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Reviews

From "life" to biology and backward: The long gestation of a scientific discipline

The gestation of german biology, J. Zammito. Chicago University Press, Chicago (2017). 560 pp., Price $45, cloth, ISBN 9780226520797

Before the 1800s there were no scientists because science as profession did not exist. There were certainly naturalists or natural philosophers interested in many different things, but there were no professional chemists, anthropologists, sociologists, geologists, economists, or biologists for the same reason: all these fields did not yet exist as scientific disciplines. Only in the 19th century, with the increasing institutionalization, bureaucratization, and expansion of science, different and relatively autonomous scientific fields took forms and identities. Germany was the first country where this happened; France, England, and the rest of the world followed (Stichweh, 2001). We all know today that science is divided into fields and the fields into disciplines and even sub-disciplines. The informal network of amateur aristocratic polymaths is long gone, and an army of salaried specialists has replaced them. But how did all this come about? In other words, how did scientific disciplines arise, change, and diversify? The answer to these questions is far from simple. Each discipline has its own contingent trajectory. Each field is deeply entrenched in its national and transnational networks and engrained in a large series of political and economic interests. More importantly, each scientific discipline has passed through a long period of incubation, growth, and maturation in which its constitutive concepts have been shaped, refined, and stabilized, cohering from a host of chaotic ideas.

Zammito's book addresses one of these disciplinary trajectories: the long gestation of biology as scientific field from the 18th to the early 19th centuries. Although Germany is the focus of the monograph, the author does an excellent job of showing how the construction of the life science was a transnational business. We are introduced into a dense network of friendly or unfriendly relations, traditions and reciprocal influences lurking behind the great 18th century bio-philosophical speculations. From France, England to the Italian peninsula, from the Swiss confederation, Sweden, Netherlands to a fragmented Germany, naturalists from the many corners of Europe added small or large bricks to the large disciplinary edifice of "Biology". However, Biology itself was not the result of a broad transnational interest for institutionalizing a vague and preexisting research field. Before a new science of the "organic" could be framed, a new concept had to be shaped: i.e. "life". In fact, Zammito explores how this concept was conceptually forged tracking the convergence of previous traditional lines of research: natural history, medical physiology, and developmental morphology. Biology itself could be located at the crossroads between a theoretically-minded physiology and an empirically-driven philosophy. In brief, on Zammito's account, the "gestation" of biology relied on a cluster of creative individuals who wove diverse conceptual threads into an overreaching theoretical program aiming at mapping and understanding what they increasingly identified as "living" phenomena in opposition to non-living ones.

In what follows I will first outline a very succinct resume of Zammito's complex narrative and, in the second part, I explore few related issues about the historiography of scientific disciplines and connect them to Zammito's own proposal. In particular, I focus on some problematic presuppositions driving many attempts to figure out how scientific disciplines emerge.

If there is one fundamental thing we learn from the first pages of Zammito's monograph is that many of the controversial debates surrounding the emergence of the life science in Germany in the late 18th century had already a long tradition. Stahl or Haller, Herder or Kielmeyer, Trevinarus or Schelling, Goethe or Blumenbach were the critical heirs of French and British scholars. For example, Zammito convincingly shows how experimental Newtonianism informed novel versions of naturalism and materialism throughout the 18th century. A new philosophical sensibility surfaced through the writings of the Dutch physician Heman Boearhaave, the authority of the French polymath Georges-Louis Leclerc Buffon, and the multifaceted *savant* Pierre Louis Maupertuis; a sensibility that dodged the *Charybdis* of mystical animisms and the *Scylla* of naïve mechanisms. Indeed, the experimental approach that had characterized Newton's *Optics* in contrast with his much more theoretical (and mathematical) *Principia,* constituted the backdrop for the emergence of a new way to look at nature, especially in relation to established fields such as natural history and medicine. In the hands of different French natural philosophers and intellectuals, a non-mathematical physics open the way to a materialist interpretation of natural phenomena, including highly complex entities such as living bodies. On this new account, nature was not a clock awaiting souls to move. Nature was instead a living mechanism containing the rules and laws of its own activities.

