

# **Metabolism: Milk, Blood and Material Exchanges in the History of the Life Sciences (1620-1840)**

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## **Keywords**

Materiality of the human body; bodily fluids in science and medicine; models of nutrition and metabolism; the emergence of the modern life sciences; milk in pharmaceutical and dietary practice.

## **Pitch**

What is milk? Modern people would argue it is a food whose nutritional benefits result from its chemical compounds. Early modern people, in contrast, judged milk as a bodily fluid with a plethora of physiological meanings. Surely, like blood, milk was the only nutriment by nature, but as such it was also a sign for many metabolic processes occurring during lifetime. Not chemical methods but the study of physiological processes explained the material character and health value of milk, while, at the same time, the changing shape of a fluid that runs out of the body should provide indications of the invisible processes going on within. Accordingly, any model of the human materiality was based on generative instead of structural ideas. Even anatomy with its topographical mapping of body parts involved the study of processes rather than discrete organs and structures. Physiology was an indispensable complement to autopsy, yet mainly a vivid narration fed from many ancient texts.

## **Scope and aims**

This book examines the different knowledge shifts that took more than two hundred years to suppress such thinking in terms of flow processes (often named “economy of fluids”) in favour of a technological epistemology that investigates fluids and other biomaterials in a structural perspective of building blocks and chemical reactions within the cells of organisms. It is the first study of models of metabolism in the history of the life sciences, arguing that the modern concept of metabolism did or even could not exist before the turn of the 19<sup>th</sup> century, because it heavily relies on empirical definitions of chemical elements, cells, molecules, and other concepts of building blocks in nature. Until the end of the 18<sup>th</sup> century, as I have just implied, quite the opposite epistemology can be observed. Thinking in terms of matter transformations and metabolic changes was paradigmatic for every scientific enterprise, including chemistry or pharmacy. The scientific modelling of metabolism, thus, gives us a perfect example of the need of historical epistemology in the sense of the parallel reconstruction of scientific theory in combination with a view on instruments, methods and sources of knowledge making. In fact, the incorporation of new phenomenotechnique into medicine and

physiology was crucial to the development of the modern concept of metabolism that illustrates the dialectic connections between scientific models and experimentation.

I first came to the historical practices of metabolic thinking and reasoning, when I asked the question, how did early modern scholars explain the nature of milk. Very soon I got aware that authors did not think in terms of a standard fluid, when they discussed the very properties of milk. Their use of the word „milk“ could not be conveyed by a modern equivalent, because it encompassed an entirely different approach to how the properties of milk were conceived. In contrast to today's sciences, early modern scholars were busy with the issue of milk generation and lactation. To them the white liquid was the result of a multi-staged process, in which substances constantly change. For this reason, natural philosophers like doctors or midwives differentiated between several milks, e.g. the one in the uterus or the digestive organs, the colostrum, and the „real milk“ after birth (in the childbed). They determined milk as a substance that has the ability to transform itself into blood, bones, flesh, and nerves. Thus, all the existing thoughts on the topic provided an understanding of the enigmatic acts of creation and generation, processes that involved an idea of something that has not yet taken shape.

As a historian working on the modern knowledge history of milk, I started to analyse the different ways to explain matter transformations in medicine, pharmacy, alchemy, and natural philosophy trying to understand why, since the middle of the 17<sup>th</sup> and during the 18<sup>th</sup> century, chemists became more influential in medical theory and practice. My work to write a history of milk in science shifted into a history of the theories of matter transformation, using *milk* as an epistemic object that mirrors scientific struggles, debates and collaborations between constantly changing fields of what today is called life sciences. But while asking for the fate of a mundane object in the history of the life sciences, I was constantly running through changing meanings and uses of milk. Therefore, the book also offers a knowledge history of milk that goes beyond the debates in scientific circles. Interested in the relation between scientific and everyday knowledge, I included descriptions of dietary practices or widespread ideas about the health value of milk (and a healthy body). Moreover, in order to understand the emerging impact of the modern life sciences, every chapter of this book implies paragraphs that exemplify transitions in the pharmaceutical or medical use of milk and its derivatives, or the economic value of different kinds of milk. Hence, the aim of this book, which provides a more or less continuous narrative, is two-fold: On the one hand, it offers a first problem-oriented account of the emergence of the modern life sciences, bringing together the history of physiology, chemistry, natural philosophy and medicine. On the other hand, I am telling the story of milk whose meaning has dramatically changed during the transitional period of the 17<sup>th</sup> until the 19th century life sciences.

