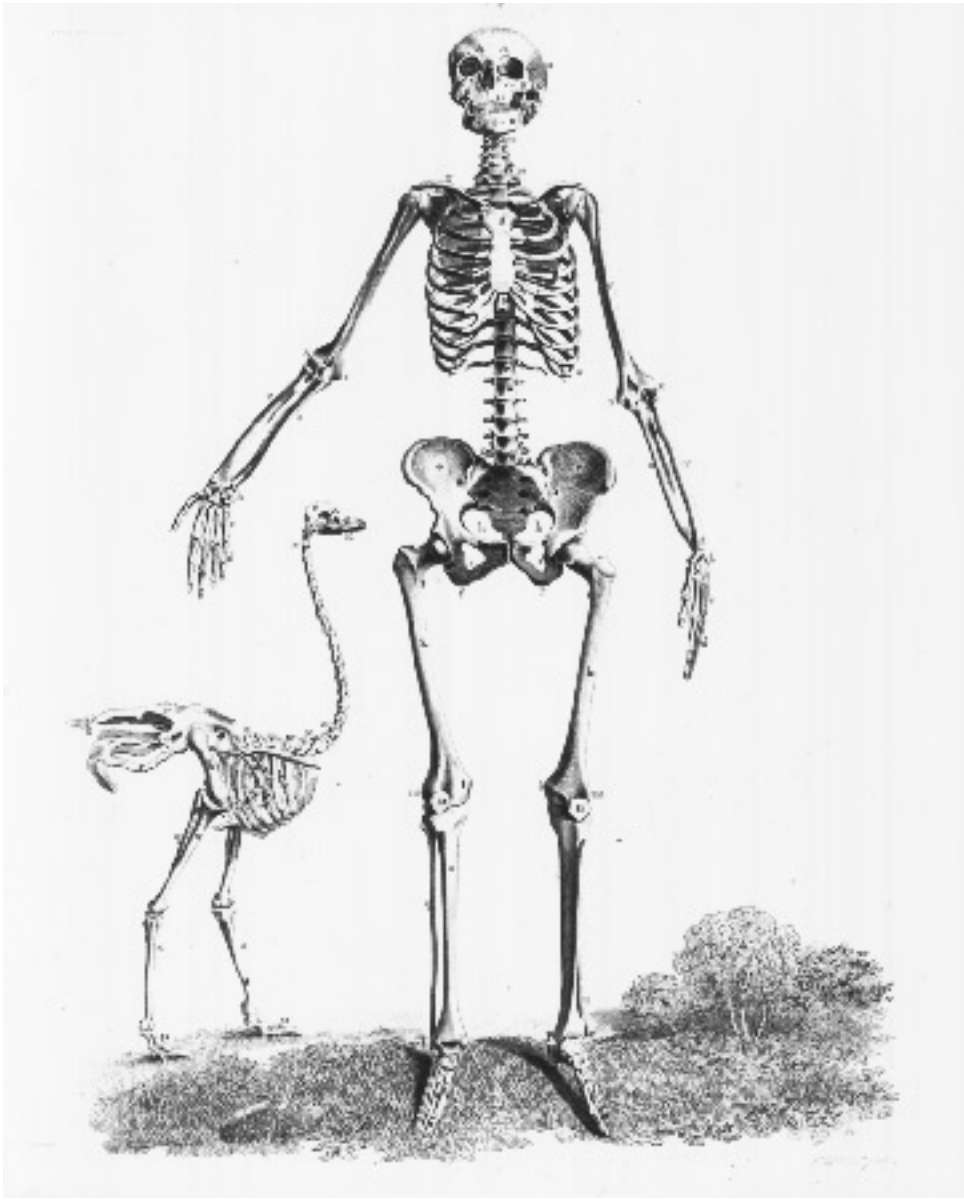

Figure 8.4. The French anatomist Marie-Geneviève-Charlotte Thiroux d'Arconville's female skeleton compared to that of an ostrich; each is remarkable for its large pelvis. From John Barclay, *The Anatomy of the Bone of the Human Body* (Edinburgh, 1829), plate 4. By permission of the Boston Medical Library.

each having a distinct telos – physical and intellectual strength for the man, motherhood for the woman. The Harvard medical doctor Edward Clarke expressed this vision of physical and social complementarity at its apogee a century later: in the same way that "the lily is not inferior to the rose, nor the oak superior to the clover," the man is not superior to the woman; each is different and suited to its own ends.[38] Women's separate perfections did not, however, make them the equals of men in matters of public power but rather destined them for the private sphere and domesticity.

