An Introduction to *Scientific Masculinities*

by Erika Lorraine Milam* and Robert A. Nye†

ABSTRACT

This volume seeks to integrate gender analysis into the global history of science and medicine from the late Middle Ages to the present by focusing on masculinity, the part of the gender equation that has received the least attention from scholars. The premise of the volume is that social constructions of masculinity function simultaneously as foils for femininity and as methods of differentiating between "kinds" of men. In exploring scientific masculinities without taking the dominance of men and masculinity in the sciences for granted, we ask, What is masculinity and how does it operate in science? Our answers remind us that gender is at once an analytical category and a historical object. The essays are divided into three sections that in turn emphasize the importance of gender to the professionalization of scientific, technological, and medical practices, the spaces in which such labor is performed, and the ways that sex, gender, and sexual orientation are measured and serve as metaphors in society and culture.

The substantial literature on gender studies of science and women in science provides a wide array of tools for understanding complex gender dynamics and amply demonstrates the gendered nature of all human activity, including the importance of gender in the lived experiences of scientists, engineers, and medical practitioners. Historians who developed gender as a category of analysis sought to move beyond dualisms like male/female or masculine/feminine to create sliding scales of sex, gender, and sexuality. In this they succeeded marvelously, yet scholarly attention within the history of science has largely continued to engage with elite men—the largest category of historical actors about whom we write—as a foil for theorizing the gendered, classed, or racialized experiences of others, but otherwise as belonging to an unmarked social category. In light of the ubiquitous presence of men as scientists, engineers, and doctors throughout history, then, what are the consequences of changing the kinds of questions we ask about the scientific enterprise from "why did scientists think X" to "why did *male* scientists think X"? Or, more exactly, what does it add to our understanding of the sciences if we factor in masculine social and cultural perspectives of time and place?

Recently, historians have begun to explore the masculine cultures of the "field"

*Department of History, 136 Dickinson Hall, Princeton University, Princeton, NJ 08544-1017; emilam@princeton.edu.
†Department of History, Oregon State University, Corvallis, OR 97331; nyer@onid.orst.edu.

sciences, engineering, and technology, as well as mathematics, the physical sciences, computer science, medicine and its specialties, genetics, and other fields encompassing many historical periods and cultures.[1] Gender, as these histories illustrate, is not just a topic we should address episodically in our teaching and research; it is a powerful analytical tool with which to rethink science as a fundamentally gendered activity, whether or not women are present. The predominantly male groups that shaped the work of science, technology, and medicine also authorized the construction of gendered and sexed bodies. Entirely male enterprises were haunted by the specter of femininity because distinctions between bodies, behavior, social origin, and race fell along a readily feminized spectrum of "more or less" masculine. Similarly, scientific and medical norms took their dominant form from men's concerns about feminine or effeminizing "pathologies" or departures from ideals of male beauty or health.[2]

This volume holds in tension the masculine cultures of doing science and the study of sexed bodies within the sciences and medicine. Our challenge was to bring to light the ways that these scientific masculinities have operated over time and within different cultures without reenacting history by excluding women or femininity from the story.

The first efforts to open up the issue of gender in the history of science in the 1960s were feminist analyses of the causes and reasons for the exclusion of women from professional science, technology, and medicine. Several myths needed to be exploded: science was an objective enterprise unsuited to women; women had contributed historically little to scientific developments; when they did contribute, it was in fields appropriate to their natures and skills. The job of unpacking these myths fell to philosophers, sociologists, and historians of science. Philosophers have worked to discredit the notion of the gender neutrality of valid science, sociologists have illuminated the

[1] David Noble, *A World without Women: The Christian Clerical Culture of Western Science* (New York, 1992); Sharon Traweek, *Beamtimes and Lifetimes: The World of High Energy Physics in Japan* (Cambridge, Mass., 1988); Elizabeth Lunbeck, *The Psychiatric Persuasion: Knowledge, Gender and Power in Modern America* (Princeton, N.J., 1994); Bruce Hevly, "The Heroic Science of Glacier Motion," *Osiris* 11 (1996): 66–86; Naomi Oreskes, "Objectivity or Heroism? On the Invisibility of Women in Science," *Osiris* 11 (1996): 87–116; Robert A. Nye, "Medicine and Science as Masculine Fields of Honor," *Osiris* 12 (1997): 60–79; Ruth Oldenziel, *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945* (Amsterdam, 1999); Roger Horowitz, *Boys and Their Toys? Masculinity, Technology, and Class in America* (New York, 2001); Jane Margolis and Allan Fisher, *Unlocking the Clubhouse: Women in Computing* (Cambridge, Mass., 2003); Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago, 2003); Kristen Haring, *Ham Radio's Technical Culture* (Cambridge, Mass., 2007); Grace Yen Shen, "Taking to the Field: Geological Fieldwork and National Identity in Republican China," *Osiris* 24 (2009): 231–52; Ellen S. More, Elizabeth Fee, and Manon Parry, eds., *Women Physicians and the Cultures of Medicine* (Baltimore, 2009); Henrika Kuklick, "Personal Equations: Reflections on the History of Fieldwork, with Special Reference to Sociocultural Anthropology," *Isis* 102 (2011): 1–33; Ian Nicholson, "'Shocking' Masculinity: Stanley Milgram, 'Obedience to Authority,' and the 'Crisis of Manhood' in Cold War America," *Isis* 102 (2011): 238–68; Rob Boddice, "The Manly Mind? Revisiting the Victorian 'Sex in Brain' Debate," *Gend. & Hist.* 23 (2011): 321–40.

