

THE INDUSTRIAL LANDSCAPES OF DENMARK 1840-1970

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Introduction

Denmark can be characterised as a small country with a large and highly productive agricultural sector. At the same time the industrial sector, which is often thought of as small by foreigners as well as Danes, is and has for a long period been of the same size as the European average.¹

Apart from the agricultural products the natural resources of the soil are relatively few. Therefore industries using local raw materials, like chalk and lime, which are concentrated in a limit number of locations and clay and gravel which are spread almost evenly all over Denmark, is more the exception than the rule. The number of landscapes directly formed by extractive industries is accordingly limited. Apart from agricultural raw materials most materials for industrial production have to be imported.

Although the size of the foodstuff industry is and has been relatively larger than in most other European countries the countryside was reserve for agriculture and industry was therefore located in the urban areas. But unlike the dramatic changes in the English Midlands the Danish urban system was not transformed radical during the first phase of industrialization and urbanization. The location of industry followed the existing urban system with its many harbour towns and which in terms of size was dominated by the capital, where industry first agglomerated. In the long term industry has spread from Copenhagen as a central place to the less central and smaller urban areas during the 20th century.

In terms of organization a relative large part of the Danish industrial firms has been small, flexible and craft like among these the cooperative dairies is the best known.

This paper will focus on how the natural resources have shaped Danish industry during changing techno-economic paradigms, and on how industry have formed the Danish landscape and especially how industry have formed particular landscapes or cultural environments in Denmark through the period 1840-1970.

The paper is based on statistical material and the cultural environments being selected as part of the Special Effort for the Industrial Heritage in Denmark which was initiated by the National Cultural Heritage Agency in Denmark in 2004.

The literature

Basically three approaches seem to have been followed in the literature on the industrial landscape²:

- The perception of the industrial landscape

¹ Maddison, A., *Dynamic Forces in Capitalist Development*. Oxford 1991.

² Trinder, B., *The Making of the Industrial Landscape*. (1982) London: Phoenix, 1997. Palmer, M. and Neaverson, P., *Industrial Archaeology Principles and Practice*. London: Routledge, 1998. Casella, E.C. and Symond, J. (eds.), *Industrial Archaeology Future Directions*. New York: Springer, 2005. Vikström, Eva, *Industrimiljöer på landsbygden Översikt över kunskapsläget*. Stockholm: Riksantikvarieämbetet, 1994. Hyldtoft, Ole, *Industrimiljöer på landet og Råstofmiljöer*. De kulturhistoriske interesser i landskabet. Etting, V. og Grau Møller, P. (eds.) København: Miljø- og Energiministeriet/Skov- og Naturstyrelsen, 1987, 127-171.

- The location of industry
- The typology of industrial environments (big or small)

Where the perception of the industrial landscape associates with art history, the location of industry draws on a geographical approach and the typology of industrial environments have its roots in archaeology. Common for the discussions over the years have been the emphasis on the need for a holistic approach. We should not restrict ourselves to interpret the environment only in terms of the technology used or the architectural qualities but also construe for example the social relations as they appear in the physical material. Nevertheless the weak point is how to form an integrated or holistic story out of this.

One possible approach is to use the concept of changing *techno-economic paradigms* which the economist Carlota Perez has applied to characterize the changing best-practices since the first industrial revolution. According to Perez the techno-economic paradigms is brought about by a technological revolution which is understood as a “cluster of new and dynamic technologies, products and industries, capable of bringing about an upheaval in the whole fabric of the economy and of propelling a long-term upsurge of development.”³ It includes a new input, a source of energy or a material, new products, new production processes and new infrastructure. In other words elements which are highly likely to shape the landscape. For Perez a techno-economic paradigm is a best-practice, the development and deployment of which is both driven by the relative price structure – it is cheaper – and is at the same time cultural shaped because it becomes a paradigm or a style without relation to the price structure defining the model for the normal practice. It is certainly possible to question neo-evolutionary economics and the interpretation made by Perez, although after the end of bubble in 2001 it does seem to have some predictive power. The approach may be too technological deterministic, although it does imply a social shaping of the technology. And certainly there is no agreement on the dating or even the exact number of the technological revolutions. Instead of the five paradigms Perez proposes other have suggested three.⁴ But maybe of greater importance is the lacking geographical dimension. How does a paradigm spread? Further you may question the idea of one single dominating paradigm and claim that several paradigms exist simultaneous. Nevertheless it might be rewarding to search for how and to what extent changing techno-economic paradigms have formed the industrial landscape.

