Archives Italiennes de Biologie, 149 (Suppl.): 29-37, 2011.

Matteucci and du Bois-Reymond: a bitter rivalry

G. FINKELSTEIN

University of Colorado Denver, Department of History, Denver, Colorado, USA

ABSTRACT

This essay considers a long-standing controversy between two nineteenth century pioneers in electrophysiology: the German scientist Emil du Bois-Reymond (1818-1896), and his Italian rival Carlo Matteucci (1811-1868). Historians have generally described their disagreement in du Bois-Reymond's terms: the product of a contrast in scientific outlook. While not discounting this interpretation, I want to suggest that the controversy was driven as much by the rivals' similarity as it was by their difference.

Key words

du Bois-Reymond • Matteucci • Electrophysiology • Neuroscience • History • Nineteenth century • Controversy

In 1892, in a lecture that drew on a lifetime of reflection, the Prussian physiologist Emil du Bois-Reymond compared two aspects of the Enlightenment: on the one hand, a glorious record of political engagement, scientific achievement, and literary excellence, and on the other, a "host of ignoble passions engaged in a war of annihilation – lies, slander, and forgery as powers with which the *lumière* of the time had to contend" (du Bois-Reymond, 1912b: 484) Du Bois-Reymond was glad that national hatred no longer divided Germany from France, noting that "in the avenues of exact research as in the production of elegant style" his society had "sometimes matched and occasionally even surpassed" the great achievements of its neighbor to the west. These remarks about the Enlightenment could also serve as an epitome of his attitudes to his oldest rival, the physicist Carlo Matteucci (Fig. 1a,b).

Du Bois-Reymond is best known to scientists today as an advocate for reductive explanations in biology and as a pioneer in modern neurophysiology. His fame has declined enormously from its apogee in the nineteenth century, when his photograph could be seen hanging for sale in Berlin shop windows alongside those of the Royal Family. As professor of physiology at the leading university in Germany and by many estimates the foremost biologist in Europe, du Bois-Reymond served as a spokesman for science in an age when interest was never higher. His many public lectures made him one of the most celebrated and contentious figures in Imperial Germany.

Du Bois-Reymond's renown was ultimately based on his early researches in electrophysiology. These in turn were built on the foundation of Italian discovery. In 1841, when he was only twenty-three, his advisor Johannes Müller gave him a copy of Carlo Matteucci's essay *On the Electrical Phenomena of Animals* with the comment "This is something for you" (Matteucci, 1840; S[chiff], 1893). Du Bois-Reymond agreed to "repeat, and where possible, further continue" Matteucci's experiments. The project occupied him for the remainder of his career.

Matteucci's investigations had been both novel and wide-ranging (du Bois-Reymond, 1848; Moruzzi, 1996). In 1838, using two separate detectors of electricity, he determined the presence of a current

Corresponding Author: Gabriel Finkelstein, University of Colorado Denver, Department of History, P.O. Box 173364, Denver, Colorado 80217-3364, USA

between the intact and injured tissue of muscles. That same year he also observed the disappearance of electrical currents in muscles undergoing tetanic convulsions. And in 1842, he reported to the French Academy of Sciences that he had been able to induce contractions in a frog's leg by touching the nerve of one prepared thigh to the nerve of another (Matteucci, 1843; Clarke and Jacyna, 1987). These findings earned him the approbation of the leading scientists in Europe, and in 1844 Matteucci was awarded the Copley Medal by the Royal Society of London.

Priority has its benefits. Du Bois-Reymond once called Johannes Müller "the German Cuvier", stating that the French naturalist commanded the same advantage over his advisor that Galilei and Newton commanded over Laplace and Gauss or Lavoisier over Berzelius, namely "to have done the greatest things simply because they were there to be done" (du Bois-Reymond, 1912a: 271). Towards the end of his life du Bois-Reymond depicted his own success in much these same terms. "Back then", he recalled at a celebration of his twenty-fifth year as a professor, "the field of physiology resembled a great new continent where entire lands had not yet been taken in possession. Johannes Müller pointed out to me regions that I could seize as a new Conquistador" (Anon., 1883). The analogy was apt: in the same way that Cortez played down native assistance in his conquest of Mexico, du Bois-Reymond skirted around Matteucci's pioneering discoveries, the base for his own exploration of the field of animal electricity.