[2] From the plentiful literature on these issues, see Ann Laura Stoler, *Race and the Education of Desire: Foucault's History of Sexuality and the Colonial Order of Things* (Durham, N.C., 1995); Joanna Bourke, *Dismembering the Male: Men's Bodies, Britain and the Great War* (London, 1996); George L. Mosse, *The Image of Man: The Creation of Modern Masculinity* (New York, 1996); Charlotte Furth, *A Flourishing Yin: Gender in China's Medical History, 960–1665* (Berkeley and Los Angeles, 1999); Alexandra Shepard, *Meanings of Manhood in Early Modern England* (Oxford, 2003), 47–69; and Christina S. Jarvis, *The Male Body at War: American Masculinity during World War II* (DeKalb, Ill., 2004).

practical obstacles and constricted pathways leading to careers for women in science, and historians have studied the diversity of historical, cultural, and disciplinary situations in which previously "invisible" women contributed to scientific and medical research and teaching.[3]

Though much of the early work on science and gender was about men, patriarchy, and a masculinist domination of nature, the need to identify how and why women had been marginalized necessarily took precedence over using the tools of gender analysis to understand the particular characteristics of masculine scientific and professional cultures.[4] Because women collectively and as individuals had been invisible, historians left largely unexamined the discriminatory hierarchies within all-white male cultures, which advanced the careers of some men while excluding or marginalizing other men (and, by extension, women) on the basis of class, race, religion, or sexual orientation.[5] Gender theory teaches us that masculine/feminine binaries are conceptually conjoined; to define the masculine as not feminine or vice versa evokes the other as an inevitable component of identity. This has meant in practice that imputations of effeminacy have been mixed together with other justifications for excluding qualified men from scientific cultures who did not seem to be the "right" kind of man. We must take these different perspectives seriously: social constructions of masculinity function simultaneously as foils for femininity and as methods of differentiating between kinds of men.

In the last decades, "gender" has thus evolved from merely a grammatical category

[3] Some important philosophical interventions in this area are Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven, Conn., 1985); Helen Longino, *Science as Social Knowledge* (Princeton, N.J., 1990); Sandra Harding, *The Science Question in Feminism* (Ithaca, N.Y., 1986); see also Muriel Lederman and Ingrid Bartsch, eds., *The Gender and Science Reader* (New York, 2001). Key sociological works include Henry Etkowitz, Carol Kemelgor, and Brian Uzzi, eds., *Athena Unbound: The Advancement of Women in Science and Technology* (Cambridge, 2000); Sue V. Rosser, *The Science Glass Ceiling* (New York, 2004); Margaret A. Eisenhart and Elizabeth Finkel, *Women's Science: Learning and Succeeding from the Margins* (Chicago, 1998). Pioneers in history have been Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (San Francisco, 1980); Londa Schiebinger, *Has Feminism Changed Science?* (Cambridge, Mass., 1999); Margaret Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore, 1982); Rossiter, *Women Scientists in America: Before Affirmative Action, 1940–1972* (Baltimore, 1995); Rossiter, *Women Scientists in America: Forging a New World since 1972* (Baltimore, 2012); Ellen S. More, *Restoring the Balance: Women Physicians and the Profession of Medicine, 1850–1995* (Cambridge, Mass., 1999); in this same vein, see also Sally Gregory Kohlstedt and Helen E. Longino, eds. *Women, Gender, and Science: New Directions*, vol. 12 of *Osiris* (1997). The most comprehensive source for appreciating the depth and global scope of recent historical studies of gender is Teresa A. Meade and Merry E. Wiesner-Hanks, *A Companion to Gender History* (Oxford, 2004).

[4] See, e.g., the retrospective article in the thirty-five-year-old journal *Sex Roles*: Joan C. Chrisler, "In Honor of *Sex Roles*: Reflections on the History and Development of the Journal," *Sex Roles* 63 (2010): 299–310.

[5] Michael S. Kimmel, *The History of Men: Essays in the History of British and American Masculinities* (Albany, N.Y., 2005); R. W. Connell, *Masculinities* (London, 1995). Historians have studied race as both a historical object and a marker of social discrimination and privilege; see, e.g., Nancy Leys Stepan, *The Hour of Eugenics: Race, Gender, and Nation in Latin America* (Ithaca, N.Y., 1991); Keith Wailoo, *Dying in the City of the Blues: Sickle Cell Anemia and the Politics of Race and Health* (Chapel Hill, N.C., 2001); and Alondra Nelson, *Body and Soul: The Black Panther Party and the Fight against Medical Discrimination* (Minneapolis, 2011). Historians of colonialism and eugenics have also interrogated the construction of whiteness as race in much the same way that we explore masculinity as gender: Warwick Anderson, *The Cultivation of Whiteness: Science, Health, and Racial Destiny in Australia* (Carlton South, Victoria, 2002); Alexandra Minna Stern, *Eugenic Nation: Faults and Frontiers of Better Breeding in Modern America* (Berkeley and Los Angeles, 2005); Julian B. Carter, *The Heart of Whiteness: Normal Sexuality and Race in America, 1880–1940* (Durham, N.C., 2007).

to a crucial aspect of modern selfhood.[6] The history of this evolution illuminates the many ways scientific language constructs our perceptions of the world and is itself constructed by material and cultural change. Psychologist John Money and his colleagues at Johns Hopkins first used gender as a nongrammatical term in the 1950s to create a protocol for rearing intersex children whose genitals had been surgically "improved" to resemble typical male or female organs.[7] In this protocol, Money and his associates invoked "gender" to denote the assigned sex of rearing, as they assumed the power of the environment would prove stronger than the children's ambiguous sex. Psychoanalyst Robert Stoller later coined "gender identity" to describe the end point of a successful transition for intersex and transsexual individuals. Feminist theorists later appropriated "gender" to emphasize the means by which culturally enforced norms created and maintained different (and fundamentally unequal) expectations for how men and women were supposed to behave.[8] Ironically, in the last two decades, psychiatrists, doctors, scientists, and other scholars have begun to use gender as a valid substitute for sex, transforming gender into a foundational marker of personal identity. That is another, and very complicated, story, one in which physicians and scientists appear to recapitulate in language an essentializing difference between masculinity and femininity.[9]

Feminist scholars have also deployed gender as an analytical tool for interpreting the past. A recent forum in the *American Historical Review* on Joan Scott's epochal 1986 article, "Gender: A Useful Category of Historical Analysis," revealed historians' prodigious use of gender analysis in their work in the intervening years.[10] In her own remarks, Scott foregrounded the linguistic turn as a powerful lesson for her and her generation, teaching her "to understand that differences of sex were not set by nature but were established through language, and to analyze language as a volatile, mutable system whose meanings could never finally be secured." She continued by inviting her readers "to think critically about how the meanings of sexed bodies are produced,

[6] Of course, many languages don't have gender and when they do, gender doesn't always track with sex; Greville G. Corbett, *Gender* (New York, 1991).

