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Introduction

The Stormy Swirl of Sensations

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Abstract

Our special issue approaches knowledge as a product of intermingled sensory experiences in ways that confound neat divisions of body/mind, exterior/interior, subject/object, cognition, emotion, and imagination. Rejecting "cognitive ocularcentrism," as well as approaches that focus on any single sense, we articulate an intersensorial framework premised on the entanglement of touch with other senses, particularly sight. Through this, we highlight hidden epistemic multiplicities, intersubjectivities, and literary strategies for the study of gender in the history of science, especially in reference to the gendering of personae and emotions. The putative rise of the visual in modern science was always already intersensorial, no matter how much cognitive ocularcentrism sought to tame this. By attending to seeming *distractions* within knowledge production, our issue seeks to reintegrate science back into the immersive flow of intersensorial experience and recover the sensuous webs that connect actors, geographies, fields, and time periods habitually separated.

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> Sitting with his face exposed to the wind whipped up from the sea, he opened his notebook and reviewed his matrices, so nervous that he committed one error after another, and had to start over again from the beginning. When he proved that the first was coherent, he could feel his body again. During the second, his hand shook from the cold. His pencil left tiny marks on the paper above and below his calculations, as if he had resorted to the symbols of an unknown language. His matrices were all consistent: Heisenberg had modelled a quantum system based wholly on direct observation. He had replaced metaphors with numbers and discovered the rules governing the inner phenomena of atoms. His matrices allowed him to describe the location of an electron from one moment to the next, and how it would interact with other particles. He replicated in the subatomic world what Newton had done for the solar system, using only pure mathematics, with no recourse to imagery. […] Heisenberg thought of the consequences knowledge of this nature might have, and was struck with a feeling of vertigo so profound that he had to restrain the impulse to throw his notebook into the sea. He felt he was looking past atomic phenomena towards a new sort of beauty. Too agitated to sleep, he walked towards a boulder jutting directly over the water. He climbed to the top, and sat down to wait for the sunrise with his legs dangling over the edge, listening to the waves beating against the rocks below.[1]

> Around two or three o'clock in the morning I saw that the conservation of energy was correct. I was extremely excited, and it was just early in the morning already. I decided that I would go out for a walk and so I did. I rather half-climbed on one of the cliffs of Heligoland just for excitement. And I felt, 'Well, now something has happened.' So then after a while I went back and I went sound asleep. Then I started writing on a paper.[2]

1 Benjamín Labatut, *When We Cease to Understand the World*, trans. Adrian Nathan West (London: Pushkin Press, 2020), 106–107.

2 American Institute of Physics, College Park, MD USA, Niels Bohr Library and Archives, Interview of Werner Heisenberg by Thomas S. Kuhn, Oral History Interview Session VII, February 22, 1963. Cf. the similarly laconic account in Werner Heisenberg, *Physics and Beyond: Encounters and Conversations*, trans. Arnold J. Pomerans (New York: Harper & Row, 1971), 61,

Our problem begins with the two epigraphs above—or, more specifically, with the gap between them. Both describe that moment, fêted by Carlo Rovelli as "the most impressive scientific revolution of all time," when in the summer of 1925 in Heligoland, a young Werner Heisenberg hit upon the mathematics that would help found quantum mechanics.[3] The first quote is fiction, from Benjamín Labatut's 2020 novel *Un verdor terrible*; the second is Heisenberg's own testimony recalled in 1963.

Historians of science have by now developed a sophisticated arsenal for treating the latter. Beneath the laconic restraint with which Heisenberg mentions the "half-climb" following his moment of discovery, scholars might easily point to the role of athletic training and an inhibited "emotional style" in shaping scientific masculinity since the last quarter of the nineteenth century.[4] One might even see within this masculinity the crafting of a more specific scientific persona: Heisenberg's account, perhaps drawing upon the figure of the *Bergsteiger* (mountaineer) as a national symbol of heroic survival and perseverance, seems one step in the emergence of mountaineering as a marker of collective identity among physical scientists.[5] Then, there is an argument concerning transfers of tacit knowledge. Per Hermann von Helmholtz, "wanderings" (*Irrfahrten*) through the hills, tracing and retracing steps to reach a summit, resemble the procedures of laboratory experimentation.[6] When one learns to climb, one learns too the techniques requisite for science.

"I was far too excited to sleep, and so, as a new day dawned, I made for the southern tip of the island, where I had been longing to climb a rock jutting out into the sea. I now did so without too much trouble, and waited for the sun to rise."

3 Carlo Rovelli, *Helgoland: Making Sense of the Quantum Revolution*, trans. Erica Segre and Simon Carnell (New York: Riverhead Books, 2021), Preface, Apple Books epub.

4 Andy Warwick, "Exercising the Student Body: Mathematics and Athleticism in Victorian Cambridge," in *Science Incarnate: Historical Embodiments of Natural Knowledge*, ed. Christopher Lawrence and Steven Shapin (Chicago: University of Chicago Press, 1998), 288–326. On emotional style, see Otniel E. Dror, Bettina Hitzer, Anja Laukötter, and Pilar León-Sanz, eds., "History of Science and the Emotions," special issue, *Osiris* 31, no. 1 (2016); Paul White, ed., "The Emotional Economy of Science," Focus section, *Isis* 100, no. 4 (2009): 792–851.