Contravening nature's laws was said to hold dire consequences. Women's desire to develop their intellect was considered the highest form of egoism, threatening to undermine their own health and the health of the race. Dr. Clarke offered examples from clinical studies of women whose education at the new U.S. women's colleges (including Smith, Wellesley, and Bryn Mawr) had resulted in sterility, anemia, menorrhagia, dysmenorrhea, even hysteria and insanity. The message was clear: intensive intellectual endeavor threatened to damage a woman's reproductive organs, causing her ovaries to shrivel. A latter-day Rousseauian, Clarke urged women to revere nature's calling "to cradle and nurse a race."[39]

The abundant ideology idealizing woman as the angel of the home applied only to middle-class Europeans. In 1815, Georges Cuvier, France's premier comparative anatomist, performed his now infamous dissection of the South African woman known to many by the English name Sarah Bartmann. The very name given this woman – Cuvier always referred to her as *Vénus Hottentotte* – emphasized her sexuality. (Passionate tendencies found in warm climates were often attributed to the planetary influence of Venus.) His interest in her body focused on her sexual parts; nine of his sixteen pages recording the dissection are devoted to Bartmann's genitalia, breasts, buttocks, and pelvis. Only one short paragraph evaluated her brain. In his memoir on the Hottentot Venus, Cuvier took up the issue of whether science had African origins: "No race of Negro," he declared, "produced that celebrated people who gave birth to the civilization of ancient Egypt, and from whom we may say that the whole world has inherited the principles of its laws, sciences, and perhaps also religion." Without exception, the "cruel law" of nature, he concluded, had "condemned to eternal inferiority those races with a depressed and compressed cranium."[40] Such was the fate of Sarah Bartmann.

Neither the dominant theory of race nor that of sex in this period applied to non-European women, particularly those of African descent. Like other

[38] Edward Clarke, *Sex in Education: A Fair Chance for Girls* (Boston, 1874), p. 15.
[39] Clarke, *Sex in Education,* pp. 33, 39, 62, 101–2, 136.
[40] Georges Cuvier, "Extrait d'observations faits sur le cadavre d'une femme connue à Paris et à Londres sous le nom de Vénus Hottentotte," *Mémoires du muséum d'histoire naturelle,* 3 (1817), 259–74, especially 272–3. See also Sander Gilman, *Sexuality: An Illustrated History* (New York: Wiley, 1989), and Anne Fausto-Sterling, "Gender, Race, and Nation," in Jennifer Terry and Jacqueline Urla (eds.), *Deviant Bodies: Critical Perspectives on Difference in Science and Popular Culture* (Bloomington: Indiana University Press, 1995), pp. 19–48.

females, they did not fit comfortably in the great chain of being, in which primarily males were studied for their comparative superiority. Like other Africans, they did not fit European gender ideals. As a recent book on contemporary black women's studies has put it, all the blacks were men and all the women were white.[41] On both counts – of her sex and her race – Bartmann was relegated to the world of brute flesh. Elite European naturalists who set such store by sexual complementarity when describing their own mothers, wives, and sisters rarely included African women in their new definitions of femininity.