[7] For an account of the work of Money and his colleagues, see Elizabeth Reis, *Bodies in Doubt: An American History of Intersex* (Baltimore, 2009), 115–52.

[8] Robert Stoller, *Sex and Gender* (New York, 1968); Joanne Meyerowitz tells part of this story in "A History of 'Gender,'" *Amer. Hist. Rev.* 113 (2008): 1346–56; on the dilemma of being stuck with the older term when "gender" would be preferable, see Irene Hanson Frieze and Joan C. Chrisler, "Editorial Policy in the Use of the Two Terms 'Sex' and 'Gender,'" *Sex Roles* 64 (2011): 789–90; the medical history may be found in Anne Fausto-Sterling, *Sexing the Body: Gender Politics and the Construction of Sexuality* (New York, 2000), 45–78. For the clinical process of sex determination, see Sandra Eder, "The Volatility of Sex: Intersexuality, Gender and Clinical Practice in the 1950s," *Gend. & Hist.* 22 (2010): 692–707.

[9] See the article by the evolutionary biologist David Haig, "The Inexorable Rise of Gender and the Decline of Sex: Social Change in Academic Titles," *Arch. Sexual Behav.* 33 (2004): 87–90; see also Robert A. Nye, "The Biosexual Foundations of Our Modern Concept of Gender," in *Sexualized Brains: Scientific Modeling of Emotional Intelligence from a Cultural Perspective*, ed. Nicole C. Karafyllis and Gotlind Ulshöfer (Cambridge, Mass., 2008), 69–80. The most up-to-date scientific research on the sex/gender distinction is reviewed in Anne Fausto-Sterling, *Sex/Gender: Biology in a Social World* (New York, 2012). See also Rebecca Jordan-Young's lucid elaboration of sex, gender, and sexuality as inextricably intertwined three-ply yarn in *Brain Storm: Flaws in the Science of Sex Differences* (Cambridge, Mass., 2010).

[10] Scott's article was incorporated into her book, *Gender and the Politics of History* (New York, 1988); see "AHR Forum: Revisiting 'Gender: A Useful Category of Historical Analysis,'" *Amer. Hist. Rev.* 113 (2008): 1344–1429.

deployed, and changed."[11] We keep her invitation in mind when exploring how and why scientists constructed gender in particular social, material, and cultural contexts.

Masculine cultures of science influenced scientists' construction of normative male (and female) anatomy, sexual orientation, and behavior and provided frameworks from which to draw upon modern technology to define masculinity and declare technology a masculine subject. These cultures also supplied masculine perspectives on popular writing about exploration, science, and technology, even where many of the writers or readers of these works were women. Depending on the sociocultural context, male scientists chose from among a variety of masculine roles, including laboratory-based scientist-heroes,[12] outdoor, self-reliant men,[13] sensitive and sympathetic readers of nature,[14] and family men.[15] When women did enter the scientific workplace—in domestic settings, laboratories, field sites, and classrooms—gendered models from the broader culture often determined how these integrated spaces were organized, perhaps along patriarchal or familial lines or, more ordinarily, following the ambient norms of gender segregation.[16] Although popular conceptions of science mirrored the gendered realities of contemporary scientific culture, they also preserved and popularized certain images of masculinity at the expense of others, particularly scientists who were also men of action—just think of Richard Feynman, L. S. B. Leakey, or, as an extreme example, Steve Irwin. Further, through film, advertising, journalistic attention, and mere happenstance, these visions of science and scientists help generate cultural values and popular interests.[17]

Most historians of gender, however, eschew a radical nominalism that considers bodily sex to be a mere "effect" of language.[18] Though some scholars have embraced cultural explanations of naturalized bodies loosely drawn from Judith Butler's concept of gender performativity, others prefer the French sociologist Pierre Bourdieu's notion of habitus, according to which femininity and masculinity are embedded in

[11] Joan Scott, "Unanswered Questions," *Amer. Hist. Rev.* 113 (2008): 1422–9, on 1423.

[12] Natasha Myers, "Pedagogy and Performativity: Rendering Laboratory Lives in the Documentary *Naturally Obsessed: The Making of a Scientist*," *Isis* 101 (2010): 817–28.

[13] Donna Haraway, "Teddy Bear Patriarchy: Taxidermy in the Garden of Eden, New York City, 1908–1936," in *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York, 1989), 26–58; Gregg Mitman, "Cinematic Nature: Hollywood Technology, Popular Culture, and the American Museum of Natural History," *Isis* 84 (1993): 637–61.

[14] Janet Browne, "I Could Have Retched All Night: Charles Darwin and His Body," in *Science Incarnate: Historical Embodiments of Natural Knowledge*, ed. Christopher Lawrence and Steven Shapin (Chicago, 1998), 240–87; Jim Endersby, "Sympathetic Science: Charles Darwin, Joseph Hooker, and the Passions of Victorian Naturalists," *Victorian Stud.* 51 (2009): 299–320; Rob Boddice, "Vivisecting Major: A Victorian Gentleman Defends Animal Experimentation, 1876–1885," *Isis* 104 (2011): 215–37.

[15] John Tosh, *A Man's Place: Masculinity and the Middle-Class Home in Victorian England* (New Haven, Conn., 1999).

[16] Marsha L. Richmond, "The Domestication of Heredity: The Familial Organization of Geneticists at Cambridge University, 1895–1910," *J. Hist. Biol.* 39 (2006): 565–605; Michael Hoskin, *Discoverers of the Universe: William and Caroline Herschel* (Princeton, N.J., 2011); Steven J. Peitzman, *A New and Untried Course: Women's Medical College and Medical College of Pennsylvania* (New Brunswick, N.J., 2000).

[17] Bernard Lightman, *Victorian Popularizers of Science: Designing Nature for New Audiences* (Chicago, 2007); Salim Al-Gailani, "Magic, Science and Masculinity: Marketing Toy Chemistry Sets," *Stud. Hist. Phil. Sci. Pt. A* 40 (2009): 372–81; David A. Kirby, *Lab Coats in Hollywood: Science, Scientists, and Cinema* (Cambridge, Mass., 2011).

