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THE EARLY INDUSTRIALIZATION IN THE  
TRONDHEIM AREA AND THE FACTORY  
ON THE NIDELVEN 1843 - 1876

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## **THE EARLY INDUSTRIALIZATION IN THE TRONDHEIM AREA AND THE FACTORY ON THE NIDELVEN 1843-76<sup>1</sup>**

The Factory on the Nidelven river, called "Fabrikken ved Nidelven" in Norwegian was situated on the riverbanks just opposite the Cathedral in Trondheim. This firm built the first Norwegian steam ship, only ten years after the first arrival of a steam ship in the Trondheim harbour. In 1861-62 the factory built the first Norwegian locomotive, this was even before the Trondheim got its railway connection. How was this achieved ?

This factory was the second largest industrial enterprise in Trondheim up till 1860 and by far the largest in the following years. It did not only have an important economic impact in the city, the activity in this factory was to become an important part of the city life. The thick black smoke from the factory chimneys and the shipbuilding activity undoubtedly set their marks upon the surroundings until the firm went bankrupt in 1876. It was both an actual and a symbolic expression of the new industrial era which was to come.

The mechanical industry had a key function in industrial and economic development during the 19th. century. Not because it grew fastest or was the largest industry, but because it built and maintained the machinery and equipment which was needed in other enterprises. It was instrumental in the technical changes which transformed agriculture, transportation and mining among other branches. The development of this kind of industry was perhaps one of the reasons why the economic growth was so rapid in Norway in this period - as of course in other western countries.

This makes history of the Factory on the Nidelven interesting in an international perspective as well. It illustrates a central part of the history of the developed world, the history of how people - even in one of the peripheries of the western world - learnt to master the British iron- and steam technology.

### **The economic life in the Trondheim area 1835-1875**

The Factory on the Nidelven was founded in a small city. Trondheim had only 12 400 inhabitants in 1835 and it grew at a relatively slow rate. The growth accelerated in the second part of the 1860's. This was partly due to rich fisheries. Trondheim had 22 500 inhabitants by 1875, but although the population had almost doubled since 1835, Trondheim remained junior to both Bergen and Oslo.

It was four activities which made up the basis for the economic life in Trondheim in the mid 19th century: coppermining, export of timber and fish and regional trade. There was little industrial activity inside the city itself in the 1840's, such enterprises were mainly founded adjacent to water power which was substantially cheaper than steam power. The timber was processed in local sawmills in the Central Norway, the fish needed almost no processing. Apart from the mining activity Trondheim was primarily an an administration- and trade centre for the Central Norway, and to a certain extent also for northern Norway.

Mining implied other experiences and other challenges than the trade. It was complex both in a technical and managerial sense and it brought with it a certain industrial activity in the outskirts of Trondheim. E.g. a rolling mill for copper plates, an enterprise producing sulphuric acid and a gunpowder mill.

Within the city itself, the most important industry up till the 1840's was the liquor distilleries. Alcoholism and drinking however was the major social problem of the time (the

average consumption of alcohol was more than three times as high in as today in Norway) so this industry faced severe regulations and lost eventually its economic importance in Trondheim. There was also a few other enterprises like breweries, flour mills, a sugar refinery and so forth. But with the exception of a major shipyard (for sailing ships), there was no other large enterprises within the city than the Factory on the Nidelven in the 1840's.

A number of new industrial firms were established in the 1850's, during the boom which followed the Crimean war, including breweries, a nascent textile industry, a steam driven saw mill and a large tannery exporting machine belts made of walrus hides.

The establishment of some new industrial firms in the 1850's did not change the face of Trondheim. As late as in 1875 only 5% of the city population was employed in the industry. But this picture can be somewhat modified. In addition to this industrial activity came a formidable production within the crafts. And as I later will show, the craft production and craft skills were very important for the following industrialization. In 1845 there was more than 500 masters employing 500 journeymen and apprentices. This was small scale production, but it was at least as important for the city as the industry, at least up til the 1850's.

The agriculture, the fisheries, the timber trade and to some extent shipping remained more important in the regional economy than the industry. All these branches were quite profitable and in addition they were subject to quite rapid technological changes in this period. The Factory on the Nidelven was instrumental in this development. It built much of the new equipment which was necessary in the transformation of the traditional economic activities. This factory thus had a key role in the regional economic life, even if the region as such "failed" to industrialize.

