History in the Education of Scientists: Encouraging Judgment and Social Action

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Abstract: The authors of this essay reflect on the experience of co-teaching a course on the history of genetics and race. The collaboration has pushed them both—a historian of science and a biologist—to consider how to make space for moral and scientific judgment in a history classroom. Drawing on examples from the course, they argue that it is possible to encourage social action and thoughtful critiques of past and current science without succumbing to a whiggish narrative of progress.

> ***Harvey Mudd College seeks to educate engineers, scientists, and mathematicians well versed in all of these areas and in the humanities and the social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society.***
> **—Harvey Mudd Mission Statement**

We often joke that new students and faculty at Harvey Mudd College should be able to recite our mission statement from memory after just a few hours on campus. It is quoted frequently in presentations and conversations, pointing toward some of our most ambitious goals: to be both a STEM school and a liberal arts college and to graduate students with impressive technical expertise *and* an understanding of the entanglement of science, technology, and society. As a historian of science (Vivien) and a biologist (Dan), we each contribute to these goals in different ways through our teaching. The opportunity to teach a history course together, however, gave us the chance to address our institution's mission more fully. It stretched us both beyond our usual disciplinary methods and pushed us to imagine how historical understanding might encourage certain kinds of judgment and action.

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Even before teaching this course, Dan hoped that our students were thinking critically about how their scientific work intersects with society, but encouraging these discussions had not been central to his course goals. If discussions of policy or societal impact happen in his biology courses, it is often at the end of a class meeting or on one or two special days at the end of the semester. Even with time built in for these conversations, the technical focus of a biology course does not give students the right set of tools to understand or examine science and society. Vivien's history classes do offer some of these tools, but the main object of analysis is past and not current science. Just as in Dan's courses, if there is time to talk about contemporary science and technology, it tends to happen in the last few minutes of class, after she signals that the historian hats can come off. Both of us recognize that pushing these discussions about the societal impact of current or future science to the margins of our courses implicitly signals to our students that we value these conversations less than traditional disciplinary work.

The experience of co-creating a seminar in history titled "Genetics and Race" prompted us to rethink this pedagogical stance. We taught this seminar to eighteen students in a format structured mainly around whole class and small group discussion. Students wrote short, argumentative papers in response to course readings and worked on an independent research project culminating in a formal history paper. For many of our students this was their first college-level history class, but all the students had taken at least one semester of college biology, usually through Harvey Mudd's core curriculum. While we did not focus on teaching biology content, we did cover it where necessary to make sense of a particular historical episode. Students really appreciated having both a scientist and a historian in the room, one telling Dan in course evaluations, "I really enjoyed your in-class explanations of the science," and another noting that "explanations of the science concepts early in the course were very useful."

Having a biologist in a history classroom allowed for a deeper engagement with the details of past science. Even more, this collaboration pushed us to articulate the value of historical analysis to science in an explicit and instrumentalist way. Vivien's usual agnosticism as a historian trained to analyze past science without judgment felt uncomfortable for Dan, who wanted to teach this course to shape better scientists. At first, our goals as a historian and a scientist seemed at odds, echoing an underlying tension that permeates a number of the essays in this collection. In his piece, John Powers documents the increasingly "divergent professional aims of chemistry teaching and the history of chemistry" over the twentieth century and argues that we may have to be at peace with a coexistence of different versions of the history of science, rather than hoping for full collaboration between scientists and historians.[1] But Vivien has gradually become more confident that historians *do* have an active role to play in shaping future science. It is absolutely possible to help students draw explicit lessons from the past without losing historical complexity and without succumbing to a whiggish narrative of progress. And if we want to be part of shaping a future science that is anti-racist and anti-imperialist, one that promotes equity, diversity, humility, and respect, then we need to feel confident that historical expertise allows us to make certain kinds of judgments. In what follows, we draw on examples from this co-taught course on the intertwined history of genetics and race to argue that the history of science can encourage responsible social action and have a positive impact on the content of future scientific knowledge.

[1] See the essay by John Powers in this Focus section.