Where du Bois-Reymond surpassed his rival was in technique. Essentially, what he did was to refine the study of living tissue with physical instruments, substituting exact methods for Matteucci's cruder procedures (Rosenthal, 1878; Finkelstein, 2003). Matteucci had employed a version of Leopoldo Nobili's galvanometer to detect electricity in animal tissue, but as his instrument was neither sensitive nor reliable, he generally preferred to use the "rheoscopic frog", or a frog's gastrocnemius with the skin removed and a length of nerve left attached. Touching the nerve of this preparation with even the slightest charge caused it to twitch, making it a convenient and reliable laboratory device – so much so that one might question why du Bois-Reymond even bothered with a galvanometer at all. The answer is threefold. First, unlike Matteucci, du Bois-Reymond believed that there was nothing unique in animal electricity, and he was afraid that organic detectors would encourage vitalist interpretations of the phenomenon. Second, a rheoscopic frog could only respond to electric charge, unlike a galvanometer, which could indicate both the strength and the direction of an electric current, a precondition of further progress in his field. Third, du Bois-Reymond wanted to leave his mark on science, and since Matteucci had the advantage in discovery he emphasized procedure, originating apparatus and techniques that remained in use for a century.

Du Bois-Reymond's innovations primarily addressed two defects of the galvanometer. The first was a spurious response caused by chemical reactions between the leads of the device and the material being investigated, a problem that du Bois-Reymond initially solved with a buffer of electrolytic solution and later with an amalgam of zinc and zinc sulphate (Fig. 2). The second was the lethargy of the instrument, whose oscillations were so slow and so small that they sometimes could be seen only through a microscope. As du Bois-Reymond could do little to shorten the period of response, he lengthened the time of input by inducing tetanus in the tissue being investigated. Sequential contractions of the muscle fibers summed in the galvanometer, producing deflections that could be observed in the time that it took for the needles to swing.

Armed with a superior galvanometer and better technique, du Bois-Reymond confirmed Matteucci's first finding of a current of injury, modified his second finding from a disappearance to a diminution of animal electricity in muscles undergoing tetanus, and reinterpreted his third finding of induced contraction as the effect of this diminution, which he identified as the electrical signal transmitted by the nerve. All this sounds simple enough, but that is true of all great innovations, which only look obvious in retrospect. At the time of his investigations few scientists appreciated du Bois-Reymond's breakthroughs. In Berlin "it almost took moral coercion" to get Müller to look at the new instruments that he installed in the physiological laboratory (du Bois-Reymond, 1912a: 267). In Vienna the faculty preferred to hire his friend Ernst Brücke. In Heidelberg the rumor was that his "lectures were as specialized as his research…" (Tuchmann, 1993: 143). In Paris he was attacked