This development in Central Norway shows that it was possible to modernize more or less within the old economic framework. In spite of being relatively little industrialized the average incomes in the region, as well as in Norway as a whole, was well above the European average in this period. According to Paul Bairoch only Great Britain, the Netherlands and Denmark had substantially higher incomes pro capita than Norway.<sup>2</sup> The region was peripheral first of all in a geographical sense, in being situated so far from Great Britain and the Continent, but this does not imply that the Trondheim region was especially backward in an economic sense.

### **The establishment of the Factory on the Nidelven**

The Factory on the Nidelven was founded by three wealthy and very able businessmen in Trondheim in 1843. All of them were willing to take great risks throughout their carriers. Two of them were heavily involved in mining. It proved difficult to introduce steam power to drain the mines and I suppose that it also may have been difficult to repair heavy equipment. It had also been necessary to get British mechanics in order to modernize the rolling mill for copper plates in the 1830's. The establishment of the Factory on the Nidelven may have been intended as a remedy for this situation, but this can not have been their only aim. The mechanical workshop was combined with a iron foundry and a steam mill - at first glance an rather unlikely combination of activities. But the trade with flour and cast iron products fitted well into the entrepreneurs merchant activities and there was obviously a market both for flour and for cast iron products locally.

The three businessmen did not of course possess the necessary technical skills. The British engineer, John Trenery, who worked as a master mechanics at a British owned copper

mine in the very far north of Norway, was asked to be their consultant in the planning of the factory. Trenery must have made a very good impression. Only a few days after his arrival in Trondheim he was offered both the post as manager for the works and one fourth of the ownership of the enterprise. He led the factory until his death in 1864.

It was Trenery who actually planned and built the factory. Thus, British know-how was combined with local capital and local knowledge of the market situation. In spite of this Trenery seems to have built the workshop more or less after a "British model", with less consideration to the local conditions. The mechanical workshop was in fact one of the best equipped in Scandinavia in the early 1840's, for which there was limited need in the Trondheim area at that time. It was a technical success but when it comes to economy, results were rather mixed. The three businessmen lacked the required technical knowledge and John Trenery did not know the local market conditions. This may illustrate how difficult it can be to transfer technology and a factory system from one place to another.

The Factory on the Nidelven produced mainly cast iron products like pumps and stoves and wheat flour for the local market in the early years, but the entrepreneurs had much higher ambitions than this. After six years - in 1849 - the first Norwegian steamship "Nidelven" was built at the factory, named after the river on which the factory was situated. This was a much more complex task than ever done by any Norwegian mechanical workshop. It was a milestone in the industrial history of Norway. How did they achieve this? The manager John Trenery recruited three British mechanics to this work. He also bought some of the large part for the marine steam engine in Britain, but most of the work was done in Norway, by Norwegian workers. Most of them had backgrounds as blacksmiths, gunsmiths, carpenters et.c. and they had presumably got some skill in using machine tools at the factory. This was the technical basis which the factory had when it built its first steam ship. However, the leap from traditional craftwork and semi skilled mechanical work to shipbuilding turned out to be more difficult than expected. The delivery was delayed for many months and the steamship "Nidelven" soon got technical problems. This may also have been due to poor maintenance from the ship operator who had little experience with steamships, but all the same - the building of the steamship was probably done at an economic loss.

The factory continued however to build some steamships during the 1850's and the work force rose from 40 men in the 1840's to 80 men in 1855, and expanding to 150 in 1860. In 1860-61 the factory tried to enter an even more difficult market. The factory now built the first Norwegian locomotive. To construct locomotives is a very complex technical task, much more difficult than for example building steam ships. This factor alone made it a very risky project. And the factory built this locomotive even before the railway reached Trondheim, an example of how eager they were to build new and advanced equipment. It was also done in spite of that the manager of the state lead railway company clearly favoured British locomotives. There was no preference for the Norwegian built locomotive.

The factory did not succeed in building a locomotive of equal quality as the competing British locomotive works, which were larger and more specialized. The locomotive had not enough power to be in everyday use, as the railway line had very steep slopes, but the locomotive functioned well enough to be used as a reserve and maintenance locomotive for almost 20 years.

