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Between men and machines: women workers in new industries, 1870–1940

The employment of women in the new industries clearly differed from that in the traditional industries. This article sets out to explore this difference. The new industries produced goods which could not be seen as a continuation of earlier products. Hence the work could not easily be labelled male or female by analogy or tradition. There was no carry-over of guild-like regulations from earlier industries that could influence the employment of men or women as workers in these industries. Unions in these industries had not yet taken root. As the products and the production techniques were continuously changing, there was not enough time for traditions to develop within the new industries. It was difficult to gender jobs by making claims on the basis of skill. Skill, in itself a biased concept, played a much smaller role in the new industries than in the traditional industries.[1] Claims on the required physical strength could also not easily be justified.

Circumstances in the new industries seemed to encourage the employment of large numbers of women. Various authors have drawn attention to the fact that it is surprising that these industries did not employ more women. From a cost perspective, and considering the lack of traditional barriers, employers might have seized the opportunity to employ more women. Mike Savage thinks that the reason fewer adult women were employed than could rationally be expected is that employers preferred to employ other kinds of cheap labour such as juveniles, and workers from disadvantaged ethnic groups.[2] Ellen Jordan suggests that employers in the new industries were bound by their middle-class ideas about what work was suitable for women, and hence employed fewer women than would have been possible.[3]

Harriet Bradley has pointed out that the newness of work must not be overestimated. Most 'new' work was rooted in existing tasks. The sex-labelling of tasks in 'new' work was

[1] Ann Phillips and Barbara Taylor, 'Sex and skill: notes towards a feminist economics', *Feminist Review*, VI (1980), 79–88. See also Gertjan de Groot and Marlou Schrover (eds), *Women Workers and Technological Change in Europe in the Nineteenth and Twentieth Centuries* (London, 1995).

[2] Mike Savage, 'Trade unionism, sex segregation, and the state: women's employment in "new industries" in inter-war Britain', *Social History*, XIII, 2 (May 1988), 209–30.

[3] Ellen Jordan, 'The exclusion of women from industry in nineteenth-century Britain', *Comparative Studies in Society and History*, XXXI, 2 (April 1989), 273–96.

almost always modelled on sex-labelling in existing, albeit even vaguely similar, work.[4] Miriam Glucksmann focuses on the supply side of labour. She has drawn attention to three mutually interacting changes. Mass production relied on changes in the domestic economy, which depended on the emergence of new forms of employment for women, which in turn rested on mass production. The new industries offered work opportunities for the young women who were entering the labour market, as the demand for domestic labour, both paid and unpaid, decreased due to the products of the new industries. This process, however, was not fast enough to make the employment of more women feasible.[5]

This article sets out to explore what facilitated or hindered the employment of women in the forerunners of what were to become the largest Dutch, and indeed among the largest of the world's enterprises: Unilever, AKZO and Philips. These producers of margarine, rayon and electrical appliances were characterized by their rapid growth, their domination of local or regional labour markets, their domination of production, and an international orientation. The production of margarine, although a butter substitute, in no way resembled the production of butter. Rayon factories produced yarn, but like margarine, only the final product resembled silk yarns. Light bulbs, and later radios, did not have clear forerunners at all. As many aspects of the work in the new industries were completely new, these industries offer a unique opportunity to study the initial process of the gendering of work.

UNILEVER, AKZO AND PHILIPS

Margarine was invented in 1869. Its production was first taken up on an industrial scale by the two biggest Dutch butter traders, Jurgens and Van den Bergh. They merged in 1927 to form the Margarine Unie. Two years later, this firm, the world's largest margarine producer, merged with the world's largest soap producer, the British Lever brothers, to form Unilever.[6] Unilever became a major European margarine and soap producer, but also produced meat products, vegetable oils, candles and later all sorts of other products in the fields of food and cleaning.

The method for producing artificial silk or rayon on an industrial scale was developed in Great Britain and the United States. The founder of the Dutch rayon industry, J. C. Hartogs, learned to apply the viscose spinning process while working at the British Courtland rayon factory. In 1911, he founded the first Dutch rayon factory (Nederlandsche Kunstzijdefabriek, ENKA) in Arnhem, followed, in 1922, by a second factory in Ede. Later a sorting department was set up in Rotterdam. ENKA thrived during the First World War. In 1929 ENKA merged with the German Vereinigte Glanzstoff Fabriken AG

[4] Harriet Bradley, *Men's Work, Women's Work. A Sociological History of the Sexual Division of Labour in Employment* (Cambridge, 1989).

[5] Miriam Glucksmann, *Women Assemble. Women Workers and the New Industries in Inter-war Britain* (London, 1990), 261, 269, 275; 'In a class of their own? Women workers in the new industries in inter-war Britain', *Feminist Review*, XXIV (Autumn 1986), 7–38.

[6] Charles Wilson, *The History of Unilever. A Study in Economic Growth and Social Change* (London, 1954); Marlou Schrover, *Het vette, het zoete en het wederzijdse profijt, arbeidsverhoudingen in de margarine-industrie en in de cacao- en chocolade-industrie in Nederland 1870–1960* (Hilversum, 1991).

