

# Chapter 10

## Energy: A Revolution with Steam



Harry Lintsen

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**Abstract** The chapter analyses the radical changes in the supply chain of fossil fuels between 1850 and 1910. It does this in relationship to the development of industry and investigates the consequences for the factory system, the environment and class relations.

The modernisation of the economy was an important precondition for the increase in welfare and the decline of extreme poverty. It involved agriculture and nutrition, infrastructure and transportation, industry and steam technology. Agriculture, foods, infrastructure and transportation were discussed in previous chapters. Industry and steam technology are the focus of this chapter.

The transition to coal and steam was accomplished in this period. It was typical of the Netherlands that the development of steam technology did not in the first place lead to the establishment of factories, but to the modernisation of workshops and small firms. Craft production remained dominant. To be sure, labour relations became more business-like due to liberalisation and sharp competition, especially in the cities, but it never came to social disruption or class conflict.

The emergence of steam technology raised questions about the safety of the vicinity and the nuisance inflicted on residents. A Steam Law and a Steam Inspectorate were relied on to minimise the risks of possible explosions. The nuisance law was intended to prevent irritating smoke, smell and vibrations as far as possible. However complaints about nuisance were almost never sufficient cause to refuse a permit. In most cases the interests of industry prevailed.

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Harry Lintsen with contributions from Rick Hölsgens and Ben Gales.

**Keywords** Modernisation · Steam technology · Small firm · Class struggle · Safety · Nuisance

## 10.1 36 h Lugging Warm Stearin Around<sup>1</sup>

An odd gathering assembled on Monday, January 10, 1887 in one of the meeting rooms of the second chamber of parliament. On one side of the table sat a reputable commission of eight persons. Chairman was the former lawyer Herman Verniers van der Loeff. As parliamentarian he stood out as a conservative liberal, vehemently opposed to suffrage for workers, among other things. On the other side of the table sat four women, uncomfortable, shy and poorly clothed. They were workers at the Royal Factory of Wax Candles in Amsterdam.

The four women were being questioned by a parliamentary board of enquiry that was investigating the well-being of workers in factories and workshops in the Netherlands. In the course of earlier sessions it had already become clear that Verniers van der Loeff played the leading role and that he did that with great zeal and manifest expertise. In this case he had to mobilize all his resources to put the women at ease and to get them to talk frankly about their situation. He succeeded only in part. But a number of issues did surface, as the following fragments from the transcript reveal<sup>2</sup>:

Chairman: ... How long then do you work at a stretch?

Hendrika Kamphuisen: 36 hours

Chairman: Did that happen recently?

Henrika K.: About four weeks ago.

...

Chairman: What did you have to do during those 36 hours, tell us that. Walk around with warm stearin?

Hendrika K.: Yes

Chairman: And transfer that to the trays?

Hendrika K.: Yes, in the machines.

Chairman: The machines, by this you mean the forms containing the candles?

Hendrika K.: Yes

Chairman: So you have to pour the vessels with stearin over into the forms and cut off the candles. That is your work during the 36 hours. You were never able to sit?

Hendrika K.: No, sir.

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<sup>1</sup> The introduction is based on: H.W. Lintsen et al., *Made in Holland: Een techniekgeschiedenis van Nederland [1800–2000]* (Zutphen 2005), 155–157.

<sup>2</sup> *De arbeidsenquête van 1887: Een kwaad leven.* (Nijmegen 1981), Part 1 Amsterdam, p. 220–222. The publication is a reprint of the labour enquiry of 1887 with an introduction by J. Giele.

Chairman: At night you were not given an hour to rest?

Hendrika K.: from 12 to 1.

Chairman: And during this time you could lie on the floor a bit?

Hendrika K.: Yes. I would look around for a soft plank.

...

Chairman: ... Now is this good or bad for adolescent girls and women?

Hendrika K.: Almost nobody can take the night work. The next day most are ill and complain about pain in the legs, in the head, in the lower back...

The publication of the hearings and the report of the commission caused a wave of indignation. The public responded with complete disbelief. That such things were possible in the Netherlands. In hearing after hearing, one abuse followed the other: women who worked outrageously long hours, children that were beaten, workers subject to capricious bosses, low wages, unhealthy working conditions, dangerous machines and on and on.