[18] See, e.g., three recent texts on gender history: Kathleen Canning, *Gender History and Practice* (Ithaca, N.Y., 2006), esp. 168–92; Laura Lee Downs, *Writing Gender History*, 2nd ed. (New York, 2010); Sonya O. Rose, *What Is Gender History?* (London, 2010).

bodies and structures in ways that perpetually reconfigure gender difference.[19] In Bourdieu's sociological account, the capacity of language to summon ontological categories (like gender) into being "does not lie . . . in the language itself, but in the group that authorizes and recognizes it and, with it, authorizes and recognizes itself"—dubbed the "officialization effect."[20] This process implants particular qualities in bodies, which are felt and perceived by others to be natural, endowing gender with a lived corporeality.

A similar process worked to pathologize same-sex desire, even before discursive distinctions between heterosexual and homosexual sexual orientation emerged in late nineteenth-century medicine and science. Heterosexual desire in this discourse could be identified by a number of somatic and psychic "signs," which were regularly aligned with the prevailing norms of male bodies and masculine comportment, while the bodies of homosexuals were scrutinized for morphological defects and evidence of effeminacy.[21] The prestige of Western medicine was such that this model was replicated by many of the medical professions of modernizing nations elsewhere in the world.[22]

As Nelly Oudshoorn has argued, early feminist critiques of the masculine construction of female bodies perpetuated the notion that male bodies were a stable, unmarked category, "untouched by time and place."[23] Their research revealed how, in comparison to men's bodies, scientists often defined women's bodies as the immature, "default" pattern from which maleness differentiated.[24] In the modern era, a growing scientific and medical understanding of the building blocks of sex has roughly coincided with a new cultural self-consciousness about the constructedness and mutability of bodies. Resistance to this new understanding remains intact, not least due to some of the research that helped establish the myriad pathways of sex development. However, the possibility of alternate developmental outcomes, together with cultural

[19] Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York, 1990); Butler, "Performativity's Social Magic," in *Bourdieu: A Critical Reader*, ed. Richard Shusterman (Oxford, 1999), 113–28. See also Brooke Holmes, *Gender: Antiquity and Its Legacy* (Oxford, 2012), on the ways in which Butler and other theorists worked with stories from ancient Greece and Rome to problematize strict boundaries between cultural "gender" and biological "sex."

[20] Pierre Bourdieu, *The Logic of Practice*, trans. Richard Nice (Stanford, Calif., 1990), 109–10; see also Bourdieu, *La domination masculine* (Paris, 1998).

[21] See on this history Vernon A. Rosario, *Science and Homosexualities* (London, 1997); Alice Dreger, *Hermaphrodites and the Medical Invention of Sex* (Cambridge, Mass., 1998); Jennifer Terry, *An American Obsession: Science, Medicine, and Homosexuality in Modern Society* (Chicago, 1999); Henry L. Minton, *Departing from Deviance: A History of Homosexual Rights and Emancipatory Science in America* (Chicago, 2002). See also Luis Campos, "Mutant Sexuality: The Private Lives of Plants," in *Making Mutations: Objects, Practices, Contexts*, ed. Luis Campos and Alexander von Schwerin, Max Planck Institute for the History of Science, Preprint 393 (Berlin, 2010), 49–70.

[22] Sabine Frühstück, *Colonizing Sex: Sexology and Social Control in Modern Japan* (Berkeley and Los Angeles, 2003); Frank Dikötter has also argued that Western models of homosexuality, spermatorrhea, and masturbation were adopted by Chinese medical professionals in the Republican period to reinforce procreative sexuality: Dikötter, *Sex, Culture and Modernity in China: Medical Science and the Construction of Sexual Identities in Early Republican China* (Honolulu, 1994); and Dikötter, *Imperfect Conceptions: Medical Knowledge, Birth Defects and Eugenics in China* (New York, 1998); cf. Susan L. Mann, *Gender and Sexuality in Modern Chinese History* (New York, 2011).

[23] Nelly Oudshoorn, "On Bodies, Technologies, and Feminisms," in *Feminism in Twentieth-Century Science, Technology, and Medicine*, ed. Angela N. H. Creager, Elizabeth Lunbeck, and Londa Schiebinger (Chicago, 2001), 199–213, on 206.

[24] For example, see Cynthia Eagle Russett, *Sexual Science: The Victorian Construction of Womanhood* (Cambridge, Mass., 1989).

acceptance of the idea that we can refashion our bodies, has turned scholars' discriminating gazes to the construction of male bodies.[25]

Scientific understandings of male bodies have never been entirely fixed. Medievalists and early modernists, for example, were inspired by Greek medicine, which encouraged many contemporaries to think of bodies as governed by the influences of internal humors and the environment and therefore subject to change.[26] Neither modern science nor modernity itself succeeded in eliminating this mutability; instead they have further complicated the problem and raised the stakes. As historian Christopher Forth has written, the conditions of modernity "at once reinforce and destabilize the representation of masculinity as an unproblematic quality of male anatomy." In his analysis, "the double logic of modern civilization" became a process promoting and supporting male interests while simultaneously "threatening to undermine those interests by eroding the corporeal foundations of male privilege."[27]

Constitutionally, the masculinity of bodies defined by scientific research functioned at overlapping metaphorical levels, including the physical body (or individual health), the social body (or integrity of the community), and the national body (and its status relative to that of other countries).[28] In this way, the sciences of masculinity have existed in both familiar contexts, where the idea of masculine bodies is naturalized according to our contemporary perspectives, and in the less familiar ones, where these very categories can be problematic and thus provide another means by which to deconstruct the powerful normative claims of science.

As historians we must attend to both the gendered linguistic conventions of scientific cultures and the cultural history of scientific and medical research on male bodies. This volume seeks to develop a set of tools for understanding the pervasive role of masculinity in shaping normative scientific research. In exploring scientific masculinities without taking the dominance of men and masculinity in the sciences for granted, we ask, What is masculinity and how does it operate in science? Our answers remind us that gender is at once an analytical category and a historical object. Joan Scott is right—the language of gender is volatile and highly mutable—yet masculinity persists as a marker, maker, and companion of privilege. The deep irony revealed by Forth's analysis is that despite this close association, the privilege of masculinity seems perpetually under siege.

