

The Enlightenment in Practice: Swedish Travellers and Knowledge about the Metal Trades

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The World of Pin-Making

In February 1725 the Swedish traveller Henrik Kalmeter arrived at Gloucester after a journey from Bristol that had seen him looping through the Welsh border to visit the ironworks at Pontypool. Arriving in Gloucester he noted that the town was not impressive. It was ‘not particularly large’ and there was nothing to see apart from the Cathedral, a ‘mighty gothic construction’. Nor was there much to admire about the town’s economy, which Kalmeter described as ‘not very flourishing’.¹ The only point of interest was pin-making: ‘Most of the people in Gloucester are employed in pin-making, which is run by 19 or 20 masters’ each keeping as many as ‘50 persons for labour.’ As much as 80 tons of English brass-wire was consumed annually by these masters. Pin-making might not have been the most important of trades in Britain during the 1720s, but Kalmeter took the time to describe it. A loose paper in his diary contains a table with the prices and costs of manufacturing twelve different kinds of pins. Each part of the production chain was described, with details of what ‘the persons for labour’ were doing. Some were ‘kept’ for cutting the wire, some for pointing the ends, others for doing the heads, polishing and painting the pins, and so on.

Kalmeter, anticipating Adam Smith, stressed the elaborate division of labour. It is important to understand, however, that Kalmeter was concerned with rather more than the division of labour. In common with other Swedes of his generation, he was reluctant to abstract manufacturing procedures from the wider socio-economic setting. The fabrication of commodities was conceptualised as an integral part of a wider landscape of marketing and exchange. When Swedish intellectuals spoke of ‘trade’ they were invoking a category that encompassed both manufacture and commerce – a category that they used in a distinctive way, a way characteristic to enlightened north European thought in the early eighteenth century.

That system of thought and its relationship to the broader Enlightenment is the subject of this article. The relationship between eighteenth-century thought and the material world of making and selling commodities is not a conspicuous feature of recent Enlightenment scholarship. Yet it should be. It should be because economic analysis bears centrally upon the problem of improvement, of whether social and material progress is possible, which became one of the Enlightenment's central claims. An examination of economic thought is therefore a way of posing questions about the chronology of the Enlightenment. When did progress become recognised as both desirable and achievable? For Kalmeter progress was not on the agenda, but for the countrymen who followed in his footsteps, towards the later decades of the century, it gradually became an integrated aspect of their descriptions of what they saw in foreign countries. This article aims at tracking down this process, of how progress became a crucial feature in how Swedish travellers perceived the metal trades.

Travelling in the Mechanistic World

Kalmeter's career was typical of a Swedish public servant in the eighteenth century. Born in 1693, he studied at Uppsala University and entered the Board of Mines after graduation. In Sweden, where iron and copper were the paramount export commodities, the Board of Mines was one of the most important state bureaux.² In 1718 Kalmeter was sent overseas to study foreign economic conditions – a common step for a promising state functionary. He spent most of the 1720s abroad, before settling in Stockholm as an employee of the Board of Commerce.

Kalmeter's first overseas mission took in Germany and Holland, then Britain, before returning home via France. In 1723 he was back in England, with instructions from his employer, and passed the next two years travelling through the country. His first year was spent in London making notes on shipbuilding, glassworks, and the market for iron and steel. Leaving the capital, he headed west through Salisbury en route for Cornwall with their copper and tin mines. He lingered in the Mendip Hills to witness the excavation of calamine, indispensable for brass-making, before arriving at Bristol, the commercial centre of the west. He remained there for a month, inspecting the port and its industrial suburbs. Gloucester, with its pin-making, was to be the next stop.

Three decades later two more Swedes, Samuel Schröder and Reinhold Angerstein, followed the same course of life. Both served the Board of Mines and both travelled abroad. Schröder left Stockholm in 1748 and visited Holland, England,

France and Germany before returning in 1751. Angerstein was even more widely travelled, and between 1749 and 1755 he also saw Hungary, Italy, Spain and Portugal. They used Kalmeter's travel-plan as their own blueprint, spending prolonged spells in London, going to the North-East, and devoting time to Bristol and Birmingham.³ Throughout, they kept diaries, just as Kalmeter had done. It was expected of them as educated travellers. The eighteenth century was a great age of travel, one in which well-established forms of travels, like pilgrimages and journeymen's walks, were complemented by new varieties: the philosophical, the sentimental, the scientific, and the civilised.⁴ The Swedes belonged to a new subset that might be called 'travellers in trade'. Most scholarly attention has been accorded to scientific and civilised travel. Carl Linnaeus and Joseph Banks exemplify the first of these, those who took the Grand Tour the second.⁵ However, new forms of journeys rose in importance. The Swedish architect Carl Hårleman (1746) argued that travellers overseas should concentrate on those features that might 'serve the utility of the fatherland'. Too much energy had been expended by 'ignorant' Swedes preoccupied with 'amusing themselves' in foreign countries; carefully planned trips with a fixed purpose were to be preferred.⁶ A similar stress on utility was to be found in Josiah Tucker's *Instructions for Travellers* (1757), which sought to arm English travellers with the analytical tools needed for 'improving the moral and political Theory of Trade and Taxes'. This was to be done through the comparative observation: travellers were to keep on an eye open for new features abroad and to record how foreign 'systems operate on different people'.⁷

These texts were part of an *ars apodemica* (art of travelling) tradition that dated back to the Renaissance. They shared a methodological rigour. A traveller should have a fixed aim, and the actual voyage should be useful not only for himself but for what Hårleman called the 'fatherland'; travelling was to be viewed as a virtue both from a personal and public viewpoint. The apademic programme was nothing if not systematic; travellers were to be armed with a battery of questions to ask when arriving at new places.⁸ The systematic approach should continue when diaries and travel reports were compiled. The information had to be arranged in such a way that readers would comprehend what was communicated. The aim was to organise the perceptions in a non-personal way, and what was desired was a 'catalogue' of 'important matters' that could be viewed as 'museum, in which specimens of every variety of human nature may be studied'.⁹

The apademic tradition faded away in the late eighteenth century, but as late as 1757 Tucker wrote that a traveller should

bear in mind the grand Maxim, That the Face of every Country through which he passes, the Looks, Numbers, and Behaviour of the People, their general Cloathing, Food, and Dwelling, Their Attainments in Agriculture, Manufactures, Arts and Sciences, are the Effects and Consequences of some certain Causes; which Causes he was particularly sent out to investigate and discover.¹⁰

Kalmeter and Schröder belonged to the *ars apodemica*, and their diaries have to be treated with care. They cannot be analysed only in relation to what they describe, but also as examples of the *genre* they were written in. The Swedes were also exponents of another intellectual project, one with which the *ars apodemica* was fully compatible: mercantilism.