Such a "vitalization" of nature was behind what Timothy Lenoir and other scholars have called vital materialism (Lenoir, 1982). The stance assumed that the whole of nature could be explained in terms of matter and its intrinsic and extrinsic movements. Just as Newton could explain the movement of terrestrial or extraterrestrial bodies by positing the existence of a material force cementing the whole universe, naturalists could postulate the existence of material forces buttressing, organizing and driving living matter. Vital materialism was, however, the consequence rather than the cause of experimental Newtonianism. In fact, the latter preceded the most audacious materialist (and atheist) speculations on the nature of life phenomena. To Zammito, one of the most eminent representatives of experimental Newtonianism in the German speaking world was the Swiss physician Albrecht von Haller. Haller's works were eagerly discussed in the second half of the 18th century. Born a year after Buffon, Haller's fame was virtually unrivaled, especially thanks to his physiological concepts such as sensibility and irritability, which sparked debates all over Europe. His experimental empiricism, married with a non-reductionist sensibility, left an indelible mark on the discussions preceding the emergence of the life science in the 19th century. So important was Haller's influence that that, as Zammito suggests, "… all roads to Biology in Germany over the

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course of the eighteenth century went through Haller" (88).

But a pious and devoted protestant such as Haller could not accept many of the irreligious implications of experimental and mechanical sciences. Not surprisingly, several French naturalists and philosophers did not share Haller's religious concerns, expanding the agenda of "experimental Newtonianism" well beyond Haller's self-imposed limits. In fact, Buffon or Maupertuis' great speculations not only included a non-mathematical physics with empirical leanings; they essentially upheld a materialistic "vitalism" that left no room for transcendent agents. Buffon's ambitious naturalism and Maupertuis' defense of a dynamic view of matter constituted essential ingredients for the making of a science of life. The epicurean materialism circulating among the French savants made it possible to consider organic machines as self-organized and organizing entities, not as the crowning achievements of a benevolent architect. Despite this, both experimental Newtonianism and the wildest conjectures linked to vital materialism were only necessary conditions for the constitution of Biology as a science; they were insufficient for it by themselves. The other fundamental ingredient was a progressive *historization* of nature.

Throughout the 18th century, more and more naturalists started to visualize the mineral conformation of the earth as the product of diachronic forces. From natural history, which classified natural objects as part of the static plan of an omnipotent creator, naturalists like Buffon visualized the earth as a developing entity. The historicization of the earth anticipated the historicization of life. No one better than the polymath and Kant's pupil Johann Gottfried Herder embodied such universal stance encompassing both the natural and human world. Herder interpreted natural history as a history of nature; namely, as a whole developing process that gradually ascended in complexity. Organisms followed up less organized entities, and a "genetic force" accounting for the intrinsic creativity and unpredictability of nature pervaded the whole ascension. Herder transgressed Kant's philosophy as well as the French materialists overtook Haller's religious concerns: they all extended the power and autonomy of nature beyond any possible theological or intellectual limit, so that nature itself could appear as a self-organizing, dynamic, and creative entity contrasting with the vision of a static universe ruled by universal laws (or a *primum movens* demiurge).

Zammito's narrative, however, does not end with Herder's sweeping speculations. Before Biology could reach the status of a discipline, other important pieces needed to be put in the right place. This is the moment at which the science of life begins to fall into German hands. The long development of experimental Newtonianism and vital materialism that had mainly busied the minds of French naturalists started to permeate the debates of many distinguished German naturalists. Of course, Kant and Herder had already opened a broad conceptual avenue for thinking about the nature of life phenomena; but, while Kant had express doubts about the very possibility of a proper life science, Herder's conception of pervasive and hierarchical natural forces applicable to virtually everything lacked any specificity. Those who took the burden of demonstrating the feasibility and necessity of a new science dedicated to the nature of "life" were the German physician Johan Friedrich Blumenbach, the naturalist Karl Friedrich Kielmeyer, and a group of enthusiast *Naturphilosophen,* often inspired by the deep intuitions of Goethe and the philosophical wanderings of Schelling. What most of these ambitious scholars shared was the idea that nature needed to be conceived as a dynamic process in which new levels of organization emerged. In short, the deep historicity that Herder had famously defended in his *Ideen* informed the new scientific agendas that would eventually conduce to the crystallization of Biology as discipline in the hands of more focused scholars.