Up to that time in the Netherlands, the debate on the factory system had been rather 'academic.' If authors (especially in academic circles) referred to concrete abuses, they usually cited reports from England, sometimes Belgium or another country. A very few were acquainted with the factory on the basis of actual observation. But the parliamentary enquiry of 1887 put a face on the Dutch factory system. About 150 people were interviewed. The 'bare' verbatim transcript of questions and answers made the introduction to factory labour almost a personal experience.

There is something remarkable about the parliamentary enquiries of 1887 and 1890. They loosened tongues about the factory system. But on closer reading it is obvious that more is at issue, as witness the following fragment from the enquiry, in which the home-working tailor Petrus Schröder is questioned:

Petrus S.: Then it happens – our trade is unpleasant on this point – that we have to work through the night, especially on Friday and Saturday nights; then all too often it happens that the children, no less than the father, if they are up to it, sleep for only an hour or work at one stretch until Sunday morning 10 o'clock...

Chairman: How old are the children of whom you now speak?

Petrus S.: They sometimes begin at age 9 or 10. Such children often have to help out between school time and until 11 or 12 o'clock in the evening...<sup>3</sup>

The description did not diverge very much from that given of the factory. It was even questionable whether craft labour as performed at home or in workshops was a better option than factory labour. Here too child labour, women's labour, accidents, unhealthy situations, occupational diseases, capriciousness, long working hours, monotony etc. were the rule. Craft work, as it was described, had suffered such conditions for centuries, but never had these abuses led to public indignation. Apparently, more was at issue in regard to the social debate on labour. It was not only a response to the emergence of the factory system, but also motivated by changed attitudes among the bourgeoisie to the well-being of the worker. The factory as a new phenomenon was a stimulus to think about the production factor

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<sup>3</sup>*De arbeidsenquête van 1887: Een kwaad leven*, 220–222.

'labour' in general and to formulate new values and norms for quality of life. In other words, in addition to a structural change in the economy, one could also speak of a cultural revolution in society.

The factory was one of the most important technical-organisational innovations of the modern economy. It was characterised by a concentration of labour and capital (in the form of machines and apparatus). The modernisation of the economy was a broad phenomenon that affected agriculture and nutrition, infrastructure and transport, industry and the factory. Agriculture, nutrition, infrastructure and transport have been discussed in preceding chapters. In this chapter industry and the factory are in the limelight with a focus on coal as the energy source and the steam engine as prime mover. We start with the changes in industry but will certainly come back to the issue of labour. And the persistence of poverty will also draw our attention. Did the changes in industry contribute to the mitigation of poverty?

## 10.2 Finally an Industrial Nation and a Decline of Extreme Poverty<sup>4</sup>

The liberalisation of international trade since the 1840s had meant booming business for agriculture, but not for Dutch industry. Agricultural prosperity depended in the first place on the international competitive advantage of the Netherlands in the area of cattle husbandry, allowing trade in agricultural produce like butter, cheese and cattle to flourish. It was thus more attractive to invest in agriculture than in industry. In addition, domestic prices for foodstuffs rose to British levels and the cost of living increased.<sup>5</sup> That had far-reaching consequences for the domestic market and a series of economic sectors. The growth of the entire food processing industry, that counted for the bulk of industrial production, stagnated. The same was true of the construction, clothing and leather industries.

Finally, there were big problems in the 'colonial complex,' in which the Netherlands Trade Society (NHM) monopolised the most important flows of trade between the Dutch East Indies and the Netherlands.<sup>6</sup> It began with a crisis on Java at the beginning of the 1840s. Trade in calico all but collapsed and the NHM struggled with serious overcapacity. Even more problematic was the fact that the industrial sectors closely connected to the 'colonial complex' were not prepared for the liberalised international market. For years the NHM had protected the Dutch cotton, shipbuilding and maritime shipping sectors against foreign competition. It had moreover all but failed to invest in the modernisation of these sectors. Cotton, shipbuilding and maritime shipping found themselves adrift in heavy seas. The cotton

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<sup>4</sup>For the first part of this section see: J.L. van Zanden and A. van Riel, *Nederland 1780–1914: Staat, instituties en economische ontwikkeling* (Amsterdam 2000), 277–288.

<sup>5</sup>Van Zanden and van Riel, *Nederland 1780–1914*, 282.

<sup>6</sup>Van Zanden and van Riel, *Nederland 1780–1914*, 278–281.