This is hardly the place for delineating the content of mercantilist thinking, or to investigate into its different national traditions.¹¹ It is enough to stress the core traits of early eighteenth-century economic thought. The central tenet of mercantilism was the idea of a positive balance of trade, indicating that the global structure of trade was a zero-sum game, wherein every nation's gain was somebody else's loss. The English Navigation Acts, as well as its Swedish equivalent, *Produktplakatet* of 1724, were vivid expressions of the idea that economic change could only be promoted through political measures. It was unthinkable for mercantilists that economic change could stem from the internal dynamics of a national economy. Stasis was the default setting, and this even if some scholars have talked of how 'progressive ideologies triumphed' in the early eighteenth century.¹² Economic reasoning employed by contemporaries was trapped within a static world view, and Larry Stewart has argued that improvement might have become an 'epistemological conclusion'.¹³ This is corroborated by Daniel Defoe, who stated that 'Discoveries' lead to 'Improvement of Mankind in all the Parts of useful Knowledge', and thus that developments was still in God's hands.¹⁴

A second important trait in mercantilist thinking is its capacious definition of trade. Earlier studies of mercantilism have conceptualised trade much as we do today, as commerce, but for Defoe trade meant something else: it was a combination of features and practices that bound together production, commerce and labour.¹⁵

The general heads of Home-Trade are best contain'd in the *two* plain and homely Terms *Labouring* and *Dealing*. 1st *The Labouring Part*, this consists of Art, Handicraft, and all Kinds of Manufactures; and those who are employ'd in these Works, are properly called *Mechanicks* [...].

2. *The Dealing Part*; this consists of handing about all the several Productions of Art and Labour, when finish'd by the Hand of the industrious Mechanick, and made useful to Mankind [...].¹⁶

Contemporary Swedish travellers were no strangers to this kind of reasoning. When Schröder analysed the English iron trade towards mid-century he used the concept of a *Jernsystem* ('iron-system'), a network of interlocking production sites in northern Europe and around the Atlantic – mines, furnaces, forges, mills and the workshops of artisans, from blacksmiths to watch-makers, who used iron or steel in their trades – attached to each other by different forms of commercial links. Naturally enough, as it was difficult to decide where this system began or ended, Schröder's vision necessarily became 'totalising' – everything was linked to everything else. He was dealing with an amorphous network that spread around the Atlantic basin, one whose links had to be investigated. Britain was its indisputable centre based upon artisans' skills and division of labour; 'the English excel ahead of other nations in the organisation of methods for labour in common, as in dexterity of the execution'. As a sound mercantilist Schröder believed that this network was essentially static until states intervened.¹⁷

The trip that Kalmeter took from London in 1724 is further evidence of the 'totalising' ambition of Swedish travellers. The route he followed was a literal tracing of the commodity-chain of a pin, from the metallic ore to its final use in the textile trades. He witnessed copper mining in Cornwall, calamine being dug in the Mendip Hills, and the smelting of the two minerals into brass at Bristol. This was the source of the 80 tons of brass annually consumed by Gloucester's pin-makers. The subsequent role of the finished pins was followed in turn. None of the Swedish travellers missed the fact that pin-making was undertaken in regions famed for textiles. Gloucester was located in the midst of an important woollen region and Warrington, another pin manufacturing centre, lay close to the northern textile districts. Warrington pins had an important role in Schröder's discussion about the woollen market in Leeds:

Market is kept twice a week [...]. At these times [the weavers] [...] place their parcels [of cloth] in four rows along the main street. [...] Then the merchants arrive, cloth-manufacturers, or commission agents, each with a little book in their hands with samples attached. They walk along the rows to locate pieces of cloth, to try some, and to bargain for a price [...]. [They] mark the same with a *pin* on the lead-stamp on the cloth and with the same *pin* a hole is made in the book along the sample, meaning that a purchase is done.¹⁸

The commodity chain of pin-making might be said to have ended in Leeds, but that was far from obvious to Schröder. He immediately turned his rambling gaze in new directions. Cloth from Leeds was finished in the town, then shipped to Hull, from where it was sent 'further to the whole wide World'. There were no

starting-points, nor were there any ends. There was instead a gigantic ‘totality’ that had to be viewed and described.

Both the apodemic tradition, with its emphasis on ‘non-personal’ descriptions, and the ‘totalising’ mercantilist world-view were rooted in the prevailing religious ideas. The contemporary view of God’s creation was that it was essentially static and governed by natural laws that gave it symmetry and order. It could be described in systematic terms. Alexander Pope pointed out ‘how System into System runs’, all ‘upheld by God’.¹⁹ There might have been disagreements about the relationship of God to the world he had created and how scientific discoveries were to be linked to religious doctrine, but there was an essential unanimity around the proposition that God’s work was visible in nature and that it was the task of mankind to unveil its magnificence.²⁰

For Gottfried Wilhelm von Leibniz there was no contradiction between scientific endeavour and the Christian faith, and the mechanically structured world was a sign of God’s purpose. Indeed, knowledge of God was the ultimate aim of philosophy, and this could be achieved through logic and mathematics as well as through the Bible.²¹ Physico-theology, a more distinctively British strand of natural theology, suggested a similar conclusion. Writers such as John Ray and William Derham developed Newtonian ideas about the divine master-plan behind the universe. Since the natural world was permeated by the very spirit of the Almighty the investigation of that world was not merely scientific, it was sacred. As Derham wrote in his *Physico-Theology* (1713):

Let us cast our Eyes here and there, let us ransack all the Globe, let us with the greatest accuracy inspect every part thereof, search out the inmost Secrets of any of the Creatures; let us examine them with our nicest Rules, pry into them with our Microscopes, and most exquisite Instruments, still we find them to bear testimony to their infinite Workman; and that they exceed all humane Skill so far, as that the most exquisite Copies and Imitations of the best Artists [...].²²

This was the context for Defoe’s talk of discoveries and improvements; ‘inspir’d Minds’, would ‘search’d Nature to the bottom, inside and outside [...] anatomiz’d the Globe, and [give] us the naked Skeleton of its most secret Parts, for us to act upon in our farther Enquires’. God, thus, created the world and inspired people to discover it, and that was the only route to the improvement of societies.²³

Both the natural theology of Christian Wolff and British-style physico-theology, of Ray and Derham, found a ready audience in Sweden. The importance of the former to Swedish theology and science cannot be overstated. From the

1730s his ideas reigned supreme in both the cathedral chapter and the university at Uppsala. Churchmen embraced Wolff's rational theology in their fight against atheism and pietism, whilst his scholarly adherents included the mathematician Samuel Klingenskierna, Anders Berch, the first professor of economics, and the great Linnaeus himself.²⁴ As for physico-theology, Derham was translated into Swedish in 1736 and Swedes were quick to elaborate upon him. All mankind, wrote Carl Gustaf Löwenhielm in 1751, had been allotted 'understanding and gifts of genius' with which to investigate nature.²⁵ Linnaeus went further: 'God had created a universal order' and that he had a 'purpose for every created thing'.²⁶ Unveiling this *oeconomia naturæ* was a religious duty and for Linnaeus this required travel. Only by journeying could people truly discover Creation's wonder.²⁷ We can look upon the writings of Linnaeus as an attempt to synthesise the apodemic tradition and mercantilism as means of understanding the World as an expression of divine will.