GENDERED KNOWLEDGE

Historians have detailed the accomplishments of women scientists, the exclusion of women from scientific production, the various ideological props and cultural supports justifying that exclusion, the gendering of the persons and cultures of science, and the scientific perusal of female anatomy. Fewer have shown how gender has molded the very content of the sciences. Gender became one potent principle organizing eighteenth-century understandings of the natural world, a matter of consequence in an age that looked to nature as the guiding light for social reform. Let me sketch two examples of how gender molded the results of science. The first is the gendering of Linnean botanical taxonomy, where Europe's tenacious gender roles were overlaid onto unsuspecting plants and their sexual relations.

As extraordinary as it seems today, it was not until the late seventeenth century that European naturalists began recognizing that plants reproduce sexually. The ancient Greeks, it is true, had some knowledge of sexual distinctions in plants: Theophrastus knew the age-old practice of fertilizing date palms by bringing male flowers to the female tree; and Pliny tells us that peasants' agricultural practices recognized sexual distinctions in trees such as the pistachio.[42] Plant sexuality, however, was not a major focus of interest in the ancient world. In this era and throughout the medieval period, plant classification generally emphasized the usefulness of plants to human beings as foods and medicines.

Plant sexuality exploded onto the European stage in the seventeenth and

[41] See Gloria Hull, Patricia Bell Scott, and Barbara Smith (eds.), *All the Women Are White, All the Blacks Are Men, But Some of Us Are Brave: Black Women's Studies* (Old Westbury, NY: The Feminist Press, 1982). For the relationship between the science of sex and race, see Nancy Leys Stepan, "Race and Gender: The Role of Analogy in Science," in David Theo Goldberg (ed.), *Anatomy of Racism* (Minneapolis: University of Minnesota Press, 1990), pp. 38–57; and Londa Schiebinger, *Nature's Body: Gender in the Making of Modern Science* (Boston: Beacon Press, 1993), chaps. 4 and 5.

[42] Pliny, the Elder, *Natural History,* trans. H. Rackham (Cambridge, MA: Harvard University Press, 1942), 12, pp. xxxii, 45; A. G. Morton, *History of Botanical Science: An Account of the Development of Botany from Ancient Times to the Present Day* (New York: Academic Press, 1981), pp. 28, 38. For a more detailed discussion of gender in early modern botany, see Schiebinger, *Nature's Body,* chap. 1.

eighteenth centuries for a variety of reasons, including the general interest in sexual differentiation among humans. When sexuality in plants was recognized, everyone wanted to claim the honor of having discovered it. In France, Sébastien Vaillant and Claude-Joseph Geoffroy tussled over priority; in England, Robert Thornton complained that the honor was always given to the French, although properly it belonged to the English. Carl Linnaeus, always keen to reap his due reward for scientific innovation (and not, in fact, the first to describe sexual reproduction in plants), claimed that it would be difficult and of no utility to decide who first discovered the sexes of plants.[43]

Even in this era, interest in assigning sex to plants ran ahead of any real understanding of fertilization, or the "coitus of vegetables," as it was sometimes called. Botanists distinguished certain parts of plants as male and female (as Claude Geoffroy reported) "without knowing well the reason." The English naturalist Nehemiah Grew, the first to identify the stamen as the male part in flowers, developed his notion of plant sexuality from his knowledge of animals. In his 1682 *Anatomy of Plants,* Grew reported that "the attire" (his term for the stamen) resembles "a small penis," the various coverings upon it appear to be "so many little testicles," and the globulets (or pollen) act as "the vegetable sperme." As soon as the plant penis is erected, Grew continues, "this vegetable sperm falls down upon the seed-case or womb, and so touches it with a prolific virtue."[44]

By the early part of the eighteenth century, the analogy between animal and plant sexuality was fully developed. Linnaeus, in his *Praeludia sponsaliorum plantarum,* related the terms of comparison: in the male, the filaments of the stamens are the *vas deferens,* the anthers are the testes, and the pollen that falls from them is the seminal fluid; in the female, the stigma is the vulva, the style becomes the vagina, the tube running the length of the pistil is the Fallopian tube, the pericarp is the impregnated ovary, and the seeds are the eggs. Julien Offray de La Mettrie, along with other naturalists, even claimed that the honey reservoir found in the nectary is equivalent to mother's milk in humans.[45]