JUDGMENT AND WHIG HISTORY

Some of the reluctance that historians often feel when asked to articulate the specific value of history to practicing scientists comes from the sense that scientists want a narrative of progress, something most historians are unwilling and unable to provide. In fact, warning students new to the history of science that they must overcome this temptation often happens on day one. Peter Bowler and Iwan Morus introduce this concern on the second page of their undergraduate textbook *Making Modern Science*, warning against a whig history "that treats the past as a series of stepping stones to the present—and assumes that the present is superior to the past." When scientists like Steven Weinberg actively advocate for a whig history of science, the disciplinary divide seems pretty stark.[2]

The concern is that careful, complex histories will be simplified and distorted to make the current epistemic and ontological commitments of science seem inevitable. Stephen Brush argued, many decades ago now, that science teachers are only interested in history that helps "to teach modern theories and techniques more effectively." It makes sense, he noted, for these teachers to "only take from the past that which seems to have significance to the present," especially stories that support an ideal of value-free objectivity. But this was, and continues to be, an unfair characterization of the goals of science teachers, who do not merely want to pass on to students a static story of received science. This certainly was not Dan's hope for our history course. It can be quite hard, however, to find ways to incorporate a more nuanced understanding of science into science classrooms. In this Focus section, Daniel Gamito-Marques offers one possible model, relying on storytelling tropes to relate the evolution of science concepts.[3] The fact that these stories might be surprising to scientists and science students does not necessarily make them unwelcome. As Brush notes, "there is only one established dogma in science—that scientists do not blindly accept established dogma."[4] If a central pedagogical goal of science education is to nurture critical, questioning students, how can historians of science be part of that project?

The first thing historians need to do is disentangle concerns about perpetuating a triumphalist history of science from questions of where and when it is appropriate to pass judgment. In his classic book warning of the dangers of whig history, Herbert Butterfield admonishes the historian who wants to be an "avenger," arguing that "above all it is not the role of the historian to come to what might be called judgments of value." Taking this to heart, one of the key ways in which we actively work to avoid narratives of progress is by withholding judgment and adopting a symmetric stance toward scientific beliefs that we might now judge to be true or false.[5] No one is perhaps more acutely aware than the historian of science of how unhelpful "truth" is as a criterion of judgment. What counts as good evidence and true knowledge seems to be continually shifting. But this critical insight from the field does not mean that we have to abandon any hope of evaluating past science. Following standpoint theorists like Sandra Harding, what would it look like to start from the experiences of marginalized individuals and communities and ask what past science looks like from those perspectives?[6] Instead of asking whether past science was true, can we ask whether it was just? And how will honing our ability to think

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[2] Peter Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: Univ. Chicago Press, 2005), p. 2; and Steven Weinberg, "Eye on the Present—The Whig History of Science," *New York Review of Books*, 17 Dec. 2015.

[3] Stephen Brush, "Should the History of Science Be Rated X?" *Science*, 1974, *183*:1164–1172, on pp. 1166, 1171. See also the essay by Daniel Gamito-Marques in this Focus section.

[4] Brush, "Should the History of Science Be Rated X?" p. 1165.

[5] Herbert Butterfield, *The Whig Interpretation of History* (New York: Scribner's, 1951), pp. 3, 73; and Sergio Sismondo, *An Introduction to Science and Technology Studies* (Chichester: Wiley, 2010), p. 48.

[6] Sandra Harding, "Rethinking Standpoint Epistemology: What Is 'Strong Objectivity'?" *Centennial Review*, 1992, 36:437–470.

about justice in the past help our students to consider what justice might look like in the present?

RESPONSIVE SOCIAL ACTION

Though we did not state this explicitly in our syllabus, one of our main goals for the course was to encourage our future scientists to see themselves as social actors. Speaking directly to Harvey Mudd's mission statement, which promises that students will graduate with a "clear understanding of the impact of their work on society," a strong thread of discussion in our course asked students to consider their social responsibility.

The course offered numerous examples showing how "genetics quickly came to provide the formative language of modern racism," with little action on the part of scientists to push back against this trend. We examined the Immigration Restriction Act of 1924, legislation that instituted quotas for immigrants from southern and eastern Europe. To justify this legislation, politicians and expert witnesses used genetic theories to bolster claims about biologically inferior races. Harry Laughlin, the director of the Eugenics Record Office (and proponent of forced sterilization), gave expert testimony to the House Committee on Immigration and Naturalization, characterizing himself "simply as a scientific investigator to present the facts." Laughlin testified that "recent immigrants, as a whole, present a higher percentage of inborn socially inadequate qualities than do older stocks" and invoked the persistent and already in the 1920s highly criticized idea that racial mixing leads to degeneration. The historian Kenneth Ludmerer points out that even though these claims were faulty according to the biology of their time, "virtually no geneticist or biologist of note publicly contradicted Laughlin's work."[7]