It is these works of God whose investigation we should practise. He has introduced us to this world, which is furnished and grazed with an unspeakable multitude of different produce of nature. He has before these eyes, which He has given us, presented what ought to be seen and by our souls pondered. That this world, as well as everything on it, is created for the sake of mankind is the common view of theologians. We must therefore not [...] push aside the works of God, but instead be guided by them to admire the Master [...]. *The inspection of nature gives a foretaste of the felicity of heaven.*²⁸

Linnaeus' conclusion was that '[n]o science in the world is higher, more necessary and more useful than Oeconomy as all humans' earthly welfare is founded upon it'.²⁹ His colleague Berch concurred: To study the economy was essential as it showed 'from where a Society's common benefit flow', with nature furnished by the Creator. Religion was, Berch stressed, a 'helping-tool' to economic science, and 'all sciences have the happiness of Humanity as their ultimate purpose [and are all] in the service of Oeconomy'.³⁰

Optimism and the World of Enlightenment

Taking a lead from Voltaire, historians have labelled the first half of the eighteenth century as a period of 'optimism'. The French *Philosophe* let his anti-hero Candide unwillingly venture on a grand odyssey through what his companion Pangloss, the thinly disguised Leibniz, constantly referred to as 'the best of all possible worlds'. Voltaire had Candide wandering around in a world whose limits had been set by

the compassionate Creator, and in which everything he could hope to experience had been set down in all its inter-connected majesty at the creation. Candide's universe was static and unchangeable.³¹ It would be an overstatement to say that Kalmeter was an 'industrial Candide', but it is nevertheless true that he belonged to a tradition of 'optimism'; being a part of an intellectual milieu in which it was assumed that the world, being ordered to God's plan, could be described in a non-personal way.

A twentieth-century French philosopher has repeated much of what Voltaire articulated in Candide, using a quite different 'discourse'. In his *Les Mots et les choses*, from 1966, Michel Foucault also stressed the 'interconnected' nature of the 'Classical age'; 'the coherence that existed [...] between the theory of representation and the theories of language, of natural orders, and of wealth and value.' According to him a period is always dominated by an episteme, principles and rules, that structure what people could think.³² Essential aspects of such an episteme for these Swedish travellers, in the first half of the eighteenth century, were beliefs in the power of the Divine Creator and his creation; ideas about mercantilism, natural history and the *ars apodemica* all followed from such a fundamental principle. Foucault has also pointed to the importance of religion for this period, and its importance in the process of gaining a better knowledge about the World; 'God still employs signs to speak to us through nature'.³³ Another similarity between the two Frenchmen is that they both looked back to this static and interconnected world, and that they did so with a firm belief that things had changed; Leibniz was to Voltaire a philosopher of the past, and Foucault pointed to the beginning of the nineteenth century as a period when the episteme of the Classical age gave way to the episteme of the modern world. Neither of them, however, gave any guidelines of how to investigate the actual process of historical change.³⁴

Kalmeter and his mid-century followers clearly belonged to 'an age of optimism', or the 'Classical age' to talk with Foucault, and they were no advocates of progress. This does not mean, however, that they did not partake in the making of this new age of improvements. With hindsight it is possible to point towards some of the more 'modern' aspects of these texts, and the relationship between the traveller static beginnings and these 'novelties' must be scrutinised. The attention to division of labour and pin-making in Kalmeter's and Schröder's diaries clearly presage two of the most important books of the eighteenth century, the *Encyclopédie* (1751–1780) of Denis Diderot and Jean Le Rond d'Alembert and Adam Smith's *The Wealth of Nations* (1776), and our Swedish companions could be analysed in relation to the twin-processes of the Industrial Revolution and the Enlightenment, harbingers of the modern World.

Kalmeter could not in 1725 have anticipated that the combination of division of labour and pin-making would half a century later constitute the pivotal example in a book that sought to escape the static box of mercantilism. Famously, Smith commenced his book by stating that the ‘greatest improvement in the productive powers of labour [...] seem to have been the effects of the division of labour.’ Kalmeter noted the elaborate organisation of labour in the pin trade, but did not recognise it as an ‘improvement’. For his part, Smith was unaware of Kalmeter’s unpublished words. His choice of pin-making, that ‘very trifling manufacture [...] in which the division of labour has been very often taken notice of’, was influenced from another source.³⁵ He had turned to the *Encyclopédie*.³⁶

After describing a pin as a ‘petite instrument de métal’ the entry *Épingle*, in the fifth volume of the *Encyclopédie*, from 1755, stated that ‘une épingle éprouve dix-huit opérations avant d’entrer dans le commerce’. Then followed a meticulously detailed description of all these different operations: how the brass-wire was prepared at draw-benches and cut to suitable sizes, how the points were sharpened and heads made, and so on. References to three plates were made throughout, and it is obvious that the aim was to recreate pin-making as a totality. Even the position of the legs of a boy shown sitting on the workshop floor was specified: the correct position would help him operate the scissors used to cut the wire more effectively.³⁷

In one respect there is a resemblance between the *Encyclopédie* and the Swedish diarists. Diderot and d’Alembert noted that dealing with the mechanical arts, unlike the sciences and the liberal arts, presented a difficulty in that they embodied a kind of knowledge that was rarely inscribed, even though artisans were often adept at verbal descriptions. Diderot and his ‘staff of writers’ therefore had to act as ‘Midwives’ to the artisans’ ‘Minds’ by ‘visiting them at their works’. There the encyclopaedists would ‘ask them questions; write down their information; clear up and methodize their Thoughts; learn the proper Terms in their Arts’. None of that was unfamiliar to Kalmeter, or Schröder! However, there was one important difference. Whereas the Swedes belonged to the static world of mercantilism the Frenchmen had a different agenda. Diderot scorned earlier modes of description: ‘Most of those [older] Encyclopædias [...] are of little Use to the present Age; wherein the Arts and Sciences have made such a farther Progress. Many Truths are at present discovered.’ It was along this road, one illuminated by pin-making and the division of labour, that Adam Smith travelled.³⁸

The contrast between the two sets of thinkers bears centrally on a problem in eighteenth-century studies identified by Daniel Roche, that of understanding ‘how change became possible in a world that *saw itself* as stable, changeless’.³⁹ Our

Swedish travellers embodied mercantilism, physico-theology and the apodemic tradition. They represented what in the *Discours préliminaire* was characterised as the 'esprit de système'. This was the ordered, immobile universe of Leibniz. To this d'Alembert counter posed the 'esprit systématique' of active human intervention. To the editors of the *Encyclopédie* it was important to draw a line between the older static world-view and their new, dynamic approach to the world. For d'Alembert and Diderot the *Encyclopédie* was about promoting this new world, and in doing so it was to endorse a new unity between not only the sciences and the liberal arts, but also the mechanical arts. The new world was to be put in place, not by a benevolent Creator, but by humans merging what d'Alembert called the 'general Branches of Knowledge', 'Memory, Reasoning, Imagination' into 'objects of our Minds [...] spiritual or material'.⁴⁰

Enlightenment Studies

The publishing of the *Encyclopédie* initiated a debate in which philosophers have analysed the implications of the metaphor of enlightenment, and to a large extent its main themes were already present in Diderot's and d'Alembert's work. There was the discussion on 'progress' and so was the awareness that the world consisted of 'spiritual or material' substances and that these could be conceived 'by Memory, Reasoning, or Imagination'. The editors also wanted us to see the world as either science, the liberal arts or the mechanical arts. These features have been present ever since, and with hindsight we might arrange the sometimes animated debate around four interlocking themes; chronology, spatiality, content, and in the last half-century also about the Enlightenment's links to modern society.⁴¹

However, the debate has seriously deviated from the original program in one important aspect, and that is the neglect of the material side of the process. The discussion during the twentieth century has been conducted within the spiritual side of the spectrum, dealing mainly with two branches of the tree of knowledge; science and the liberal arts. This omission is clearly visible in a classical text by Peter Gay from the 1960s:

There were many philosophes in the eighteenth century, but there was only one Enlightenment. A loose, informal, wholly unorganized coalition of cultural critics, religious sceptics, and political reformers [...] a vastly ambitious program, a program of secularism, humanity, cosmopolitanism, and freedom [...] in a word, of moral man to make his own way in the world.⁴²

It has lasted until recently before this absence has been tackled. John Robertson has in his *The Case for the Enlightenment* remained loyal to this agenda in that he treats the Enlightenment as a unified program, beginning around 1740. He has, however, entered a route where the Enlightenment's material side is given a more pronounced place. Even if the Enlightenment is understood as 'ideas', these are formed around a process of improving human conditions. No scholar has emphasised more strongly the place of political economy within Enlightenment Studies than Robertson, writing that 'the intellectual coherence of the Enlightenment may still be found [...] in the commitment to understanding, and hence to advancing, the causes and conditions of human betterment in this world.' Political economy is seen as a 'social activity' of 'self-interested exchange' and 'division of labour'.⁴³

With an emphasis on the 'betterment in this world', Robertson would be supported by scholars such as Roche and Peter Reill. The latter have argued that the first half of the century belonged to 'mechanical natural philosophy', which from mid-century was challenged by what Reill called the 'Enlightenment vitalists', with an emphasis on a dynamic worldview. The new phase was signalled by publications such as Buffon's *Histoire Naturelle*, from 1749, and the *Encyclopédie*.⁴⁴ The latter, thus, aimed for a new world of creative people where progress was achievable, and where change was in the hands of anyone striving for it. If most scholars would be in agreement over a turning-point around mid-century, and the crucial role of the *Encyclopédie*, it is a problem that only parts of the program have been heeded by later observers, with the mechanical arts left outside. That was hardly the intention of the men acting as midwives to a new, vitalist and progressive, age. To them changes in human material conditions were equally on the agenda, and even if they hardly could forecast the coming of the Industrial Revolution this was in line with their ambitions. Robertson has pointing us in the direction of political economy, but what is needed is an analysis trying to reconcile the striving for progress of Enlightenment *Savants* with the development of the Industrial Revolution.

The mechanical arts have, for certain, been used by scholars working on industrialisation, but mainly as illustrations to their analyses.⁴⁵ Robert Darnton was a pioneer. In his work on the *Encyclopédie* he dealt with the actual making of that great work, with paper-making and printing, using its texts and plates as a main source.⁴⁶ Printing was also used by John Pannabecker in his analysis of how Diderot represented mechanical arts in texts and plates.⁴⁷ Liliane Hilaire-Pérez took a further step in her analysis of Diderot's views on wax painting.⁴⁸ Diderot's thoughts on work lay at the heart of Cynthia Koepp's comparison between the traditional French society and descriptions in the *Encyclopédie*; the editor hardly strove for an equal society, but a

different social division of labour, 'one that moved far beyond the somewhat clumsy categories of the three orders [to] "an alphabetic order", for a new world'.⁴⁹ In recent years a more implicit relationship has been drawn between the Enlightenment and the material world. Ken Alder set the tone in his *Engineering the Revolution* (1997), by uniting a vision of human betterment and the will of engineers to reform the worlds of production. This was to be achieved by 'taking a "systems" approach to production, in which both tools and human beings are consciously arranged into a purposeful whole'. This, as well as the emphasis on the 'utopian aspiration to regenerate society', had its roots in the 'Enlightenment program'.⁵⁰

Another link between the mental world of the eighteenth century and the material world is forged by Joel Mokyr, with the invention of the concept the *Industrial Enlightenment*. Mokyr had been frustrated by traditional explanations of the Industrial Revolution, and meant that analyses of technology should circle around 'useful knowledge'; knowing 'natural phenomena that potentially lend themselves to manipulation', but also that one needs to know 'what' before one can think of 'how'. This implies a chronology where observations and classifications, as well as abilities of 'establishing regularities, principles, and "natural laws"', precede skills of manipulating the material world. To Mokyr the Industrial Enlightenment is the missing link between the scientific revolution of the seventeenth century and the Industrial Revolution.⁵¹

Alder and Mokyr have both analysed the relationship between intellectual development and the material world, but from different view-points. Alder assume a continuous interplay between the sphere of production and the mental world, while Mokyr sees the Industrial Enlightenment as a precondition for later industrial development. He also stresses the 'material' side of technology, with Alder viewing division of labour as the major trait behind a change in eighteenth-century workshops. The latter thus comes closer to the world of Defoe, Schröder and Enlightenment *Savants*, and its subsequent change. New working procedures might alter the way eighteenth century people thought about trade, but new ways of perceiving the worlds of labour also affected production.

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The adventures of Henrik Kalmeter in the 1720s are a good starting-point to a discussion about the European Enlightenment, and the distinction made between the 'esprit de système' and the 'esprit systématique'. This article is about how a static society was turned into one in which progress was essential, and thus about the

chronology of the Enlightenment and when people started to acquire ‘a new focus on the betterment in this world’. However, it is essential in such a study to link the ‘spiritual’ world to ‘material’ developments. If the Enlightenment is viewed along lines of human betterment it is essential to link it to the Industrial Revolution.

There is a spatial side to this story, with the essence of travelling being mobility across space. This was what Kalmeter did, as he moved around in Europe. In recent years there has been an upsurge in research on the spatial side of the Enlightenment. Scholars like Charles Withers have indicated that the Enlightenment did not just have a specific geography, but more importantly that spatial matters featured in the very making of the Enlightenment. We are not dealing with something that was French, or even European, but rather a process; ‘the *connected* nature of Enlightenment’.⁵²

In stressing the interplay between time and space, discourse and ‘material objects’ this study finds inspiration in the works of Roche:

The history of Enlightenment France becomes the history of the way in which men and milieus variously appropriated mental structures and cultural values in a permanent confrontation of economic and social horizons that was the very root of their existence. The aim is not to study ideas and behaviours as “reflections” or rationalizations of social interests, but to perceive the intrinsic values and interrelations that placed them at the point where discourse, texts, and practices came together. [...] to understand the possible connections between facts of intellectual culture and facts of material culture.⁵³

Roche is thus aiming for *l’histoire totale* with a complex web of links between discourse and practice as well as between the spiritual and material ‘objects of our Minds’. However, Roche is not only about structures and connections; he is also about mobility, movements and change. Carla Hesse has aptly called an article ‘Roche on the Move’, where she stresses that he explains change from the mobility of a society. Mobility creates unbalances within the complex web of a society, which in a creative process makes change happen. Kalmeter was all about mobility, travelling as he was in Europe while observing economic structures and trade patterns, and even if he was not fully aware of it he thus created ‘unbalances’ and made change a possible option.⁵⁴