Sexual differentials, built on the imperfect analogy between plant and animal life, led to the privileging of certain sexual types over others. Most flowers are hermaphroditic, with both male and female organs in the same individual. As one eighteenth-century botanist put it, there are two sexes (male and female) but three kinds of flowers: males, females, and hermaphrodites or, as they were sometimes called, androgynes. Although most eighteenth-century botanists enthusiastically embraced sexual dimorphism, the conception of

[43] Jacques Rousseau, "Sébastien Vaillant: An Outstanding Eighteenth-Century Botanist," *Regnum Vegetabile,* 71 (1970), 195–228. Giulio Pontedera powerfully rejected the entire notion of plant sexuality in 1720 (*Anthologia, sive de floris natura*). "The Prize Dissertation of the Sexes of Plants by Carolus von Linnaeus," in Robert Thornton, *A New Illustration of the Sexual System of Carolus von Linnaeus* (London, 1799–1807).

[44] Nehemiah Grew, *The Anatomy of Plants* (London, 1682), pp. 170–2.

[45] Linnaeus, *Praeludia sponsaliorum plantarum* (1729; reprinted Uppsala: Almqvist & Wiksell, 1908), section 15; Julien Offray de la Mettrie, *L'Homme plante* (Potsdam, 1748).

plants as hermaphroditic ran into resistance. William Smellie, chief compiler of the first edition of the *Encyclopaedia Britannica* (1771), rejected the whole notion of sexuality in plants as prurient and disapproved of the term "hermaphrodite," noting when using the word that he merely spoke "the language of the system." Smellie denounced Linnaeus for taking his analogy "far beyond all decent limits," claiming that Linnaeus's metaphors were so indelicate as to exceed those of the most "obscene romance-writer."[46]

The ardent sexing of plants coincided with what is commonly celebrated as the rise of modern botanical taxonomy. In the sixteenth and seventeenth centuries, plant materials from the voyages of discovery and newly established colonies flooded Europe (increasing the number of known plants by a factor of 4 between 1550 and 1700), and new methods were developed for organizing these new riches: by 1799, when Robert Thornton published his popular version of the Linnean system, he counted fifty-two different systems of botany. Classification systems were based on different parts of plants. John Ray based his on the flower, calyx, and seed coat; Tournefort, in Paris, grounded his in the corolla and fruit; Albrecht von Haller, taking a very different approach, argued that geography was crucial to an understanding of plant life and that embryogenesis should also be represented in a system of classification. Despite the number and variety of systems, Linnaeus's taxonomy swept away these other systems and, from the 1740s (at least outside France) until the first decades of the nineteenth century, was generally considered the most convenient system of classification.

Linnaeus founded his renowned "Key to the Sexual System" on the *nuptiae plantarum* (the marriages of plants), that is, on the number of husbands (stamen) or wives (pistils) in a particular union. His famous *Systema naturae* divided the vegetable world (as he called it) into *classes* based on the number, relative proportions, and position of the male parts or stamens (Figure 8.5). These classes were then subdivided into some sixty-five *orders* based on the number, relative proportions, and positions of the female parts or pistils. These were further divided into *genera* (based on the calyx, flower, and other parts of the fruit), *species* (based on the leaves or some other characteristic of the plant), and *varieties.*[47]

One might argue that Linnaeus based his system on sexual difference because he was one of the first to recognize the biological importance of sexual reproduction in plants. But the success of Linnaeus's system did not rest on the fact that it was "natural"; indeed Linnaeus readily acknowledged that it was highly artificial. Although focused on reproductive organs, his system did not capture fundamental sexual functions. Rather it focused on purely morphological features (that is, the number and mode of union) – exactly those

[46] William Smellie, "Botany," *Encyclopaedia Britannica* (Edinburgh, 1771), vol. 1, p. 653.
[47] Carl Linnaeus, *Systema naturae* (1735), ed. M. S. J. Engel-Ledeboer and H. Engel (Nieuwkoop: B. de Graaf, 1964).