5 Tait Keller, *Apostles of the Alps: Mountaineering and Nation Building in Germany and Austria, 1860–1939* (Chapel Hill, NC: University of North Carolina Press, 2016); Wilfried Films, "From Bergsteiger to Bergkrieger: Gustav Renker, Luis Trenker, and the Rebirth of the German Nation in Rock and Ice," *Colloquia Germanica* 42, no. 3 (2009): 223–244; Michael S. Reidy, "Mountaineering, Masculinity, and the Male Body in Mid-Victorian Britain," *Osiris* 30, no. 1 (2015): 158–181. On scientific heroism, see Naomi Oreskes, "Objectivity or Heroism? On the Invisibility of Women in Science," *Osiris* 11, no. 1 (1996): 87–113.

6 Henning Schmidgen, *The Helmholtz Curves: Tracing Lost Time*, trans. Nils F. Schott (New York: Fordham University Press, 2014), 15.

Yet something in Labatut's fictional account and its stormy swirl of sensations pulls us in a different direction. We know that despite the sedate nonchalance of their recollections, our actors were ever immersed in streams of sensory experience, conscious and unconscious. We know that beyond the evidence contained in the diagrams, visualizations, reports, and inscriptions they produced, our actors were surrounded with a mélange of sounds, smells, and tastes as they wrote; with artifacts along which they ran and tapped their hands as they experimented. Vertigo and the roar of waves; insomniac wandering; the chilly envelope of pre-dawn; wind-lashed hands trembling to put pencil to page: however much history opposes itself to fiction, Labatut's dramatization remains compelling, for it nourishes our suspicion that knowledge emerges through intermingled sensory experiences in ways that confound neat divisions of body and mind; exterior and interior; subject and object; cognition, emotion, and imagination. How the fullness of these sensory experiences may have shaped thought and action seem either lost to historians or, if recoverable, too tangled to unknot into distinct objects of analysis.

It is this puzzle of sensory experience that our special issue seeks to address. Collectively, the articles here confront the "imbricated and twisted" phenomenon of intersensoriality in order to re-interrogate approaches to gender in the history of science.[7] As a discipline concerned with the development of empirical knowledge, the history of science has long overlapped with a philosophical-historical tradition that traces elite understandings of the sensorium and its epistemic function.[8] Discussion of the role of the senses in shaping scientific practices also forms an integral part of work on embodiment, emotion, and tacit knowledge.[9] While indebted to this scholarship, we nevertheless suggest

7 David Howes, "Introduction: Empires of the Senses," in *Empire of the Senses: The Sensual Culture Reader*, ed. David Howes (Oxford: Berg, 2005), 9.

8 Lissa Roberts, "The Senses in Philosophy and Science: Blindness and Insight," in *A Cultural History of the Senses in the Age of Enlightenment*, ed. Anne C. Vila (London and New York: Bloomsbury, 2014), 109–132; Robert Jütte, *A History of the Senses: From Antiquity to Cyberspace*, trans. James Lynn (Cambridge: Polity, 2004); Jessica Riskin, *Science in the Age of Sensibility: The Sentimental Empiricists of the French Enlightenment* (Chicago: University of Chicago Press, 2002); Esther Cohen, "Towards a History of European Physical Sensibility: Pain in the Later Middle Ages," *Science in Context* 8 (1995): 47–74; G.S. Rousseau, ed., *The Languages of Psyche: Mind and Body in Enlightenment Thought* (Berkeley: University of California Press, 1990); Jonathan Rée, *I See a Voice: A Philosophical History of Language, Deafness and the Senses* (London: HarperCollins, 1999).

9 Lawrence and Shapin, *Science Incarnate*; Dror, Hitzer, Laukötter, and León-Sanz, "History of Science and the Emotions"; White, "The Emotional Economy of Science"; Pamela O. Long, *Artisan/Practitioners and the Rise of the New Sciences, 1400–1600* (Corvalis: Oregon State University Press, 2011); Pamela H. Smith, *The Body of the Artisan: Art and Experience in the Scien-*

that something remains amiss. Specifically, the senses in the history of science remain prisoners of a cognitive ocularcentrism. The basic outlines of this ocularcentrism are by now familiar to readers who have followed the field's "visual turn."[10] Earlier periods, we are told, may have relied on the "mindful hand"; may have recognized that empiricism was as much a matter of subjective sensation and sentiment as it was "hardnosed, unemotional" observation and experiment.[11] But then came a great disciplining. Scientific practitioners became subject to "new experimental techniques that required them to subordinate [...] their own bodies in the service of machines."[12] Objectivity came to entail a mechanical suppression of subjectivity analogous to what Marcel Mauss, in "Techniques of the Body," had described as the overwhelming trajectory of modernity: a "resistance to emotional seizure" and the "domination of the conscious over emotion and unconsciousness."[13] Over the course of this

tific Revolution (Chicago: University of Chicago Press, 2004); Charles T. Wolfe and Ofer Gal, eds., *The Body as an Object and Instrument of Knowledge: Embodied Empiricism in Early Modern Science* (Dordrecht: Springer, 2010).