**Table 10.1** The distribution of the workforce across agriculture, industry and services (in percent)

	1850	1890	1910
Agriculture	40	36	30
Industry	31	32	34
Services	29	32	36
	<b>100</b>	<b>100</b>	<b>100</b>

Source: J.P. Smits, E. Horlings and J.L. van Zanden, *Dutch GNP and its components, 1800–1913* (Groningen 2000), Table C.1, 115–117

industry was the first to extricate itself from the legacy of the NHM. After the 1860s, the transition to factory production enabled cotton manufacturers to confront international competition. It took considerably longer for shipbuilding and maritime shipping. They regained an international presence only in the 1890s with the transition to steam and iron.

It seemed that it was only in the long term that Dutch industry began to profit from the liberalisation of economic life and the integration of domestic and international markets.<sup>7</sup> Its recrudescence began in the 1860s. Among the first signs were the establishment of bread and flour factories. The industrial renaissance was characterised by, among other things, specialisation – for example by a number of new agricultural industries like beetroot sugar fabrication and the margarine industry. The emergence of a shoe-making industry in the Langstraat (North Brabant) also fit this pattern. Dutch industry also became internationally more competitive. Wages lagged behind those of other countries, the cost of foreign coal had declined and the cost of imported raw materials and fabricated products had developed favourably. Modernisation proceeded across a broad front and industry began to assume a central place in economic development. The size of the industrial workforce began to exceed that of the agricultural workforce (Table 10.1). At the start of the twentieth century about an equal number of workers were employed in industry and in the service sector (each about 35% of the workforce).

Liberalisation and industrialisation exerted considerable influence on the development of extreme poverty in the Netherlands. The country was in a sorry state from the end of the 1840s up to the end of the 1860s (Graph 7.1).<sup>8</sup> Population growth and the growth of the gross domestic product declined in the 1840s and 1850s (Table 10.2). Even on a per capita basis, the GDP declined. To be sure, some branches of agriculture and trade flourished, but the profits accrued to only a small elite of farmers and merchants. The recession in industry and in other parts of the economy in connection with increasing inequality led to an increase in extreme

<sup>7</sup> Van Zanden and van Riel, *Nederland 1780–1914*, 283–287. Some branches of industry flourished thanks to chance circumstances. The printing industry, for example, fared well thanks to the rescinding of the newspaper seal (a tax measure) in 1871 that made newspapers considerably cheaper and increased the demand for them.

<sup>8</sup> See appendix 4.1 for a quantitative analysis of poverty in the nineteenth century.

**Table 10.2** Contribution of agriculture, industry and services (in per cent of total) to the growth of the gross domestic product (GDP), 1840–1913

	1840–1850	1850–1860	1860–1870	1870–1880	1880–1895	1895–1913
Population growth	0.71	0.65	0.87	1.12	1.17	1.40
Growth GDP	1.11	0.59	2.38	1.74	2.10	2.37
Growth GDP per capita	0.40	−0.07	1.51	0.62	0.93	0.97
<b>Contribution to growth of GDP</b>						
Agriculture	34.3	−0.7	24.9	−6.6	11.6	2.6
Industry	8.1	−6.1	32.1	68.3	34.2	37.0
Services	57.6	106.8	43.0	38.3	54.3	60.4
	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: J.L. van Zanden and A. van Riel, *Nederland 1780–1914. Staat, instituties en economische ontwikkeling* (Amsterdam 2000), table 4.2. 152 and table 8.1. 345

poverty. It is estimated that 30–40% of the Dutch population around 1860 lived under the poverty line. In some years that amounted to more than a million Netherlanders. The magnitude of extreme poverty would decline in the course of the 1860s. After 1870 that happened quite rapidly. At the beginning of the twentieth century about 6% of the Dutch population continued to be extremely poor.

From the 1870s on the Dutch population increased by more than 1% per annum and from the 1880s the GDP by as much as 2%. Industry, along with trade, was the chief engine of the economy (Table 10.2). This is not to say that that agriculture no longer played a role. Quite the contrary, agriculture, the food processing industry and the trade in food products were still the building block of most important complex in the Dutch economy.