Due to lack of space I will not go into the changing perception of the industrial landscape in Denmark although the “missing” image of Denmark as an industrial country is an essential theme. Currently there is ongoing research on the agrarian image and on the representation of workers in the fine arts. In the following I will sketch first the changing structure and location of industry and then the transformations of the industrial landscape.

The structure and location of industry

When we look at Denmark with its 5.5 million inhabitants as an industrial landscape or region we are reminded that the demarcation is some what arbitrary as the industrial structure of the

³ Perez, Carlota, *Technological Revolutions and Financial Capital*. Edward Elgar, Cheltenham UK. Northampton MA, USA 2002, 8.

⁴ Freeman, Chris and Loucã, Francisco, *As Time Goes By. From the Industrial Revolution to the Information Revolution*. Oxford: Oxford University Press, 2001. Isacson, Maths: *Tre industriella revolutioner?*. Industrialismens tid. Ekonomisk-historiska perspektiv på svensk industriell omvandling under 200 år. Eds. Maths Isacson and Mats Morell. Stockholm, 2002, 11-28.

neighbouring areas of Southern Sweden and Northern Germany is relative similar. And there have been a number of contacts in this wider area. For example the first spinning machine in Denmark was built around 1779 by a Swede, Nordberg, who had visited England several times. And the constructor of the first locally built steam engine in Berlin from 1816, Freund, had been an apprentice in the smithy of his cousins in Copenhagen the son of which built the first engine in Denmark from 1828 (constructed by a Dane and not imported) after being an apprentice in Berlin.⁵ So it could be argued that this whole area constitutes one single industrial region. On the other hand the cooperation across the changing borders has been relative limited until recently. Here I will restrict the scope to the present Denmark and make a few comparisons with Swedish industry to point out the differences and thereby characterise the Danish industrial landscape although it should not be forgotten that the two countries in the wider perspective is rather similar.

Further it should be noted that Denmark is situated along the important trade route between the Baltic Sea and the North Sea so that trade, shipping and fishery has been relative important occupations. Before industrialization started the level of urbanization was high compared to the other Nordic countries 21 % compared to 13-6 % in 1840.

The start and course of industrialization in Denmark has often been discussed by Danish historians and various periodizations have been put forward. Both the 1870s, 1890s, 1840s and 1920s has been proposed as the starting period of the process. This in it self seems to suggest that it was a drawn out process. Often economic historians use the average growth of the GNP per capita as a measure of industrialization. When the growth is 1 % or more industrialization is thought to have started. On the basis of the existing calculations of the GNP (which probably should be recalculated) that appears to have been the case in Denmark in the years around 1840. Likewise the share of the population living in urban areas (defined as built up areas with 200 or more inhabitants) started to rise from around 1840, from a level of around 20 % in 1840 to around 85 % in 1980.

When we look at the employment of the population on the basis of the population censuses (which are imprecise on this point) the share of the population employed in agriculture declined from 1840 and especially after 1870, while the share employed in industry and crafts was rising from around 1840 and until around 1970. At the same time the share employed in service rose even faster especially in 1890s, 1950s and after 1970. On the basis of these figures it is tempting to see Denmark as an agricultural society until approximately 1930, as an industrial society between approximately 1930 and 1970 and as a knowledge or network society from approximately 1970. It is interesting to note that the employment of the Swedish population shows much the same pattern although there are differences. In 1870 the share of employment in industry and the service sectors were slightly larger in Denmark and during the period when industry dominated the share employed by industry was slightly larger in Sweden than in Denmark respectively 45 % and 40 %.⁶