The technical achievements ended probably as financial disasters. The Factory gave no large revenues and it got into severe economic problems in the early 1860's.

### **1862-69, a cautious interlude**

Because of the economic problems the the Factory on the Nidelven was reorganized as a limited company in 1862. One of the original partners kept his part but the others sold out. Few of the leading trading houses in Trondheim bought shares in the new company. Most of the shares was bought by the factory's customers, small industrialists, contractors and craftsmen who had relatively limited funds. They had no possibility to raise sufficient capital for the reorganized firm.

The new ownership did not introduce a new era for the Factory. The firm lacked capital to do any large investments and it concentrated at first on technically simple production which was suited to the interests of the new owners - and which involved little risk. The local small industrialists were definitively not interested in prestige projects like the speculative locomotive building. They also quit shipbuilding for some years. Instead they concentrated on making cast iron products as ovens, pumps, builders supplies, maintenance and so forth.

This situation was changed gradually. The workshop started once again to build steamships, which was a more capital intensive and more risky business. The new manager - the Norwegian engineer Sophus Weidemann - wanted to concentrate more on shipbuilding, but the shareholders were still somewhat cautious. What we see is a more or less classical situation where the engineer wants to pursue the technical possibilities with less regard to the risks involved.

Profits remained low throughout the 1860's and could not finance the necessary investments. The owners tried to issue new shares with no success. Instead they guaranteed for the company's debt, so that the Factory at least could raise loans. This guarantee tied the shareholders to the company, making it difficult to deviate from the company's strategy, without risking huge personal losses. And this had grave consequences in the following years, as the company changed to more adventurous policy.

### **1869 - 1876; New leaders, unprecedented growth - and bankruptcy**

In 1869-70 the shareholders elected new directors for the firm, placing one of Trondheims wealthiest and most daring merchants as president for the firm. This coincided with the beginning of a long boom in the Norwegian economy, in which the mechanical industry blossomed. Such a situation provided very much freedom for the new leaders. The Factory on the Nidelven extended substantially, an expansion which was entirely based upon expensive loans. The work force was doubled from 150 to 300 men during the year 1870 alone. Through continued growth and a merger with another local iron foundry it employed more than 400 men in 1872, making it perhaps the largest private mechanical workshop in Norway.

The Factory now started to build large steam liners for passenger transport. This was a much more complex task than building small steam ships for local transport which had been done earlier. These liner contracts resulted in huge losses, but simpler work for the local business community was very profitable during the boom, so the firm managed to balance their sheets for the time being.

As long as the economic boom continued the huge loans was no more than a potential problem for the firm. The shareholders must have believed that the investments and the

technical innovations would reap rich awards in the future, but this was not to happen. The boom changed into a severe depression in the autumn of 1873. This coincided with the disappearance of herring from the coast in 1874. The merchants trading with fish went broke, dragging others with them in a chain reaction within the business community in Trondheim. In October 1876 the Factory on the Nidelven declared bankruptcy. This was the end of the pioneering period.

### **An industrial enterprise in a peripheral region - possibilities and limitations to growth**

The Factory on the Nidelven played a crucial role in the industrial and economic development in the region north of Bergen. It produced and maintained the machinery and equipment which was necessary in other enterprises. A large part of the products was made in cooperation with the customers, this was the case both for large and small orders. In this way technical change was incorporated in the local economic system - giving an impetus for faster economic growth.

Sidney Pollard emphasizes precisely this kind of interaction between different industrial branches and firms.<sup>3</sup> It was this mutual incentives and competition which sped up the technical and economic development in Western Europe. Pollard suggests that the industry in a region must have a certain size in order to develop economic mechanism that promote a self-sustained economic growth. If there are too few industrial firms in an area the internal competition and stimuli will be too weak to make an industrial breakthrough.

This seems to be what happened in the Trondheim area. Even if the region was reasonably a par with the economic development in the 1840's and 1850's it did not industrialize to any great extent. One of the reasons to this may be that most of the major trading houses in Trondheim were quite conservative in their investment strategies and they were more or less negative to take part in industrial ventures which involved financial risks.