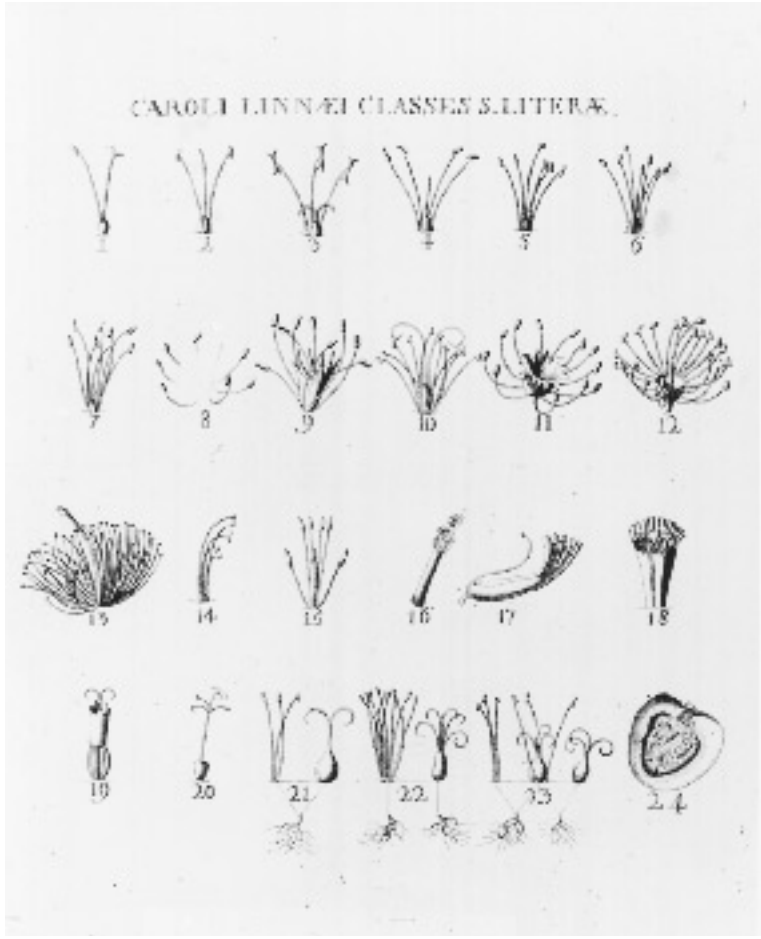

Figure 8.5. "Carl Linnaeus's Classes or Letters" illustrating Linnaeus's sexual system. Printed with Linnaeus's *Systema naturae* beginning with the second edition (1737).

characteristics of the male and female organs *least* important for their sexual function.

In view of this fact, it is striking that Linnaeus chose to highlight the sexual parts of plants at all. Furthermore, Linnaeus devised his system in such a way that the number of a plant's stamens (or male parts) determined the *class* to which it was assigned, whereas the number of its pistils (the female parts) determined its *order*. In the taxonomic tree, class stands above order. In other words, Linnaeus gave male parts priority in determining the status of the organism in the plant kingdom. There is no empirical justification for this outcome; rather Linnaeus brought traditional notions of gender hierarchy whole cloth into science. He read nature through the lens of social relations in such a way that the new language of botany incorporated fundamental

aspects of the social world as much as those of the natural world. Although today Linnaeus's classification of groups above the rank of genus has been abandoned, his binomial system of nomenclature remains, together with many of his genera and species.

My second example of gender in the content of science comes from zoological nomenclature. In 1758, in the tenth edition of his *Systema naturae,* Carl Linnaeus coined the term *Mammalia* (meaning literally "of the breast") to distinguish the class of animals embracing humans, apes, ungulates, sloths, sea cows, elephants, bats, and all other organisms having hair, three ear bones, and a four-chambered heart. In so doing, he idolized the female mammae as the icon of that class.