The size of the industrial branches changed during industrialization. The textile industry was large already in 1840 but declined especially after 1945 while the engineering industry employed a raising share of the employed in the whole period from 1870 to 1972. Compared with Sweden Danish industry employed more people in the foodstuffs industries and less in the engineering industries. Apart from the transformations of the industrial branches it appears as characteristic that

⁵ For further examples see Rasmussen, Frank Allan, *Crossing the North Sea: Some Examples of Transfer of Marine Technology from Britain to Denmark 1800-1912*. The North Sea Resource and Sea Way. Proceedings of the North Sea History Conference Aberdeen 1993. Published in 1996 by the Arts & Recreation Department Aberdeen City Council.

⁶ For the Swedish figures Isacson, Maths, *Den högindustriella epoken*. Stockholm: Dædalus 2000, 53-67.

almost all branches were represented, which suggests that most technologies were tried with more or less success. For example two hammer mills were established in the 1850s to produce different kinds of edge tools although it might be expected that they could be produced cheaper in the Bergslaget or the Black Country. Nevertheless the hammers worked for several decades. Gradually import substitution declined, but according to the present available BNP calculations the industrial export first exceed the agrarian export as late as in the 1960s.

It is commonly assumed that the firms grew bigger and bigger as industrialization developed and the economy “matured”, you could postulate a development:

- from small family based, paternalistic firms,
- over bigger, first neo-paternalistic and then more bureaucratic firms, maybe organized as a joint-stock enterprise and vertical and horizontal integrated
- to the big multinational and multidivisional firms.

But at least in Denmark most firms did not become vertical or horizontal integrated and even less multinational. Further the structural change in the economy after 1970 has for some demonstrated that the big firm not necessarily is the goal of history.⁷ And Piore and Sabel have argued for the non- inevitability of mass production and the big firm and instead point at the smaller firm and flexible production as an alternative.⁸ The small firms do not necessarily lack behind the big companies or form the minor partner in a dual economy. In Denmark it is possible to differentiate between at least three kinds of organizations: the relative big companies like Carlsberg, Burmeister & Wain or Danfoss, the cooperative dairies and slaughterhouses which until around 1960 were many and often small but today are few and big, and finally the many small scale firms.⁹ Although there are severe data and definition problems it seems likely that the average size of the Danish firms grew from the 1890s to the 1920s and again from the late 1940s and until around 1970. But then from the 1990s the average size diminished. And compared with Sweden it becomes clear that the average size of the Danish firms were substantial smaller than the Swedish apart from a few years around 1970.

Finally when we look at the location of industry it is characteristic that most industry was situated in urban areas and not in the countryside. In 1855 when approximately 38 % of the mechanical power used was waterpower only 26 % of the workforce was employed in the countryside. And this share fell to 12 % in 1958. The location of the industry followed the existing urban system rather close, the higher the rank of the town the more industry and the more industrial branches. During the industrialization the urban system did not change dramatically. But some towns altered their rank in the system. For example Århus went from a fifth rank to a second rank between 1855 and 1880 at least partly because it became a railway junction and the harbour was extended while especially Helsingør and to a degree Aalborg and Odense lost momentum. Further a new layer of towns was added from the 1870s and especially after 1890. The so called “railway towns” typically situated at a distance from the old market towns and servicing the local agriculture. These small

⁷ Lamoreaux, Naomi R. Raff, Daniel M.G. and Temin, Peter, *Beyond Markets and Hierarchies: Towards a New Synthesis of American Business History*. American Historical Review, 2003, 404-433.

⁸ Piore, M.J. and Sabel, Ch., F., *The Second Industrial Divide Possibilities for Prosperity*. New York: Basic Books, 1984.

⁹ Kristensen, Peer Hull and Sabel, Charles, *The small-holder economy in Denmark: the exception as variation*. World of Possibilities. Flexibility and Mass Production in Western Industrialization. Eds. Charles F. Sabel and Jonathan Zeitlin. Cambridge: Maison des Sciences de l’homme, Cambridge University Press, 1997, 344-378.

towns also attracted some industry. Industry seldom dominated a town completely; normally a substantial part of the population was employed in the service sector. Until around 1950 a little less than half of the industry was located in the Copenhagen area. Other areas of concentration were the towns in East Jutland and Odense at Fun. Although the capital had a dominating position as the centre of industry the share of the industry in western Denmark (Jutland and Fun) have gradually risen from 32 % in 1872 to 58 % in 2004.