### 10.3 Steam for Big and Small<sup>9</sup>

A crucial factor in the industrialisation process was the development of energy technology. From a technological perspective, energy is transformed into useful effects in the economy by the application of capital and labour. Labour's contribution is limited, namely by the amount of food that a worker or an animal can consume. For this reason a human can deliver continuously about 0.1 hp and a horse about 0.5 hp in the course of a day.<sup>10</sup> Mechanical prime movers break through these limits. With the technology of the time, windmills could deliver a maximum of 30 hp, but only

<sup>9</sup>See for this section: H.W. Lintsen, 'Een land met stoom', in: H.W. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving* (Zutphen 1995), volume VI, 191–216 and Lintsen et al., *Made in Holland*, 133–154.

<sup>10</sup>For the horsepower of different prime movers, see: Lintsen, 'Een land met stoom', notes 3–7 in chapter 7, 294–295.

**Table 10.3** The average growth of labour productivity in industry, 1807–1913 (in percent)

Period	Average growth labour productivity per annum (%)
1807–1830	0.2
1830–1842	0.7
1842–1860	–0.6
1860–1890	4.8
1890–1913	1.3

Remark: The growth of labour productivity in the period 1860–1890 is above all concentrated in the years 1860–1875. After this it even declines a bit. See: Van Zanden and van Riel, *Nederland 1780–1914*, Graph 6.3 on p. 245

Source: J.P. Smits. ‘The determinants of productivity growth in Dutch manufacturing, 1800–1913’ (Paper presented at the workshop National Accounts, Utrecht 1992), Graph 1

**Table 10.4** The number of prime movers in industry by type, 1850–1890

	±1850	±1860	±1880	±1890
Horse mills	1930	1710	910	570
Windmills	3050	3400	3120	1790
Water mills	470	500	250	160
Steam engines	290	820	2740	3930
Gas engines			10	20
<b>Total</b>	<b>5740</b>	<b>6430</b>	<b>7030</b>	<b>6470</b>

Remark: The figures are rounded off to the nearest ten

Source: H. Lintsen, ‘Een land met stoom,’ in: H. Lintsen et al. (eds.), *Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving* (Zutphen 1995), part VI, table 7.1. 192

when the windmill was really big and there was a stiff breeze blowing. The average power of a windmill throughout the year was considerably lower, about 6 hp. Water mills in the Netherlands with their very modest hydraulic heads usually delivered no more than 10 hp. The production ceiling that the Netherlands was able to achieve with the classic technologies was once again shattered by steam technology. But first the country had to develop into a ‘steam society,’ that is to say into a society in which infrastructure, institutions, legislation, entrepreneurial behaviour and production processes were adapted to steam technology. That process was accomplished in the nineteenth century and in particular after 1850.

In the nineteenth century industrial labour productivity tripled. That increase was achieved almost entirely in the period 1860–1890 with an annual growth in labour productivity of 4.8% (Table 10.3). This growth was realised above all with steam engines and their associated production technologies. The number of steam engines increased rapidly after 1860 at the expense of wind, horse and water mills (Table 10.4). The transition to steam technology seemed an inevitable process. But for the entrepreneurs of the day it was anything but that.

Between 1860 and 1890 manufacturers were confronted with a variety of options for their production processes and with numerous uncertainties in decision-making. Prior to 1860 steam could not, under prevailing conditions, compete with wind and water. After 1890 there were still limited possibilities for the classic means of production. During the transitional phase, entrepreneurs had a choice of different possibly successful manufacturing strategies: continuing with the mill and cottage industry, combining mills and steam engines, adopting small steam engines or large-scale use of steam technology. The situation was made even more complex by a ceaseless stream of innovations. The changing prices of raw materials, new but unclear market expectations and changing social needs. The upshot was that entrepreneurs were not facing anything like a clear set of choices, but more often a confusing muddle. As much as possible, therefore, they adopted a course of gradualism as a strategy of coping with the possibilities and impossibilities of steam.

While the transition to steam followed a tortuous path, one could still speak of the inevitable advance of the steam engine. Three structural developments underlay this dynamic. In the first place, the running costs of steam engines continually declined, especially for small steam engines of up to about 20 hp. Steam engines became cheaper. The costs of repair and maintenance declined. Coal became cheaper, in part because of the elimination of excise taxes on coals in 1863. All told, running costs declined in the second half of the nineteenth century by roughly 50%.<sup>11</sup>

Further, steam engines were increasingly coupled to new and dedicated machinery, for example rollers instead of millstones in the grain mills, hydraulic presses instead of hammers in the oil mills, and churns instead of centrifuges in the dairy industry. It did not take long before the multiplication of production by means of a steam engine became both possible *and* necessary in order to compete with 'classic' means of production.

