Müller's Lab: A Depressed Scientist and His Unruly Students in 19th-Century Berlin

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How do human interactions affect scientific ideas? To answer this question, I have been studying the relationships among renowned physiologist Johannes Müller and his students during 1833 -1858, when the modern laboratory was first starting to develop. What I have been learning about Müller and his students has supported my growing idea that there can be no sharp division between life and work. The experiments that Müller's group performed and the discoveries that they made are inseparably linked to their everyday experiences in 19th-century Berlin.

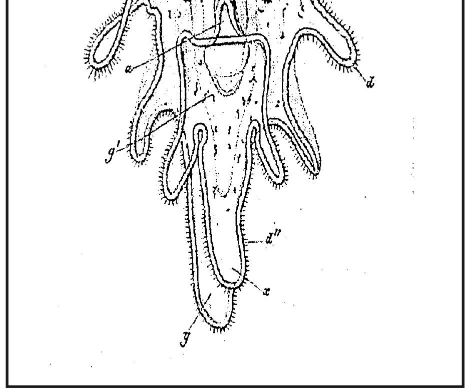
What makes Müller and his group an especially interesting lab to investigate? First, Müller's own life reflects the shifts of 19th-century politics as a seismograph represents the earth's motions (Haberling, Koller). A shoemaker's son, Müller began studying medicine at the University of Bonn just three years after the Prussians reopened it following the withdrawal of Napoleon. During Müller's second year as a medical student at the University of Bonn, his father died, and he survived financially only with the help of powerful patrons, including the Prussian minister of culture. As a researcher, Müller worked at a frenetic pace, studying the sensory, nervous, lymphatic, circulatory and reproductive systems, sometimes simultaneously. In 1828, just after he married the musically gifted Nanny Zeiler, he collapsed from overwork, suffering a long, depressive episode from which many feared he would never recover. But Müller did, going on to make his greatest contribution to physiology: the concept of specific sense energies. This theory dictated that the nerves of our sensory organs are designed to respond to only one kind of stimulus, with the consequence that our experiences and knowledge are shaped by the capacities of our sensory organs. Müller also provided strong evidence that sensory and motor nerves branched off from the spinal cord along different pathways.

In 1833, when the most prestigious German chair of anatomy and physiology became available — a professorship at the University of Berlin — Müller made an all-out effort to win it. He succeeded, and from 1833 onward he became the center of a dynamic group of researchers, investigators who shaped the modern sciences of biology, bacteriology, neurophysiology, psychophysics, pathology and embryology. Between 1833 and 1840 Müller published several editions of his *Handbook of Physiology*, which would become the standard textbook on the subject for much of the 19th century. Yet strangely, despite his success as a physiologist, Müller devoted himself increasingly to anatomy, performing almost no physiological experiments after 1840.

In 1847-48, in addition to his regular duties, Müller served as rector (president) of Berlin University. In the spring of 1848, street fighting broke out between government troops and workers demanding political rights and better living conditions, and hundreds of people were shot. At the university, some of the students and faculty sided with the workers, including Müller's former student Rudolf Virchow, who fought at the barricades. The struggle was complicated by right-wing student factions calling for a united German empire. At the time, Germany consisted of many loosely affiliated states, only some of which were ruled by the Prussian king. In retrospect, Müller's students agreed that their conservative professor was no politician, the worst possible negotiator between rebellious students and reactionary officials. As a result of this stress, Müller suffered another mental breakdown and could not resume his experiments until the spring of 1849. Historian of medicine Johannes Steudel believes that Müller was a cyclic manic depressive, but this kind of categorization imposes 20th-century medicine on a 19th-century condition (Steudel, 115). Almost all of Müller's troubles can be explained by stress and overwork.

During the last 10 years of his life, Müller became famous for his studies of marine biology, dedicating most of his energy to his greatest love, the university's Anatomical Museum. In 1855, returning from a research trip to Sweden, he survived a shipwreck but was again paralyzed by depression because a young student who had accompanied him drowned. Two years later, Müller began taking large doses of opium to combat abdominal pain and the insomnia that had plagued him all his life. In the spring of 1858, one of these doses may have killed him, either by accident or as a result of his own will. As to whether their teacher took his own life, his students disagree, as they did in the lab.