In assembling the contributions to this volume, we have attempted to reach a global focus by including colonial Latin America, modern China, and the Soviet Union.

[25] On this point, see Terrance MacMullan, "Introduction: What Is Male Embodiment?" in *Revealing Male Bodies*, ed. Nancy Tuana, William Cowling, Maurice Hamington, Greg Johnson, and Terrance MacMullan (Bloomington, Ind., 2002), 1–16, on 2. Of particular importance to this new visibility was the discovery of the hormones; Nelly Oudshoorn, *Beyond the Natural Body: An Archaeology of Sex Hormones* (London, 1994); David Serlin, *Replaceable You: Engineering the Body in Postwar America* (Chicago, 2004); and Chandak Sengoopta, *The Most Secret Quintessence of Life: Sex, Glands, and Hormones, 1850–1950* (Chicago, 2006). On the operationalization of "masculine" hormones, see John Hoberman, *Testosterone Dreams: Rejuvenation, Aphrodisia, Doping* (Berkeley and Los Angeles, 2005).

[26] On late antique and medieval bodies, see Peter Brown, *The Body and Society: Men, Women, and Sexual Renunciation in Early Christianity* (1988; New York, 2008); and Joan Cadden, *Meanings of Sex Difference in the Middle Ages* (Cambridge, 1993).

[27] Christopher Forth, *Masculinity in the Modern West: Gender, Civilization and the Body* (New York, 2008), 5. See also Christopher Forth and Ivan Crozier, eds., *Body Parts: Critical Explorations in Corporeality* (Lanham, Md., 2005).

[28] Mary Douglas, *Natural Symbols: Explorations in Cosmology* (New York, 1970).

Similarly, we sought to span a wide array of chronologies by incorporating perspectives from the medieval and early modern periods in addition to those from the nineteenth and twentieth centuries. We are not trying to provide a single or unified perspective on scientific masculinities but instead to illustrate that scientific masculinities vary with respect to historical and cultural context. We thus see the broadly selective nature of the contributions to this volume (in both space and time) as a distinctive strength.

The easy dichotomies with which scholars have interrogated the gendered world—such as domestic/public, feminine/masculine, and popular/professional—break down under close scrutiny.[29] In place of these simple binaries, this volume delves into the nuanced privileges of scientific masculinities that were created by, and which sometimes resisted, overlapping discourses of morality, family life, education, class, disciplinary affiliations, and cultural identity. Owing to the mutability of masculinities, disparate generations and cultures reconstitute gendered privilege in novel terms. So-called crises of masculinity exist in each scientific culture we have investigated and cannot be reduced to specific moments of social upheaval or anxiety.[30] Despite the myriad historical incarnations of scientific cultures, masculinity tends to retain its hegemonic place.

When read collectively, these essays explore the mobilization of gendered discourses in the sciences, and the functions they served for professionals, amateurs, and popularizers who deployed, maintained, and implemented them within masculine cultures. For reasons of conceptual clarity, we have chosen to examine the gendering of scientific activities in three important domains: the professionalization of science, the practices of physical and intellectual scientific labor, and the acts of measuring and theorizing sexed bodies.[31] As the reader can see from the table of contents, we have accordingly grouped essays in three sections, but in each, we reference essays that overlap significantly with the central subject in order to illustrate the volume's unity of theme and analysis.

PROFESSIONALIZATION AND GENDER NORMS

Gender, whether conceived as an identity or normative description, consists of negotiable constructions that scientists mobilize for particular tasks.[32] These identities invariably overlap in and between persons and communities, but despite the often haphazard ascriptions of gender in the material world, there has been a persistent effort to

[29] See, e.g., James Secord, "Knowledge in Transit," *Isis* 95 (2004): 654–72; Katherine Pandora, "Popular Science in National and Transnational Perspective: Suggestions from the American Context," *Isis* 100 (2009): 346–58.

[30] Robert A. Nye, "Locating Masculinity: Some Recent Work on Men," *Signs* 30 (2005): 1937–62.

[31] Until sometime after the publication of Anne Witz's *Professions and Patriarchy* (London, 1992), which pioneered gender analysis in the field, historians and sociologists of the professions—when they considered women at all—treated them as a "given" composed of their sex and its characteristic emotional and intellectual characteristics (2–3). These include important books such as Eliot Freidson, *Profession of Medicine: A Study of the Sociology of Applied Knowledge* (New York, 1970); Samuel Haber, *The Quest for Authority and Honor in the American Professions, 1750–1900* (Chicago, 1991); William M. Sullivan, *Work and Integrity: The Crisis and Promise of Professionalism in America* (New York, 1995); Kees Gispen, *New Profession, Old Order: Engineers and German Society* (Cambridge, 1989).

[32] On the "paradoxes" of the continuous historical creation and maintenance of difference see Judith Lorber, *Paradoxes of Gender* (New Haven, Conn., 1994), 5–6.

maintain clear gender boundaries in social and cultural life. In other words, although nature loves variety, societies hate it. Medical and scientific specialists have played important roles in this process by establishing and defending natural laws of male and female difference, normal and pathological sexual orientation, and fixed gender norms using the tools of their professional expertise. They have then applied these laws to their own professional domains as criteria for admission and advancement and exported them to others. There is a clear dialectical relationship between the establishment of gender norms and professionalization processes, as several of these essays illustrate, including, as we have indicated, how some men benefited professionally at the expense of others.[33] Professional success required not only scientific acumen but in addition the ability to negotiate the gendered cultural norms of scientific society.

Several essays survey historical actors and cultures that refused to acknowledge the fluidity of sex/gender in natural or human law and sought to demarcate "natural" boundaries between male and female bodies and sexual behavior. In her investigation of hermaphroditism in the Middle Ages, Leah DeVun scrutinizes medieval surgical manuals for insights into how and why doctors "corrected" the errors of nature in the genitals of hermaphrodites. Nathan Ha considers the Cold War–era research of the Czech-born Canadian sexologist Kurt Freund, who used penile plethysmography to measure male sexual desire and orientation, a procedure with important implications for defining and (at the time) correcting gender identity.