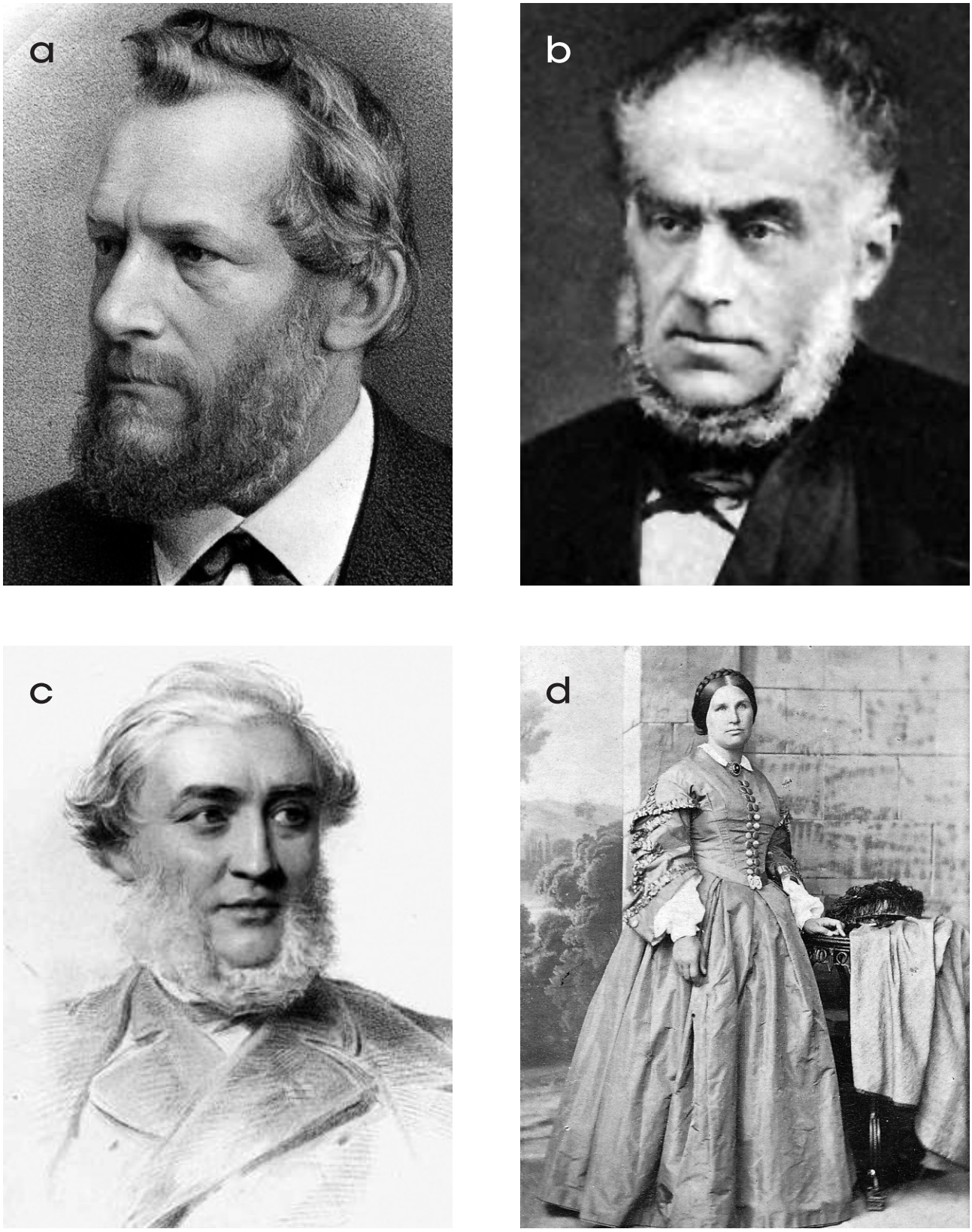

Fig. 1. - a) Emil du Bois-Reymond (1818-1896); b) Carlo Matteucci (1811-1868); c) Henry Bence Jones (1813-1873). d) Jeannette du Bois-Reymond, née Claude.