The changes of the physical landscape

In this last part I will attempt to summarise the changes in the industrial landscape of Denmark using the concept of techno-economic paradigms for periodization.¹⁰ It should be underlined that it is a sketch which is only supported by a limited amount of research on the built environment. The focus will be on the development in urban areas, because most industry was located here. It should briefly be mentioned that some linear industrial landscapes in the countryside had developed before 1840 such as “Mølleåen” north of Copenhagen¹¹ and that there had been established some estates which combined agriculture with industrial production like “Frederiksværk” although the number was few compared to Sweden.

In the period *1840-1890, the age of steam and railways*, most of the industrial works were established in built up areas in the old parts of the towns.¹² And as in the preceding period existing buildings were sometimes used. One of the first iron founders in Copenhagen for example reused buildings of a former tapestry and playing cart factory and another reused two warehouses, others started in a rented room in a cellar or in a back building. Moreover it was possible to rent space as well as mechanical power. New buildings were also added. In most cases it appears to have been the local builder and the owner who designed the buildings even though professional architects had been educated since the 1750s and engineers from 1829. At least among the iron foundries and engineering shops the building process was piecemeal and suggests that relatively small amounts of capital were needed or available and that the diffusion and adoption of new production methods were gradual. With few exceptions it was isolated processes which were mechanized. In the building process it appears that the efforts were concentrated on the functional adaptation of the isolated building to the production process rather than to the layout of the whole. Until the later part of the period the plant also often included the dwelling of the owner but not dwellings for the workers. When the plant consisted of several building they were typically arranged around one or more courtyards following one of the most common settlement patterns.

The symbol of the factory was the mill or the multi-story factory building later accompanied by the single-story building or shed both associated with the textile industry. Halls were also used for example for foundries. But the most common building type was the “wing” used for small scale

¹⁰ Perez uses the first introduction of a new technology for dating a paradigm. I use the period of diffusion. A further reason for a difference in the dating of the paradigms is that they were diffused later in Denmark than in the place of origin. This underline the need for incorporating the geographical aspect in future research.

¹¹ Tønsberg, Jeppe, *Drivkraft og bygninger på Mølleåens møller og fabrikker*. Lyngby-Bogen 1998, 11-63.

¹² Hyldtoft, Ole, *Københavns industrialisering 1840-1914*. Herning: Systime 1984. Johansen, Hans, Chr., Boje, Per and Monrad Møller, Anders, *Fabrik og bolig. Det industrielle miljø i Odense 1840-1940*. Odense Universitetsforlag 1983. Toftgaard Jensen, Jens and Norskov, Jeppe, *Købstadens metamorphose. Byudvikling og byplanlægning I Århus 1800-1920*. Dansk Center for Byhistorie/Aarhus Universitetsforlag 2005. Peter Dragsbo, *Mennesker og huse i Aabenraa – et etnologisk studie af kvarterudvikling i en nordslesvigsk købstad 1850-1920*. Esbjerg: Sydjysk Universitetsforlag 1978.

production in most industries from foundries to dairies. The “wing” also typically housed the dwelling of the owner in the first part of the period.

Apart from the extension of the navy dockyard in Copenhagen and the founding of Frederiksværk with canon foundry and powder mills both back in the 1700s industrial areas do not appear to have been planned by public authorities before 1890. But to a certain extent the Copenhagen harbour had the character of an industrial area with its changing number of one or two breweries, sugar refineries, shipyards, ropewalks, and corn mills besides the warehouses mostly from the second part of the 1700s and the navy dockyard.