A Swedish Enlightenment – Iron and Progress

A suitable point from where to continue the discussion about a Swedish Enlightenment is a hand-written travel report from around 1780.⁵⁵ The author, Salo-

mon von Stockenström, had entered the Board of Mines in 1769. He travelled around the iron making region in Sweden in 1776–1777 before embarking on a tour of central Europe the following year. His professional career was thus similar to the travellers discussed above, and his report comes from a comparable context. It belonged to the apodemic tradition, with its systematic approach along with the personal viewing. When dealing with bar iron he used a structure that might have its origin in Linnaeus' *Systema Naturae*, with 'orders' and 'classes'. Geography gave the 'orders' while different ways of making bar iron made up the 'classes'; French bar iron was made according to '4 different processes', while 'in Sweden gives chiefly 5 variations in bar iron making'. von Stockenström also remained appended to the mercantilist tradition in his use of the all-encompassing concept of trade, unifying production and commerce, although in a more loose way. He stressed the productive part, but the world of commerce was never far away. The making of iron was a mirror to the wide variety of uses to which it could be transformed, and the structure of the text was formed as a commodity chain. Volume two of his report described pig iron making, while volume three dealt with the making of bar iron. The next volume was on steel making, while the last described the metal trades. That the last volume was concluded with a section on the Italian iron market makes the point.

von Stockenström used a similar starting-point as Kalmeter and Schröder, but that was only a platform for further analysis, as he was about to leave the static world-view of his predecessors. In the introduction to volume one, on direct reduction of iron ore, von Stockenström stated that this way of making iron, although of high quality, belonged to the past. It was an 'innocent' way of making iron, as well as the 'oldest', and it lasted until the following volume before he began his treatment of the up-to-date processes. European iron making began to be seen by Swedish observers in stages of human development, and time and chronology had been brought into the analysis.⁵⁶

Another difference between von Stockenström and Kalmeter was similar to the one that Reill found between Buffon and Linnaeus. The latter epitomised the 'esprit de système', while the former actively studied the world. Reill stressed that Buffon's way of 'doing science' implied a radically different way of communicating scientific findings, and language got a more important role. Buffon preferred 'the primacy of living over inanimate matter', promoting a 'new language of nature' where descriptions of life were essential, as well as its development: 'A natural system described a body as it actually was [...] and its history.' von Stockenström started with the Linnaean system, but his descriptions came closer to this 'new language' of Buffon: meticulously detailed descriptions, emphasising the concrete

work of artisans, similar as well to the pages in the *Encyclopédie*. He might have thought in commodity chains, but his descriptions were more thorough than his predecessors. Artisans and entrepreneurs, transforming the world, were brought into his frame, along with chronology.⁵⁷

von Stockenström is worthy a characterisation as an Enlightenment *Savant*, and his report is a break towards his predecessors. They lived in a static society, with its mechanistic world-view, while he had opened his analysis to both change and human actions. In a Memorial attached to his report this was even more evident: After asserting how grateful he was to have been able to serve his employer he promptly stated that his task had been to gain 'insight' in foreign ways of making iron, and to 'enrich our knowledge about the treatment of iron, its possible *Improvements*'. He noted that the only way to 'measure' the skills of a traveller was to look for 'the adoption at home of what in foreign Nations gathered'. The static world of mercantilism had given way to the dynamic world of the travelling entrepreneur.⁵⁸

This change was not a sudden development, and the Swedish society after mid-century still bore the mark of the static mechanistic philosophy. Anders Berch's ideas remained important and discussions at the *Royal Swedish Academy of Sciences* echoed the same; von Stockenström's uncle, Eric Stockenström, stated in 1749 that 'the Creator from the beginning has built the foundation' where 'the earth hides the most necessary and noble treasures', as well as given 'the most industrious hands [the skill to] open the hardest stones'.⁵⁹ Berch's son, Christer, also followed his father in the late 1750s stating that British trades are 'in good proportions to its population.' He noted division of labour, but was keener to stress the skills of the artisans as the reason for its flourishing manufactures, as well as their 'natural system of using their national products as objects for their manufacture'. But Berch was also breaking the static structure: 'Experiments' with coke smelting took place and 'English mechanics [...] make it a pleasure to think about improvements in the mechanics of handicraft, and the artisans are attentive to observe how a machine can be improved'.⁶⁰

After mid-century the institutional landscape of Swedish iron production was altered. From the seventeenth century it had been governed by the Board of Mines with a detailed legislation, but in 1747 this partly changed when *Jernkontoret* was founded by the ironmasters. Its immediate purpose was to furnish ironmasters with running credit and to support 'bar iron to a price appropriate to its value',⁶¹ but very soon it began to act together with the Board of Mines in matters related to the attributes of Swedish iron. A lapse in quality had been detected, and the reasons were inadequate knowledge about the ore, and badly kept blast

furnaces. In 1751 a joint venture was launched to act upon these problems with the employment of an *Övermasmästare*, who was to travel to ironworks and assist ironmasters.⁶² The organisation expanded, and a growing number of employees could report from countless visits to ironworks about ore quality, the length of the production season and construction details, as well as how encountered problems were solved. They submitted reports with the single production site at its centre, with only a handful attempts made to deal with general problems. Some promised analyses of the ‘Art’ and ‘Theory’ of constructing furnaces, but no one wrote any.⁶³

This was the beginning for von Stockenström, becoming *Övermasmästare* in 1773.⁶⁴ His intellectual foundation was Schröder’s *Jernsystem*, and its emphasis on a static and spatial understanding of the world. Cracks in that façade could, however, be seen and von Stockenström became active in tearing down this ‘system’. He began making a distinction between production and commerce, as such an analytical split was necessary in his endeavour of describing European productive procedures and production sites. A better defined concept of production was a precondition for a development towards the ‘thick descriptions’ of the mechanical arts in the *Encyclopédie*. Another critical step was his abandonment of the diary for the analytical report. This had been done before, and there were intermediate forms, but von Stockenström argued that this was a necessary step in order to improve Swedish iron making. A diary would be ‘at fault in order and connections’. If ‘the enlightenment’ of the ‘whole process’ was desired one had to abstain from describing procedures at individual sites. He began replacing the local with the general, but also linked this to the possibilities of a changed future. He did not use words such as science but talked about ‘Theories’, indicating a general knowledge about procedures in furnaces and forges. This did not, however, mean an abandonment of concrete descriptions of sites and procedures – far from it – but these were inserted in a larger context, where it was possible to have a view about different methods, and not just how iron was made at single works. His cases, meticulously described in text and plates, became a tool to inform about effective workshops and how to proceed to make high-quality commodities.

von Stockenström did not describe pin making, so it is not possible to compare him with Kalmeter or Diderot, but he described needle making. Needles were made from steel, but, that apart, had similar production procedures. The first task was to cut the wire into suitable lengths, before the pieces were hardened in a furnace. They were then ‘ready for sharpening [...] which is done in a similar way as for pins’; the eyes are punched and filed before the needles are polished. The division of labour was elaborate, and the different tasks were allocated to three

categories of workers; masters, journeymen and apprentices. von Stockenström's description is meticulous, worthy the pages of the *Encyclopédie*, using both text and plates. The section ends with an account of a water-powered polish machine. von Stockenström's description is thorough but without any indication whether he saw this mechanical device as a novelty, or a revolutionary feature. He had left the static world of mercantilism behind him, and entered the world of 'esprit systématique', but still could not fully anticipate the future ahead of him!⁶⁵

A decade later this ambivalence between the static mechanistic philosophy and the vitalist dynamic world-view was once again repeated. Approaching seventy years Sven Rinman made his last contribution to Swedish iron making after a life of service. Throughout his career he had collected words and concepts used by people involved in the trade, and in 1788–1789 he published these as his *Bergwerks Lexicon*. This is a work in four volumes organising knowledge, 'with fairly complete and educating explanations of the whole trade', in alphabetic order. It is a publication that must be inserted in the European encyclopaedic tradition, although its scope is not as wide as the *Encyclopédie*, with its ambition of being a guide to 'a closer familiarity with the science of iron- and metal-making.'⁶⁶