10 Within the past two decades, influential works include: Barbara M. Stafford, *Echo Objects: The Cognitive Work of Images* (Chicago: University of Chicago Press, 2007); Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007); Klaus Hentschel, *Visual Cultures in Science and Technology: A Comparative History* (Oxford: Oxford University Press, 2014); Horst Bredekamp, Vera Dünkel, and Birgit Schneider, *The Technical Image: A History of Styles in Scientific Imagery* (Chicago: University of Chicago Press, 2015); Alina Payne, *Vision and Its Instruments: Art, Science, and Technology in Early Modern Europe* (University Park: Pennsylvania State University Press, 2015); Geoffrey Belknap, *From a Photograph: Authenticity, Science and the Periodical Press* (London: Taylor & Francis, 2020); Sachiko Kusukawa, *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-century Human Anatomy and Medical Botany* (Chicago: University of Chicago Press, 2012); Wolfgang Lefèvre, Jürgen Renn, and Urs Schoepflin, eds., *The Power of Images in Early Modern Science* (Basel: Birkhäuser, 2003); Daniela Bleichmar, *Visible Empire: Botanical Expeditions and Visual Culture in the Hispanic Enlightenment* (Chicago: University of Chicago Press, 2012).

11 Riskin, *Science in the Age of Sensibility*, 1. More generally, see Lissa Roberts, Simon Schaffer, and Peter Dear, *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation* (Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen, 2007); Smith, *The Body of the Artisan*.

12 Lissa Roberts, "The Death of the Sensuous Chemist: The 'New' Chemistry and the Transformation of Sensuous Technology," *Studies in the History and Philosophy of Science. Part A* 26, no. 4 (1995): 506. Although 'mechanism' remains dominant in characterizations of modern science, several important works have raised serious objections to this trope. See, e.g., Simon Schaffer, "Godly Men and Mechanical Philosophers: Souls and Spirits in Restoration Natural Philosophy," *Science in Context* 1, no. 1 (1987): 53–85; John Tresch, *The Romantic Machine: Utopian Science and Technology after Napoleon* (Chicago: University of Chicago Press, 2012).

13 Marcel Mauss, "Techniques of the Body," *Economy & Society* 2, no. 1 (1973): 86.

disciplining, we are told, smelling, tasting, touching—and to a lesser degree listening—fell away in favor of pure sight: rational, abstract, distant, and thus most removed from the corruptions and interruptions of flesh. Modern science, if not modernity overall, became fundamentally a "visually dependent culture."[14] This ocularcentric narrative has in turn had crucial implications for the history of science's treatments of gender. Sight's alleged triumph played an integral role in the gendering of natural knowledge and the naturalization of gender difference. Anatomical visualizations hardened the boundaries of sex. Nature, broadly written, was feminized as an object to be known through the gaze of ever more masculinized observers.[15]

To be sure, an explosion of work at the intersection of the history of science and sound studies over the past decade has relativized the notion of a "scopic regime of modernity," demonstrating that the "epistemic function of hearing expanded" significantly in the twentieth and twenty-first centuries.[16] Similar, the diagnostic and social role of touch has been major topic for mul-

14 Barbara M. Stafford, *Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine* (Cambridge, MA: MIT Press, 1993), xviii; Mark M. Smith, *Sensing the Past: Seeing, Hearing, Smelling, Tasting, and Touching in History* (Berkeley: University of California Press, 2007), 1–19.

15 Londa Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (Cambridge, MA: Harvard University Press, 1989); Ludmilla Jordanova, *Sexual Visions: Images of Gender in Science and Medicine between Eighteenth and Twentieth Centuries* (London: Wheatsheaf, 1989); Londa Schiebinger, *Nature's Body: Gender in the Making of Modern Science* (New Brunswick, NJ: Rutgers University Press, 1993); Ann B. Shteir and Bernard Lightman, *Science, Gender and Visual Culture* (Hannover, NH and London: Dartmouth College Press, 2006); Monica Green, *Making Women's Medicine Masculine: The Rise of Premodern Gynaecology* (Oxford: Oxford University Press, 2008); Leigh Whaley, ed., *Women and the Practice of Medical Care in Modern Europe, 1400–1800* (London: Palgrave, 2011).

16 Viktoria Tkaczyk, Mara Mills, and Alexandra Hui, eds., *Testing Hearing: The Making of Modern Aurality* (Oxford: Oxford University Press, 2020), 2; Martin Jay, *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought* (Berkeley: University of California Press, 1993). Key recent works at the intersection of sound studies and the history of science include Alexandra Hui, *The Psychophysical Ear: Musical Experiments, Experimental Sounds, 1840–1910* (Cambridge, MA: MIT Press, 2012); Karin Bijsterveld, *Sonic Skills: Listening for Knowledge in Science, Medicine and Engineering (1920s-present)* (London: Palgrave Macmillan 2019); Viktoria Tkaczyk, *Thinking with Sound: A New Program in the Sciences and Humanities around 1900* (Chicago: University of Chicago Press, 2023); Mara Mills and Xiaochang Li, "Vocal Features: From Voice Identification to Speech Recognition by Machine," *Technology and Culture* 60, no. 2 (2019): 129–160. For a general survey of sound studies scholarship on aural modernity, see Josephine Hoegaerts and Kaarina Kilpö, "Noisy Modernization? On the History and Historicization of Sound," *International Journal for History, Culture and Modernity* 7 (2019): 610–618.