(VGF) to form the Algemene Kunstzijde Unie (AKU). The VGF was a large firm with six factories in Germany, and many outside it. In 1930 the AKU bought up its only Dutch rival, the Hollandsche Kunstzijde Industrie (HKI). After that, it developed into a large international chemical concern. In 1969, the AKU merged with the Koninklijke Zout-Organon (KZO), itself the result of a merger between the pharmaceutical firm Organon, and a large salt mining firm, to become the chemical and pharmaceutical multinational enterprise AKZO.[7]

Philips started in 1891, in Eindhoven, as a producer of electric lamps. The mass manufacture of lamps proved so successful that all other Dutch competitors were soon taken over by this firm. Philips's expansion was not the result of one product, but of a growing range of products. During the First World War, Philips started to produce radio lamps. This was the starting point for the manufacture of other radio components and, by the end of the 1920s, complete radios. At the beginning of the 1930s, Philips was no longer a single product industry, but brought out a wide range of electrical products.[8]

During the interwar period all three firms were already multinational enterprises. The incentive to invest and expand abroad came from high tariffs, and other protective measures taken in various countries during this period. But mergers with firms outside the Netherlands also caused these firms to become much more than just major Dutch enterprises. Not only were the products and the production techniques continuously changing, but also the company structure. This affected the ways of thinking about personnel management, including the division of work between male and female workers.

The industries were characterized by a restricted number of firms, and a restricted number of plants, and a highly concentrated workforce. Jurgens and Van den Bergh, the forerunners of Unilever, already held over 70 per cent of the Dutch margarine market. They held a similar position on an international scale. Their position in the field of soaps was equally strong. After 1930, Philips and AKZO's forerunners were virtually the only producers in their respective fields in the Netherlands. Thus, by 1930, all three had developed into one-firm industries. The number of workers per plant was counted in thousands, and not in hundreds. In 1930 Philips employed over 22,000 workers, AKU some 8000, and the Dutch branch of Unilever employed more than 7000 workers, of whom over 2000 were in margarine.[9] The size of the plants made economies of scale possible, and rationalization attractive. All three firms discussed here were pioneers in

[7] Max Dendermonde, *Nieuwe tijden, nieuwe schakels (Arnhem,* 1961); Frans A. Versteeg, 'De kunstzijde-industrie te Arnhem en Ede. Een geschiedenis van de ENKA/AKU van 1911–1955', unpublished paper (Leiden, 1979); B. Klaverstijn, *Samentwijnen, via fusie naar integratie* (Arnhem, 1986).

[8] A. Heerding, *The History of N.V. Philips' Gloeilampenfabrieken*, vol. 1, *The Origin of the Dutch Incandescent Lamp Industry* (Cambridge, 1985); vol. 2, *A Company of Many Parts* (Cambridge, 1988); Ivo Jules Maria Nico Blanken, *Geschiedenis van Philips Electronics N.V. Deel III De ontwikkeling van de N.V. Philips's Gloeilampenfabrieken tot elektrotechnisch concern (1922–1934)* (Leiden, 1992); Ben P. A. Gales and Keetie E. Sluyterman, 'Outward bound. The rise of Dutch multinationals', in Geoffrey Jones and Harm G. Schröter (eds), *The Rise of Multinationals in Continental Europe* (Aldershot, 1993), 65–98; Ien van der Coelen, *100 jaar vrouwenarbeid bij Philips* (Utrecht, 1991).

[9] Schrover, *op. cit.*, 75; Blanken, *op. cit.*, 422; Dendermonde, *op. cit.*, 99.

their respective fields, not only nationally, but also internationally. They were strongly oriented towards innovations, and derived their strength from that.

The firms dominated the local labour market of Oss, Eindhoven and Ede, and to a lesser extent influenced the labour market of Rotterdam and Arnhem. They were confronted with periodic labour shortages, when they had to struggle to attract or keep labour, alternating with periods of redundancies. They expanded their production, branching out horizontally and vertically, and becoming much more than the producers of the original products of margarine, rayon and light bulbs. All three industries were capital intensive. In 1920, Philips's capital accumulated to 20 million guilders, with a personnel of 5394 (c/l ratio 3700); in 1920, Van den Bergh and Jurgens capital amounted to 63 million guilders, with a personnel of 5402 (c/l ratio 11,662); in 1920, the ENKA capital, the youngest of the three firms and still in its take-off phase, was two and a half million, with a personnel of 630 (c/l ratio 3968).[10]

In the margarine industry, labour only constituted about 5 per cent of the total production costs. At Philips, and in the rayon industry, this percentage was much higher, and fluctuated rather sharply. Around 1930 it was about 40 per cent. After that, due to rationalizations, it decreased to about 15 per cent.[11]

It is not easy to express the position and dimension of these new industries in precise figures. In 1938, the Netherlands, for instance, ranked third in the world as exporters of rayon yarn, and some 80 per cent of the Dutch yarn production was exported.[12] These figures, however, do not do justice to the importance of the AKU, which was actually much larger, because this company had production plants outside the Netherlands. Likewise, already in 1908, Van den Bergh produced 27 million kilograms of margarine in the Netherlands, but 37 million in Germany. In 1922 these figures were 36 million for the Netherlands, and three times as much for Germany. Jurgens equalled these figures with a Dutch production of 12 million, and a German production of 34 million in 1908, rising to 29 million and 143 million in 1922. In 1922 over 75 per cent of Dutch production was exported to the United Kingdom, constituting 99 per cent of British imports. In 1929, Philips had 27,000 employees in the Netherlands, and 13,000 outside it. In 1937 there were 19,000 employees in the Netherlands and 28,000 abroad.[13] The industries discussed here were not only the most important new industries in the Netherlands, but were also important on an international level.