A second reason Müller's group is so interesting to explore is the variety of his students' achievements. Jakob Henle, Müller's first and favorite assistant, anticipated Louis Pasteur in suggesting that diseases were caused by living organisms. Theodor Schwann demonstrated that all animals consisted of cells. Emil Du Bois-Reymond proposed the first experimentally supported mechanism for nerve impulse conduction and collaborated with instrument



A "rococo" sea urchin embryo drawn by Müller in 1848.

makers to design more efficient physiological set-ups (Dierig, Finkelstein). Hermann von Helmholtz measured the velocity of nerve impulses and proposed our currently accepted model of color vision. Rudolf Virchow, who took Müller's courses but was never part of his research group, convinced physicians to think about disease at the cellular level. In his political career, Virchow drove through legislation that vastly improved public health, including the funding of the Berlin sewer system in the 1870s. Robert Remak, the first Jew to be appointed professor at the University of Berlin, discovered the three layers from which human embryos develop. Ernst Haeckel, a philosopher as well as an embryologist, became famous for the controversial theory that ontogeny (individual development) recapitulates phylogeny (the development of a species or race). Like Müller, these students hoped to learn how nerves and muscles worked and how animals grew and developed; however, with their different personalities, they approached these questions in extremely different ways.

Certainly the interactions among Müller's group raise intriguing questions for historians of science, but for a third reason, they are particularly interesting to an English professor. Each of Müller's students describes him in a different way, creating his own version of what their depressed, sleepless leader was like. Literary critic Harold Bloom has coined the phrase "the anxiety of influence" to describe poets' needs to define themselves in opposition to previous generations (Bloom). This concept applies equally well to scientists. We can learn about Müller only by comparing his surviving texts (especially his letters) to those of his students. But in describing Müller, each student creates a different character, one who makes the student and his own scientific decisions look good (Holmes, Jardine). In reading their works, we have to keep in mind Madame de Merteuil's warning in Choderlos de LaClos' *Les Liaisons Dangereuses*: "you must see that when you write to someone, it is for him and not for you: you must therefore try to tell him less what you think, than what will please him most" (LaClos, my translation). The letters of Müller's group reveal only the thoughts they wanted their readers to attribute to them. Their texts do not offer direct access to the writers' minds, and one can imagine the truth only by hearing about Müller's lab from every possible perspective. One must read them as one reads a novel by William Faulkner, making judgments about the situation only after hearing from every individual character.

Müller's students are not always kind in their assessments of their mentor. In the history of psychology, Müller has become known as the man who changed the study of the nervous system from philosophical speculation into experimental science. But if we believe his students, they accomplished this task almost in spite of him rather than because of him. While they all agree that Müller encouraged them to perform experiments, they complain that Müller knew and wanted to know little about math, physics, chemistry and new technological developments. While he performed crucial physiological experiments in the 1820s and early 1830s, his real goal was an 18th-century one: to understand the "grand plan" of life by collecting specimens of every known living animal and arranging them in his Anatomical Museum. Theodor Schwann wrote that "the physical approach, which I beat into physiology and which means pursuing real explanations for the phenomena of life . . . was something Joh. Müller never had" (Du Bois-Reymond, 222). In Schwann's estimate, Müller had little or nothing to do with his discovery of animal cells. Du Bois-Reymond agreed that "what we call the aesthetics of experimentation was foreign to him" (Du Bois-Reymond, 158). As the deliverer of Müller's memorial address and the inheritor of the Berlin physiology chair, Du Bois-Reymond has become the most cited source on what it was like to work with Müller. He is also the source who must be read most carefully. From 1839 until 1858, Du Bois-Reymond struggled to study the electrical activity of nerves and muscles, depending on Müller for economic and academic survival. While he became an associate professor in the early 1850s, this often meant performing dissections for Müller's museum collection instead of his own experiments, and begging Müller to order equipment he needed for his physiological work. Coming from an elite, artistic family, Du Bois-Reymond found the subservience humiliating and expressed his annoyance in sarcastic letters to his friends. In 1849 he wrote to physiologist Carl Ludwig, "Müller has kept me occupied at the museum, carrying out what is in his opinion the highest activity of the human intellect, namely, classifying fossil vermin" (Du Bois-Reymond and Ludwig, 44, 7 August, 1849).

Johannes Müller as drawn by a British artist (circa 1837).