The most disturbing example of the geneticization of racism that we looked at in the course was a Nazi youth handbook from the late 1930s. The book emphasizes the guiding power of biology, promising, "We shape the life of our people and our legislation according to the verdicts of the teaching of genetics." Declaring that many "mental diseases are definitely known to be inheritable," the handbook uses the ideas of Mendelian genetics and recessive traits to create a fear that many hereditary characteristics "have a concealed hereditary course." It goes on to warn against "blood contamination by the Jews," building a case for genocide in the language of genetics.[8] This was an extremely difficult primary source to work with, and we spent time in class discussing whether we should be reading a source like this, asking students to consider the historical value of revisiting this kind of hatred. In the end, students agreed that the historical insights were worth the emotional toll. Reading the handbook turned out to be a powerful moment in the course, not only for students to see how the language of genetics was used to justify the Holocaust but because of the resonance between this language and the way current-day white supremacists continue to draw on genetics. In November 2018, while we were teaching this course, the American Society of Human Genetics released a statement condemning the use of "discredited or distorted genetic concepts to bolster bogus claims of white supremacy."[9] Taken all together, these examples illuminated for students the dangers of staying

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[7] Michael Yudell, "A Short History of the Race Concept," in *Race and the Genetic Revolution: Science, Myth, and Culture*, ed. Sheldon Krimsky and Kathleen Sloan (New York: Columbia Univ. Press, 2011), pp. 13–30, on p. 17. Laughlin is quoted in Kenneth Ludmerer, "Genetics, Eugenics, and the Immigration Restriction Act of 1924," *Bulletin of the History of Medicine*, 1972, *46*:59–81, on pp. 68, 67; Ludmerer's remark is on p. 68.

[8] "Handbook for Schooling the Hitler Youth," https://archive.org/details/NaziPrimerTheHitlerYouthManual. Abby Lippman coined the term "geneticization" in her critical analysis of prenatal screening technologies to point to the increasing dominance of genetic frameworks of disease and health; see Abby Lippman, "Prenatal Genetic Testing and Screening: Constructing Needs and Reinforcing Inequities," *American Journal of Law and Medicine*, 1991, *17*(1–2):15–50.

[9] "ASHG Denounces Attempts to Link Genetics and Racial Supremacy," *American Journal of Human Genetics*, 2018, *103*:636.

silent and letting science speak for itself. We hoped to encourage our students to use their expertise and social capital to advocate for social justice.

To do this meant providing space for students to consider what healthy community engagement might look like and the challenges posed by long histories of racial injustice. Early in the course, we talked about the National Bone Marrow Program, a master registry that attempts to match donors and recipients who need to have compatible human leukocyte antigens (HLAs). HLAs are unevenly distributed among ethnic and racial groups, but most people in the registries are white, making it difficult to find matches for nonwhite patients. There have been several racially targeted programs, but efforts to attract African-American donors have not been very successful. To help students understand why that might be the case, we need to bring in the kind of historical analysis done by Keith Wailoo and others to make sense of the fraught relationship of African-American communities to institutions of white medicine. We read chapters from Wailoo and Stephen Pemberton's *The Troubled Dream of Genetic Medicine* (2006), in which the authors characterize the reaction of African Americans to proposed screening programs for sickle cell disease in the 1970s as one of "ambivalence, wariness and skepticism" due to the legacy of Tuskegee and "coercive reproductive practices by the white majority."[10] We want our students, as potential future doctors or medical researchers, to understand this history as foundational to any hope of building trust and healthy community partnerships in the future.

Responsive social action also requires future scientists who understand the ways in which racialized individuals and communities might resist, reframe, or appropriate genetic constructions of identity. Near the end of the course, we spent time considering some of the implications of the new wave of genetic ancestry testing. We read work by Kim TallBear that examines the implications of genetic notions of ancestry for Indigenous communities. She illuminates the contradictions between these genetic articulations of indigeneity and older Indigenous articulations that trace kinship across "biological, cultural and political groupings constituted in dynamic long-standing relationships with each other and with living landscapes." In the following class session, we discussed the work that Alondra Nelson has done to investigate Black consumers' relationship to ancestry testing. Nelson shows that these consumers actively interpret the results of their tests in ways that are individual and unpredictable. Sometimes results from the test are seen as highly meaningful and conclusive; at other times they might lead to new questions, especially if they seem to contradict other kinds of genealogical evidence.[11] Nelson and TallBear are not historians, but including their work felt crucial to any evaluation of current genetic frameworks.