The fluidity of gender we so readily discover in analyzing masculine scientific cultures is often the result of new intellectual challenges. The emergence of novel technologies or professional opportunities may require adaptations in gendered spaces or in the identities of the scientists and technicians who must perform new tasks. Nathan Ensmenger discusses the rugged individualism favored by male computer programmers in a context of professionalization and gender competition in America from the 1950s to the 1970s. Ensmenger's male computer experts fashioned for themselves a unique masculinity that permitted a form of professional self-presentation allowing them to seem both heroic and (for women) impossible to emulate. Eugenia Lean examines periodicals aimed at women readers in early Republican China to identify the importance of feminine domesticity as a cultural trope that would entice elite men to engage in scientific and technological work in industrializing China. Lean's male propagandists for household industry thus chose to represent themselves in the feminine voices of the domestic sphere. Michael Robinson writes about the way that late nineteenth- and early twentieth-century arctic explorers embarked on their expeditions with the clear intention of later popularizing their exploits as adventures in masculine self-fashioning. Robinson's essay reveals that these travelers identified new sources of patronage for their work by recruiting female journalists to relate their essentially masculine narratives to a broader culture.[34]

[33] See, e.g., Sheila Jasanoff, ed., *State of Knowledge: The Co-Production of Science and Social Order* (New York, 2004); Mary Terrall, *The Man Who Flattened the Earth: Maupertuis and the Sciences in the Enlightenment* (Chicago, 2006); Lynn Nyhart, *Modern Nature: The Rise of the Biological Perspective in Germany* (Chicago, 2009); Eric Ash, ed., *Expertise: Knowledge and the Early Modern State*, vol. 25 of *Osiris* (2010).

[34] For some interesting recent work on the gender implications of popularizing science to mixed audiences, see Rebekah Higgitt and Charles W. J. Withers, "Science and Sociability: Women as Audience at the British Association for the Advancement of Science, 1831–1901," *Isis* 99 (2008): 1–27; Veronica della Dora, "Making Mobile Knowledges: The Educational Cruises of the *Revue Générale des Sciences Pures et Appliquées*, 1897–1914," *Isis* 101 (2010): 467–500.

Perhaps more typically, however, masculine gender ideals have been deployed as part of a rear-guard defense of established monopolies in professional life. In this vein, Alexandra Rutherford revisits mid-twentieth-century American experimental psychologists' commitment to the popular and professional assumption that the minds of men were uniquely suited to scientific inquiry. The Harvard psychologist Edwin Boring, the principal subject of Rutherford's essay, defended his besieged model of experimental psychology against the perceived feminization of his discipline. Erika Lorraine Milam focuses on the research and institution-building work of the social anthropologists Robin Fox and Lionel Tiger to understand the parallels between pop-anthropological theories of male bonding (and aggression) and the predominantly male professional identity some anthropologists feared to lose. Milam's nexus of social anthropologists, who were threatened by feminists in contemporary life and by emerging scientific fields beyond the scope of their expertise, created an evolutionary picture of males and females that reinforced traditional gender arrangements. In each of these cases, scientists countered a perilously fluid professional situation by rearticulating gendered norms of behavior.

When women began to penetrate the boundaries of these scientific domains at the dawn of the twentieth century, the shock to the men who monopolized most intellectual fields must have been stupendous.[35] As historian Paul Lucier has noted, before "scientists" came to describe those who did scientific work, Americans typically used the phrase "men of science." In the debate over the professionalization of science and what to call the men who worked in its precincts, women were essentially excluded from public conversations about scientific expertise.[36] Yet evidence also suggests that many all-male groups in the twentieth century forged self-sufficient friendships.[37] Within these groups, some men might not even have noticed the absence of women, much less felt them to be a threat; the erotics of male bonds were quite capable of filling emotional gaps, as colleagues, friends, confidants, or lovers.[38] In doing so, scientific producers and practitioners mobilized masculine discourses for authenticating lines of authority and expertise.

SCIENTIFIC LABOR AND GENDERED SPACES

Historians of science are particularly attuned to the practices of physical and intellectual labor that produce knowledge. Such practices vary between sites of research—including scientific observations, experiments in laboratories and field locales, museum collecting, and theoretical modeling—each with their own rules of engagement.[39]

[35] Margaret Rossiter, "Which Science? Which Women?" *Osiris* 12 (1997): 169–85.

[36] Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis* 100 (2009): 699–732, on 704.

[37] Jamie Cohen-Cole has written about the convivial masculinity of the social scientists and intellectuals who attended conferences in exotic natural settings; Cohen-Cole, "The Creative American: Cold War Salons, Social Science, and the Cure for Modern Society," *Isis* 100 (2009): 256–60.

[38] On this conundrum and its entanglements, see Elizabeth A. Wilson's fascinating study of male relationships in the postwar artificial intelligence movement: Wilson, "'Would I Had Him with Me Always': Affects of Longing in Early Artificial Intelligence," *Isis* 100 (2009): 839–47.

[39] Pamela Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Baltimore, 2003); Robert Kohler, *Lords of the Fly:* Drosophila *Genetics and the Experimental Life* (Chicago, 1994); Nicholas Jardine, James Secord, and Emma Spary, eds., *Cultures of Natural History* (Cambridge, 1996); David Kaiser, *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics* (Chicago, 2005); Lorraine Daston and Elizabeth Lunbeck,

Several essays deal with the gendering of the spaces within which scientists resided, worked, and produced the next generation of scholars. In her essay on the eighteenth-century French scientist René-Antoine Ferchault Réaumur's scientific household, Mary Terrall illustrates how work done in a domestic setting involving real or fictive families, including women, subsequently reached a public sphere that was gendered masculine. Terrall emphasizes the association of the aristocratic Réaumur's patriarchal masculinity with utility and curiosity for the public good. For Lean's household chemists, the imprimatur of legitimate science had been delivered in a feminine voice, whereas for Terrall's scientific household, the voice of persuasion was masculine. Each, however, relied on female scientific labor in domesticated spaces.[40] Zeb Tortorici examines crimes of sexual violence in eighteenth-century New Spain in order to chart the reciprocal influence of medico-clerical discourses and norms of male sexual behavior. He shows how medical experts construed the evidence of male and female bodies to construct narratives of gender norms, deviance, and victimhood that reflected the masculine hierarchy of their own profession. Tortorici's male medical experts were careful to maintain a masculine professional preserve in their forensic work, but even they relied on the observations of midwives in composing their public reports.