Du Bois-Reymond's memorial address to Müller buries his mentor rather than praising him. Halfway through the 160-page text, which could not possibly have been read in one sitting, he turns sharply critical, presenting Müller as a scientist who encouraged physiological experimentation in others but could never free himself from the misguided ideas that animals were controlled by an undefinable "life force" and that life was organized in a grand scheme. As Du Bois-Reymond tells the story, Müller becomes a failed predecessor whose best work the younger scientist successfully resumed. Most interestingly, Du Bois-Reymond shows his awareness that his speech will shape historians' images of Müller. When the Academy published his speech in 1860, he wrote in a footnote that "as a primary source on the life and work of a man like Johannes Müller, [my account] may perhaps claim a valuable place in the history of science" (Du Bois-Reymond, 299). The most widely cited primary source of information on Müller's lab was keenly aware that he was one.

Ernst Haeckel, 17 years younger than Du Bois-Reymond, created a different picture of Müller but likewise depicted him as a master who failed to solve problems Haeckel would address in his own work. According to Haeckel, the troubled professor would spend Sunday afternoons in his Anatomical Museum, "pacing for hours through the expansive rooms, his hands folded behind his back, busily contemplating the secret affinities of vertebrates, whose 'holy mystery (*Rätsel*)' the aligned skeletons were preaching in such a powerful way." Once, recalls Haeckel, he "shyly" asked Müller whether all of these vertebrates could have descended from a common ancestor. "Ah, if we only knew!" cried Müller. "If you could ever solve this puzzle (*Rätsel*), you would achieve the highest possible goal!" (Haeckel, 23-25; Kornmilch, 862; Krausse, 224). In 1899 Haeckel titled his best-selling book about evolution and society *Die Welträtsel* (*The Riddle of the Universe*). Like Du Bois-Reymond, Haeckel is a good story-teller, and like the senior student, he presents Müller as the man who articulated questions he went on to answer. Recalling his conversation with Müller 50 years after the fact, Haeckel constructs Müller as a character in his memory: an aging scientist fascinated and tormented by an elusive order.

In the "science wars" of the 1990s, social historians argued with scientists about how much truth science actually contains. Scholars studying language and culture insisted that science holds true only in the context of the society that created it. Scientists protested that gravity and menstruation are *real*, not constructs of language. My exploration of Müller's relationship with his students has shown me that literary analyses of science need not deny any of the physical reality of the experiments performed. Since the work in question was carried out more than 150 years ago, our access to it comes only through articles, letters and laboratory notebooks that can be analyzed with some of the techniques used to study literary texts. Studying Müller's students' motivations for writing, their sense of audience, their narrative strategies, and their creations of personae can help us to understand their science. By applying literary techniques to the history of science, I would like to show how interpretive strategies from different fields can work together to produce knowledge. The knowledge I am after is how scientific ideas arise: how personal relationships, everyday annoyances, and working conditions influence the questions that scientists decide to ask. And I do believe there is knowledge to be found. Human conflicts and unreliable equipment do not contaminate the truth. They are always a part of the story.

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Laura Otis earned a B.S. cum laude in molecular biophysics and biochemistry from Yale University and was certain she wanted to study the chemistry of the brain. While enrolled in a neuroscience Ph.D. program at the University of California, San Francisco, she conducted research attempting to learn how nerve cells exchange signals. She earned an M.A. in neuroscience, but she also discovered an affinity for literature and philosophy.

As a result, Professor Otis shifted her focus from neuroscience to comparative literature. She earned both an M.A. and Ph.D. in comparative literature from Cornell University. Her dissertation received the Messenger Chalmers Prize for the best dissertation in the humanities from Cornell in 1991.

Professor Otis attempts to open new channels of communication between people studying literature and science. She compares the methods with which scientific and creative writers approach common issues. In the classroom, Professor Otis encourages students of literature and science to appreciate each other's goals and methods. Her objective is to discourage notions of "literature and science types" by initiating dialogues among students from different fields.

Professor Otis has written extensively on this subject matter. Her first book, *Organic Memory: History and the Body in the Late Nineteenth and Early Twentieth Centuries* (University of Nebraska Press, 1994), explores a misleading idea that people can inherit their ancestors' memories. Her second book, *Membranes: Metaphors of Invasion in Nineteenth-Century Literature, Science, and Politics* (Johns Hopkins University Press, 1998), examines people's need for boundaries, or "membranes," in constructing their notions of identity. Her latest book, *Networking: Communicating with Bodies and Machines* (University of Michigan Press, 2001) is an interdisciplinary study that traces contemporary notions of "the Web" to their origins long before the Internet came into being. In addition, she has recently translated Spanish neurobiologist Santiago Ramón y Cajal's *Vacation Stories* into English.

Professor Otis has received numerous fellowships and awards based on her research. In 2000 she was awarded a MacArthur Fellowship for her interdisciplinary studies of the nervous system.-SK