Historians of science have taken Linnaeus's nomenclature more or less for granted as part of his foundational work in zoological taxonomy. There was, however, a complex gender politics informing Linnean taxonomy and nomenclature. Why Linnaeus called mammals mammals, I argue, had as much to do with the fact that there is something special about the female breast as with eighteenth-century politics of wet-nursing and maternal breast-feeding and with the contested role of women in both science and the broader culture.

For more than two thousand years most of the animals we now designate as mammals (along with most reptiles and several amphibians) had been called *quadrupeds.*[48] In coining his new term *Mammalia* Linnaeus did not draw from tradition, as was common in this period, but instead devised a wholly new term.

Were there good reasons for Linnaeus to call mammals mammals? Does the longevity of Linnaeus's term reflect the fact that he was simply right, that the mammae, indeed, represent a primary, universal, and unique character of mammals (as would have been the parlance of the eighteenth century)? Yes and no. Linnaeus chose this term even though naturalists in this period did not consider the mammae a universal characteristic of the class of animals he sought to identify (in the eighteenth century, it was commonly accepted that stallions lacked teats). More important, the presence of milk-producing mammae is only one characteristic of mammals, as was commonly known to eighteenth-century European naturalists. Linnaeus could indeed have chosen a more gender-neutral name, such as *Pilosa* (the hairy ones – although hair, and especially beards, was also saturated with gender), for example, or *Aurecaviga* (the hollow-eared ones). Or he could have chosen, perhaps, *Lactentia,* the "sucking ones," which, like the German term *Säugetiere* (suckling animals), nicely universalizes the term inasmuch as male as well as female young suckle at their mothers' breasts.

[48] Aristotle, *Generation of Animals,* trans. A. L. Peck (Cambridge, MA: Harvard University Press, 1953), p. lxix; and Pierre Pellegrin, *Aristotle's Classification of Animals: Biology and the Conceptual Unity of the Aristotelian Corpus,* trans. Anthony Preus (Berkeley: University of California Press, 1986). For a more thorough treatment of why mammals are called mammals, see Schiebinger, *Nature's Body,* chap. 2.

If Linnaeus had alternatives, if he could have chosen from a number of equally valid terms, what led him to the term *Mammalia?* Zoological nomenclature – like all language – is to some degree arbitrary; naturalists devise convenient terms to identify groups of animals. But nomenclature is also historic, growing out of specific contexts, conflicts, and circumstances.

Linnaeus created his term *Mammalia* in response to the question of humans' place in Nature. In his quest to find an appropriate term for a taxon uniting humans and beasts, Linnaeus made the breast – and specifically the fully developed female breast – the icon of the highest class of animals. In privileging a uniquely female characteristic in this way, it might be argued, Linnaeus broke with long-standing traditions that saw the male as the measure of all things.[49] It is important to note, however, that in the same volume in which Linnaeus introduced the term *Mammalia,* he also introduced the term *Homo sapiens.*[50] This term was used (as *homo* had been traditionally) to *distinguish* humans from other primates (apes, lemurs, and bats, for example). In the language of taxonomy, *sapiens* is what is known as a "trivial" name. From a historical point of view, however, the choice of the term *sapiens* is highly significant. Reason had traditionally distinguished humans from animals and, among humans, males from females. Thus, within Linnean terminology, a female character (the lactating mammae) ties humans to brutes; a traditionally male character (reason) marks our separateness from brutes.[51]

Linnaeus's fascination with female mammae arose alongside and in step with key political trends in the eighteenth century: the restructuring of child care (the campaigns against wet nurses and midwives) and the restructuring of women's lives as mothers, wives, and citizens. The portrait Linnaeus painted of the naturalness of a mother giving suck to her young fed into movements to undermine the public power of women and to attach a new value to mothering.[52]

Most directly, Linnaeus joined the ongoing campaign to abolish the ancient custom of wet-nursing. Linnaeus – himself a practicing physician – prepared a dissertation against the evils of wet-nursing in 1752. In this treatise, titled "Step Nurse, or a Dissertation on the Fatal Results of Mercenary Nursing," he alluded to his own taxonomy by contrasting the barbarity of women who deprive their children of mother's milk with the gentle care of great beasts –

[49] According to Plato, unrighteous and cowardly men returned to earth as women (*Timaeus,* 90e).