tiple explorations in the history of medicine.[17] By centering this issue around intersensoriality, however, we wish to take a step further. Rather than substituting one sense for another, we propose that it is the artificial fivefold partitioning of the sensorium itself which must be overcome. As Ludmilla Jordanova has recently reminded us, "no single sense ever stands alone [...] they are blended together in the lives of those we study and in our own existence."[18] Psychologists, too, would agree, citing our most fundamental experiences as evidence. Take, for starters, the somatosensory phenomena of proprioception, kinesthesia, and pain: everyday embodiment and emplacement, comfort and suffering, are constructed from the constant interaction of sight, smell, taste, sound, and touch.[19] A "multi-directional interaction of the senses" underpins the operations of life.[20]

Building on this, work in sensory studies has shown that the putative rise of the visual was always already intersensorial. Far from taming the nonvisual senses in favor of sight, or else privileging the distant senses of sight and hearing over "proximate" smell, taste, and touch, so-called ocularcentric modernity continued to operate through synaesthetic assemblages. The telegraph transformed words into patterns tapped by fingertips; film, per Walter Benjamin, "hit the spectator like a bullet [...] thus acquiring a tactile quality."[21] Industrial landscapes changed the taste of water; they filled the air with the stench of coal and the bilious odor of slag and oil.[22] New machines constructed oper-

17 W.F. Bynum and Roy Porter, eds., *Medicine and the Five Senses* (Cambridge: Cambridge University Press, 1993); Elizabeth Hsu, "Tactility and the Body in Early Chinese Medicine," *Science in Context* 18, no. 1 (2005): 7–34; Shigehisa Kuriyama, *The Expressiveness of the Body and the Divergence of Greek and Chinese Medicine* (New York: Zone Books, 1999), 17–108; Anna Maerker, "Towards a Comparative History of Touch and Spaces of Display: The Body as Epistemic Object," *Historical Social Research/Historische Sozialforschung* 40, no. 1 (2015): 284–300.

18 Ludmilla Jordanova, "Medicine and the Senses: Towards Integrative Practices," *European Journal for the History of Medicine and Health* 78, no. 1 (2021): 161.

19 Frank A. Geldard, "Somesthesis," in *Foundations of Psychology*, ed. Edwin G. Boring, Herbert S. Langfield, and Harry P. Weld (Hoboken, NJ: John Wiley & Sons, 1948), 360–379; Mark Paterson, "Haptic Geographies: Ethnography, Haptic Knowledges and Sensuous Dispositions," *Progress in Human Geography* 33, no. 6 (2009): 766–788.

20 Howes, "Introduction: Empire of the Senses," 9; David Howes, "Scent, Sound and Synaesthesia: Intersensoriality and Material Culture Theory," in *The Sage Handbook of Material Culture*, ed. Christopher Tilley (London: Sage, 2006), 161–172.

21 Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," in *Illuminations: Essays and Reflections*, new ed., trans. Harry Zohn (New York: Schocken, 1999), 238.

22 Joy Parr, *Sensing Changes: Technologies, Environments and the Everyday, 1953–2003* (Vancouver: UBC Press, 2010); Kate McClean and Jade French, "Two Centuries of Stink: Smell Mapping Widnes Past and Present," in *Consuming Atmospheres: Designing, Experiencing,*

ators who would turn knobs, pull levers, push buttons, press keys, and listen to the hum and whir of gears and motors.[23] All this suggests that the history of science's ingrained ocularcentrism may be less a description of actual historical transformations of sensory experience within and wrought by science, than the unwitting legitimation of a peculiar practitioner ideology. If so, then the historian of science is compelled to ask the following questions.

First, how has the cognitive priority attributed to the visual functioned to suppress competing epistemologies and actors by denying the legitimacy of their sensory experiences and associated emotions?[24] Next, how can recovering the intersensoriality of experience not only subvert claims to the cognitive priority of sight, but also provide new accounts of knowledge production typically attributed to seeing? Finally, how do deeper continuities in the entanglement of sensory experiences disturb periodizations premised on the visual, contributing thereby to the ongoing problematization of the "great divide" between modern and premodern, as well as the associated concept of "modern science"?[25] Sensorial experiences can hardly be dissociated from sentiments and subjectivities, triggering new associations, remembrances, that in turn might create new knowledge.[26] For most of history, the five external senses could not be thought of without the so-called "internal senses," precisely the

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and Researching Atmospheres in Consumption Spaces, ed. Chloe Steadman and Jack Coffin (London: Routledge, 2023), e-book.

23 Rachel Plotnick, *Power Button: A History of Pleasure, Panic, and the Politics of Pushing* (Cambridge, MA: MIT Press, 2018); David Parisi, *Archaeologies of Touch: Interfacing with Haptics from Electricity to Computing* (Minneapolis: University of Minnesota Press, 2018).

24 On the politics of the sensible, see, e.g., Erica Fretwell, *Sensory Experiments: Psychophysics, Race, and the Aesthetics of Feeling* (Durham, NC: Duke University Press, 2020); Michael Bull, Paul Gilroy, David Howes, and Douglas Kahn, "Introducing Sensory Studies," *The Senses and Society* 1, no. 1 (2006): 5. A similar comparison could be made to the political function of what Jacques Rancière has called the "distribution of the sensible"; see Jacques Rancière, *The Politics of Aesthetics: The Distribution of the Sensible*, trans. Gabriel Rockhill (London: Continuum, 2004), 7–41.

25 Andrew Cunningham and Perry Williams, "De-centring the 'Big Picture': *The Origins of Modern Science* and the Modern Origins of Science," *British Journal for the History of Science* 26, no. 4 (1993): 407–432; Smith, *Sensing the Past*, 1–3, 14, 16–17; Mark M. Smith, *A Sensory History Manifesto* (University Park: Pennsylvania University Press, 2021), 19, 68–69.