In the third place, opportunities for steam technology increased along with the size of markets. The entrepreneur opting for steam was in almost all cases 'doomed' to increased production and bigger markets. That not only applied to manufacturers with large steam engines, but also and especially to the entrepreneur with a small steam engine. Institutional barriers that hobbled large-scale production had to be eliminated, among other things urban autonomy, guilds and specific laws like the Milling Law. Various factors provided fertile soil for the upscaling of production. The construction of the railway network after 1860 and of tramways after 1880 provided access to local markets and laid the basis for national markets. The purchasing power of the population increased from the 1860s on. Producing for large and distant markets was a stimulus for steam, as the production of butter, margarine, paper, sugar and textiles showed.

Despite all this, the adoption of steam technology would not initially lead to the emergence of the factory with its large-scale production. Steam engines were first and foremost installed in small enterprises. The average power was low, around 13 hp. (Table 10.5). Only in the textiles and chemicals sectors did the average

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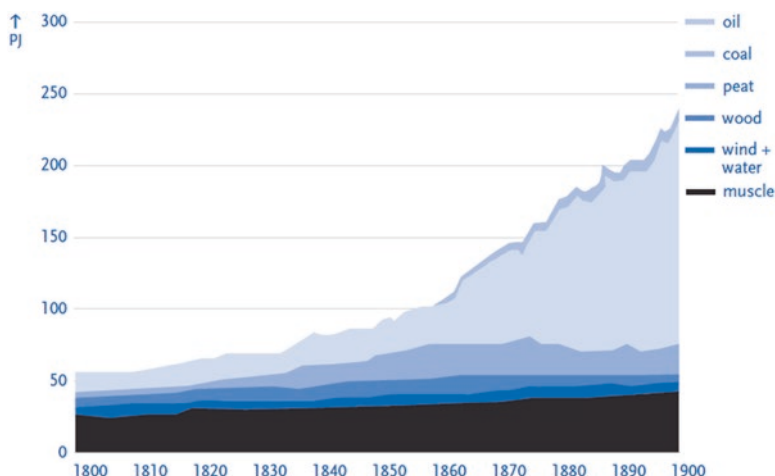
<sup>11</sup> Lintsen, 'Een land met stoom', volume VI, table 7.7, 198.



**Table 10.5** The number of steam engines in industry by sector. 1890

Sector	Number	% of total	Average power in hp
Food Processing	1308	33	10.6
Construction	467	12	15.9
Textiles	451	11	21.0
Ceramics	274	7	10.5
Shipbuilding/vehicles	265	7	3.4
Lumber	265	7	16.6
Chemicals	227	6	21.8
Metal	204	5	8.7
Misc.	464	12	
<b>Total</b>	<b>3925</b>	<b>100%</b>	<b>13.0</b>

Source: Lintsen, ‘Een land met stoom’, volume VI, table 7.6 and table on p. 270

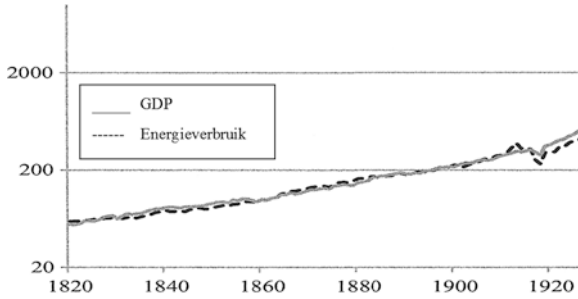


**Graph 10.1** Consumption of different energy sources, 1800–1900

Source: B. Gales and H. Hölsgens, *Energy transitions in the Netherlands: Sustainability challenges in a historical and comparative perspective* (Groningen 2016), 11 and appendix 1

exceed 20 hp. These sectors had many large mechanised enterprises. The average size of industrial firms changed slowly. Around 1890 only 20% of the population worked in enterprises with 10 or more employees. Only after that time did middle and large-sized enterprises begin to appear. In 1909 as much as 40% of the workforce was employed in middle and large-sized firms. By the early twentieth century the factory began to dominate the industrial landscape of the Netherlands.