The rest of the local economy seems to have been as dynamic as in the rest of the Scandinavian area. There was a strong activity in mining, within the fisheries and the agriculture was increasingly modernized. The public sector also played an important role, especially in communications. Trondheim got telegraph in the mid 1850's, the first railroad was built in the 1860's, and in the 1870's railways were being built to both Stockholm and Oslo. There was also established a technical college in Trondheim.

All the same, the total picture is dominated by relatively slow economic growth. There was established few large industrial enterprises in the area. The region never got the mutual competition and incentives between different firms which was evidently a reason for the fast growth, e.g. in the Oslo area. This had in turn great consequences for the Factory on the Nidelven. It had to depend on all kinds of customers. This could be a strength of course in many respects - making it flexible for technical change - but the factory had no possibility to specialize on certain activities. The market was far too small for such a strategy. Specialization - or development of know-how which few other firms possessed - seems to have given substantially higher profits than the differentiated production at the Factory on the Nidelven could give.

The long distance to other industrial areas and to other mechanical workshops implied some protection to the Factory on the Nidelven against outside competition. Their customers - had normally few alternatives when they needed new equipment. It was only for costly and

specialized machinery it could pay to import it from firms outside the region. This advantageous position gave the factory a certain competitive edge.

The relative isolation also brought with it that the factory was shielded to some extent from the effects of the technical development. The customer could in general not choose between products from different mechanical workshops. Of this reason, the Factory on the Nidelven did not need to be as advanced as their British competitors, it sufficed not to fall too far behind. This geographical protection gave the Factory a possibility to build up their technical capability over time. I don't think such a strategy or opportunity was special for the Factory on the Nidelven. But it is perhaps especially evident here in Norway, where distances to competitors are so great. I would guess such mechanism also protected Continental firms against British competition in the early phases of the industrial revolution, and later the same pattern would repeat itself in Spain and in the Balkans.

The geographical position could however work both ways. It was no problem as long as the Factory concentrated on relatively easy tasks. The disadvantages of being situated in the periphery became strikingly clear when they tried to build locomotives and steam ships. There was a rapid technical development in these branches and most innovations were British. The Factory on the Nidelven had therefore constantly to master technology which was developed elsewhere. This was both a costly and time consuming task, which threatened to marginalize the company.

The competition in shipbuilding was especially hard. The British yards had approximately 60% of the world tonnage in this period. They built cheaper ships than most of their foreign competitors. The British yards were often quite specialized and they based their production on a number of subcontractors which built different parts.<sup>4</sup>

The Factory on the Nidelven had no possibility to base itself on local subcontractors. There was no such industrial milieu in Central Norway. The company tried instead to make most parts themselves. This implied that the firm had to master a much broader technological specter than their British competitors. This clearly limited the firms possibilities and it had few chances to succeed in this area.

### **How was the technological capability developed ?**

One interesting aspect of the development of the Factory on the Nidelven river is how the British iron- and steam-technology was mastered in a local community - and in this respect the development of the factory might also give a picture of how other regions were industrialized.

Here I want to probe into the following questions: How strong was the original local technical basis ? How much of the technology came from outside Norway - from Germany and Great Britain ? How easy was it to adapt foreign methods to local needs and to use foreign (not Scandinavian) skilled workers ?

All the machines were imported from Great Britain, but at a later stage the firm built some machine tools themselves. But to buy a machine is not the same as to use it effectively. A fairly large part of the necessary skills had to be brought in from the outside in the early years. The first manager, Mr. John Trenery had a crucial role in planning, building and in running the company during the first twenty years. His sons also filled major positions within the firm.

As I already have mentioned, three British mechanics were employed during the construction of the first Norwegian steam ship. They all left the company shortly afterwards, but one of them, Mr. Stevenson, came back when the company needed assistance in order to build the locomotive in 1861-62. He stayed on until 1868, and after he quit there was no Englishmen employed with the firm until the 1890's.

The owners also recruited foreign workers to the iron foundry. The alternative was to recruit workers from Norwegian iron works, but this was probably not done in the early years. Four German foundry workers were hired in 1846-47. One of them continued until 1855 as a foreman in the foundry. A British worker took over his post in 1857-58. To sum up: The foreign element in the workforce was relatively small, but the foreign workers filled important positions in the firm. We know from other firms that foreign skilled workers often were unstable, alcoholized and not very well integrated.<sup>5</sup> This may also have been the case at the Factory on the Nidelven.

