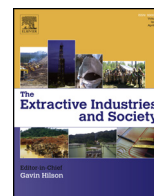




Contents lists available at ScienceDirect

## The Extractive Industries and Society

journal homepage: [www.elsevier.com/locate/exis](http://www.elsevier.com/locate/exis)



Original article

# A scarce resource? The debate on metals in Sweden 1870–1918

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### ARTICLE INFO

#### Article history:

Received 21 April 2015  
Received in revised form 21 March 2016  
Accepted 22 March 2016  
Available online xxx

#### Keywords:

Sweden  
Metals  
Industrialization  
Social construction of scarcity

### ABSTRACT

The purpose of this article is to explore the historical origins and meanings of metals scarcity in industrial society by investigating which metals were regarded as scarce by Swedish industrial actors from 1870 until 1918 and why. An analysis of material from the Swedish engineering journal *Teknisk Tidskrift* shows that the actors perceived twenty metals to be scarce during this period. Seven different factors could be identified in the scarcity debate: geological scarcity, technical difficulties in extracting the metals, the lack of substitutes, price variations, limited transport infrastructure, domestic unavailability and legal regulations. The article shows that actors and industries experienced troublesome shortages of metals even before World War I. However, they did not regard it as a geopolitical problem until the eve of the war.

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## 1. Introduction

In recent years metals scarcity has become a worldwide concern. We are increasingly dependent on metals and their sometimes unique properties for a wide range of new products, from LEDs and engines to computers and solar cells. Political and industrial actors are worried about the supply of these essential but often invisible constituents of the material world.

While actors have long been afraid of resource shortages, for example, a lack of coal, guano, tin or salt (Freese, 2006; Cushman, 2012; Ingulstad, 2015; Kurlansky, 2002), scarcity became a huge public concern at the eve of World War I. Many resource-dependent industries were deeply troubled about the lack of raw materials. Previous research has claimed that political and industrial actors, in this context, began to classify metals as “strategic”—in terms of their being vital in military applications and having an unsecure supply (see e.g. Leith, 1938; Haglund, 1984; Lesser, 1989). Platinum, as well as aluminum and tungsten, were identified as strategic metals by the US government and industrial actors, for instance, as they were short in supply and needed in military applications—ammunition, aviation and steel (Lael and Killen, 1982; Gendron et al., 2013; Limbaugh, 2010). Such concerns continued to linger after the war. The United States Geological Survey (1921) took on the task of mapping available resources, publishing a book of global geological inventories of minerals, and Smith (1919) wrote about the importance of strategic metals in

society. Metals, constituents of various material objects, became visible in the debate.

The extent to and ways in which metals scarcity was an issue before World War I have received less attention. With some exceptions (see e.g. Ingulstad et al., 2015) the wider literature uses World War I as a starting point for the debate on strategic metals. It is a well-established fact that the industrialization process in Europe and North America, and especially the Second Industrial Revolution, resulted in dramatically increased demand for natural resources. Thus it is plausible to assume that metals scarcity was recognized as a problem long before World War I, at least within industries that underwent rapid growth at the time. Additionally, this period is particularly interesting to study because of the increase in the global flows of metals. As shipping became easier, instead of having many small mining operations, industry focused on larger and more profitable ones—creating more transnational flows and Western dependencies on specific metal-rich regions.

To better understand metals scarcity, this article sets out to investigate why manufacturers and other industrial actors expressed concerns about the supply of metals during the opening decades of the Second Industrial Revolution. Previous research has focused mostly on the access of the world's leading industrial economies to metals, the British Empire and the US (see for e.g. Gendron et al., 2013; Ingulstad et al., 2015; Limbaugh, 2010). Most countries, however, are geographically small and non-imperial powers which are highly dependent on imports of raw materials to supply their industries. Sweden provides a good example—a small country with a long history of mining and steel manufacturing, which started growing rapidly in the 1870s along with metal-consuming sectors like the mechanical industry. Hence, the

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<http://dx.doi.org/10.1016/j.exis.2016.03.009>

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purpose of this article is to determine which metals were seen as scarce by Swedish industrial actors in the period from 1870 until 1918 and why.

## 2. Theoretical perspective: scarcity as a social construction

How and why do natural resources become scarce? To answer this question it is crucial to understand that natural resources are socially constructed. In other words, resources come into being only when someone defines them as such, by ascribing to them values—economic, political and cultural (Bridge 2009; Avango et al., 2013). As Zimmermann (1951:15) put it, “Resources are not: they become.” The category is not fixed, but can also be reversed. One example is cryolite, a mineral defined as a resource when it became crucial in aluminum production from the 1880s on. The aluminum industry found a synthetic substitute and eventually the need for natural cryolite decreased. Its economic value diminished and the mineral ceased to be a resource (Vikström and Högselius, forthcoming).