Zammito deems Blumenbach's historicization of nature as crucial step for the formation of biology as science. Blumenbach did not recede (as Kant had done) from the daring hypothesis that new life-forms could emerge through a historical alteration of what he called "formative drive" (*Bildungstrieb*). Blumenbach's historicist orientation was fostered by his deep interest in comparing fossils with geological strata. Some of his most successful students - such as Alexander von Humboldt or Gottfried Trevinarus - can be considered as the first advocates of a transformist (evolutionist) theory of life looking into geology for tracking organic modifications in the course of earth's history. However, one of the figures who, in the late 18th century, most contributed for clearing the path for an autonomous science of life was Kielmeyer. In his 1793 address *Uber die Verhältinisse der organischen Kräfte …*, explicitly manifested the necessity of having a new discipline investigating the specificity of organic laws. Thus, at the end of the 18th century, we have two recognized ideas behind the development of life science: the idea that "life" itself cannot simply be reduced to the law of physics and chemistry, and the idea that organisms are plastic, dynamic, and historical entities.

But the science both Trevinarus and Lamarck had called "*Biologie*" did not appear as ready-made, complete, and definitive at the beginning of the 19th century. Many more decades were required for its foundation and institutional consolidation. In the last two chapters, Zammito dedicates a great deal of effort to the important task of mapping out some of the most important philosophical discussions surrounding the emerging science. In particular, he focuses on Goethe and Schelling, whose insights went deep into the community of *naturphilosophen*. The former proposed a great synthesis between pre-formationism and epigenesis within a "transformist" framework; the latter emphasized the processual productivity of nature based on lawlike patterns. Both Goethe and Schelling saw organic metamorphosis as the foundation of the natural world. Yet the metaphysical and metaphorical insights inspiring Schelling's philosophy and Goethe morphology also informed less speculative and more empirical inclined agendas in the life sciences. Zammito mentions the anatomist and physiologist Ignaz Dollinger as the most effective and prudent inheritor of the long tradition that, from Haller, reached Schelling's heights of abstraction. Dollinger himself, unlike the fancy speculations of Lorenz Oken and other *Naturphilosophen*, set out an empirical program based on a solid notion of life as a self-reproductive system materially instantiated by an organism; at the same time, he identified the science of Biology as a "physics of the organic" (352).

This is what I consider the core of Zammito's book (which is, of course, much richer and sophisticated than my unfleshed description). While I will not question the overall narrative, which I consider entirely convincing, inspiring, very well crafted, and duly supported by historical evidence, I will explore a few issues that, in my opinion, have been often overlooked by many who have written on the origins of scientific discipline: i.e. the different historiographical assumptions behind the reconstructions of specific scientific fields.[1] Zammito dedicates two insightful, although sketchy, hints about his own inclination on the matter. First, the gestation of a science "must always entail the construction of quite specific scientific identities, modeled after paradigmatic practices" (197). In other words, the birth of a new discipline is paralleled by the establishment of a paradigmatic model that can be instantiated by important figures or works (Buffon's natural history could function as a paradigmatic model for many ensuing scholars). Secondly, the emergence of a new discipline is accompanied by the generation of a relatively tight community of scholars who share goals, ideals, and practices. The existence of a journal such as, for instance, the *Archiv für die Phisiologie* (founded by Johann Christian Reil in 1795) offered an institutional platform for such community tightening. Therefore, both Kuhnian exemplars and Fleckian collectives could, in Zammito's terms, explain part of a discipline's crystallization in one more or less coherent whole. However, while this is certainly one possible scenario, it is not the only one.

When we think about scientific disciplinary development, we might consider two opposite hypotheses. First, we can assume that a discipline

[1] With the notable exception of Lenoir, 1997.

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