26 Penélope Gouk and Helen Hills, eds., *Representing Emotions: New Connections in the Histories of Art, Music and Medicine* (Farnham: Ashgate, 2005); Martin Pickavé and Lisa Shapiro, eds., *Emotion and Cognitive Life in Medieval and Early Modern Philosophy* (Oxford: Oxford University Press, 2012); Elena Carrera, *Emotions and Health, 1200–1700* (Leiden: Brill, 2012); Dror, Hitzer, Laukötter, and León-Sanz, "History of Science and the Emotions"; White, "The Emotional Economy of Science."

ones that linked sensorial experiences with memory, imagination and cognition.[27] It is this radical severance of the external sensations from their internal re-workings and the partitioning of the former into five discrete silos that needs to be deconstructed. Put differently, if the history of science's current narrative is one of a great disciplining of the senses toward observation—of focus, attention, and restraint—then the contributions here ask scholars to *attend to seeming distractions*: to reintegrate knowledge production back into the immersive flow of intersensorial experience, and to recover the sensuous webs that connect actors, geographies, fields, and time periods habitually separated.

Our issue's articles pursue sensuous reintegration across a fittingly wide range of times and places, from medieval to modern, from Spain, Italy, and Britain to Japan, Peru, and Tahiti. Our contributors, too, have been selected to foster an interdisciplinary dialogue across the history of art, science, and medicine, and cultural history more broadly. Running through this admixture is the more specific theme of what has been termed "haptic visuality"—"the way vision itself can be tactile," and, we should add, the way touching evokes seeing.[28] All visual artifacts, we claim, are simultaneously configurations of haptic possibilities, on which more below. Our choice to link touch and vision represents a calculated attempt to upset the embedded assumptions of gender in traditional hierarchies of sensory knowledge. For the construction of sight as the noblest sense, highest in epistemic and moral value, went hand in hand not only with the denigration of touch in its fleshly immediacy, but with the marking of the latter as feminine.[29] "The dynamics of touch," Laura Gowing writes, were the prime arena for "defin[ing] women's place."[30] Following the emergence of explicitly dimorphic physiological models in the mid-eighteenth century, this cultural association came to be enshrined in a science of sexual difference. Female bodies were, according to Montpellier physician Pierre Rous-

27 Roy Porter, *Flesh in the Age of Reason: The Modern Foundations of Body and Soul* (New York: Norton & Company, 2004); Fernando Vidal, *The Sciences of the Soul. The Early Modern Origins of Psychology* (Chicago: Chicago University Press, 2011); Charis Charalampous, ed., *Rethinking the Mind-Body Relationship in Early Modern Literature, Philosophy and Medicine. The Renaissance of the Body* (New York: Routledge, 2016); Marcia B. Hall and Tracy E. Cooper, eds., *The Sensuous in the Counter-Reformation Church* (Cambridge: Cambridge University Press, 2013).

28 Laura Marks, *The Skin of the Film: Intercultural Cinema, Embodiment, and the Senses* (Durham, NC: Duke University Press, 2000), xi.

29 Constance Classen, *The Deepest Sense: A Cultural History of Touch* (Urbana: University of Illinois Press, 2012), 71–92.

30 Laura Gowing, *Common Bodies: Women, Touch and Power in Seventeenth-Century England* (New Haven, CT: Yale University Press, 2003), 53.

sel (1742–1802), "soft."[31] This tactile quality of bodies represented the broader susceptibility of the female mind to irrationality and the "tyranny of her sensations."[32] By instead taking the mutual imbrication of touch and sight as our starting point, "Touching Visions" seeks to work directly against such normative divisions of the sensorium. Collapsing models of sensory division in favor of diverse intersensorial entanglements, we argue, provides a critical method for disturbing the epistemic stability of a visual field premised on contrasts between masculine rationality versus feminine affect. Specifically, our issue explores two arenas where this disturbance might take place. First, we examine how touch reveals an epistemic multiplicity in artifacts and practices of seeing, in ways that challenge the authority of masculinized observers. Second, we look at how touch opens the act of seeing up to a liminal realm of intersubjectivity, in ways that trouble neat binaries of interior/exterior, active/passive, subject/object, and thus also the binary of masculine/feminine. Below, we elaborate on these two interventions in further detail.

Epistemic multiplicity. Visual artifacts and practices transfer and translate forms of haptic knowledge, often deriving their full energy from prior experiences and memories of touch. This lesson has already been stressed by historians of art. Consider Michael Baxandall's famous "period eye." Behind the vernacular visual skills which informed the Renaissance period eye were everyday practices with tactile and kinesthetic roots, such as barrel-gauging and dancing. Perception of space was keyed in paintings to "the repertory of stock objects used in the gauging exercises," invoking experiential understandings of the visio-haptic relation between shape, volume, and weight: in Baxandall's words, a "visual sense of concrete mass." Vividness of motion in paintings again tapped into viewers' somatic memories, drawing on the steps of the *bassa danza*, popularized as a court dance since the fifteenth century, to determine the grouping

31 Anne C. Vila, "Introduction: Powers, Pleasures, and Perils of the Senses in the Enlightenment Era," in Vila, *A Cultural History of the Senses in the Age of Enlightenment*, 15–16.