MARGARINE

Margarine started to be produced on an industrial scale between 1870 and 1900. At first, the number of workers was small. In these early years, most work in the margarine industry was done by men. Factories usually only employed one woman – for cleaning. After 1900, changes occurred as a result of the introduction of a new way of selling margarine. Until then, margarine had been sold to retailers in crates or barrels.

[10] Wilson, *op cit.*, vol. II, appendix 16 and 17; Schrover, *op. cit.*, 284; Heerding, *op. cit.*, vol. 2, 279, 337; Dendermonde, *op. cit.*, 36.

[11] Dendermonde, *op. cit.*, 99.

[12] *Het boek van de kunstzijde, samengesteld door de NV internationaal kunstzijde verkoopkantoor te Arnhem* (Arnhem, 1941), 35.

[13] P. J. Bouman, *Anton Philips. De Mens, de Ondernemer* (Utrecht, 1966), 165, 187.

Shopkeepers would take the amount of margarine the customer wanted out of the barrel, form it into a rectangular shape and wrap it. Between 1900 and the beginning of the First World War, pre-wrapped margarine took over, formed and wrapped in the factory. Selling pre-wrapped margarine enabled the producers to push certain brands, thus making advertising easier and more worthwhile. It was in wrapping that large numbers of female workers were employed.

Around 1910, the bulk work of packing margarine in crates and barrels was done by adult males, assisted by boys. That this work was originally gendered as masculine may find its roots in the work of coopers. Jurgens and Van den Bergh were originally butter traders. They did not employ many workers, as the butter was still made on farms at that time, and their only workers were coopers. Coopering was clearly a male profession. Packing margarine may have originally been gendered as male due to its similarity to this work.

In the packing department, there was about one boy to every three men. Tasks in the packing department were distributed meticulously. A 'weighter' took the right amount of margarine, and threw it into a crate. A 'stamper' made sure the margarine was fitted properly in the crate. The stamper pushed the full crate on, and replaced it with an empty one. The empty crate had been lined with tulle by a boy. Tulle was torn in pieces of the right size by a woman. A factory usually did not need more than one woman for this work. She could even combine it with cleaning. The stamper got his crate from a 'crate giver', who was assisted by a 'crate carrier'. The filled crate went to a 'leveller', a boy who smoothed the top, and impressed a picture on it. The leveller folded a piece of parchment and pushed the crate on to the 'nailer' who fastened the lid. Then the lid and the crate were marked by a boy 'crate marker', and put on a transporter by a 'crate taker'. In the 1920s, after women had made their entrance into the factory, girls of fourteen or fifteen were also employed in the bulk packing department. They filled the crates with margarine, and impressed the picture on top of the margarine. They folded the parchment, put the lids on top of the crates and lifted the 25 kilogram crates into baskets that moved on rails. Further on, the crates were 'nailed' by men.

As becomes clear from this description of the work in the wrapping department, which was later to become dominated by women and girls, the tasks were already strictly subdivided. A high degree of subdivision is usually seen as a characteristic of women's work. Furthermore, as the description shows, the work cannot be considered highly skilled. Work in the wrapping department was not, nor was it perceived to be, work that was physically too strenuous for girls, as is evident from the employment of girls in this department in the 1920s.

Large-scale wrapping of margarine in small pieces, rather than in bulk, started around 1900, and was very labour intensive. The boys employed for this job cut the muslin and paper that was used for the wrapping, wrapped the margarine, lined the crates with tulle, placed the wrapped margarine in the crates and nailed the lid on. The boys employed for wrapping at Jurgens were called Solo boys, after the brand of margarine they wrapped. The Solo department of Jurgens consisted of one overseer, six male adults and fifty-two boys. The boys in this department were very young. Despite the 1874 law forbidding the employment of boys under the age of twelve, eleven-year-old boys were employed there. In 1900 the age at which juveniles were allowed to start working was raised to fourteen or

fifteen, depending on whether they had finished the required years of schooling. Despite the law there were frequent complaints that Jurgens employed boys who were still of school age. Jurgens said that he needed more boys than were available. The firm had some trouble disciplining the boys. In 1913, the boys came up with the request, supported by the local union, to be beaten less.

After the turn of the century, the demand for pre-wrapped margarine increased. Girls were hired for wrapping. At first, the Jurgens management was reluctant to hire girls, because they could not get a permit to let girls under sixteen years of age work for the desired number of hours. In 1906, the Solo boys worked from six in the morning to eight or nine in the evening, two hours longer than the regular hours. Jurgens did get permission for these extra hours, and after the introduction of the first simple wrapping machines, in 1915, the management hired more girls.

It should be clear that wrapping small pieces of margarine was by no means considered to be women's or girls' work from the onset. Despite the shortage of boys, and the problems with discipline, it took some time before the Jurgens' management decided to hire girls on a large scale. The innovation that triggered this change was the introduction, in 1915, of a machine that looked like a large egg slicer, which cut slabs of margarine into pieces of more or less the same size. This machine was soon followed by a 'piece bank machine' which produced pieces of margarine of regular size and shape. Before these innovations, margarine had to be formed into shape with wooden blocks. Now this was no longer necessary. There were six girls to a piece bank machine. The two girls sitting nearest to the machine took the pieces of margarine and rolled them in paper. The next two girls folded the wrapping. The two girls at the head of the table placed the pieces into crates, and replaced full crates with empty ones. As the work in the wrapping department was labour intensive, much time was spent studying the way the girls worked. In 1915 one of the factories organized a competition among the girls. Nine tables of girls competed for eight hours. The girls at the table that managed to wrap most margarine received a small prize. The results of the competition were used to set a standard for the pace of work.