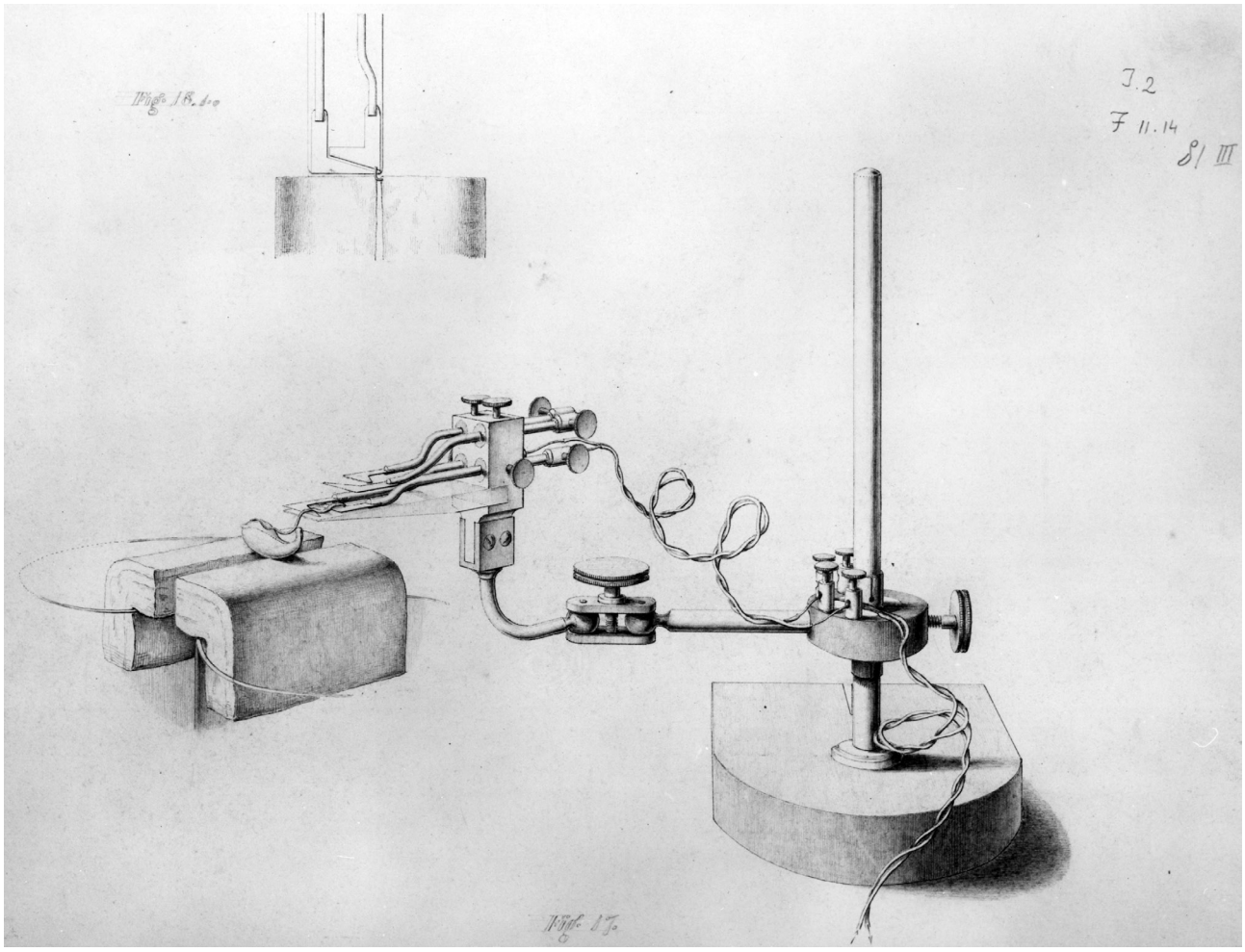

Fig. 2. - Emil du Bois-Reymond's apparatus to observe the nerve signal. *Top*: metal electrodes for stimulating the nerve. *Bottom*: arrangement for detection of the signal. The frog gastrocnemius rests across two conducting pads soaking in electrolyte (the rest of the circuit extending to the galvanometer is not shown). Metal electrodes, held in place by an adjustable stand, stimulate the nerve. The twisted wires trail off to some source of electricity, most likely a magneto-electrometer (From Finkelstein, 2003: 275).