[50] Gunnar Broberg (ed.), *Linnaeus: Progress and Prospects in Linnaean Research* (Stockholm: Almqvist & Wiksell, 1980); and Broberg, *Homo Sapiens L.: Studier i Carl von Linnés naturuppfattning och människolära* (The Swedish History of Science Society, 1975).

[51] Genevieve Lloyd, *The Man of Reason: "Male" and "Female" in Western Philosophy* (Minneapolis: University of Minnesota Press, 1984). On the boundary between human and beast, see Julia Douthwaite's study of the wild children: *Exotic Women, Literary Heroines and Cultural Strategies in Ancien Regime France* (Philadelphia: University of Pennsylvania Press, 1992).

[52] Valerie Fildes, *Wet Nursing: A History from Antiquity to the Present* (Oxford: Basil Blackwell, 1988); Hilary Marland (ed.), *The Art of Midwifery: Early Modern Midwives in Europe* (London: Routledge, 1993).

the whale, the fearsome lioness, and fierce tigress – who willingly offer their young the breast.[53]

To champions of enlightenment, the breast became Nature's sign that women belonged in the home (Figure 8.6). It is remarkable that in the heady days of the French Revolution, when revolutionaries marched behind the fierce and bare-breasted Liberty, the maternal breast figured in arguments against women's exercise of civic rights. Delegates to the French National Convention, where many of these decisions were made, declared that Nature had removed women from the political arena. In this case, "the breasted ones" were to be confined to the home.[54]

Linnaeus's term *Mammalia* helped legitimize the restructuring of European society by emphasizing how natural it was for females – both human and nonhuman – to suckle and rear their own children. Linnean systematics, in both his botany and his zoology, had sought to render nature universally comprehensible, yet the categories he devised infused nature with European notions of gender. Linnaeus saw females of all species as tender mothers, a parochial vision he (wittingly or unwittingly) imprinted on Europeans' understandings of nature.

BEYOND EUROPE

Scholars have newly turned their attention away from Europe toward the gendering of knowledge crafted during the expansive voyages of scientific discovery. Moral imperative and scientific warnings kept the vast majority of Europe's women close to home; the German anthropologist Johann Blumenbach was typical in warning that white women taken to very warm climates succumbed to "copious menstruation, which almost always ends, in a short space of time, in fatal hemorrhages of the uterus."[55] There was also the often-expressed fear that women giving birth in the tropics would deliver children resembling the native peoples of those areas. The intense African sun, it was thought, produced black babies regardless of the mother's complexion.

What are the implications of Europe's gendered regimes during the period of initial contact between the world's scientific traditions (many with gendered regimes of their own)? As European naturalists fanned out around the globe collecting strange animals and exotic plants for trading companies and scientific societies, what was overlooked and discarded or picked up and emphasized

[53] Carl Linnaeus, "Nutrix Noverca," respondent F. Lindberg (1752), *Amoenitates academicae* (Erlangen, 1787), in vol. 3. Translated by Gilibert as "La Nourrice marâtre, ou Dissertation sur les suites funestes du nourrisage mercénaire," *Les Chef-d'oeuvres de Monsieur de Sauvages* (Lyon, 1770), vol. 2, pp. 215–44.

[54] Lynn Hunt, *Politics, Culture, and Class in the French Revolution* (Berkeley: University of California Press, 1984), especially part 1.

[55] Johann Blumenbach, *The Natural Varieties of Mankind* (1795), trans. Thomas Bendyshe (1865; New York: Bergman, 1969), p. 212n2. Blumenbach codified notions long current in the culture.