Masculine scientific cultures then reproduce themselves down the generations, aided by men's experiences as boys in family life and sporting activity, in formal institutions like schools and the military, and later through the formative experiences of field and laboratory work. Shared male experiences defined the scientific cultures of the twentieth century, including all-male schooling, sports, and conventional forms of family life. This "big picture" snapshot of the multiple interrelations of the public and the private makes sense only by reference to the standard separation of the domestic and work spheres observed by the contemporary scientists.[41]

The gendering of spaces, however, rarely remained static, and several of the essays demonstrate progressive masculinization, not just as a reflection of numbers and personnel, but as exclusive gendered domains. For example, Michael S. Reidy's study of the origins of high-altitude physiological research in late Victorian British alpinism reveals the extent to which sex difference rhetorically, and often in practice, excluded women's bodies from Alpine summits. Reidy's male alpinists sought a lock on the emerging science of high-altitude physiology by defining the male body as the universal basis for their scientific observations. All men of action, they found a rejuvenating power in the Alps and forged intimate friendships with their Alpine guides.[42]

---

eds., *Histories of Scientific Observation* (Chicago, 2011); David Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago, 2003).

[40] Graeme Gooday has recently discussed the evolution of the meaning and functions of "laboratory," contrasting its "ambiguous gendering" with the "peculiar masculinity" of the workshop. The domestic laboratory *avant la lettre* was an example of such a gendered space, comprising cooperative male and female zones. Gooday, "Placing or Replacing the Laboratory in the History of Science?" *Isis* 99 (2008): 783–95.

[41] Pnina Abir-Am and Dorinda Outram, eds., *Uneasy Careers and Intimate Lives: Women in Science, 1787–1979* (New Brunswick, N.J., 1987); M. Jeanne Peterson, *Family Love and Work in the Lives of Victorian Gentlewomen* (Bloomington, Ind., 1989); Alix Cooper, "Homes and Households," in *The Cambridge History of Science*, vol. 3, *Early Modern Science*, ed. Katharine Park and Lorraine Daston (Cambridge, 2006), 224–37.

[42] For an example of how masculine embodiment practices worked in medicine, see Christopher Lawrence, "Medical Minds, Surgical Bodies: Corporeality and the Doctors," in Lawrence and Shapin, *Science Incarnate* (cit. n. 14), 156–201; for an account of the obstacles confronting women's embodiment of the practicing surgeon, see Joan Cassell, *The Woman in the Surgeon's Body* (Cambridge, Mass., 1998).

In their training and experience, alpinists, scientists, doctors, and engineers were on a trajectory designed to lead them, ideally, to an embodied identity of scientific selfhood. Just as for women, men's legacies have also rested in part on their reproductive potential through a mechanism of producing the next generation of intellectual heirs.[43] But the road to that end was strewn with obstacles, many of which came from the gendered expectations of family, class, and race. If these could be negotiated, there were still the expectations embedded in the disciplines and subdisciplines to which they aspired. These latter groups often stood in hierarchical relation to one another, inasmuch as they depended on skills and training that were traditionally performed by men or women. Whether or not such distinctions had merit, differences between science and technology or between theory and practice have been historically susceptible to gendering, often of an invidious kind. We see such distinctions emerging in the gendered work of computer scientists, in the boundaries Edwin Boring erected between his noble science and the applied work of clinical psychology, and in Lionel Tiger and Robin Fox's construction of a research and funding entity that mirrored their highly gendered view of the human past.

The historical contingencies that shaped evolving gender ideals are important parts of the accounts of how embodied scientific selves were formed and how, in turn, those gendered selves observed and ordered the world. Gendered knowledge informed the gendering of natural kinds, and vice versa. Beth Linker and Whitney Laemmli focus on the medical and sexological experts who relied on both specialized knowledge and their proximate assessments of the sexual ideals of American culture to help "rehabilitate" traumatized American veterans of World War II to sexual functionality and optimum masculine performance. Frances Bernstein examines physically disabled Soviet war veterans after World War II to illustrate how, after the upheaval and gender inversions of the war, Soviet scientists and medical authorities attempted to reconstruct men's bodies on the foundations of the stereotypical male body and its functions by developing prosthetic limbs. Bernstein's engineers did their work in an atmosphere of Cold War and national recovery that put a premium on their professional expertise to identify pathologies and rehabilitate and rejuvenate men and their families.

The physical labor associated with scientific research, then, depended not only on gendered rules of knowledge production but also on the successful embodiment of intellectual reproduction.

MEASURES AND METAPHORS OF GENDER

As a result, the body as a metaphor for health and integrity also figures prominently in many of these essays. Natural philosophers have attempted to locate "true" sex in both social roles (especially for legal reasons) and bodies (more important for physicians and surgeons).[44] In the modern era, male bodies have additionally served as symbols

[43] Traweek, *Beamtimes and Lifetimes* (cit. n. 1). For the reproduction of masculine medical cultures, see Rosemary Pringle, *Sex and Medicine: Gender, Power, and Authority in the Medical Profession* (Cambridge, 1998); Carole Dyhouse, "Women Students and the London Medical Schools, 1914–1939: The Anatomy of a Masculine Culture," *Gend. & Hist.* 10 (1998): 110–32.