at the Academy of Sciences (Foucault, 1849). And in London Matteucci held sway even after du Bois-Reymond demonstrated his technique to the Royal Institution. About the only foreign scientists who grasped the significance of his work were Henry Bence Jones, a physician to Darwin, John Hughes Bennett, a professor of medicine in Edinburgh, and Auguste de la Rive, a physicist in Geneva. All these men operated on the margins of physiology. In contrast, more illustrious scientists like Claude Bernard misconstrued du Bois-Reymond's procedures as quantitative and unoriginal (Bernard, 1965). The effect of this judgment was severe: in 1862 the Russian physiologist Ivan Sechenov found Bernard "completely indifferent" to his studies of inhibition; in 1870 the American neurologist George Miller Beard reported that French scientists wasted their energy on "the construction of fantastic instruments and apparatus that serve no purpose except to show the ingenuity of the authors"; and as late as 1880 Charles Richet and Sergei Tschiriew complained that the French lagged behind their Dutch and German counterparts in the investigation of electrophysiology (Beard, 1869-70; Tschiriew, 1879; Paul, 1972). As for the situation in Britain, du Bois-Reymond dismissed it with the remark, "Physiology does not exist there" (du Bois-Reymond to Ludwig, 2 August 1852).

Du Bois-Reymond's frustration at being misjudged was exacerbated by certain tendencies in his rival. Matteucci employed what du Bois-Reymond called "the unique tactic of self-plagiarism", meaning that he published several versions of the same article and then cited them all, a practice which confounded anyone trying to follow the chain of his attributions (du Bois-Reymond, 1847; du Bois-Reymond, 1848: xxi-xxii). Matteucci also had a habit of revising his opinions (Clarke and Jacyna, 1987). While this helped him to innovate, it only irritated du Bois-Reymond, who grew ever more defensive as he watched his competitor publish article after article while he struggled to complete his treatise on animal electricity. "You can imagine how pleasantly excited I became", he wrote to his friend Eduard Hallmann in 1845, "when I was brought news from Geneva that Matteucci had undertaken a virulent sortie against me… He could not justifiably ignore me, because my first work is now available to the French… That is why he tried to destroy me. *Mais il trouvera qu'on est dur à cuire*… To him, I am 'the *young* physiologist from Berlin'" (du Bois-Reymond to Hallmann, 25 October 1845).

Scientists thrive on recognition, and here du Bois-Reymond was no different from his peers. Bence Jones (Fig. 1c) knew that Matteucci enjoyed high esteem in England, and I suspect that he encouraged his friend to challenge this standing (Faraday to du Bois-Reymond, 15 January 1850). In 1852 the two friends published an abstract of du Bois-Reymond's work that portrayed Matteucci as confused, incompetent, and dishonest (Bence Jones, 1852). The Italian physicist reacted immediately, circulating a sixteen-page letter addressed to Bence Jones on 25 January 1853 (Matteucci, 1853).

Matteucci's motivation was clear: his reputation had been killed in Germany, wounded in France, and assailed in England. The harder question is why du Bois-Reymond could not perceive his adversary's weakness. Faraday may have had the best insight into the dispute. In a letter to Matteucci he warranted "that when du Bois-Reymond was here, he never spoke of you in hard terms or objectionably to me; probably he avoided the subject, but he did not embitter it" (Faraday to Matteucci, 3 March 1853). Faraday went on to consider that "these polemics of the scientific world are very unfortunate things; they form the great stain to which the beautiful edifice of scientific truth is subject. *Are they inevitable?* They surely cannot belong to science itself, but to something in our fallen natures" (Faraday to Matteucci, 3 March 1853).

I would like to believe that du Bois-Reymond engaged Matteucci out of respect. Gentlemen do not fight their inferiors; they either ignore them completely, or, as Voltaire discovered from the Chevalier de Rohan, have them thrashed by hirelings (Morely, 1872). That du Bois-Reymond deigned to answer Matteucci's affronts indicated his belief in scientific justice. As he explained to his wife (Fig. 1d): "My priceless enemy Matteucci … has worked continuously for the last 20 years in the same field as I. This field he has failed to illuminate basically because he cared less about truth than about acquiring a European reputation *à tout prix.* When I first made my discoveries known, he mustered everything he had to get rid of the awkward rival. He plagiarized me, libeled me, in short, he found no means too base to keep me down. Fortunately science is not like theology or jurisprudence. There is a court of final appeal, nature itself, which settles all disputes reasonably. I won and Matteucci, despite his connections in Paris and London, decisively lost" (du Bois-Reymond to Claude, 25 September [1852]).