Figure 1 shows the gender distribution of the workforce at Jurgens. The sudden influx of women is apparent. From 1916 onwards, girls, mostly between fourteen and sixteen years of age, accounted for one-third of the factory population. They partly substituted and partly supplemented the boys. There was no replacement of adult male workers by either girls or women.

The women workers were concentrated in the wrapping department. Outside it, where the oils were refined and the margarine was churned, there were hardly any female workers. Work in the churning department mainly involved moving large amounts of margarine from one machine to the next with shovels and trolleys, and was generally considered physically strenuous and unskilled. An exception was the work of the churn master. He was considered highly skilled, and paid accordingly. For the other male workers, there were few possibilities for progression or promotion within the churning department. Work in the oil refinery was considered somewhat more skilled as it involved more machines and chemicals. As in churning, however, it offered little prospect and was mainly physically hard work. As the industry expanded, more auxiliary tasks were incorporated. The large factories employed masons, painters, carpenters, machine builders and printers of labels. Many of these jobs were considered skilled. However,

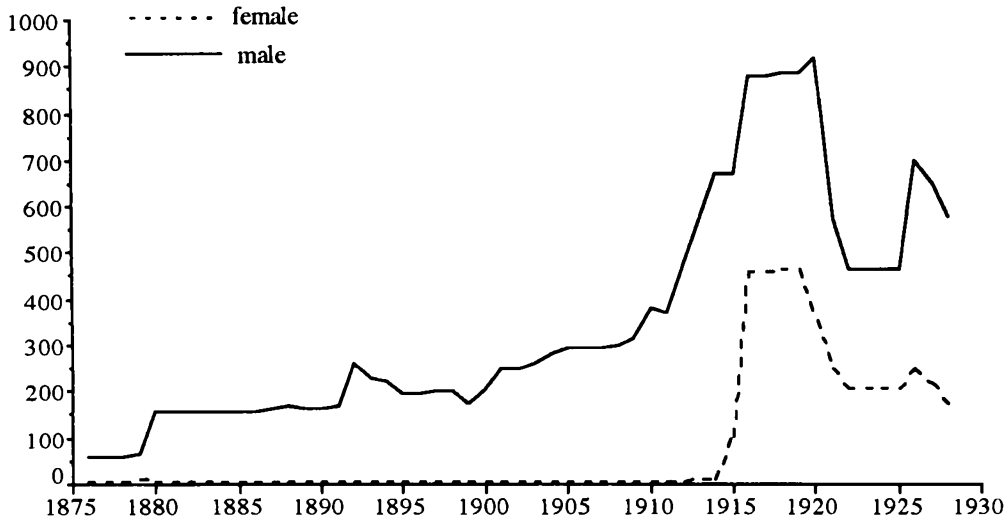


Figure 1. Female and male workers at Jurgens, 1876–1930

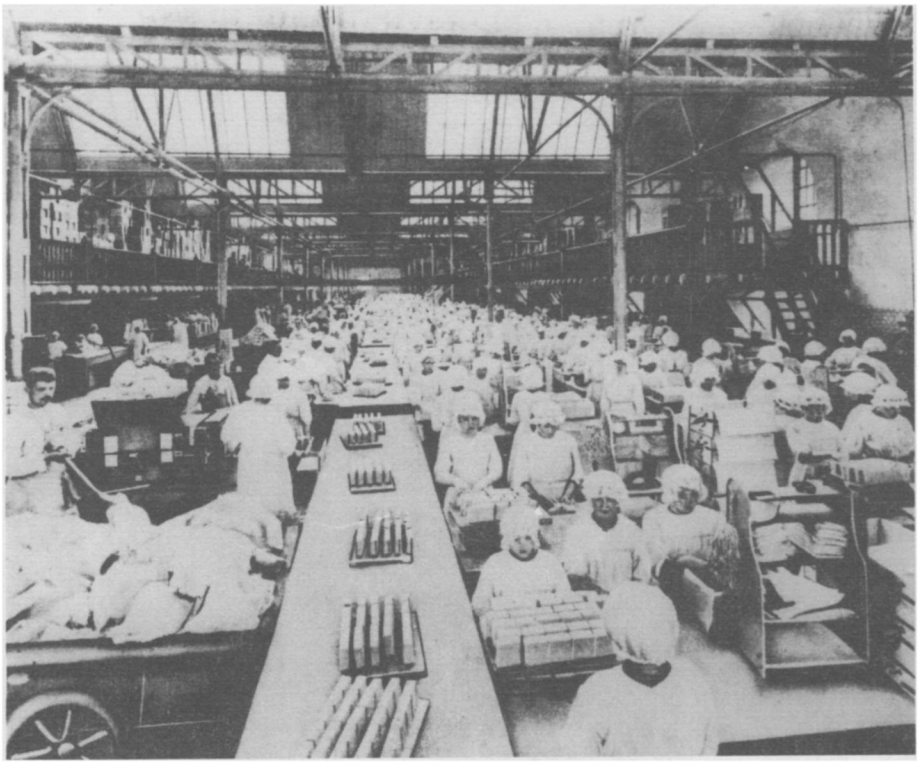
Source: Municipal records, Oss, 1876–1928.

unlike most of the other work in the margarine industry, they could not be considered 'new' in any sense. Similar jobs existed outside the margarine factory, and they were labelled and rewarded in the traditional manner within the factories.