32 Jane Rendall, "Feminizing the Enlightenment: The Problem of Sensibility," in *The Enlightenment World*, ed. Martin Fitzpatrick, Peter Jones, Christa Knellwolf, and Ian McCalman (London: Routledge, 2007), 253–271; Anne C. Vila, *Enlightenment and Pathology: Sensibility in the Literature and Medicine of Eighteenth-Century France* (Baltimore, MD: Johns Hopkins University Press, 1998); Lieselotte Steinbrügge, *The Moral Sex: Woman's Nature in the French Enlightenment*, trans. Pamela E. Selwyn (Oxford: Oxford University Press, 1995). For earlier precedents of this discourse, see Helen King, *Hippocrates' Woman: Reading the Female Body in Ancient Greece* (New York: Routledge, 1998); Charles T. Wood, "The Doctor's Dilemma: Sin, Salvation, and the Menstrual Cycle in Medieval Thought," *Speculum* 56, no. 4 (1981): 717–723; Caroline Bynum, *Holy Feast and Holy Fast: The Religious Significance of Food to Medieval Women* (Berkeley: University of California Press, 1988).

of figures and position of bodies in a way that precipitated sensations of movement.[33] Indeed, more recent scholarship has proposed that Baxandall's "period eye" might better be reformulated as a "period body" and a "period heart" in order to better capture the inherent intersensoriality of "visual" art.[34]

In short, visual artifacts and practices contain epistemic multiplicities irreducible to sight alone. Attending to these multiplicities allows our authors to trace a more complex politics of gender within the visual field by recovering hidden sensory experiences and forms of knowledge. Baxandall's direct influence is most obvious in Mackenzie Cooley's article, which teases out the haptic experiences encoded in Hieronymous Fabricius' (1533–1619) illustrations. Designed to inculcate an authoritative "anatomical eye" in his male students, Fabricius' illustrations were in fact shot through with intersensorial analogies to touch. In particular, the understanding of comparative embryology which Fabricius developed was informed by the haptic expertise of women practitioners who regularly handled chickens, tapping into their experiences of touching the transparent and semi-transparent membranes of chicken eggs. In an analogous manner, Elena Serrano examines the intersensorial sources that shaped Benito Feijoo's (1676–1764) physiology of the passions, notable for its rejection of the rising Enlightenment current of sexual dimorphism. Feijoo explained the underlying operation of the origin of love through a vibratory model of the nerves identical in both men and women. Behind this model of bodies as musical instruments stood his own experience with music and the elevated feelings that it aroused. The strumming and plucking of string instruments were certainly one source of inspiration; Feijoo was long fascinated by the lyre, violin, cithara, and above all Spanish guitar. But ultimately, Feijoo might have found his model of strumming and plucking in the human vocal cords themselves, the ideal operation of which was exemplified by the physiology of castrati, understood as having an "ambiguous gender status" similar to those of children prior to sexual differentiation.

Alongside anatomical illustrations and physiological models, several contributors also excavate epistemic multiplicity by situating visual artifacts within contested spaces of gender and recreating the intersensorial experience

33 Michael Baxandall, *Painting and Experience in Fifteenth-Century Italy: A Primer in the Social History of Pictorial Style*, 2nd ed. (Oxford: Oxford University Press, 1988), 77–81, 86–93.

34 Geraldine A. Johnson, "The Art of Touch in Early Modern Italy," in *Art and the Senses*, ed. Francesca Bacci and David Melcher (Oxford: Oxford University Press, 2011), 59–84; Adrian W.B. Randolph, *Touching Objects: Intimate Experiences of Italian Fifteenth-Century Art* (New Haven, CT: Yale University Press, 2014); Martina Bagnoli, ed., *A Feast for the Senses: Art and Experience in Medieval Europe* (New Haven, CT: Yale University Press, 2017).

of these artifacts. This is the case, for instance, in Hansun Hsiung's treatment of "thoughtographs"—the alleged result of thoughts projected directly onto photosensitized surfaces. Interpretations of thoughtographs were a major source of scientific controversy in early twentieth-century Japan, particularly between physicists and psychologists. By placing these artifacts back into the household as a site of experiment, Hsiung argues that thoughtographic controversies were ultimately struggles for sensory control over the home, pitting male scientists against housewives who, through the emergence of bourgeois domesticity in Japan, were exerting a new degree of privilege over household management. Elena Paulino, meanwhile, analyzes the space of late medieval funerary chapels. Funerary chapels were characterized by strategic ostentation, using monumental effigies and elaborate iconography to call forth the memories of the deceased. This was especially important, as access to funerary chapels was often controlled by limited conditions of perception: one might only be able to glimpse a chapel from afar. Centering on the Burgos funerary chapel, Paulino shows how its designer, the Castilian noblewoman Mencía de Mendoza (fl. 1482–1494) translated between partial sensory experiences by weaving together with the visible and invisible, the touchable and untouchable. This interplay, built on medieval noblewomen's devotional, material and aesthetic experiences, serves as a contrast with dominant contemporaneous scholastic models of the sensorium.