Thus far Faraday's beautiful edifice. Then comes the great stain: "Of course I'd find it a heavenly pleasure to secretly observe this vicious man in his own home. But there's no time for such spying…" (du Bois-Reymond to Claude, 25 September [1852]).

Against the advice of friends du Bois-Reymond met Matteucci's assault (Bence Jones to du Bois-Reymond, 3 March 1853, 9 March 1853; du Bois-Reymond, 24 March 1853). "Every great scientist has his flea", Humboldt chided him. "Matteucci is yours" (du Bois-Reymond to Dohrn, 24 January [18]76). Bence Jones warned that Matteucci had depicted him as "an irritable, unfair opponent" and worried that du Bois-Reymond might precipitate "an intemperate controversy" (Bence Jones to du Bois-Reymond, 1 May 1853, 31 May 1853). "Your great object should be not to fight and floor Matteucci but to improve your position here" (Bence Jones to du Bois-Reymond, 9 March 1853). To that end Bence Jones lobbied for the Copley medal on his friend's behalf, but colleagues at the Royal Society preferred to remain neutral until the controversy blew over. Everyone recommended that du Bois-Reymond

rejoin in French, the language of Matteucci's accusation, but du Bois-Reymond insisted on publishing in English (du Bois-Reymond to Bence Jones, 17 November 1853). He soon doubted his decision. "Let me tell you how I fell into the stupidity of responding in English to Matteucci's attack", he wrote to his wife: "The work is the most repulsive imaginable, at once laborious and boring and morally repugnant: uncovering lies, revealing spurious reasons, explaining crude mistakes, and I write slowly even in German; in short, I'm obliged to appear calm and polite. It's an irreplaceable waste of time and probably not even worth the effort. But that's how I am. I simply couldn't let him accuse Bence Jones and me of lying, not 'in plain terms' before the eyes of Europe, and once I set about writing I can't be satisfied unless it's carried through with logic, thoroughness, clarity, and elegance" (du Bois-Reymond to Claude, 21 May 1853).

Du Bois-Reymond's final draft, *On Signor Carlo Matteucci's Letter*, still impresses (du Bois-Reymond, 1853). In just forty-one pages he deflected Matteucci's charges, mounted a counterattack, and defeated his foe. His argument was as simple as it was effective: in every contest he had fought Matteucci on foreign ground; henceforth Matteucci would have to meet him on his own. To make his case du Bois-Reymond described their controversy with exceptional lucidity. His best brief, however, was his presentation: where Matteucci expressed outrage in French, du Bois-Reymond solicited understanding in English.

The *Letter* ended the controversy. Bence Jones was utterly convinced. "I want it out quickly", he wrote to du Bois-Reymond in June. "I think it will do much good here. You have kept your temper and can afford to do so" (Bence Jones to du Bois-Reymond, 15 June 1853). He distributed the pamphlet at the Royal Society later that year (Bence Jones to du Bois-Reymond, 23 November 1853, du Bois-Reymond to Claude, 11 July 1853). Its effect, however, remained uncertain. Du Bois-Reymond never received the Copley medal, and by the time his achievements were recognized in England he had ceased to care. Bence Jones could only apologize for his colleagues' ignorance. "If you had not sent a copy of your book to Mr. Faraday I verily believe your name would not as yet have been heard of here…" (Bence Jones to du Bois-Reymond, 28 December 1852, 1 May 1853). Du Bois-Reymond agreed. "There is something rather pleasant in the thought that in Germany we have a whole department of science, teeming with discoveries of the deepest interest, of which not a soul, excepting you, has an idea in England" (du Bois-Reymond to Bence Jones, 24 July 1863, Bence Jones to du Bois-Reymond, 20 September 1863). He was even plainer to his wife. Having finished a set of lectures at the Royal Institution in 1866, he remarked, "The bovine stupidity of English scientists outside their 'own line' is simply outrageous…. It's as if their reason were veiled by thick fog" (du Bois-Reymond to Claude, 11 April [1866], 17 April [1866]; Romano, 2002).