Rinman noted that it was difficult to compile such a work, as not only was it necessary to describe the trade he had been used to, but it had also been altered: 'New shoots on the old trunk [...] have admirably developed the cultivation, and shown secure proofs [...] of important improvements'.⁶⁷ Among these he named chemical analyses, knowledge about the 'Kingdom of Stones', as well as the making of metals. However, as von Stockenström before him, he had problems of appreciating all the different novelties. From England he had heard about ways of making bar iron with mineral coal, but he did not see anything new in that. It was no improvement, but just another way of making bar iron. Rinman was describing puddling:

With Reverberer-furnaces is normally understood [...] a furnace to bring the melted iron, through labour and re-melting, [...] into a forgeable bloom, from which bar iron later can be drawn out, as in England with success have been made, only with the flames from mineral coal. A good bar iron, [...] will never in this way be expected [...].⁶⁸

Towards a Chronology: Enlightenment, Trade and Progress

In 1751 Diderot and d'Alembert began to edit the *Encyclopédie*, and published the *Discours préliminaire*. Their ambition was to create a 'Connection of all the Parts of

Human Knowledge’ as well as present ‘the general Principles [...] of every Science, and every Art, whether liberal or mechanical’, and the ‘compilation’ of knowledge would constitute a tool with which the future could be made. The *Encyclopédie* would serve ‘farther Progress’, and a chronological distinction was made between the ‘esprit de système’ of the past and the ‘esprit systématique’ of the future.⁶⁹

These two works have been of crucial importance in the debate about the chronology and character of the Enlightenment, ever since their publication; they set limits to what has been on the agenda. However, one area has been conspicuously absent in the subsequent debate, the mechanical arts, or the ‘material objects of our Minds’. In spite of some recent studies this lack of research has been harmful to our understanding of the process, especially so if the *Encyclopédie* ‘was about [...] achieving prosperity through technological change.’⁷⁰ The aim of this article has been to address this problem by linking the Enlightenment to the world of trade and production.

A further ambition has been to follow the lead of Roche in attempting to analyse eighteenth century developments in terms similar to the way they were perceived at the time: ‘to see how change became possible in a world that saw itself as stable’ To Roche change was the result of unbalances created in a society by mobility, such as unbalances between ‘intellectual culture’ and ‘material culture’, as well as within each of them. Mobility was the starting-point to this article, dealing with Swedish travellers, and the analysis has circulated on how they described what they saw during their journeys.

When Kalmeter went to England in the 1720s he witnessed division of labour within the pin trade, and he described a commercialised economy. Subsequent travellers made similar observations, and what they saw differed from what they were accustomed to in their native Sweden. But to take such views as a validation for the presence of a fully-fledged Enlightenment with clear ideas about progress is problematic. Instead these travellers must be inserted in a different framework, and they have to be placed in the static universe of the mechanistic philosophy where nature was the creation of a benevolent God, and where change was not a possibility. Kalmeter and Schröder belonged to the ‘esprit de système’! However, we must not underestimate the fact that their descriptions of differently organised trades paved the way for future developments; they created ‘unbalances’ and were forerunners for the ‘esprit systématique’.

Mechanistic philosophy and mercantilism reigned supreme in Sweden well into the second half of the century and von Stockenström had Schröder’s *Jernsystem* as his beginning, but he was to leave this behind. von Stockenström replaced the diary with a systematic report in the late 1770s, and the remarks he made

became more general in character. He also began to dissolve the encompassing concept of trade, and began to write ‘thick descriptions’ of iron making. The outcome of these steps became an alertness that the synchronic structure of the *Jernsystem* had to be replaced by a diachronic view with progress at its helm. To von Stockenström travellers in foreign countries should look out for ways to improve Swedish iron making by copying foreign procedures.

von Stockenström and Rinman ought to be placed in a line of Swedish Enlightenment thinkers. They both promoted views about the possibility of progress, dealt with technological problems from a more general perspective, and the latter was the author of an *Encyclopédie* in the field of metal making. However, neither of them fully bridged the gulf between the Enlightenment and the world of production, and no-one foresaw the Industrial Revolution. To them ‘human betterment in this world’ only reached as far as detailed descriptions of workplaces and ‘mechanical arts’, and they failed to notice a water-powered polishing machine or puddling as progressive novelties. On the other hand it is questionable if Diderot reached any further in his venture of describing French pin making. Perhaps he too was stuck in the ‘esprit de système’ for another couple of decades before the ‘esprit systématique’ and the Industrial Revolution began to make a real impact. With hindsight we can spot the beginning to the process of industrialisation, but to people of the latter decades of the eighteenth century that still remained in the shade.

Notes

This text has a long history, and was presented at the workshop ‘The Influence of the Enlightenment and the French Revolution in Scandinavia (1750–1850): Myth or Reality?’ at Freiburg Institute for Advanced Studies in 2010. I thank Jean-François Berdah and Ulrich Herbert for the invitation and the participants for valuable comments. I am also grateful for comments made by two anonymous referees, Kenneth Nyberg, Colin Jones, Leos Müller and Inger Jonsson. As always my greatest gratitude goes to Chris Evans. This article could be viewed in a somewhat larger context, of adding views on technology to views on urban development and economic liberty. See Göran Rydén, ‘Viewing and Walking: Swedish Visitors to Eighteenth-Century London’, *Journal of Urban History*, vol. 39 (2), 2013, and Göran Rydén, ‘Eskilstuna *Fristad*: The Beginnings of an Urban Experiment’, in *Sweden in the Eighteenth-Century World: Provincial Cosmopolitans*, ed. Göran Rydén (Aldershot: Ashgate, 2013).