Similarly, scarcity is a social construction. Resources are not by definition scarce, but are constructed as such by actors, in texts, in debates, through political decisions or technological innovations—and by the larger structures and historical contexts in which they act. In other words, scarcity cannot be explained solely by geological abundance, but has to be understood in terms of actors’ perceived difficulties to access a resource. How a resource is categorized, according to the political geographer Gavin Bridge (2009), explains more about society than about the thing itself. Scarcity is a complex concept that mirrors society’s values and demands. Economists, such as Barbier (2011), usually define scarcity of natural resources as a mismatch between supply and demand. Such simple definitions may seem reasonable, but they do not help us to understand the factors underlying the reasons for a discrepancy between demand and supply.

Actors portray resources as scarce when they lack cheap, easy and reliable access to them. Global circumstances and local conditions could both play a role in this context. Only through empirical research, however, can we determine which underlying factors were crucial for actors’ understanding of metals scarcity.

## 3. Method

To explore why actors perceived metals as scarce in Sweden, I have analyzed all metal-related articles published in the leading Swedish engineering journal at the time, *Teknisk Tidskrift*. The journal was widely read among researchers within the university-based engineering sciences as well as by practitioners from the growing industrial sector in Sweden.

*Teknisk Tidskrift* was published once a week from 1870 until 1977, at first privately by Wilhelm Hoffstedt, a lecturer at the Technological Institute in Stockholm. In 1879 the Swedish Engineering Association (Svenska Teknologföreningen) took over the journal and continued to publish it once per week. From 1893 the journal was divided into one weekly main part, and a series of thematic booklets, which were published eight times a year, devoted to themes such as architecture, civil engineering, chemistry and metallurgy/mining, electrotechnology, mechanics and shipbuilding. With time *Teknisk Tidskrift* grew in scope. While it consisted of almost 200 pages per year around 1880s, in 1920 the journal consisted of about 1800 pages (Svenska Teknologföreningen, 1920).

The journal reported on discoveries and trends within the engineering sciences and industry, both in Sweden and abroad, including many debates regarding critical contemporary issues. Moreover, the journal published summaries of national and international meetings along with articles and notices from

various domestic and foreign journals. Sometimes, foreign engineers’ reports were included in the journal and thus became part of the Swedish discourse.

*Teknisk Tidskrift* was a journal for engineers by engineers. Some writers were well-known, established engineers, whereas others seem to be more obscure. I have tried to find out as much about the engineers as possible, but some remain unknown. This indicates that a variety of actors had the opportunity to contribute to the content of the journal. As *Teknisk Tidskrift* reached a broad audience, and included discoveries from both national and international journals, it is reasonable to assume that it largely mirrored actual concerns in Sweden. The ones who are most affected by scarcity are the users of metals – the steel industry, the electricity industry, the mechanical engineering industry, etc. – and it is their ongoing anxieties that the journal reveals.

In about 45,000 pages of *Teknisk Tidskrift*, I found forty-two articles and notices which are the foundation for this article. Based on this material I identified seven factors that figure in discourses in which actors defined certain metals as scarce: geological scarcity, technical difficulties in extracting the metals, the lack of substitutes, price variations, limited transport infrastructure, domestic unavailability and legal regulations. These factors structure this paper and I argue that they explain why industrial actors and manufacturers perceived metals to be scarce.

## 4. The industrial breakthrough in Sweden

The Second Industrial Revolution in Sweden is commonly considered to have taken off in the 1870s (see e.g. Schön, 2012; Isacson, 2007). Economic historians and historians of technology have identified several drivers behind this transformation of Sweden from an agricultural country into an industrial nation—a domestic supply of natural resources, in combination with the successful development of transport infrastructure and the transmission of electricity over longer distances (Schön, 2012; Sundin, 1981). The process was also influenced by a larger global transformation in which natural resources played a prominent role. Barbier (2011), for example, named the period 1870–1914 the “golden age of resource based development”. Precisely during this period, as Gunnar Eriksson shows in *Kartläggarna* (1978), Sweden’s natural resources were inventoried by the Swedish state and industries. Sweden had a favourable position at the time due to its abundant available natural resources within the country’s borders—wood, iron ore and water.

At this time, several resource-based industries, such as the steel industry, grew rapidly. The Swedish steel production increased tenfold between 1870 and 1914 (Stråth, 2012). Apart from that, several successful Swedish companies within the mechanical industry were established, such as L.M. Ericsson, ASEA, and SKF (Schön, 2012). These and other companies developed and introduced several new innovations from the 1890s which were essentially made of steel, such as ball bearings, separators and steam turbines (Sveriges industriförbund, 1961). From the 1890s the industrialization gained speed, resulting in burgeoning steel, mining and mechanical industries. In order to meet this demand, the steel industry developed ever more sophisticated special steels with specific properties by adding small amounts of alloying metals. These usually had to be imported from abroad.

Sweden’s industrialization was closely related to global developments. Natural resource flows became more international with the expansion of infrastructure and decreased fuel prices. Sweden played a role as both an importer and exporter of natural resources from the 1870s until and during World War I. The increased demand for copper in transmission cables, for example, changed Sweden’s role from a copper exporter in the 1870s to an importer in the 1920s (Sveriges industriförbund, 1961). Sweden

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