The reason for increasing the number of female workers at Jurgens was not that they were more easily available than male workers. In 1919, Jurgens went to quite a bit of trouble to attract female labour. The girls and women recruited during this period did not move to Oss, as some of the men did, but commuted to work from places 30–40 kilometres away. The railways could not accommodate the increase in the number of female commuters, and the Jurgens management pressed for an increase in the frequency of the commuter trains.

The introduction of machines, which coincided with the increase in the employment of women and girls, did not make the work in any way simpler. Rather, the machines required more co-ordination, and made the pace of the work more hectic. Thus technological change cannot be said to have led to deskilling, as is the common notion. In the 1920s, more sophisticated wrapping machines were introduced, and the number of girls employed in the industry decreased. These changes not only affected the girls; throughout the factory, machines replaced workers. Mechanization was not the only reason for the decrease in the labour force. In the 1930s there was a decline in Dutch margarine production and part of the production was moved to England following the merger with Lever. Furthermore, the price of butter was low as a result of the agricultural crisis, and butter consumption rose, replacing margarine.

The wrapping machines were improved over the years. Shortly before the Second World War, machines no longer only produced the pieces of margarine of regular size and shape, but also wrapped them. The large Unilever factory in Rotterdam had forty of these machines. Between the forty machines stood thirty-nine 'stoppers'. These were male

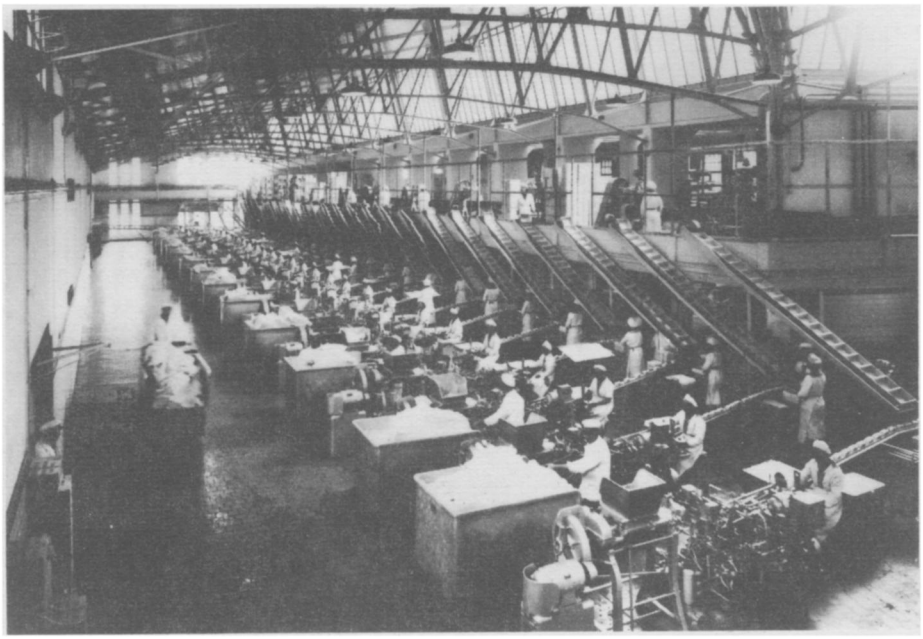


Figures 2 and 3. These photos clearly show the reduction of female workers as a result of mechanization. Photo 1 shows the wrapping department of the Jurgens' margarine factory in 1918. On the front left is a 'stopper', a man who filled the 'piece bank machines' with margarine. These machines formed pieces of margarine which were taken from the machine by two women who placed them on the conveyor belt. On the other side of this belt there were two women who wrapped the margarine, two more who folded the wrapper and two who filled the crates. Additional women carried empty and full crates to and from the table.

Photo 2 shows Van den Bergh's wrapping department around the Second World War. The work of the 'stoppers' remained unchanged. Machines now formed and wrapped the margarine. Sitting on the machines were women who were called engineers. Standing behind them were the wrappers, who took the wrapped packages of margarine and placed them in boxes. Empty carton boxes slid down from a gallery where they were made by female workers operating stapling machines

Sources: Jan Cunencentrum Oss, 91.16.43; Gemeente-archief Rotterdam, XV 164–03 G28352.

workers who had to fill the machines with margarine. The stopper moved 9–14 tons of margarine a day. Around the Second World War, the stoppers were replaced by cranes. On each of the machines sat a woman engineer. She was assisted by a female wrapper, who stood behind her, usually a girl of about fourteen. It took some time to become handy at this job. The wrapper had to take four packages of margarine at the same time from the moving conveyor belt and put them into a carton. The full cartons were placed on another belt, and closed and sealed further on by two more girls. If a girl was a skilled wrapper she could become an engineer as a form of promotion. The work was considered monotonous,



hectic and highly disciplined. A cause of complaint among the girls and women were restrictions regarding visits to the toilets.

The work of the stopper was considered unskilled, but required physical strength. The work of the wrapper required training, and some girls never got the hang of it. To become an engineer, women first had to pass the phase as a wrapper, and then had to receive some additional training. The alternative was to become an overseer. The women doing this work were usually somewhat older, but as the average age of the female workers was low promotion to overseer could be attained by the age of twenty. The work of the female engineers can be considered as more skilled than that of their male co-workers, the stoppers. The improvements in the machinery did not deskill the work of the female workers. On the contrary, the work became more skilled, and a career prospect was offered. This contradicts the image of female work, which is generally seen as not offering any prospects.