1. 'Henrik Kalmeters resa', Kungliga Biblioteket, Stockholm, M 249, vol. III, fol. 599 ff.
2. In spite of its impact on both technology and science in eighteenth century Sweden no comprehensive analysis exist for the Board of Mines. Important studies are, however, Svante Lindqvist, *Technology on Trial: The Introduction of Steam Power Technology into Sweden, 1715–1737* (Uppsala: Avd. för vetenskapshistoria, 1984), and Hjalmar Fors, 'Kemi, paracelsism och mekanisk filosofi: Bergskollegium och Uppsala circa 1680–1770', *Lychnos* 2007, pp. 165–198.
3. 'Dagbok rörande Handel, Näringar och Manufakturur m.m. Uti Danmark, Holland, England, Frankrike och Tyskland. Under verkstälde resor, åren 1748–1751 för'd af Samuel Schröder', Kungliga Biblioteket, Stockholm X:303, in four volumes, and 'Dagbok öfver Resan genom England åren 1753, 1754 och 1755 af Reinhold R. Angerstein'. Jernkontorets Bibliotek, Stockholm.
4. Larry Wolff, 'Travel Literature', in *Encyclopedia of the Enlightenment*, ed. Alan Charles Kors (Oxford: Oxford University Press, 2003), vol. 4.
5. Jacob Christensson, *Konsten att resa: essäer om lärda svenska resenärer* (Stockholm: Atlantis, 2001); Hanna Hodacs and Kenneth Nyberg, *Naturalhistoria på resande fot: om att forska, undervisa och göra karriär i 1700-talets Sverige* (Lund: Nordic Academic Press, 2007); Jeremy Black, *The British and the Grand Tour* (London: Croom Helm, 1985).
6. Carl Hårleman, *Tankar i anledning af Utländska Resor förestälte uti et Tal för Kongl. Svenska Vetenskapsakademien* (Stockholm, 1746), pp. 3 f.
7. Josiah Tucker, *Instructions for Travellers* (London, 1757), quotation from pp. 3–4.
8. The classic reference for this topic is Justin Stagl, *A History of Curiosity: The Theory of Travel 1550–1800* (Chur: Harwood Acad. Publ., 1995); Pär Eliasson, *Platsens blick: vetenskapsakademien och den naturalhistoriska resan 1790–1840* (Umeå: Umeå universitet, 1999).
9. Stagl, *A History of Curiosity*, pp. 81 and 112–121, quote from p. 81; and Peter Gay, *The Enlightenment: An Interpretation. The Science of Freedom* (New York: Norton, 1977), p. 320.
10. Tucker, *Instructions for Travellers*, p. 10.
11. Lars Magnusson, *Mercantilism: The Shaping of an Economic Language* (London: Routledge, 1994); David Ormrod, *The Rise of Commercial Empires: England and the Netherlands in the Age of Mercantilism* (Cambridge: Cambridge University Press, 2003) deals with English and Dutch mercantilism; Chris Evans and Göran Rydén, *Baltic Iron and the Atlantic World in the Eighteenth Century* (Leiden: Brill, 2007), pp. 216 ff., analyses Swedish and English mercantilism.
12. Roy Porter, *Enlightenment: Britain and the Creation of the Modern World* (London: Allen Lane, 2000), pp. 30 and 47; and Magaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (Oxford: Oxford University Press, 1997), p. 68.
13. Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge: Cambridge University Press, 1992), p. xxxiii.
14. Daniel Defoe, *The History of the Principal Discoveries and Improvements, in the Several Arts and Sciences: Particular the great Branches of Commerce, Navigation, and Plantation, In all Parts of the known World* (London, 1727), pp. 2 and 223.

15. Modern scholars have begun to pay attention to a much wider understanding of economic practices. See Andre Wakefield, *The Disordered Police State: German Cameralism as Science and Practice* (Chicago IL: University of Chicago Press, 2009), and Emma Rothschild, *The Inner Life of Empires: An Eighteenth-Century History* (Princeton NJ: Princeton University Press, 2011).
16. Daniel Defoe, *Plan of the English commerce: Being a complete prospect of the trade of this Nation, as well home as foreign* (London, 1728), pp. 2 f.
17. Schröder, vol. II, fol. 458 f. and 483–497. See also John Hope Mason, *The Value of Creativity: The Origins and Emergence of a Modern Belief* (Aldershot: Ashgate, 2003), pp. 72 ff.
18. Schröder, vol. I, fol. 385 ff. Italics added by the author.
19. Alexander Pope, *An Essay on Man, being the first Book of Ethic Epistle to Henry St. John, L. Bolingbroke* (London, 1734), pp. 8–9.
20. John Hedley Brooke talks about ‘The diversity of natural religion’, in ‘Science and Religion’, in *The Cambridge History of Science. Volume 4: Eighteenth-Century Science*, ed. Roy Porter (Cambridge: Cambridge University Press, 2003), p. 743.
21. Konrad Marc-Wogau, ‘Inledning’, in Gottfried Wilhelm von Leibniz, *Valda skrifter* (Stockholm: Natur och kultur, 1990); Tore Frängsmyr, ‘Christian Wolff’s Mathematical Method and its Impact on the Eighteenth Century’, *Journal of the History of Ideas*, vol. 36, no. 4 (1975), pp. 653–668.
22. William Derham, *Physico-theology: or, a demonstration of the being and attributes of God, from his works of creation. Being the substance of XVI sermons...* The second edition, with additions (London, 1714), p. 38.
23. Defoe, *Principal Discoveries and Improvements*, pp. iv–v. See also John Ray, *The wisdom of God manifested in the works of the creation* (London 1691).
24. Harry Lenhammar, *Sveriges kyrkohistoria. 5: Individualismens och upplysningens tid* (Stockholm: Verbum, 2000), pp. 94–106.
25. Carl Gustaf Löwenhielm, *Tal om landt-skötsel, hållit för Kongl. Svenska Vetenskaps akademien* (Stockholm, 1751), pp. 5–11.
26. Tore Frängsmyr, ‘Den gudomliga ekonomin: religion och hushållning i 1700-talets Sverige’, *Lychnos: Lärdomshistoriska samfundets årsbok 1971–1972*, p. 244.
27. For a recent evaluation see Hodacs and Nyberg, *Naturallistoria på resande fot*.
28. Carl Linnaeus, *Om undran inför naturen* (Stockholm: Natur och kultur, 2005), p. 59.
29. Carl Linnaeus, ‘Tankar om Grunden til Oeconomien genom Naturkunnoghet och Physiquen’, *Kongl. Swenska Wetenkaps akademien handlingar* (Stockholm, 1740), p. 406.
30. Anders Berch, *Inledning til den almänna busbålningen, innefattande grunden grunden til politie, oeconomic och cameral wetenskaperne* (Stockholm, 1747), unpaginated foreword, pp. 6, 15 f. and 272; Lars Magnusson, *Äran, korruptionen och den borgerliga ordningen: essäer från svensk ekonomihistoria* (Stockholm: Atlantis, 2001), pp. 25–49.
31. Haydon Mason, ‘Optimism, Progress, and Philosophical History’, in *The Cambridge History of Eighteenth-Century Political Thought*, eds. Mark Goldie and Robert Wokler (Cambridge: Cambridge University Press, 2006), pp. 195–199.

32. Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (New York: Vintage Books, 1994), p. xxiii.
33. Foucault, *The Order of Things*, p. 59.
34. See for example William H. Sewell Jr, *Logics of History: Social Theory and Social Transformation* (Chicago IL: University of Chicago Press, 2005). Sewell writes that 'the early Michel Foucault [...] had [...] an insistence on the systematic nature of cultural meaning' (p. 161) and that he had problems of dealing 'with the problems of historical change' (p. 189).
35. Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (Indianapolis IN: Liberty Classics, 1981 [1776]), pp. 13 f.
36. See Robert Allen, *The British Industrial Revolution in Global Perspective* (Cambridge: Cambridge University Press, 2009), pp. 146–148, for a different agenda.
37. *Encyclopédie, ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers. Tome Cinquième*, eds. Jean Le Rond d'Alembert and Denis Diderot (Paris, 1755), 804–808, quote from p. 804; *Recueil de Planches, sur les Arts Mécaniques, avec Leur Explication. Troisième Livraison*, ed. Denis Diderot (Paris, 1765). See http://www.lexilogos.com/encyclopedie_diderot_alembert.htm
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39. Daniel Roche, *France in the Enlightenment* (Cambridge MA: Harvard University Press, 2000), p. 6. Italics added.
40. d'Alembert and Diderot, *The Plan of the French Encyclopaedia*, pp. 19, 48 and 50 ff. See also Julie Candler Hayes, *Reading the French Enlightenment: System and Subversion* (Cambridge: Cambridge University Press, 1999), and Göran Rydén, 'System och föränderlighet i synen på det svenska bergsbruket under 1700-talet', *Sjuttonbundratat* 2008.
41. Lynn Hunt and Margaret Jacob, 'Enlightenment Studies', in *Encyclopedia of the Enlightenment*, ed. Alan Charles Kors (Oxford: Oxford University Press, 2003), vol. 1, pp. 418–430.
42. Peter Gay, *The Enlightenment: An Interpretation*. Vol 1. *The Rise of Modern Paganism*. Vol. 2. *The Science of Freedom* (New York: Norton, 1977), quote from vol. 1, p. 3. For Sweden see Tore Frängsmyr, *Sökandet efter upplysningen: perspektiv på svenskt 1700-tal* (Stockholm: Natur och kultur, 2006); Marie-Christine Skuncke, 'Was There a Swedish Enlightenment?', in *Norden och Europa 1700–1830: synvinklar på ömsesidigt kulturellt inflytande*, ed. Svarvar Sigmundsson (Reykjavík: Félag um átjándu aldar fræði, 2003).
43. John Robertson, *The Case for the Enlightenment: Scotland and Naples 1680–1760* (Cambridge: Cambridge University Press, 2005), pp. 8 and 28 f. Joel Mokyr has in his *The Enlightened Economy: An Economic History of Britain 1700–1850* (New Haven CT: Yale University Press, 2009), followed suit by stating that 'the ideas of liberal Political Economy [was] The Enlightenment's proudest offspring', p. 65.
44. Peter Hanns Reill, *Vitalizing Nature in the Enlightenment* (Berkeley CA: University of California Press, 2005). Roche, *France in the Enlightenment*.