[44] Holmes, *Gender* (cit. n. 19); Katharine Park, *Secrets of Women: Gender, Generation, and the Origins of Human Dissection* (Cambridge, Mass., 2006); Londa Schiebinger, *Nature's Body: Gender in the Making of Modern Science* (Boston, 1993).

of national health, complementing a persistent concern about women's reproductive fitness as a necessary component of twentieth-century eugenics.[45]

Lean highlights the connection between the economic independence of Republican China and the physical health of the new nation. Reidy's adventurers, too, performed their exploits against a backdrop of national pride and competitiveness. The advent of the Cold War provided a particularly vivid dramatization of the virtues of masculine aggression, heterosexual and reproductive norms, and economic productivity. Milam's anthropologists elucidated the evolutionary origins of male aggression, just as Linker and Laemmli's experts strove to reenable men disabled in war. Ha's study of Kurt Freund reveals the pervasive anxiety of the Cold War era about homosexuality, which was perceived as a threat to the reproductive fertility that undergirded national prosperity on both sides of the Iron Curtain.[46]

Before the predominance of the nation-state, other kinds of overlapping gendered spheres prevailed as metaphors for health and bodily integrity. DeVun's anatomists saw hermaphrodites as both confirming and challenging God's natural order. The racialized notion of "pure" Spanish blood was an important part of the mental furniture of Tortorici's medical experts and judges as they considered sexual norms and sex. As Terrall describes, in Réaumur's eighteenth-century French household, the natural, the social, and the familial were reconciled in the model of King and the (benevolent) "little monarchy" of the family patriarch.[47]

Though medicine and science have put a premium on aligning sexed bodies, gender, and sexuality as reflections of the natural order, we understand each of these things to be in some sense performative. Sex and gender have been concealed or travestied by clothing or masks, sexuality announced or parodied in word and gesture, and gendered voices appropriated for practical effect.[48] Thus, the voices of Tortorici's midwives were subsumed into the medical experts' official reports, and Réaumur's female assistant wrote and spoke, but in a framework devised by him. Inversely, the women psychologists in Rutherford's study used their voices in both female and male registers to negotiate integration and difference in a masculine scientific culture. In Robinson's account, Elsa Barker assumed a male voice and perspective in order to depict her

[45] See, e.g., Angelique Richardson, *Love and Eugenics in the Nineteenth Century: Rational Reproduction and the New Woman* (New York, 2003); Alexandra Stern, *Eugenic Nation: Faults and Frontiers of Better Breeding in Modern America* (Berkeley and Los Angeles, 2005). On the primacy of the male body in modern metaphors of social and national health, see Forth, *Masculinity* (cit. n. 27), 114–200.

[46] For some useful recent work on American military masculinity in the modern era, see David K. Johnson, *The Lavender Scare: The Cold War Persecution of Gays and Lesbians in the Federal Government* (Chicago, 2004); Andrew J. Huebner, *The Warrior Image: Soldiers in American Culture from the Second World War to the Vietnam Era* (Chapel Hill, N.C., 2008); Aaron Belkin, *Bring Me Men: Military Masculinity and the Benign Façade of American Empire, 1898–2001* (New York, 2012). On the heterosexual imperative in the Cold War era, see Margot Canaday, *The Straight State: Sexuality and Citizenship in Twentieth-Century America* (Princeton, N.J., 2009); Carolyn Herbst Lewis, *Prescription for Heterosexuality: Sexual Citizenship in the Cold War Era* (Chapel Hill, N.C., 2010); Dagmar Herzog, *Sex after Fascism: Memory and Morality in Twentieth-Century Germany* (Princeton, N.J., 2005).

[47] Many of these matters are also discussed in Lorraine Daston and Katharine Park, *Wonders and the Order of Nature, 1150–1750* (New York, 1998).

[48] Julia Epstein and Kristina Straub, eds., *Body Guards: The Cultural Politics of Gender Ambiguity* (New York, 1991); see also Marjorie Garber, *Vested Interests: Cross-Dressing and Cultural Anxiety* (New York, 1992); Judith Halberstam, *Female Masculinity* (Durham, N.C., 1998); Mark Simpson, *Male Impersonators: Men Performing Masculinity* (New York, 1994); Pat Califia, *Sex Changes: The Politics of Transgenderism* (San Francisco, 1997).

masculine subject matter, while Ensmenger's programmers subverted masculine dress norms while inventing new ways to perform their occupational hypermasculinity.

In this framework, concerns over imposture, duplicity, and scientists' own expectations constitute a potential threat to medical experts' and scientists' attempts to measure what they believed were the underlying "real" effects of gendered identities.[49] Thus, Ha shows that Freund worried about his subjects' attempts to subvert the outcome of his experiments. The sexologists looking to rehabilitate sexually disabled soldiers in Linker and Laemmli's study were certainly aware of the gap between the personal capacities and behavioral expectations of the men in their studies and their wives and girlfriends as they puzzled over diagnoses and therapy, and Bernstein's engineers and bureaucrats in postwar Russia may have considered similar issues with their disabled veterans.

Both men and women deployed these multiple instantiations of gender in strategic ways. No one-to-one correspondence exists between men and masculinity or women and femininity, either in history or today.

FINAL THOUGHTS

The constructedness of gender means that contemporaneous varieties of masculinity and femininity were available to men and women alike, for whom they might serve as identities with material corporeality or as performative scripts for colonizing new terrain. As the historically dominant sex, men have deployed masculine stratagems both against other men and against women, though for centuries a sufficient foil against women was the policing by male experts of the physical boundaries between the sexes. Women in premodern or preindustrial scientific households were likely content to do their creative or scientific work in one or another of the real or fictive family roles open to them. But as women eventually sought entry to scientific workplaces in positions of equality, the masculine cultures of the lab, the classroom, and the field were mobilized to screen out or segregate women from full participation. This has proven to be, at best, a delaying tactic. Some women quickly learned to emulate masculine models of speech, gesture, and work to negotiate their entry to formerly all-male preserves, but other women followed a script that demanded real gender equality rather than simply trying to be "one of the boys."

The essays in this volume identify the kinds of scientific masculinities in operation at various times and places but also ask how these masculinities were constructed and maintained, and the functions they served for the men and women who invoked them. Rather than seeing masculine scientific and technical cultures as static embodiments of historically particular moments, as a whole the volume documents the ways in which masculinities in science have been deployed, emulated, borrowed, and ultimately reproduced. The result has been long-standing masculine traditions in science that are at once differentiated, flexible, nuanced, and incredibly persistent.

[49] Two recent articles discuss this aspect of performativity in science: Iwan Rhys Morus, "Placing Performance," *Isis* 101 (2010): 775–8; and Michael Wintroub, "Taking a Bow in the Theater of Things," *Isis* 101 (2010): 779–93. On the Cold War connection with sexuality, see esp. Ken Alder, *The Lie Detectors: The History of an American Obsession* (New York, 2007); see also Richard Ofshe and Ethan Waters, *Making Monsters: False Memories, Psychotherapy, and Sexual Hysteria* (Berkeley and Los Angeles, 1994).