What are we to make of these disagreements? Some historians ascribe them to the characters of the scientists involved. Personally, I do not find that this interpretation sheds much light on the question. Controversy continues to be a fixture of science, and character is subjective. Colonel Edward Sabine told Bence Jones that "he thought from what he saw of M. M[atteucci] at the British Association meetings that he was clever, quick tempered, but a gentleman & desirous of truth" (Bence Jones to du Bois-Reymond, 6 April 1853). Bence Jones judged otherwise. As he was editing Faraday's papers he discovered nearly a hundred letters from Matteucci. "I have read them all notwithstanding the vile handwriting & French", he wrote du Bois-Reymond in 1868. "These letters begin in 1834 and end in 1863 4 or 5 & throughout the whole set Matteucci begs begs begs. You never saw such a beggar… For 34 years he must have been begging everyone he knew here… Well in this life honours & glories & a good many other things go by luck or at least not by reason & right" (Bence Jones to du Bois-Reymond, 28 September 1868). Opinions also divided over du Bois-Reymond. Nearly every contemporary witness recalled him as kind and polite, yet the force of his criticism provoked no shortage of enemies.

Other interpretations of this controversy see it in terms of a conflict of ideas. For du Bois-Reymond, an atheist in the tradition of the Enlightenment, Matteucci's vitalism represented the superannuated beliefs of the Catholic Church. Alternatively, for Georges Canguilhem, a patriot in the French Resistance, du Bois-Reymond's mechanism recalled all things dead and German (1955; cf. Chimisso,

2003). The problem with these readings, whether the canonical story of the demise of vitalism or the revisions of mechanism that followed, is that they take the dispute at face value, emphasizing intellectual distinction as the engine of history. To me du Bois-Reymond and Matteucci's rivalry speaks more of what Freud called the narcissism of minor differences. Both researchers worked at the intersection of physics and physiology; both believed in the liberal promise of science; and for most of their lives both had to contend with the inveterate difficulties of cramped laboratories, inadequate support, political turmoil, and professional isolation.

In the fall 1852, just before the final act of his dispute with Matteucci, du Bois-Reymond accompanied a rich acquaintance on a trip to Italy. Like most travelers making the Grand Tour he marveled at the beauty of the art and landscape, and like most he found Italy ruined by poverty, ignorance, and corruption. He blamed the Catholic Church, reminding his wife that "a miserable regiment of parsons has rendered a blooming landscape fallow, so that in this way Italy, Spain, and Ireland have been struck from the list of civilized countries and France has been brought to the edge of the abyss" (du Bois-Reymond to Claude, 26 October 1852). As he saw it, the true measure of history was science, and he marveled at the railway tunnels and viaducts crossing the Apennines, the cabinet of anatomical models in Florence, and the discoveries of Luigi Galvani, Leopoldo Nobili, and Giovanni Battista Amici (du Bois-Reymond to Claude, 23 September 1852, 25 September [1852], 28 October 1852, 30 October 1852). To du Bois-Reymond, real culture rested in knowledge: "When someone like me is unhappily accustomed to imagining the discovery of the compass or Newton's general theory of gravity as a greater deed than Brutus's murder of Caesar, or Cicero's speeches against Cataline, or any kind of incidental revolting scrap between Emperor and Pope, what then? [Other people's] hearts may skip when they are shown an inscription that describes how many *sesterces* the games cost that such-and-such a consul gave the people on such-and-such an occasion. My heart skips in Somerset House before the manuscript of the *Principia mathematica* or in the Cathedral of Pisa before the swinging lamps that set Galileo Galilei on the trail of his greatest discovery" (du Bois-Reymond to Claude, 14 October 1852).

Du Bois-Reymond considered science to be the solution to confessional discord, political strife, endemic poverty, stultifying backwardness, and international irrelevance – in short, all the evils that plagued *Germany* in the 1850s. Italy mirrored his society the way that Matteucci mirrored himself.

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