45. Celina Fox has stated that analyses by ‘Social historians [...] dealing with visual sources [...] was one-dimensional, treating them merely as illustrative of technology, economic and social change.’ See her *The Arts of Industry in the Age of Enlightenment* (New Haven CT: Yale University Press, 2009), p. 3.
46. Robert Darnton, *The Business of Enlightenment: A Publishing History of the Encyclopédie 1775–1800* (Cambridge MA: Harvard University Press, 1979), pp. 177–245.
47. John R. Pannabecker, ‘Representing Mechanical Arts in Diderot’s “Encyclopédie”’, *Technology and Culture*, vol. 39, no. 1 (Jan., 1998), pp. 33–73.
48. Liliane Hilaire-Pérez, ‘Diderot’s View on Artists’ and Inventors’ Rights: Invention, Imitation and Reputation’, *British Journal for the History of Science*, 2002, 35, pp. 129–150.
49. Cynthia J. Koeppe, ‘The Alphabetic Order: Work in Diderot’s Encyclopédie’, in *Work in France: Representations, Meaning, Organization, and Practice*, eds. Steven Laurence Kaplan and Cynthia J. Koeppe (Ithaca NY: Cornell University Press, 1986), pp. 229–257.
50. Ken Alder, *Engineering the Revolution: Arm and Enlightenment in France, 1763–1815* (Princeton NJ: Princeton University Press, 1997), quotes from pp. xii, 4 and 15.
51. Joel Mokyr, *The Gifts of Athena: Historical origins of the Knowledge Economy* (Princeton NJ: Princeton University Press, 2002), quotation from pp. 3–15.
52. Charles Withers and David Livingstone, ‘Introduction: On Geography and Enlightenment’, in *Geography and Enlightenment*, eds. D. Livingstone and C. Withers (Chicago IL: University of Chicago Press, 1999), p. 12; Charles Withers, *Placing the Enlightenment: Thinking Geographically about the Age of Reason* (Chicago IL: University of Chicago Press, 2007).
53. Roche, *France in the Enlightenment*, p. 7.
54. Carla Hesse, ‘Roche on the Move’, *French Historical Studies*, vol. 27, no. 4 (Fall 2004), pp. 741–745.
55. Salomon von Stockenström, Utländska jern- och stålprocesserna, vol. 1–3 and 5, Jernkontorets arkiv, Fullmäktige, F IIa, vol. 25–28, Riksarkivet, Stockholm. Vol. 4 is found at Stora Kopparbergs Centralarkiv, Manuskript- och Avskriftssamlingen, vol. 74, Arkivcentrum i Dalarna, Falun. Cited as von Stockenström, foreign journey, vol. 1–5. Bertil Boëthius, *Jernkontorets Historia. Del III: 1. Jernkontoret och tekniken före götstålsprocesserna* (Stockholm, 1955), pp. 18 ff.
56. von Stockenström, foreign journey, vol. 1.
57. Reill, *Vitalizing Nature*, pp. 48 and 69 f.
58. Ödmjukaste Memorial, från Salomon von Stockenström, 12 maj 1781. Jernkontorets Arkiv, Fullmäktige E II: 23, Riksarkivet, Stockholm. Italics added.
59. Eric Stockenström, *Bergsmanna-näringens nytta och skötsel, förestäld uti et tal, til Kongl. Svenska Vetenskaps akademien* (Stockholm, 1749), pp. 2, 8 and 10.
60. Christer Berch relation öfver sin resa, 1757–1761, Uppsala University Library, Handskriftsavdelningen X407b.
61. Bertil Boëthius and Åke Kromnow, *Jernkontorets Historia* (Stockholm, 1947–1968), vol. I–III; Eric von Stockenström, *Tal om svenska Järn-Bruksnäringen, samt om Jern-Contoiret. Hället*

- för Kongl. Vetenskaps Akademien, vid Præsidiij Nedläggande Den 11 April 1767 (Stockholm, 1767), p. 29.
62. Boëthius and Kromnow, *Jernkontorets Historia*, vol. I, pp. 463 ff.
63. Boëthius and Kromnow, *Jernkontorets Historia*, vol. I, pp. 476 ff, and vol. III, pp. 1–19; Masmästerirelationer, 1752–1785, Jernkontorets bibliotek, Stockholm.
64. Boëthius and Kromnow, *Jernkontorets Historia*, vol. III, pp. 17 ff.
65. von Stockenström, *foreign journey*, vol. V.
66. Sven Rinman, *Bergwerks Lexicon* (Stockholm, 1788–1789). Quotation from Part I, Företal without page references.
67. Rinman, *Bergwerks Lexicon*, Part I, Företal, without page references.
68. Rinman, *Bergwerks Lexicon*, Part II, p. 413
69. d’Alembert and Diderot, *The Plan*, pp. 2, 19 and 115.
70. Roche, *France in the Enlightenment*, p. 575.

Summary:

The Enlightenment in Practice: Swedish Travellers and Knowledge about the Metal Trades

Ever since the publication of the *Encyclopédie*, in the decades after mid-eighteenth century, there has been an on-going debate about the implications of the metaphor of enlightenment, mainly based on themes discussed in Diderot’s and d’Alembert’s work. Sadly, however, one major field has been left outside; scholars have dealt with two branches of the tree of knowledge, science and the liberal arts, but ignored the branch of mechanical arts. This article takes a starting-point in the reintroduction of political economy, with division of labour, and technology into an assessment of the Enlightenment. It has the ambition of discussing the process whereby progress became a central feature of eighteenth-century thinking, as well as relating this to a discussion about travelling to other places. It deals with Swedish travellers going to Britain, and central Europe, to view differently organised trades with elaborate division of labour, more skilled artisans, fitted into a commercial economy.

Keywords: Travelling, Enlightenment, Economic thinking, Technological development, Metal Trades, Progress