Energy consumption in the nineteenth century changed dramatically with the advent of steam technology. Total energy consumption in that century is estimated to have become five times as high, while the population increased by about two and a half times (Graph 10.1). Energy consumption increased at the same rate as the GDP (Graph 10.2). Around 1850, 84% of the energy was derived from the tradi-



**Graph 10.2** Economic growth and energy consumption, 1820–1920 (1860 = 100)  
 Source: B. Gales, A. Kander, P. Malanima and M. del Mar Rubio Varas, ‘North versus South: Energy transition and energy intensity in Europe over 200 years’, *European Review of Economic History* 11 (2007), no. 2, 219–253

**Table 10.6** Energy consumption and greenhouse gas emissions in the Netherlands in 1910 and 2007 set off against the norms of the European policy agenda of 2007

	Situation 1900	Situation 2007	European Norm for 2020	Remark
Energy consumption	304,000 TJ	2,879,000 TJ	2,303,000 TJ	European policy agenda 2007: 80% of 1990
Greenhouse gas emissions	22,000 kton	178,000 kton	100,000 kton	European policy agenda 2007: 80% of 1990

tional sources: humans, animals, wind, water and turf. By the turn of the century that percentage had decreased to 34%. Coal became far and away the dominant source of energy.

On the eve of the First World War 88% of Dutch coal was being imported from abroad. That made Dutch energy supplies vulnerable. Some were quite concerned and advocated the exploitation of coal layers in the province of South Limburg (see Chap. 15). Others trusted to international law, that made it difficult to proclaim export restrictions and blockades against neutral countries in time of war. Such countries could take it for granted that their trade flows would not dry up.

What were the consequences for the natural environment of this transition to an economy based largely on fossil energy sources? Climate change and greenhouse gas emissions were non-issues in those days. But even from a present-day perspective the transition was still hardly a problem. Energy consumption and the associated greenhouse gas emissions were low by present-day standards and lay far beneath the norms that are now being pursued for the Netherlands (Table 10.6). Matters were quite different, however, as far as safety was concerned and nuisances from smells, soot and smoke.

## 10.4 Coal and Steam as Nuisance<sup>12</sup>

The increasing use of coal and steam had palpable consequences for the immediate surroundings. Safety was the first issue to attract government intervention. As early as 1824, King William I ruled that boilers should be inspected to prevent explosions. This decision was the basis of additional legislation, ultimately leading to the Steam Law of 1869.<sup>13</sup> In the meantime the government had delegated boiler inspection to the Steam Service (*Stoomwezen*). This service enjoyed an outstanding reputation and was held to be quite conscientious. Steam boilers had to be fitted with a number of devices such as two safety valves and an alarm system in case they ran out of water. Boiler manufacturers provided these devices as standard equipment. The regular inspections could not prevent the occurrence of occasional explosions. They were not frequent – as far as we can tell only four of them in the 1880s – but in some cases at the cost of human life.

The owner of a steam installation also had to deal with legislation that now falls under what we know as the Nuisance Law (*Hinderwet*). He always needed a permit and the surrounding residents could protest the installation of a steam engine. The

<sup>12</sup> See for this section: Lintsen, ‘Stoom in ontwikkeling’.

<sup>13</sup> Nineteenth-century regulations concerning the safety of boilers included the following decisions and laws:

The ‘Decision containing the specification of temporary safety measures on the use of steam engines’ (*Besluit houdende daarstelling van voorloopige veiligheidsmaatregelen bij het aanwenden van stoomwerktuigen*’, 6-5-1824, Staatsblad nr. 32).

The ‘Decision concerning changes in the earlier legislated safety regulations on the use of steam engines’ (*Besluit houdende wijziging der vroeger voorgeschrevene veiligheids-maatregelen bij het aanwenden van stoomwerktuigen*’, 26-9-1833, Staatsblad nr. 58).

The ‘Decision concerning specifications in regard to the inspection of the steam engines noted therein and the supervision of their use’ (*Besluit houdende bepalingen nopens het onderzoek der daarbij vermelde stoomwerktuigen en het toezigt op hun gebruik*’, 24-5-1855, Staatsblad nr. 40).

The ‘Law regulating supervision of the use of steam apparatus’ (*Wet regelende het toezigt op het gebruik van stoomtoestellen*’, 28-5-1869, Staatsblad nr. 97).