### **Connections and contributions to existing literature**

The secondary literature on the subject of this book is very incomplete. This becomes obvious from a view on the growing literature on the history of milk. Studying milk and milk-related issues from the 18<sup>th</sup> to the 20<sup>th</sup> centuries, most scholars focus on social, economic, political and technological questions regarding the dairy business. Very few, among them British geographer Peter Atkins, so far emphasised epistemological questions about the materiality of milk. In his book *Liquid Materialities* (2010) Atkins explores the research on

milk's compositional material, with a particular focus on how it was defined, 'disciplined', and regulated by food and animal scientists, public analysts, and government inspectors during the period of roughly 1850-1950. He points out that the meaning of milk, on close inspection, is fully in the human realm, but scientists never could handle the material of milk without restrictions. Knowledge production about milk was a „muddling along towards understandings“, seeking the natural and policing the real substance. Instead of analysing instruments, laboratories, firms and legal institutions – as classical history of science and technology would have done – Atkins concentrates with reference to Foucault on the "dispositifs" that generated expertise and norms produced by science.

The production of scientific knowledge about food in earlier periods of history, either in relation to the processes, devices and machines which accompanied that knowledge, or to the development of physiological theories about nutrition, has been mainly neglected. Although there exists much food history (e.g. Ken Albala) so far only few historians of early modern science examined the relation between food and science (Emma C. Spary), or the intersection between science, medicine, and chemistry or pharmacy (Jonathan Simon). Further on, histories of early modern life sciences are still rare, although it is well known that during the time period between roughly 1570 and the early 1800s, anatomy was transformed from a textually sensitive, canonically informed exposing of the insight of the human cadaver into a far-reaching experimental physiology that was shaped by natural philosophy, and impacted by chemical methods, theories, and language,

Tracing the study and representation of milk (and blood) backward through different periods of the history of the life sciences reveals a kind of liquid history that needs to draw on sources from many different fields. Various specialists in the history of the life sciences have examined each of the periods and knowledge traditions I have been looking at. My work is indebted to the new histories of chemical practice being produced by Bernadette Bensaude-Vincent, Ursula Klein, Lissa Robert and others, the renaissance of the history of alchemy and matter transformation with its relation to medicine (e.g. Jennifer Rampling, Evan Ragland) and it is very much influenced by the constantly increasing studying of early modern materiality and material culture (Pamela H. Smith, Paula Findlen, Simon Schaffer). While the secondary literature on the history of anatomy is vast, the literature on the history of physiology (understood as the theory of the normal functioning of living organisms) is still very incomplete, however, in recent years it starts to get more interest. Since Jacques Roger's magisterial work on the life sciences in early-modern France (English 1998), most work so far has been done on either natural history in general, and animal generation in concrete, including questions on heredity, race, or gender, (among others Katherine Park, Mary Terall, Londa Schiebinger). Historian of medicine Andrew Cunningham differentiated between 'old physiology' and 'new physiology' in order to distinguish the developing culture of experimental practice from earlier traditions of theorizing the body. And trained philosophers (e.g. Justin E. Smith, Charles Wolfe, Hasok Chang, Claus Zittel) offer important insights about overlaps and interconnections between natural philosophy and life sciences. Most authors, however, tend to focus on single philosophers, schools or traditions; in the history of philosophy as well in the history of science it is also not common to exceed the period of examination from the 17<sup>th</sup> to the 19<sup>th</sup> century.