These kinds of problems with the highly paid foreign workmen might have induced the owners to rely on local workers. Most of the skilled work was done by Norwegians. How was this achieved in a region with weak mechanical and industrial traditions ?

### **Local craft traditions and training within the firm**

The production at the Factory on the Nidelven demanded a high level of skills from the workmen. In what extent was the old craft skills relevant for this type of work ? It was especially the blacksmiths ability to work with iron which proved important. A lot of the workers started in the company's service as blacksmiths and later became machinists, mechanics and so forth. In addition to this other craftsmen such as carpenters and coppersmiths had a certain importance for the firm. The factory also employed some gunsmiths, who were the only precision tool makers in the district at the time. The firm could in other words rely upon quite strong local craft traditions and these skills were clearly relevant for the industrial production. I don't think such a recruitment policy was anything special for the Factory on the Nidelven. Such craft traditions existed in most regions in Europe, and they could more or less easily be adapted to the modern British technology. This is one important reason, and in my opinion a grossly undervaluated reason, why the industrial revolution could spread so fast from Britain to the Continent and later to the peripheries such as Scandinavia.

But we also see that the workers must have learnt substantial skills at work within the factory. The dependance on foreign workers steadily diminished at the same time as the production turned more and more complex. There were fewer foreigners employed at the factory when the locomotive was built than in when they made simple cast iron products in the early years. And there was no skilled foreign workers at the firm when it built passenger liners in the 1870's.

In the 1860's and 1870's even the management were Norwegian, but they were still trained in Britain. Even if it was possible to build upon local craft traditions, the advanced technics still came from the outside. It had obvious advantages to use Norwegian engineers instead of let's say British engineers. Because of the language it was much easier for native leaders to instruct and lead the workers. Perhaps it also played a role that they had roots in the relatively egalitarian Norwegian society, with much less distance between workers and managers than



in most other European societies, and thus making it possible to cooperate better at the workplace.

### **An "industrial" mentality ?**

The factory work had other social frames than the work in the agriculture or in the craft guilds. A lot of industrial workers had great problems with adapting to the new conditions, which resulted in widespread drunkenness, a lack of punctuality, shirking and so forth. These problems were serious from the employers point of view and is accordingly thoroughly analysed in the literature on the industrial revolution.<sup>6</sup> However, I have'nt met any traces of such problems in the source material which I have gone through. This does not imply that such difficulties did not occur at the Factory on the Nidelven, they certainly did, but it may suggest that the management did not see such things as a major problem. They focused instead on technical, economic and capacity difficulties.

A one-sided focus on management-labour problems may veil important features of the industrial work and the industrialization process. On the contrary I will assume that the workers effort and creativity was one of the major reasons for the extraordinary dynamic development which characterized the mechanical industry in the 19th. century. The skilled workers were undoubtedly the most valuable assets which the Factory on the Nidelven had. These workers had a crucial role both in training of new workers and in the day to day production.

In the 1850's and onwards the factory produced fire fighting equipment, tools, agricultural equipment, steam engines, mining equipment and so forth. This is indeed an impressive list if we think of the creative work which lies behind the each different product. The workshop undertook almost any mechanical task which the local business community needed. The production thus became very differentiated and not at all specialized. The management and the foremen had little possibilities to lead or supervise all the details in the production. There was never more than one or two engineers employed within the firm.

The skilled workers had thus to carry out many of the demanding tasks on their own. They had to find good solutions to very different technical problems. This was perhaps a more important element in their work than the routine tasks. The skilled workers were also responsible for the design and the finish of many products. In this way the work became a learning process and to a certain extent also a creative process. This side of the work is often forgotten in descriptions of the early phases in the industrial revolution. I assume that one major reason to the technical success of the Factory on the Nidelven lies in the work ethic. It required a certain self discipline or group discipline from the workers to get things done, since they were not directly controlled in their work. What is more important is that the work also required a will to do creative work. The employees attitudes to what was good work or a "fair days work" had obvious consequences for the results. The Factory on the Nidelven could never have made the wide range of products without a relatively stable and industrious work force.