Intersubjectivity. Paulino's invocation of "touch" as both physical sensation and the movement of memory, much like Serrano's discussion of the arousal of amorous passions, makes clear the term's slippage between external world and psychological interiority. Indeed, in Paulino's paper, feminine bodies leak, ooze, and seep in their fluid porosity, merging into the spaces around them. This blurring of boundaries points to the longstanding dilemma of touch's locational ambiguity: touch, as Constance Classen writes, is "simultaneously everywhere and nowhere."[35] Named by Aristotle as the "primary sensation that belongs to all animals," touch remained enigmatic within *De sensu*. Lacking both a clear organ—a "medium," in Aristotle's terminology—as well as a clear object, touch seemed a sense simultaneously external and internal.[36] *De anima* announced

35 Classen, *The Deepest Sense*, 55.

36 Daniel Heller-Roazen, *The Inner Touch: Archaeology of a Sensation* (New York: Zone Books, 2007), 27–29; Richard Sorajbi, "Aristotle on Demarcating the Five Senses," *Philosophical Review* 80 (1971): 68–78. For the further development of this problem in Scholasticism, see Fernando Salmón, "A Medieval Territory for Touch," in *Sexuality and Culture in Medieval and Renaissance Europe*, ed. Philip M. Soergel, Studies in Medieval and Renaissance History 3rd ser., vol. 2 (New York: AMS Press, 2005), 59–81.

the puzzle more succinctly: "It remains a question whether touch is many or one."[37] Rather than taking this imprecision between interior and exterior as a problem, several articles in this issue use it as an opportunity to examine how haptic visuality can deconstruct the power relations of "visual mastery" between seer and seen, bringing the distanced observer into intimate contact with the observed.[38] Put simply, when observers too are *touched by what they see*, bodies meld and the neat demarcation between active subject and passive object dissolves.

This is perhaps most apparent in representations of the body in pain. Referencing both medical encounters as well as depictions of the suffering of martyrs and Christ's crucifixion, for instance, Ludmilla Jordanova speaks of a deeper "somatic affinity" generated between viewer and artwork. Pain eyewitnessed induces a "whole-body response" in the viewer; emotional empathy is paralleled by an agonized corporeal "revolt" of physical sensations.[39] Harriet Palfreyman's article takes up what is closest to Jordanova's "somatic affinity," using this to address anxieties surrounding masculinity and the persona of the gentleman physician in early twentieth-century Britain. Specifically, Palfreyman examines how Leonard Mark's (1855–1930) attempts to communicate his own experience of acromegaly in print negotiated with gentlemanly ideals of physical vigor and psychological stoicism. Known for its enlargement of the head, hands and feet, acromegaly was characterized by the visual spectacle of the debilitated body. However, Mark's 1912 *Acromegaly* pitted itself against such spectacle, amassing visual evidence—including microscopic sketches of his chin hair and a photograph of a medieval statue—to convey the "affective intimacies of pain." By involving viewers empathetically in splitting headaches and uncontrollable tears, Mark's haptic visuality disavowed a model of masculinity focused on the practitioner's physical body, instead emphasizing the physician's productive documentation of interior experiences of ailment.

Whereas Palfreyman highlights the intimate intersubjectivity of pain, Ester García-Moscardó's contribution supplements existing work on colonialism's scopic regimes by bringing these into conversation with the boundary-blurring nature of touch as a technology of domination.[40] Analyzing the short-lived

37 Heller-Roazen, *Inner Touch*, 29. For a historical account of touch as comprising three different senses of muscle, temperature, and movement, see Nicholas J. Wade, "The Science and Art of the Sixth Sense," in Bacci and Melcher, *Art and the Senses*, 19–58.

38 Marks, *Skin of the Film*, 131–132, 184–192.

39 Jordanova, "Medicine and the Senses," 164.

40 Nicholas Mirzoeff, *The Right to Look: A Counterhistory of Visuality* (Durham, NC: Duke University Press, 2011); for a broad definition of technology as an apparatus for the main-

Spanish occupation of Tahiti (1772–1776) by the viceroyalty of Peru, García-Moscardó shows the ways in which aforementioned Enlightenment constructions of the female body as "soft" and "susceptible" were mapped onto Tahitians, underwriting a strategy of "seduction" toward natives. "Seduction" shaped a sensory politics of contact zones that consciously contrasted with military violence. Gifts offered by Peruvian envoys, centered on artifacts such as clothing, jewelry, and tools, were ostensibly intended to transform the visual appearance of Tahitians, cloaking them in a costume of civility to the European eye. But simultaneously, as objects directly worn on or handled by native bodies, gifts were conceptualized in relation to touch. In particular, the Spanish spoke of these gifts as "caresses," reaching from skin into the soul. Conceived as sweet and pleasant, caresses would not only change the look of natives, but ultimately induce a mentality of voluntary submission. The intersubjectivity of touch here operated not as a means of empathy, but as the framework for an asymmetrical romance.

Methodologically, García-Moscardó's article exemplifies an approach essential to the thrust of this volume: she takes metaphors such as "caress" and "seduction" seriously rather than as mere rhetorical flourishes, treating them as profound deposits of lost sensory experiences. This allows her to analyze the costumed pageant of Tahitians as not only visual spectacle, but as an intertwining of touch and sight. Several examples of haptic visuality excavated throughout this issue follow a similar pattern. A statue at the Reims Cathedral cradling its head in its hands becomes, for Palfreyman, an emblem of the headaches which wracked Mark's body; a reference to a "plucked guitar" serves, for Serrano, as a link between Feijoo's nervous physiology and his experiences of song; a clenched fist, veins bulging, clears a path for Cooley to explore the unstated practices of touch in Fabricius' anatomy.

