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# Closing Remarks

42nd History of Technology Conference “Raw materials,”  
Schaffhausen, November 2021

Ines Prodöhl

From the eighteenth century onwards, societies in Europe have become more and more specialized in manufacturing and processing goods. Starting in Great Britain, many European economies successively shifted from formerly being agrarian to now becoming industrialized. This process has become known as industrialization and went hand in hand with steadily growing cities, the invention of factory work, the improvement of infrastructures for transporting goods, and the development of sophisticated processing machines and methods. Closely related to industrialization was the rise of what have become known as consumer societies, as people would no longer produce the things they needed for daily life, but purchase them ready made. Cotton from Manchester is an excellent example here. Cotton never grew in England, but in the British colonies in North America, Egypt, and India, from where it was shipped as raw fiber to cities like Manchester. Thanks to the invention of the spinning jenny in the 1760s, the material was processed first to yarn, then turned into cloth, and eventually successfully marketed all over the world.

The 42nd History of Technology Conference at the Iron Library set out to shed more light on the raw materials at the heart of manufacturing processes, such as

turning fiber into yarn. While the subject matter was thus defined, the periods and places for historical investigations were left open, and the participants were invited to focus on technological innovations, social and economic transformations, and global connections through the lens of individual raw materials. Consequently, some speakers, such as Tina Asmussen, Ole Sparenberg, and Luise Elsässer, raised the question of what a raw material is. How does any given material which mother earth has on offer become a raw material or resource for further processing? Is it possible to apply the term to various “materials” across time and space, or is it more closely related to the process of industrialization?

A look into old encyclopedias might help in finding the first answers to these questions. One of those that was an authority on economic questions in the early eighteenth century was the ‘Curieuses und reales Natur- Kunst- Berg- Gewerck- und Handlungs-Lexicon’ from 1712.<sup>1</sup> Compared to many other more general encyclopedias of the time, it focused explicitly on how to mine, obtain, process, and trade any given material. It was published in 14 editions up to 1792, but surprisingly, none includes the German terms for “raw material” and “resource” respectively. Instead, the encyclopedia defined materials in general as “all raw

goods and ingredients” – in other words, goods that were not yet processed.<sup>2</sup> It was more than a hundred years later that the German language differed between material and raw material. In the late 1800s, ‘Brockhaus’ *Konversations-Lexicon* had an entry on “Rohstoffe” and defined them as “natural products which humans turn into everyday objects by applying mechanical or chemical manufacturing processes.”<sup>3</sup> With that, the encyclopedia suggests that any given material turns into a raw material once it is further processed.

### How does any given material which mother earth has on offer become a raw material or resource for further processing?

Using these observations as a starting point, it seems more appropriate to ask about the conditions under which a material turns into a raw material. Who decides whether humans can, or should, make use of a given material, and in which way? Is this all driven by consumer demand or also influenced by power structures, be it from a governing body or a merchant? Who or what are the driving forces behind the rise and fall of a resource? All speakers at the conference offered answers to these questions, even though the questions were not necessarily at the heart of their research. The presenters looked at recent developments but also went back in time as far as the Middle Ages, and they could shed light on developments in places as diverse as Malaysia, Denmark, China, and the deep sea. This diversity notwithstanding, all speakers identified certain conditions which enabled and facilitated the making of raw materials. In sorting them, I was able to identify three categories: knowledge, business ventures, and governmental control. It seems that the interplay between entrepreneurs, the prevailing knowledge and perception of a given material, and political regulations are crucial for the process of turning a material into a raw material.

No material turns into a raw material without humans having knowledge about how to make use of it. That insight seems obvious, but deserves some consideration to fully understand the dimensions related to it. Information about how to process and make use of a material and its components is crucial, and so are those who gain this knowledge, either as laymen or trained people or knowledge institutions. After all, chemical and mechanical technologies for further processing had to be invented by someone. In modern times, knowledge producers are often scientists, just as the agronomists and forest scientists Martin Baumert and Torsten Meyer presented in their talk about reshaping nature after the excavation of lignite in the German areas of the Lausitz. From Baumert and Meyer, we learned that East German academics were deeply engaged in the exploitation of the environment.