I will suggest that these attitudes to work and to develop and use new technology was quite common, not only in Norway, but at least in large parts of Western Europe in the 19th. century. As David Landes has pointed out this may be one of the deeper causes behind the industrial revolution. He emphasises not only the western peoples strong inclination to

subjugate nature and the natural forces, but also their inclination to adapt their lives after economic rational goals.<sup>7</sup> I will suggest that it is natural to see both the work ethic and the mentality towards new technology, which we see in action at the Factory on the Nidelven, in the light of these deeper structures of thought.

### **A desire to master new technology ?**

The mechanical industry had a central function in the economic and industrial development in the 19th. century. Much of the dynamic element in this period must be explained by the mechanical industry's ability constantly to develop and master new technology. In this lecture I have used the Factory on the Nidelven as an example of this development. This company steadily expanded its production from relative easy to more advanced tasks.

So far, I have emphasized how the firm learned to master new technology and how the firm interacted with local and foreign enterprises. At the end of my lecture I will raise the question: Why did the factory again and again try to make more advanced products ? They started with making relative simple articles as ovens, kitchenware, pumps and so forth. Then they started building steam ships, locomotives, ending with large passenger liners in the 1870's. The reasons for such a development is seldom questioned. It fits very well into our conception of history, where the western technical development and the mastery of nature is seen as something quite natural. But is this really so evident ? If we go back to the Factory on the Nidelven - was it really logical for the owners that they should take the great risks which shipbuilding and locomotive building involved ? It never proved profitable, but all the same, they continued to extend the production towards more advanced products through most of the 30 years of this period.

On one hand, the factory had to master new technology. They were undoubtedly pressured both by their competitors and customers to keep up with the general technical development. There was a demand for more advanced products and the firm could not fall too far behind if they wanted to stay in business.

But this can only partly explain the development of the firm. There was absolutely no need to build locomotives or passenger liners. In the first case, the public railway company warned that they didn't even want to buy the locomotives from the firm. In other words, the external demand is no sufficient explanation of the drive to master new technology.

When I described how the firm managed to build their technological basis - in a region which more or less lacked industrial and mechanical traditions - I mentioned that the workers creativity and work ethics must have played an important part. There must have been a will to master new technology. This will was not restricted to the skilled workers. We can also observe such an attitude among the engineers and owners of the company. Some of the shareholders were clearly reluctant to the more or less adventurous policy of the firm, but with exception of the early 1860's most of them agreed to extend the production in a more advanced direction. Some of the most important shareholders were very enterprising men with an extraordinary "go a-head" spirit. It is very tempting to see these men in the light of Schumpeters entrepreneur theories. They were dynamic men with a strong creative will and they often acted opposite of what was seen as economic rational.

The development to extend the production in a more advanced direction was a general tendency in the mechanical industry. There was such a development at all the major

mechanical workshops in Norway in this period. It should however be noted that the attempts to master new technology often ended with ruin. Most of the large mechanical workshops in Norway either went broke or had to be reorganized in the period up til the turn of the century.

1. This working paper is based upon chapter 2 and 13 in Pål Thonstad Sandvik: *Fabrikken ved Nidelven, mekanisk industri i en europeisk periferi*, Trondheim 1993.
2. Printed in Sidney Pollard: *The Peaceful Conquest, the Industrialization of Europe 1760-1970*, Oxford 1981, p.185 and 233.
3. Sidney Pollard: *The Peaceful Conquest, the Industrialization of Europe 1760-1970*, Oxford 1981.
4. Sidney Pollard and Paul Robertson: *The British Shipbuilding Industry 1870-1914*, London 1979.
5. Kristine Bruland: *European Industrialization and British Technology, the Norwegian Textile Industry 1840-1900*, Oxford 1989.
6. See among others. E.P. Thompson: *The Making of the British Working Class*, 1980 and Sidney Pollard: *The Genesis of Modern Management*, London 1968, Edvard Bull: *Arbeiderklassen blir til*, Oslo 1985 and Knut Kjeldstadli: *Jerntid*, Oslo 1987.
7. David Landes: *The Unbound Prometheus, Technological and Industrial Change in Western Europe from 1750 to the Present*, Cambridge 1969, s.21-31.