Women workers in the margarine industry earned less than men. Adult women, on average, received 37 to 52 per cent of the minimum wage of adult male workers. The starting wage of girls was a little below that of boys, but differences were small at the age of thirteen. At this early age, both boys and girls received about 20 per cent of the male minimum wage. The wage of the boys was usually somewhat above, and that of the girls somewhat below, this percentage. However, there were exceptions to this rule. In 1926 and 1927, girls at Jurgens received higher wages than their male peers. Usually, the wage differences between boys and girls increased with age. The boys' wages rose faster, and continued to rise longer than those of the girls. The male workers' wages stopped increasing at the age of 20–23, the female workers' at the age of 18–20. The ratio between men's and women's wages remained the same throughout the whole period. It is noticeable

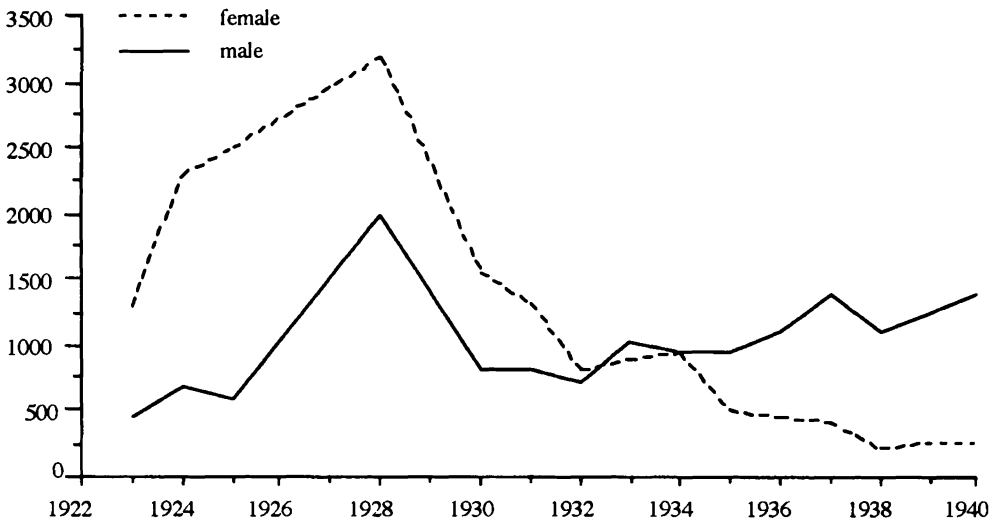


Figure 4. Female and male workers at ENKA, Ede, 1923–40

Source: ENKA-archive (Arnhem), annual reports.

that, while fighting for higher wages in general, the unions never tried to change this ratio. In all their suggestions for improving the working conditions, the unions never deviated from a wage for women that was 50 per cent of that for men.

RAYON

A rayon factory consisted of a chemical and a textile department. Men were employed in the chemical department; women in the labour-intensive textile department.[14] As can be seen in Figure 4, rayon factories originally employed more women than men.

There were several tasks a woman could be put to in the textile department, which consisted of a twining-mill, a reel-room and a sorting-room. Newly employed girls usually started in the twining-mill.[15] In this department, two threads were twined into one strong one. The women had to change the bobbins that collected the rayon thread. This made the women rather fidgety, because they had to grasp into the working machine, risking injury. Furthermore, the women had to be careful not to damage the threads. In the reel-room, rayon was transferred from bobbins onto reels. This was done by women working on small machines. If a thread broke, a woman had to repair it. The machine stopped automatically in order to allow her to do this. Every quarter of an hour the woman had to remove the old reel and put a new one into the machine. The work in the reel-room was less

[14] This distribution is similar to the one in Great Britain. BPP, 1929–30, XVII, 23: 'Men are mainly employed in the processes up to spinning, and women in the subsequent processes of twisting, reeling, bleaching, winding, sorting and grading.'

[15] Based on an interview in the social democratic women's magazine held with three girls working in the rayon factory: 'In de kunstzijdefabriek', *De Proletarische Vrouw*, 5 March 1925 (20).

nerve-wracking than that in the twining-mill. In the sorting-room, a large number of women were employed for cleaning rayon threads, repairing them if necessary, and sorting them by quality. The women doing this work had to be very accurate. The sorting-room was seen as the elite department for women, with only very tidy and precise workers employed there.

There was much pressure on the women to produce more and better quality rayon. The management used fines and bonuses to reach this goal. In the reel-room, for example, women were fined if they did not make at least thirty-five skeins a day. In the sorting-room, women were fined if the job was not done properly. In order to enable the overseer to control the work of every individual woman, a personal number was attached to her work. Discipline was strong. There was one mistress for every fourteen women or girls, and there were three head mistresses and two male head overseers in every department. What one mistress or overseer did not see was noticed by another. The women knew that if one of them was addressed, it meant she had a fine. Bonuses were given to increase production. There were women whose bonus equalled their basic wage of ten guilders. Their names were put on a list as an example to the others. But the women who made such a bonus started before the official time and trotted all day. Not every woman was able or willing to work so hard. The result of the pressure on the workers was that productivity increased greatly in the 1920s. As one woman said in 1925: 'We work with the same number of girls as before, but we work twice as hard for the same amount of money.'