CRITICAL ENGAGEMENT WITH SCIENTIFIC KNOWLEDGE

Besides encouraging responsive social engagement, we hoped that this course would prompt students to be vigilant and critical of the continued ways in which race is used to organize populations in genetics. To accomplish this, we did not want merely to offer students a parade of racist science to reject. As Evelynn Hammonds and Rebecca Herzig argue in the introduction to their excellent collection of primary source documents on concepts of race, "a tactic of

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[10] Ian Hacking, "Why Race Matters," *Daedalus*, 2005, *134*:102–116; and Keith Wailoo and Stephen Pemberton, *The Troubled Dream of Genetic Medicine: Ethnicity and Innovation in Tay-Sachs, Cystic Fibrosis, and Sickle Cell Disease* (Baltimore: Johns Hopkins Univ. Press, 2006), pp. 150, 20–21.

[11] Kim TallBear, "Genomic Articulations of Indigeneity," *Social Studies of Science*, 2013, *43*:509–533, on p. 510; and Alondra Nelson, "Genetic Genealogy Testing and the Pursuit of African Ancestry," *ibid.*, 2008, *38*:759–783.

'debunking' scientific racism appears insufficient to the demands of the present moment."[12] Examining concepts of race in science, students can see how these claims have been deeply embedded in structures of injustice and oppression.

Historians of science pay careful attention to the way knowledge is constructed, and this history can give students the tools to rebut persistent claims about race. Late in the semester we read selections from *The Bell Curve* (1994) with the hope that students would see, as Daniel Kevles has pointed out, that there is nothing new in Richard Herrnstein and Charles Murray's arguments about race and IQ, that they are "old hat." By that point we have already read selections from Stephen Jay Gould's *The Mismeasure of Man*, tracing arguments about heredity and IQ back to the flawed tests deployed by Henry Goddard in the early twentieth century. We look at some of those early IQ tests together, pulling out the ways in which questions were dependent on cultural knowledge and education, and students learn how critiques of these tests emerged as early as the 1920s. Reading Gould and then Richard Lewontin's *Human Diversity* (1982), students are equipped to see the fallacy of equating "heritable" with "inevitable."[13] Both biologists argue that the mere fact of heritability tells us nothing about possible environmental modification of traits.

History can also help students understand why race has been such a powerful and persistent social and scientific category. We read Ian Hacking's essay "Why Race Matters" at the start of the semester, using it as a lens for thinking through some of the primary sources we encounter in the course. Hacking points to the "imperial imperative" of colonial states to classify colonized peoples in order to subjugate them. Students are able to see that imperial imperative right away when we read Francis Galton, for instance, noting how he positions eugenics as "of paramount interest to the state" and justifies British imperialism by arguing that the "feeble nations of the world are necessarily giving way before the nobler varieties of mankind."[14]

Following Hacking, we wanted students to understand that race is not a "natural kind." But we also wanted to make sure that our future scientists understood that the social realities of racism have created health disparities that might appear to be biological indicators of race. In the United States, epidemiological studies have shown that Americans of African descent have higher rates of hypertension, but in other countries—including Brazil, Trinidad, and Cuba—racial disparities are much smaller. Even in the United States rates are variable, with darker dark skin correlated with higher rates compared to lighter dark skin. In order to understand what Troy Duster has called the "biosocial complexity" of these racial health disparities, students need to learn the history of racist policies and institutions in the United States that have led to multigenerational trauma and vast inequities in resources and access to medical care.[15]

Overall, we hope that after this class our students will continue to be extremely cautious about categories of race that they might use to frame their future research. We read Jonathan

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[12] Evelynn M. Hammonds and Rebecca M. Herzig, "Introduction," in *The Nature of Difference: Sciences of Race in the United States from Jefferson to Genomics*, ed. Hammonds and Herzig (Cambridge, Mass.: MIT Press, 2008), pp. xi–xv, on p. xi.

[13] Richard J. Herrnstein and Charles A. Murray, *The Bell Curve: Intelligence and Class Structure in American Life* (New York: Free Press, 1994); Daniel Kevles, "Genetics, Race, and IQ: Historical Reflections from Binet to *The Bell Curve*," *Contention*, 1995, 5(1):3–18, on p. 4; Stephen Jay Gould, *The Mismeasure of Man* (New York: Norton, 1996); and Richard Lewontin, *Human Diversity* (New York: Scientific American, 1982). For examples of early intelligence tests, with instructions and analysis, see Lewis Terman, *The Measurement of Intelligence* (New York: Houghton Mifflin, 1916).