However, knowledge producers are also those actors who through their expertise either influence the production and manufacturing processes or made technical improvements. Lena Asrih was interested in finding out how societies of the Middle Age identified mining prospects. Her main interest lay in prospecting, and with that, the production of knowledge as a starting point for a mine. Likewise, Tina Asmussen, in a talk about lead in the early modern period, centered around knowledge, although rather related to perceptions and the socio-cultural dimensions of factual or assumed knowledge about lead. Asmussen pointed out that the material, practices of gaining and using it, and past understandings of it were deeply intertwined. She reminded us that historians do good in making sure to include past perceptions and the “social life of things” in their understanding of a material.

### No material turns into a raw material without humans having knowledge about how to make use of it.

While Asrih and Asmussen focused on perceptions, others tied the question of knowledge and knowledge producers to actual technical improvements regarding the processing of raw materials. Florian Preiß reflected on technical developments regarding the use of eggs in industrial products, such as albumen prints. In addition, Ole Sparenberg talked about knowledge when pointing to the technological and economic challenges related to harvesting manganese nodules in the deep sea. The nodules consist mainly of layers of iron and manganese hydroxides, but also contain valuable metals including nickel, copper, and cobalt. It has often been proposed to gather them from the seabed as raw materials, and even though there were several attempts worldwide, especially in the 1960s and 1970s, such ambitions have waned due to the difficulties of the required technologies and high costs.

This year’s conference had the title “Unternehmen Rohstoff,” pointing out that working with a material is both an undertaking and a business. In fact, a second significant category, or rather actor group for turning any given material into a raw material for further processing, are venturesome entrepreneurs and businessmen. In his talk about two early modern merchants, Matthias Baumgartl emphasized the role of certain business practices for minimizing risk and securing the success of an enterprise. He talked about the importance of formalizing mining and trade, for example by founding cooperation and making binding contracts. In a talk about Danish oil palm plantations in Malaysia, Matthias Heymann also focused on enterprises and the role of businessmen for gathering raw materials. One of the major actors in his analysis was the Aarhus Oljefabrik, which processed oil seeds into vegetable

oil for margarine production and fodder for livestock. Aarhus Oliefabrik was a magnate with worldwide influence over the cultivation and trade in oil seeds, such as the fruits of the oil palms. Heymann pointed out that it is important to keep colonial and imperial power structures in mind when talking about the history of resources, as the business in raw materials has often been accompanied by social and economic asymmetries between the regions of their origin and the places of their processing.

Yet another speaker focusing on business was Egor Lykov, who talked about oil drilling in the Caucasus region around 1900. He stressed the role of entrepreneurs and engineers Alex Bary and Vladimir Shukhov for helping to build the technical and infrastructural preconditions for the modernization of Russia. As Lykov pointed out, their expertise and money led to more advanced refining and separation systems, allowing the raw material to be used as gasoline, diesel, kerosine, asphalt, fuel oil, and others. Less direct though still prevailing was the connection between business and raw material in Luise Elsässer's talk about the full cycle of a European working horse around the turn from the nineteenth to the twentieth century. She analyzed the use of horses as commodity, working power, and food, from its breeding to its disposal, thereby pointing to the animal's various economic values.

Ugo Venni and Edward Yanchevski also pointed to the connection between raw materials and business in their presentation on procuring plastics for GF Piping Systems. They suggested that the definition of raw materials depends on the perspective. A given material might not necessarily be a raw material to everyone, but plastics are clearly one for GF. Venni and Yanchevski's approach is a reminder that the understanding of the term raw material is not static, but has been changing over time. Until about 100 years ago, entrepreneurs often needed to oversee the entire process from gathering resources to delivering the final product. In the 1930s, for example, American car producer Henry Ford kept his engineers and scientists in Michigan busy with finding synthetic alternatives to rubber, ivory, and ebony, all of which were being used in car production. His aim was to replace them with less expensive materials to offer a car more affordable to the masses. Contrary to Ford, GF doesn't need to go as far as finding the crude oil itself, but can work with intermediate products, such as plastics, which for them are raw materials. In such a way, it is specialized knowledge of chemical processes that has resulted in elaborate processing methods and has extended the range of what defines as a raw material.