Figure 8.6. Nature portrayed as a young virgin, her breasts dripping with mother's milk. From Charles Cochin and Hubert François Gravelot, *Iconologie par figures: ou Traité complet des allégories, emblêmes &c.* (Paris, 1791), "Nature." By permission of the Pennsylvania State University Libraries.

because gender politics sent into the field mostly unmarried males largely estranged from domestic economies and reproductive regimes? These are questions that remain to be answered. One element that can be identified is a marked disinterest in collecting for the certain aspects of the female side of life; in particular, collecting agencies showed little interest in expanding Europe's pharmacopeia of abortifacients (although they did collect innumerable

Figure 8.7. Merian's *flos pavonis.* The indigenous and slave women in Surinam used the seeds as an abortifacient. Maria Sibylla Merian, *Dissertation sur la generation et les transformations des insectes de Surinam* (The Hague, 1726), plate 45. By permission of the Wellcome Institute Library, London.

menstrual regulators). In a moving passage in her magnificent 1705 *Metamorphosis insectorum Surinamensium,* the German-born naturalist Maria Sibylla Merian, one of the few women to travel on her own to record the bounty of nature, describes how the African slave and Indian populations in Surinam, then a Dutch colony, used the seeds of a plant she identified as the *flos pavonis,* literally "peacock flower (Figure 8.7)," as an abortifacient: "The Indians, who are not treated well by their Dutch masters, use the seeds [of this plant] to abort their children, so that their children will not become slaves like they are. . . . They told me this themselves."[56]

[56] Maria Sibylla Merian, *Metamorphosis insectorum Surinamensium* (1705), ed. Helmut Deckert (Leipzig:

In the explosion of knowledge generally associated with the Scientific Revolution and global expansion, European awareness of herbal antifertility agents, such Merian's *flos pavonis,* declined dramatically. Contrary to other trends, where naturalists assiduously collected local knowledges of plants for medicines and potential profit, there was no systematic attempt to introduce into Europe new and exotic contraceptives and abortifacients gathered from cultures around the globe. Mercantilist policies guiding global expansion did not define trade in such plants as a lucrative or desirable business, nor did the pro-natalist policies of governments encourage the collection of such knowledge.[57] Gender in the emergence of eighteenth-century global science is a topic requiring further research.

PAST AND FUTURE

In the seventeenth and eighteenth centuries, science was a young enterprise that was forging new ideas and institutions. Men of science at this time can be seen as standing at a fork in the road. They could either sweep away traditions of the medieval past and welcome women as full participants in science, or they could reaffirm the traditions of the past and continue to exclude women from rarefied intellectual pursuit. The social and intellectual circumstances directed science down the latter path; paradoxically, the Scientific Revolution participated in the rise of scientific sexism, scientific racism, and, in some cases, the collapse of knowledge systems central to women's health and well-being. The nature of science, however, is no more fixed than is the moral nature of men or women. Understanding the historical circumstances that have distanced women from science and have led to the gendering of aspects of its content can help in the complex task of reworking gender relations in modern science.

Insel Verlag, 1975), commentary to plate no. 45. On Merian, see Margarete Pfister-Burkhalter, *Maria Sibylla Merian: Leben und Werk 1647–1717* (Basel: GS-Verlag, 1980), and Elisabeth Rücker, "Maria Sibylla Merian," *Fränkische Lebensbilder,* 1 (1967), 221–47; Rücker, *Maria Sibylla Merian* (Nuremberg: Germanisches Nationalmuseum, 1967); Schiebinger, *The Mind Has No Sex?* chap. 3; Davis, *Women on the Margins;* Helmut Kaiser, *Maria Sibylla Merian: Eine Biographie* (Dusseldorf: Artemis & Winkler, 1997); and Kurt Wettengl (ed.), *Maria Sibylla Merian, 1647–1717: Artist and Naturalist* (Ostfildern: Hatje, 1998).

[57] Londa Schiebinger, "Lost Knowledge, Bodies of Ignorance, and the Poverty of Taxonomy as Illustrated by the Curious Fate of *Flos Pavonis,* an Abortifacient," in Caroline Jones and Peter Galison (eds.), *Picturing Science, Producing Art* (New York: Routledge, 1998), pp. 125–44.