[14] Hacking, "Why Race Matters" (cit. n. 10), p. 114; and Francis Galton, "Hereditary Talent and Character (1865)," in *The Bell Curve Debate*, ed. Russel Jacoby and Naomi Glauberman (New York: Times Books, 1995), pp. 393–409, on pp. 394–395.

[15] Troy Duster, "Race and Reification in Science," *Science*, 1995, 307:1050–1051, on p. 1051.

Kahn's account of the history of BiDil, the first drug approved by the Food and Drug Administration with a race-specific indication: to treat heart failure in Black patients. As Kahn uncovers the flaws in the steps that led to this approval decision, he notes the impact of federal databases that organize genetic information about populations into groups that often become shorthand for familiar racial categories. These decisions about how best to organize population data are reminiscent of the stance taken by the mid-twentieth-century evolutionary biologist Theodosius Dobzhansky, who advocated for the use of race for reasons of efficiency. He argued that race was simply a method of making genetic "diversity intelligible and manageable." However, as Michael Yudell points out, "despite the best intentions by scientists . . . [this] ultimately helped to preserve the concept of race in science . . . its methodological utility to evolutionary biologists and population geneticists would quickly be exploited and manipulated."[16] The story of BiDil shows that this pattern continues today.

HISTORY AND THE EVALUATION OF SCIENCE

As history of science does more to confront the ways in which modern science has been intertwined with structures of racism and colonialism, historians will need to decide when to abandon a key methodological and pedagogical stance: the symmetric way in which we often approach past scientific controversy and debate. In other classes, Vivien asks students to consider the explanatory power of phlogiston and to imagine why Galileo's colleagues refused to look through his telescope. Asking students to remain agnostic about heliocentrism or the existence of particular immaterial fluids seems an appropriate step in encouraging careful historical inquiry. But this detached stance did not feel appropriate or sufficient in this course. Dan insisted that it was our job to help students use history to begin to evaluate contemporary scientific claims about genetics and race.

So far, we have only taught this course once, and, in retrospect, we did not do enough to think through these questions about historical judgment with our students. In course evaluations, one student did invoke the college mission, telling us that "the course fit with the Mudd mission statement" and reflecting, "I will be a better/more socially aware scientist as a consequence of this course." Another student, however, still wanted "more tie-ins to the present." This reaction is not surprising, since many of the questions we have posed here only crystallized in the process of writing this essay. We do think that deliberately centering the frameworks of feminist and postcolonial scholars in our pedagogy seems like a promising way to build productive partnerships between historians of science, STS scholars, scientists, and science teachers. Calling on Harding again, as historians we can show science students that "all knowledge attempts are socially situated" *and* help them to consider which "social locations are better than others as starting points for knowledge projects."[17] As scientists, we can model critical self-reflection of our role as social actors by engaging in conversations about the complex and sometimes disturbing history of our disciplines—and not simply leave these conversations to professional historians. We both feel better prepared to have these conversations with students much more explicitly the next time we teach this class.

Overall, the essays in this Focus section offer multiple visions for truly collaborative pedagogies that cross disciplinary boundaries through new kinds of storytelling and experiential learning. Unfortunately, these visions are arriving just as many of us have been thrown suddenly into online learning and unexpected technological experiments owing to the global pandemic.

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[16] Jonathan Kahn, *Race in a Bottle: The Story of BiDil and Racialized Medicine in a Post-Genomic Age* (New York: Columbia Univ. Press, 2013); and Yudell, "Short History of the Race Concept" (cit. n. 7), pp. 20 (quoting Dobzhansky), 21.

[17] Harding, "Rethinking Standpoint Epistemology" (cit. n. 6), p. 441.

Once we find ourselves able to innovate again, we will need to acknowledge the discomfort that any kind of pedagogical experiment is bound to inspire as we find ourselves expanding the questions we ask and the methods we use in our classrooms. Our flexibility, however, promises to be more than worth it, opening doors to groups previously excluded from both science and history. In a time of crisis and eroded trust in science, it is all the more vital that we continue to work with our students to confront past injustice and encourage action leading to healthier scientific institutions in the future.