The turnover of female labour in rayon was very high. Most of the girls left the factories voluntarily; very few were discharged. Nervous girls went to work as domestic servants, others married and left. As a result there was a constant in- and outflow of girls. None of them considered work in the rayon factory as permanent, although some stayed longer and became mistresses.

The textile departments of the rayon factories employed girls because they were cheaper than men. There are no wage figures prior to 1933. In the 1930s, the girls in Arnhem earned nearly half the wages of the unskilled men. In Ede, the women's wage was almost two-thirds of the wages of the men. The difference in wage between Arnhem and Ede can be explained by shortages in the Ede labour market. There were fewer girls available than the rayon factory required. In general, the employer preferred girls to boys, because of the lower wages. However, this was not the only reason. Girls were said to be more careful with the rayon threads than boys, and this seems to have been true. Due to rising unemployment in the 1930s, there was considerable pressure on employers to replace girls with men or boys whenever possible. The directors of the rayon factories were not adverse to these ideas, but experiments replacing girls by boys were not successful.

In the 1920s, the demand for rayon grew enormously, and new factories sprung up all over the world. The costs were relatively unimportant, as demand seemed unlimited. The years of expansion came to an end with the onset of the Depression in 1929. The world market price of rayon declined rapidly. In order to be able to compete, employers looked for a way to cut costs. The obvious way was to mechanize production and rationalize the labour process. The mechanization of production resulted in what became known as the 'direct' process. The mechanization mainly affected women. In the direct process, rayon was no longer put onto a reel in the textile department, but was spun directly onto a cone in the chemical department. This cone could then be used for weaving or hosiery. The

Figure 5. Women workers at the ENKA twining-mill in Arnhem in 1919

reel-room was replaced by the less labour-intensive cone-room. The sorting-room disappeared altogether. Hundreds of women had worked in these departments prior to 1929. As a consequence of the mechanization, the rayon factories changed from women's factories into men's factories. The change in gender is apparent in Figure 4. Rayon production became dominated by men. The male predominance was strengthened by the rationalization of the labour process that came after the mechanization. Rationalization mainly affected the girls that were still left at the factories, rather than the men.

In 1930, productivity of the female workers was increased not through the introduction of new machinery, but through the Bedeaux system. An average female worker could gain sixty Bedeaux points an hour, an experienced worker eighty. The minimum wage was based on sixty Bs, and those who reached eighty Bs gained 25 per cent above the minimum wage level with the effect of a 10 per cent reduction in production costs.

ELECTRICAL APPLIANCES

Philips started off as a women's factory. In the 1890s, the production of incandescent lamps was women's work. In this, Philips differed from other factories. Outside the Netherlands, production of incandescent lamps had already been taken up in the 1880s. In these early experimental years, the production of lamps was still more of a craft than an

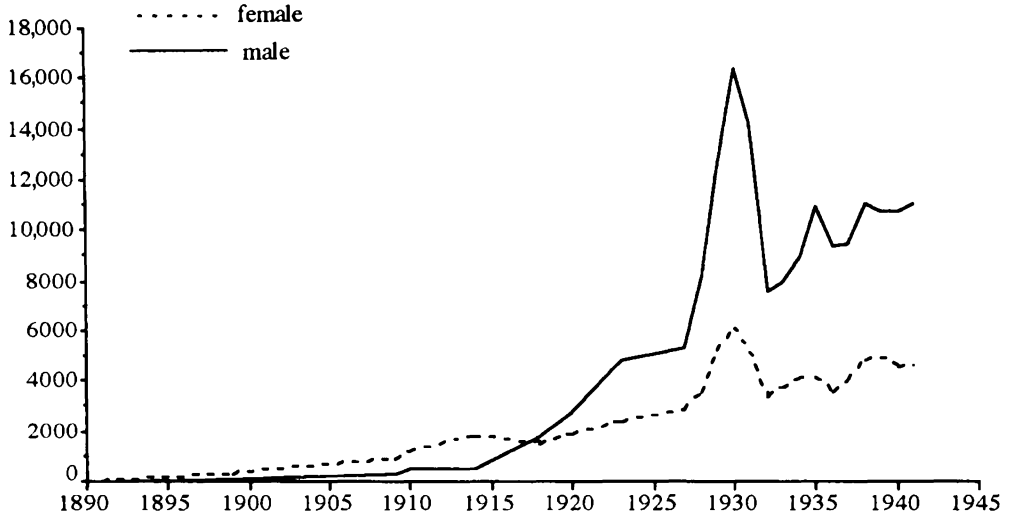


Figure 6. Female and male workers at Philips, 1891–1941

Source: Ien van der Coelen, *100 jaar vrouwenarbeid bij Philips* (Utrecht, 1991), 15.

industry, and most work was done by highly skilled men. Only later were they replaced by female workers.[16] Philips's production of lamps, however, did not evolve from skilled manual craft, but involved a process based on division of labour from the outset. All operations were carried out by semi-skilled women. After the First World War, there was a noticeable shift in the gender composition of the workforce, as can be seen in Figure 6. Men outnumbered women, and Philips became a men's factory.