Ford's efforts in finding plastics and other synthetic materials came to a halt in 1941 when the U.S. government asked the country to stop public and private research projects unrelated to the war effort and focus on war production instead. The end of Ford's research leads to the third and final actor group for turning a material into a raw material: political actors and governmental regulations.

The state can be a regulating actor with controlling power, able to prohibit certain activities and support others. Hailian Chen showed how the Qing dynasty (1644–1912) not only enabled and facilitated zinc production, processing, and transportation in China, but also controlled it. Chen analyzed the dynamic relationship between knowledge producers, businessmen, and, finally, governmental actors for mining, trading, and processing this metal. Jørgen Burchardt was also interested in the significance of governmental actors. He talked about the trade in scrap metal in Denmark in the postwar period, thereby again pointing to a shifting understanding of what can count as a raw material. Recovered metals from vehicles, machineries and building supplies had high monetary values, as they were needed for reconstruction purposes. The Danish government prohibited the exporting of scrap metal until the 1970s, and Burchardt therefore identified the Danish state as an important actor for keeping the business in scrap metals in Denmark running up until then. Yet another speaker focusing on governmental actors was Bastian Linneweh, who analyzed how the British government influenced the entire global rubber market by controlling prices for rubber in its colonies in the interwar period.

Even though governmental actors were not at the center of Lena Asrih's presentation on prospecting mines in medieval times, she pointed to their presence when naming mining laws and thus regulations as one of the sources for her work. Governmental actors and the regulating role of a state also became clear in Martin Baumert and Torsten Meyer's talk. The natural regeneration of moonlike landscapes in the Lausitz was only possible because the East German government supported scientists in finding ways to make the destroyed land useful once again – if not outright requesting that they do so.

While scientists or laypersons, people of business, and governing bodies were important for making use of a given material, they could not act without a functioning infrastructure that bridged distances between production, processing, and consumption. It was often the same people who facilitated transportation and communication networks, as most of the speakers pointed out as well. In addition, their roles could overlap and they could often have various functions at the same time, such as those finding, regulating, and excavating the zinc ores in China, or those searching for manganese nodules in the deep sea, an adventure undertaken through cooperation between academic, governmental and business actors. Interestingly enough, the understanding of the term raw material has always been rather dynamic, as the interplay of the actors and categories necessary to make a raw material also decides if and when the object falls out of that definition again. In any case, the coincidence between sufficient information and perceptions, adventurous entrepreneurs willing to invest their capital, and governmental regulations enabling production, processing, and trade seem to be central for the making of a raw material.

## About the author

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Ines Prodöhl is Associate Professor at the University of Bergen and specializes in global economic history in the nineteenth and twentieth centuries. She is particularly interested in two different research fields: commodity or material history, and the history of book publishing. Agricultural commodities are often at the center of her attention, and she focuses on production, trade, processing, and consumption in a global context. As for book publishing, she is most interested in the business history of European publishers from the eighteenth to the twentieth centuries. She received a PhD in history from the University of Heidelberg in 2008 and worked at the German Historical Institute in Washington, D.C., before joining the University of Bergen in 2018.

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## Annotations

- 1 Paul Jacob Marperger and Johann Hübner, *Curieuses und reales Natur- Kunst- Berg- Gewerck- und Handlungs-Lexicon Darinnen, nicht nur die in der Philosophie, Physic, Medicin, Botanic, Chymie, Anatomie, Chirurgie u. Apothecker-Kunst, Leipzig 1712.*
- 2 Marperger and Hübner 1712 (see n. 1), p. 797.
- 3 Brockhaus' *Konversations-Lexicon* Vol. 13, Leipzig 1895, p. 927.