

**Yuriko Tanaka 田中祐理子, *Kagaku to hyoushou: “Byougenkin” no rekishi 科学と表象: 「病原菌」の歴史 [Science and Representation: A History of “Bacteria”]***

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Yuriko Tanaka’s *Science and Representation: A History of “Bacteria”* consists of four case studies, each of which is devoted to a specific person: Girolamo Fracastoro, Antonie van Leeuwenhoek, Louis Pasteur, and Robert Koch. This structure might strike some readers, particularly those who are familiar with the history of science, as rather an old-fashioned approach. Glancing at its table of contents, I wondered whether the book intended to explore the history of its given discipline by focusing on selected prominent (male) scientists whose contributions are deemed decisive from a present-day perspective. Such old-fashioned historiography often starts by identifying the “fathers” of the discipline and then chooses some later figures to be those who finally gave it its “modern contours.” In the history of microbiology, Fracastoro and Leeuwenhoek tend to play the former role, and Pasteur and Koch the latter. Though this type of progressive and positivistic narrative once flourished in the history of science, it has been subjected to severe criticism in the past few decades. Soon after I started reading her book, however, I was reassured that the author was well aware of that criticism.

Tanaka begins the book with a historiographical reflection, stating that she is taking up the four aforementioned figures precisely *because* they have been represented as the key scholars in the old literature on the history of microbiology (35). While she focuses on them too, her aim is by no means to rehearse the now obsolete narrative. Instead, she hopes to explore the gaps and tensions between the old and new historical scholarship on their work. For this purpose, she emphasizes that these four figures held perspectives and made claims that cannot be easily incorporated into the standard history of microbiology. In other words, her premise is that the history of a given discipline is too often constructed by distortedly representing the reality of past figures. In the case of microbiology, Fracastoro and Leeuwenhoek in particular fell victim to such distortion. The standard history of the discipline suggests that they saw

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what they could have never seen, in order to incorporate them as the discipline's early figures, while the demand for this incorporation emerged only after Pasteur and Koch created the discipline in the latter half of the nineteenth century.

This book has, therefore, two parallel agendas. On the one hand, it presents case studies of the four prominent scholars; on the other, it intends to reflect on the historiography of microbiology through its consideration of how the four came to be grouped together and represented as the discipline's founders. The significance of running these agendas in parallel could have been maximized if the author were to manage to intertwine the two and provide a fresh perspective on each. I will return to this point at the end of this review.

In the subsequent four chapters, Tanaka discusses the four scientists. Chapter 1 is devoted to Fracastoro. She begins her examination by describing the process of how Fracastoro was rediscovered from almost total oblivion and came to be credited as a precursor of modern microbiology. Historians of medicine in the first half of the twentieth century praised him for his correct recognition of the mechanism of disease propagation (e.g., Garrison 1929). Fracastoro, they claimed, had already believed in the existence of microorganisms that carried diseases from one body to another. Tanaka points out that their understanding was conditional not only on the later emergence of the discipline of microbiology but also on a specific scientific discovery that they themselves witnessed: the identification of *Treponema* as the cause of syphilis. The excitement of this discovery prompted historians to search for the originator of the idea that invisibly small animals caused diseases. In this process, they found Fracastoro (note that he composed a poem entitled "Syphilis") and attributed to him various insights that he could never in fact have attained in the sixteenth century.

This anachronistic perception was based on historians' interpretation of Fracastoro's phrase "the smallest and insensible particles" (61). These particles, which he also called "*seminaria*" (seedbeds), carried diseases from one body to another and multiplied themselves in an infected corpus. This explanation by Fracastoro seemed to indicate that he had already recognized some microscopic animate beings as the cause of contagious diseases. However, Tanaka argues that Fracastoro's "particles" should be placed in a much wider cosmological perspective. His theory of invisible particles, in fact, can be made sense of only if we understand Fracastoro's wider worldview, in which forces of sympathy and antipathy interacted with each other and thereby produced the orderly courses of nature. This overall mechanism of the universe manifested itself in animated bodies as the transmission of diseases through *seminaria*. Terms like *seminaria*, therefore, did not designate something literally animate; instead, they were part of his attempt to explain the invisible realm with reference to the visible domain of the world. The literal interpretation of Fracastoro's "seedbeds" could be possible only after the world invisible to him was made visible by the development of microscopes.