The ‘Decision to implement the law of May 28 1869, regulating the supervision of the use of steam apparatus’ (*Besluit tot uitvoering der wet van 28 mei 1869, regelende het toezigt op het gebruik van stoomtoestellen*, 4-9-1869, Staatsblad nr. 154).

The ‘Law concerning regulation of the supervision of the use of steam apparatus’ (*Wet houdende regeling van het toezicht op het gebruik van stoomtoestellen*’, 15-4-1896, Staatsblad nr. 69).

The ‘Decision to implement the Steam Law (Law of 15 April 1896), (*Besluit tot uitvoering der Stoomwet (wet van 15 april 1896)*’, 19-10-1896, Staatsblad nr. 163).

The ‘Decision concerning the establishment of a protocol for civil servants, as stipulated in article 7 of the Steam Law (Law of 15 April 1896), (*Besluit tot vaststelling van eene instructie voor de ambtenaren, bedoeld in art. 7 der Stoomwet (wet van 15 april 1896)*, 14-1-1897, Staatsblad nr. 45).

In 1855 the government entrusted supervision to a separate agency, the Steam Service. Prior to that the government contracted the services of experts that performed inspections as an adjunct to their main occupations.

number of objections is unknown, but there were regular complaints.<sup>14</sup> An engineer sent to investigate conditions in the city of Zutphen heard from house painters working near a steam mill that ‘windows painted two days ago were once again speckled with black particles.’ He also reported that laundry hung out to dry appeared to be covered with black dust. Houses located downwind of the steam engine were unable to open their windows ‘...without breathing in choking fumes instead of fresh air.’ Also, at some houses ‘...the gutters and courtyards were full of dust and everywhere in the neighbourhood the windows were apparently dirty and glazed with smoke.’ Finally, the engineer examined the rainwater destined for consumption and found it to be ‘completely black.’<sup>15</sup>

Nearby residents sometimes also had problems with the boiler and the steam engine themselves. A certain Mr. Wouters of Nijmegen was one of them and protested the construction of a steam grain mill in the shed next to his home. The shed and the dwelling were separated by a brick wall ‘partly with a thickness of one brick and also a half brick.’ To make matters worse, Wouter’s box bed was positioned next to the shed, ‘surrounded only by a half-brick thick wall and only 60 inches (=0,6 m – HL) distant from the sheathing of the boiler.’ Wouters expected to sleep poorly. It was claimed that: ‘Because of the situation of the boiler and chimney, so close to the box bed and separating wall, his house will become unbearably hot, which in addition to the noise and the vibration of the engine, the threat of fire and explosion of the boiler will make the inhabitation and in general the renting of a portion of the house impossible...’<sup>16</sup> The workshops equipped with steam engines were more often than not located in the narrow streets of the city centres, surrounded by houses in which people lived and worked and ‘difficult to access in case of fire and dangerous for the entire neighbourhood.’ But factories on the edges of towns could also be dangerous and a nuisance.

Complaints about emissions and other nuisances were only rarely considered sufficient cause to refuse a permit. The interests of industry were usually allowed to prevail. Still, the laws did have some effect on steam technology. Where the government considered the complaints grounded, conditions were imposed, for example increasing the height of a chimney, the construction of a free-standing foundation and the installation of spark arresters in the chimney. Tolerance for smells, soot and smoke would change in the twentieth century. That not only had to do with the increase of coal consumption. Changed attitudes toward smells, soot and smoke also played a role. The city-dweller of the nineteenth century was pretty case-hardened regarding smells and trash in the streets, canals and creeks. But,

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<sup>14</sup>For the history of the Nuisance Law and its predecessors: J. Lintsen Sr., ‘De werking van de hinderwet tijdens de industrialisatie van Nederland (1890–1910)’, *Jaarboek voor de Geschiedenis van Bedrijf en Techniek JBGBT* 4(1987), 190–209.

<sup>15</sup>Report by J. van Ortt, hoofdingenieur, 27 juli 1863, no. 1561, Rijksarchief in Gelderland, G.S. Nijverheid inv.nr. 25.05112/2.