In the period *1890-1950, the age of steel, electricity and heavy engineering*, the firms as well as the actual plants on average became larger, and the period appears to be characterised by an increasing interest in production flows and the internal transportation at the plant. This also meant an increasing use of planning. It is of course possible to find planned plants before 1890 such as cement factories or the small railway repair works in Århus from 1868. But it is characteristic that the numbers of engineering candidates rose from 165 in the period 1880-89 to 975 in the period 1910-19. One of the principal ideas in the planning of urban areas was the segregation of different functions and classes so as to separate areas for industry, different kinds of dwellings and business. This was for example part of the stipulations for the planning competition for Greater Copenhagen in 1908. And in praxis a number of areas were reserved for industrial use often situated near a railway line and/or a port as the industrial area in the Copenhagen Free Port which opened in 1894. A few years later the railway system of Copenhagen was transformed when a central railway station replaced several older terminal stations and thereby connecting former separated lines north and west of city, a system introduced in Stockholm in the 1870s and in Berlin in the 1880s. It should be added that the number of planned industrial areas increased from the 1930s and again from the 1950s.

At the level of the singular plant the same tendencies can be observed among the bigger firms. One example is the engineering works of Burmeister & Wain in Copenhagen. From the establishment of the firm in 1845 in the inner part of the port and until around 1870 the layout consisted of an increasing number of relative small buildings mostly in one or two stories and situated around several courtyards. The communication between the workshops took place not through the buildings but across the courtyards. The plant did not include housing for the workers, but the two owners lived at the plant on top of one of the workshops. After 1870 the owners removed their residence from the premise and the shipyard was moved to the outer harbour. At the old premises where the engineering works continued, the smaller workshop buildings were gradually replaced by larger halls as well as a single multi-story building. From the 1890s these halls were interconnected by crane ways with electrical driven travelling cranes. Generally the combination or integration of different building type appears as typical of the period.

These structural changes influenced the location of industry. In Greater Copenhagen, where the industry as late as the 1880s had been concentrated in the old built up area, the concentration of industry had by the time of the First World War moved to the periphery.¹³ Likewise the formation of a central business district started from the mid 1880s. The areas outside the old ramparts had turned into classic working class areas with a mixture of densely build dwellings around one

¹³ Hyldtoft, Ole, *From Fortified Town to Modern Metropolis. Copenhagen 1840-1914. Growth and Transformation of the modern City*. Hammarström, I. and Hall, Th. (eds.). Stockholm: Swedish Council for Building Research 1979, 49-58.

backyard after another like the “Mietkasernen“ of Berlin as well as a few dwellings built by philanthropic societies and neo-paternalistic factory owners. On the other hand the factory owners themselves and other well situated middle-class people lived further north of the city or in the centre. While this spatial pattern shows a new distribution of functions the social segregation does not appear to have increased significantly (although there are serious measurements problems), not because it was not present but because the pre-industrial town was already socially segregated.

In the period *1950-70, the age of oil, the automobile and mass production*, many of the features already introduced in the preceding period spread. The numbers of municipalities and counties with a framework plan for their area increased markedly and so did probably the number of designated industrial areas, now typically situated near a main road or one of the new motorways. The overall planning at the national level and not least the location of the new motorways was also debated and a board of national planning was established in 1961, but a legally binding master plan for the whole country was never agreed upon.

At the level of the individual plant there seems to have occurred a change. According to the pioneer of the history of Danish industrial architecture, Jørgen Sestoft, the period is characterised by a change towards multi-functional, single-story industrial buildings where the production lines inside easily can be rearranged, as opposed to the industrial buildings of the 1800s which in optic of Sestoft were designed to follow the technology they were built to contain.¹⁴ These multi-functional single-story buildings is no doubt characteristic for a major part of the industrial plants built after 1945 and together with the planned, mono-functional industrial areas or parks as they are sometimes named, they constitutes what Reyner Banham has called a “flatscape”. Spontaneously the multi-functional buildings in the mono-functional area might appear as a contradiction, but according to Banham these buildings and areas can largely be understood as a planned adaptation to horizontal transportations systems.¹⁵