The second chapter, on Leeuwenhoek, again starts with a historiographical reflection. Like Fracastoro, Leeuwenhoek became the subject of historical study in the first half of the twentieth century. The most substantial was Clifford Dobell's 1932 *Antony van Leeuwenhoek and "Little Animals."* The difficulty Dobell encountered has to do with Leeuwenhoek's characteristic ways of seeing and writing. His extremely fine-tuned microscopes enabled him to see many minute things that had never been observed before. The replication of his findings consequently posed an enormous

challenge to his contemporaries, who, in fact, remained uncertain about the truth of some of them. Even a modern scientist like Dobell, who had far more advanced knowledge of “little animals,” had to struggle to make sense of what Leeuwenhoek meant in his writings. The difficulty was further increased by Leeuwenhoek’s writing style. Lacking formal higher education, he could read and write in no other than his native tongue—Dutch. Even in his own language, he was not able to effectively convey his findings, making his writings even more difficult to decipher. As a result, his contemporaries, though taking his factual statements seriously, undervalued the precise way in which he reported his research. It was only after the establishment of microbiology that his words themselves became a serious subject of historical scholarship.

The third and fourth chapters focus on the emergence of microbiology as a discipline, through examinations of the work of Pasteur and Koch. Tanaka pinpoints the moment when Pasteur moved to the study of fermentation, a decisive turning point in his long career. In that research, he arrived at the conclusion that fermentation was not a purely chemical phenomenon (a theory then dominant among leading scholars) and explained that it was instead caused by microscopic living entities, which he called “germs.” From 1878 onward, he began to apply his germ theory to the field of medicine and identified various microbes that carried diseases from one body to another through self-propagation. Tanaka notes that, though Pasteur’s activities did straddle multiple disciplinary boundaries, many of his theories were underpinned by a single belief. Since 1857, he had persistently believed in the existence of germs as the origin of life, which would then underlie a wide range of natural phenomena; germs had transmitted life since the creation of the world, and they played the role of actualizing the order of nature not only in the vegetative and animal kingdoms but also in the realm of minerals. Pasteur’s general theory of germs was foundational to his conception of nature as a whole.

Chapter 4 contrasts Pasteur’s germ theory with Koch’s bacteriology. Koch dismissed the method of analysis employed by Pasteur as too loose and therefore incapable of identifying a specific microscopic animal as the cause of a disease. He thus developed the method of “pure culture” to extract and multiply the bacterium that was supposed to cause the disease. Only in complying with this procedure, Koch insisted, could one establish a causal link between the existence of the bacterium and the disease. To represent his findings, he used microscopes and photographs, taking meticulous care to regulate the ways in which his discoveries were disseminated among the scholarly community. Indeed, this strong will to regulate constituted the core of Koch’s scientific activities. Standardizing every single procedure, he molded bacteriology into a science that could be replicated by anyone in any place.

In the concluding chapter, which revolves around Bruno Latour’s provocative assertion, “Ferments did not exist before Pasteur came along” (18), Tanaka opposes this position, claiming that it would make it impossible to understand why the present understanding of the natural world has superseded those of the past. Without assuming something diachronically common, we cannot connect one historical moment to another. This also means that Latour deprives us of the opportunity to reflect on why we often see Fracastoro’s and Leeuwenhoek’s names in the history of microbiology; his position fails to capture the way we have actually come to recognize the past. Tanaka, therefore, supposes something external to, and independent from, our

knowledge. However provisional our understanding of the world might be, it always makes us reflect on the past in terms of its relevance to the present.

Overall, this book presents an informative overview of the four prominent scholars' investigations into the microscopic world. It digests past scholarship and succeeds in organizing a unified narrative, and it would provide a useful guide for anybody working on the history of microbiology or on any one of these four intellectuals. Its critique of Latour's assertion is also sound and insightful, especially in its criticism of him for making historiographical reflection impossible.

The book, however, fails to achieve its original aim—that is, to intertwine the two agendas that I mentioned earlier. During the course of reading it, the following questions continued to haunt me: Is this work written as an original piece of research on Fracastoro, Leeuwenhoek, Pasteur, and Koch? Or does it intend to explore the history of how these four figures have been grouped together as the “fathers” of microbiology, with the intention of reflecting on the way they are represented in the historiography of microbiology? The likely answer from the author would be “both.” Within the scope of a single book, she aims to combine the two, now and then relating the discussion of the four scholars to her examination of how they have been represented in the past. But this intertwining of the agendas turns out to be unsatisfactory for both aspects. As a collection of case studies on the four figures, the author's exploration relies too much on secondary literature. On Fracastoro, for instance, she adds little to the work of Vivian Nutton (1990), Hiro Hirai (2005), and Concetta Pennuto (2008). I suspect the same is true for the other three. The book is also disappointing as a reflection on the historiography of microbiology. The author does not carry out any substantial investigation on the historians and scientists who forged ways of representing the past of the field in a particular manner. This, unfortunately, does not live up to the standards set by the current surging interest in the history of historical writing. The two agendas deserve and demand something original, I feel, and the lack of it made their integration rather unfruitful in this particular work.

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