Reflecting on this approach allows us to return to the contrast between Heisenberg and Labatut's fictionalization with which this introduction began. For modernity as portrayed by historians of science was perhaps not a taming of the senses by sight, so much as a change in protocols of representation in the scientific record. As Lissa Roberts has noted, the sources that inform our craft and trade—particularly as one approaches the modern period—seem to perform a certain self-erasure, eliminating "the presence of direct sensory evidence from the public records."[41] Consequently, the scholar seeking to undo

tenance of power, see Francesca Bray, *Technology, Gender and History in Imperial China: Great Transformations Reconsidered* (London: Routledge, 2013), 1–35.

41 Roberts, "Death of the Sensuous Chemist," 507.

this erasure must read sources in a manner attentive to seemingly decorative or incidental metaphors and analogies, scrutinizing these figures for the implied intersensorial experiences that they "smuggle"—to borrow Cooley's term—surreptitiously into texts. Put differently, historians of science should read sources with a literary imagination.

A parallel claim might be made, too, for adopting literary strategies in relation to scholarly writing. This claim is pursued by Hsiung in his recreation of thoughtographic experiments. Juxtaposing perspectival narratives of the same experiment, Hsiung attempts to reveal fundamental conflicts in the hidden sensory experiences of historical actors keyed to their gendered personae. On the one hand, his approach demonstrates just how partial and selective scientific accounts have been in discarding concomitant sound and touch in experimental spaces, treating these other stimuli as merely incidental to the final visual evidence. More often than not, these discarded remnants become the traces through which to retrieve the voices of actors excised from the scientific record. On the other hand, literary experimentation allows Hsiung to immerse readers in the irreducible multiplicity of sensory experiences. Holding readers in a state of aporia functions as a method of resisting the urge of scholars to render their own singularly definitive—and thereby also exclusionary—account of the past.[42] This proves especially important when we lack the testimonies of marginalized actors involved in knowledge production, such as the female medium of Hsiung's article.

If all history is in some way born from a consciousness of our present, then exploring such methods to address intersensoriality seems imperative. For intersensoriality is our condition. Citing smartphones, tablets, automatic doors, fitness trackers, and body scanners, Henning Schmidgen has characterized the experience of contemporary life as one irretrievably embedded in technologies with which we look, listen, touch, and hear, and which are nearly always looking at, listening to, touching, and hearing us.[43] Such technologies not only extend and enhance our senses, but fundamentally transform the ontology of our bodies: we are all today, to differing degrees, cyborgs.[44] In this

42 The literature on narrative techniques in historiography is obviously vast, but for key discussions specific to the history of science, see Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998), 186–206; William Clark, "Narratology and the History of Science," *Studies in the History and Philosophy of Natural Science. Part A* 26, no. 1 (1995): 1–71.

43 Henning Schmidgen, *Horn, or the Counterside of Media* (Durham, NC: Duke University Press, 2022), 3.

44 Hélène Mialet, *Hawking Incorporated: Stephen Hawking and the Anthropology of the Knowing Subject* (Chicago: University of Chicago Press, 2012); Gillian Haddow, *Embodiment and*

issue, we have been able to take one small step toward recovering earlier histories of this intersensorial condition through a specific examination of haptic visuality. Our choice does not necessarily imply that seeing and touching stand in a privileged relationship—a stance more strongly argued in Ludmilla Jordanova's "Afterword" to this issue—but rather marks an attempt to open the question to future explorations of the entanglement between hearing, taste, and smell, teased for example by the treatment of the aural and haptic connections in Serrano's article.[45] Methodologically, too, this inquiry would benefit from the kinds of interdisciplinary collaborative techniques recently embraced by sensory history, including collaborations with chemists to recreate primordial smellscapes from before the dawn of the species.[46]

Preliminary though our issue may be, we hope that the articles here will urge historians of science to begin acquiring what Mark Smith has called the "sensate habit." By "sensate habit," Smith suggests that sensory history, rather than forming a niche subfield of its own, may be better approached as a kind of attitude towards sources—"an embedded way of remaining vigilant about and sensitive to the full sensory texture of the past"—that cuts across areas of specialization within the historical discipline.[47] In the same spirit, we believe that the success of "Touching Visions" may be measured less by whether or not it inspires the creation of a "sensory history of science" as such, than by the degree to which historians of science in the future simply take as common sense the following: to understand is to grasp, as much as it is to see.

Everyday Cyborgs: Technologies that Alter Subjectivity (Manchester: Manchester University Press, 2021); Stefan Lorenz Sorgner, *We Have Always Been Cyborgs: Digital Data, Gene Technologies and the Ethics of Transhumanism* (Bristol: Bristol University Press, 2021).

45 On the imbrication of taste and touch in medicine, for instance, see Mark R.S. Jenner, "Tasting Lichfield, Touching China: Sir John Floyer's Senses," *The Historical Journal* 53, no. 3 (2010): 647–670; for a general outline of the possibilities of such intersensorial research, see David Howes, "Hearing Scents, Tasting Sights: Towards a Cross-Cultural Multimodal Theory of Aesthetics," in Bacci and Melcher, *Art and the Senses*, 161–181.

46 Inger Leemans, William Tullett, Cecilia Bembibre, and Lizzie Marx, "Whiffstory: Using Multidisciplinary Methods to Represent the Olfactory Past," *American Historical Review* 127, no. 2 (2022): 849–879.

47 Smith, *Sensing the Past*, 5.