But the flatness was a style too signalling modernity and American efficiency. It is in this period that not only the single-story factory but single-story housing (etplanshuse) as well became the norm. The single-story plant was promoted in the leading journal of architecture from 1946 with the architect Preben Hansen as one of the leading spokesmen. This American turn took place during and after the Second World War and was later supported as part of the Marshall program. But even though the size of the firms were growing it is clear that most of the Danish plants were small compared to the Ford and GM plants which were presented in the professional journals as models. Some of the most commented on Danish plants were in 1954 the *Atlas Works* for the production of refrigerators or in 1962 the chocolate plant *Toms Fabrikker*, a firm which just after the war had introduced the “Yankee Bar” as a copy and competitor to the American “Mars Bar”. The plant was designed by Arne Jacobsen and can be seen as a distillation of the ideal of the American single-story plant, just like Jacobsen a few years before had designed the SAS Building in Copenhagen including a hotel and the SAS Town Terminal as a distillation of an American skyscraper based on the model of Lever House. Even a “shop-town” or trading estate for small firms from 1953 in Copenhagen was designed as a large single-story plant although divided into small sections. Many well founded functional reasons can be given for the spread of the single-story plant but at the same time it appears to have become a style used also where the functional reasons seems less convincing.

¹⁴ Sestoft, J. *Arbejdets bygninger*. Copenhagen: Gyldendal 1979, 170.

¹⁵ Sestoft, 183.

But this modernistic, big-firm American ideal was not absolute. The period like the preceding also saw new “small-scale” industrial landscapes where dwellings and production was not separated. One example is the “Artisan-Town” in Greve south of Copenhagen which developed from the late 1950s.¹⁶ Surrounded by greenery as industrial areas should be according to the planners about 50 small family firms gradually build a small shop on their plot and then typical some years later a dwelling. The term family firm should be understood literary. In most of the firms husband and wife worked together and sometimes the children participated. Occasionally friends were employed or participated as partners. And employees started their own firm nearby. Another more well-known example is the textile area around Herning in Jutland where most of the buildings are from the decades after the Second World War although local textile production had started as a protoindustry. Here again is a mixture of dwellings, outbuildings and garages where you can be sure the owner once had one or two knitting machines working. And there are more regular “flatscape” industrial areas along the “Factory Road”.

Ending

What I have sketched is that the industrial landscape to a large extent appears to reflect the changing techno-economic paradigms as they diffused and were adopted in Denmark.

During the period 1840-1890 mechanization and steam engines spread and were typically housed in “wings”, multi-story mills and hall, all building types which had been introduced earlier, or in single-story sheds, which were introduced in the period. New large technical systems like railways were established and hereby also the need for large scale planning. But the layout of most plants seems to have followed one of the most common settlement patterns in the Danish towns, houses arranged around one or more courtyards. At the beginning of the period the dwelling of the owner was often situated at the plant. This suggests a resemblance to the paternalism of the crafts. On the other hand the workers did not typically live at the plant. Especially in the later part of the period the workers organized strikes and trade unions which had a breakthrough in the 1870s. Partly as a reaction to this some factory owners started to build workers housing among other neo-paternalistic welfare measures. Before this philanthropic societies had started to build workers housing especially in Copenhagen in the 1850s.

In the second period 1890-1950 when electricity and steel spread the firms in average grew bigger and more bureaucratic as did the interest for planning both private and public. The plants became larger and more attention was paid to the over all layout and its relation to production and transportation flows. The combination of different building types also became more common. Already in the beginning of the period the functional segregation of the urban areas appears to have increased, a tendency which was later to be promoted by public planning. Likewise a substantial part of the housing was provided by cooperative associations supported by the public a sign of the growing influence of the Social Democratic Party, which had been formed in 1878.

In the third period 1950-1970 the features of the second period were intensified and the numbers of segregated industrial areas increased radically while the single-story factory was promoted as the most rational and still larger parts of the urban areas were transformed into flatscapes.

¹⁶ I owe this example to an unpublished report by Kirsten Egholk, 2005 Greve Museum.

But besides these characteristics mainly describing the development of the larger firms a part of the industrial landscape was formed by small firms.