<sup>16</sup>Cited in: Lintsen, ‘Stoom in ontwikkeling’, 128.

increasingly, smells would be experienced as intolerable stenches and trash as waste and pollution.<sup>17</sup>

## 10.5 A Velvet Revolution<sup>18</sup>

The modernisation of the economy in England had aroused mixed feelings in the Netherlands. Many had looked with awe at the economic power that the country had developed. But many had also regarded the consolidation of a class society with trepidation and recoiled from the social tensions that that brought with it. Steam technology had been an important catalyst in bringing things to this pass. In England it had led to mechanisation, large-scale production and the emergence of the factory. With the factory system a new group of entrepreneurs had emerged that became the core of a bourgeois middle-class. Simultaneously, factory workers became a new group in the working class. In striking contrast to the luxury of the ‘nouveau riche’ stood the poverty of the factory proletariat. It created the fertile soil for an unprecedented class struggle.

Despite this, violent class conflicts would barely occur in the Netherlands in the nineteenth century and steam technology would be enthusiastically embraced. An important cause was the way in which steam technology in the Netherlands had been implemented in the first phase of industrialisation. Industrialisation proceeded across a broad front and spread throughout the entire country. A significant number of steam engines could be found in the food processing industry, the most important industrial sector and additionally in almost every branch of industry. One also found steam engines in both the coastal provinces and in the interior. To be sure, there was a visible concentration of steam engines in the provinces of South and North Holland and somewhat also along the large rivers, but large agglomerations of factories characteristic of industrialisation in regions like Lancashire, the Borinage, Lorraine, and the Ruhr region did not exist in the Netherlands.<sup>19</sup>

The Netherlands was unique in that the application of steam technology did not in the first instance lead to a factory system, but rather to the modernisation of workshops and small manufacturing enterprises. Craft production remained dominant. To be sure, labour relations in the large cities and elsewhere became more formal due to liberalisation and sharper competition, but these developments did not lead

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<sup>17</sup> See for example: A. Corbin, *Pestdamp en bloesemgeur: Een geschiedenis van de reuk* (Nijmegen 1986). Also: Lintsen et al., *Made in Holland*, 56–58.

<sup>18</sup> See for this section among others: H.W. Lintsen, *Een revolutie naar eigen aard: Technische ontwikkeling en maatschappelijke verandering* (inaugural lecture Delft, 1990) and Lintsen et al., *Made in Holland*, 142–143.

<sup>19</sup> E. Nijhof and A. van den Berg, *Het menselijk kapitaal: Sociaal ondernemersbeleid in Nederland* (Amsterdam 2012), 45.

to a breakdown of the old social order.<sup>20</sup> The informal relations characterising economic life persisted. The owner of small workshops continued to work alongside his employees and was barely distinguishable from them. Above all, he did not become part of a new bourgeois elite.

It is remarkable how much attention was given after 1870 to appropriate technology for small businesses in circles of tradesmen, industrialists, engineers and politicians, despite the fact that they by no means distanced themselves from large-scale industry. A wealth of publications appeared on the use of small engines and machines. The zenith of this propaganda offensive was the exposition of craft machinery in 1907. According to some, modern technology made the rationalisation of small firms possible and thus contributed to the strengthening of the crafts. 'If mechanical power has truly come to serve the craftsman and to facilitate the development of his independence,' according to the director of the Trade School in the Hague in 1890, 'then we can foresee a new period of the flowering of small industry and prosperity for its practitioners.'<sup>21</sup> The dominant ideological currents shared the enthusiasm for steam technology and mechanisation. Liberals, confessionals and socialists ranged themselves solidly behind technical progress.<sup>22</sup>

Though the Netherlands was spared a disruptive class struggle, this did not mean that there were no heated debates on industrialisation. The parliamentary enquiries of 1887 and 1890 had put the labour issue squarely on the political agenda. Though there the question of poverty played an important role, the issue had assumed a different character. It had shifted from extreme poverty to the 'social question.'

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<sup>20</sup>J.L. van Zanden and A. van Riel point to the formalisation of the labour market in Amsterdam and in the province of Groningen and the region of the *Achterhoek*. Van Zanden and van Riel, *Nederland 1780–1914*, 305–307.

<sup>21</sup>Cited in D. van Lente, *Techniek en ideologie: Opvattingen over de maatschappelijke betekenis van technische vernieuwingen in Nederland, 1850–1920* (Groningen 1998).

<sup>22</sup>Van Lente, *Techniek en ideologie*, op. cit. The enthusiasm of liberals and socialists for technological progress is an international phenomenon. An almost total lack of opposition to technology is striking for the Netherlands.

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