Two factors caused this shift. In the first place, technological changes reduced the number of women necessary for direct production. Second, Philips's move towards horizontal integration led to the founding of factories that mainly employed men. In 1902, for instance, Philips started to build its own machinery. This implied that a large number of skilled men had to be attracted, or that unskilled workers had to be trained. Later, Philips established its own glass, board and paper factories, and employed its own factory builders. Like engineering, these were mainly men's jobs. With growing production, the need for overseers rose accordingly, and these were also mostly men.[17]

The percentage of women that were employed declined, but women remained the core of the production workers. Their share in the workforce was reduced, largely because Philips's activities outside simple production grew strongly over the years. The production of electric lamps, radio lamps and the bulk of the assembly jobs remained women's work. Women often shifted from one product to another. After 1924, the number of women employed in incandescent lamp production declined steadily. At the same time, however, the number employed in the production of radios grew, for women who became superfluous in one department were immediately placed in another. Because of the shift in

[16] Arthur A. Bright, *The Electric-lamp Industry. Technological Change and Economic Development from 1800 to 1947* (New York, 1949), 124.

[17] Heerding, *op. cit.*, vol. 2, 219.

the focus of Philips's production, and the constant innovation within each production process, the position of women is best described by looking at each process separately. We describe women's work in three production processes in some detail: these were the production of two different types of incandescent lamps, and that of radios.

In the first phase of its existence (1891–1907), Philips only produced lamps with a carbon filament. In this phase, Philips was almost completely a factory of women and girls. They all did work that was directly related to the production of electrical lamps. Some men worked as overseers, or in the turnery. Work on the carbon filament lamps was divided into a large number of small operations.[18] The production of lamps consisted of three main stages: production of the carbon filament, attaching the carbon filament to a copper filament, and melting this onto the bulb. The filament for the carbon lamp was made chemically and wound onto a drum to dry. It had to be unwound, measured and carbonated. Measuring the carbon filaments was a precise job that required a rather long period of training. The filament was electrically charged under a bell jar, fused with a small piece of platinum connected to a filament of copper. It was fixed into the globe of the lamp by sealing the stem of the globe to the carbon filament. Unlike the other work described here, this operation was done by both boys and girls. After the lamps were assembled, the air was pumped out of them, and they were sorted by intensity, polished and wrapped. Most of the work done by girls needed little training, although care was required when handling the carbon filament. After every step in production, the valuable products had to be counted – a job that needed much attention.

In the beginning, most of the operations described above were done by hand. A constant search for the optimal use of raw material and labour resulted in a chain of small technical innovations. In 1898, for example, the number of filaments that could be charged electrically at the same time in the bell jar was increased from one to three. The operation was also simplified. Originally, four girls were required for each set of bell jars: the first operated the taps and switches, two others inserted the ends of the filament into the terminals on the stand and later removed them, and the fourth checked the resistance. A device was developed that automatically switched off the current when the correct resistance was reached. From then on, one girl could do the job alone.[19] However, the main technological improvements came with the introduction of new machines, shortly after 1900, that made it possible partly to mechanize the production process. The most important of these were the sealing machine, the stem-making machine and the funnel machine. Furthermore, there were machines for straightening and cutting wire, and a semi-automatic capping machine. The capacity of the mechanical vacuum pump was increased, and the method of its operation simplified.[20] The introduction of these new machines reduced the number of girls needed for each specific task, shortened the training time and increased productivity.[21] Between 1902 and 1906 labour productivity more than doubled.[22] However, as the machines were introduced at a time at which the market was

[18] The description of the tasks done by girls is based on a book by a social democratic engineer who visited Philips in 1909: Theodorus van der Waerden, *Geschooldheid en techniek* (Amsterdam, 1911), 210–13.

[19] Heerding, *op. cit.*, vol. 2, 208.

[20] *ibid.*, 216.

[21] Van der Waerden, *op. cit.*, 213.

[22] Heerding, *op cit.*, vol. 2, 217.

rapidly expanding, the number of girls who were employed remained the same. The thirty girls who straightened and cut the platinum were replaced by a machine operated by one man. The girls made redundant by the machine were placed elsewhere in the factory. This sometimes led to a deskilling of the girls' work. The sealing machine replaced the girls who had sealed by hand. Before the introduction of the machine, girls had to be skilful in rotating and blowing glass.[23]

In 1907, Philips built a new factory to produce metal filament lamps. At its introduction, the production of a metal filament lamp required five times as much labour as did a carbon filament lamp. Every lamp consisted of at least five filaments and the production process was much more complicated. However, as soon as the new lamp was introduced, the process of mechanization and rationalization started anew. In 1934 a machine was introduced that automatically assembled the different components of the incandescent lamp. The mechanical fingers and arms of this machine made the nimble fingers of the women workers superfluous. Later, separate machines were integrated into one system, and women only needed to check the products.

In the late 1920s, Philips started to produce radios. Soon, radio production required more labour than the production of incandescent lamps. Although the production of radio lamps was mechanized to a larger degree than that of incandescent lamps, it was still more labour intensive. The production of the radio lamp needed more checking than the production of a normal lamp. Many women were involved in its production. The assembly line was the perfect way to keep costs low. It enabled cheap mass production of radios and other electrical appliances. The subdivision of operations that accompanied the introduction of the assembly line made it possible to work with unskilled labour. Furthermore, it proved to be the perfect instrument to control the speed of work. Philips was one of the first firms in the Netherlands to install an assembly line. At the assembly line, all internal parts of a radio were assembled in a metal frame. After the electrical assembly was finished, the frame was tested and adjusted. Then a wooden case with loudspeakers was put on, and the radio was tested again. The assembly line was marked with spots. Every spot denoted a radio. The worker had to take the radio from the spot, perform an operation, and replace it on the same spot. The moving spots set the pace of work.[24] Work on the assembly line was not restricted to women. Unlike the Philips factories that were later founded in Britain, the assembly lines at Philips in the Netherlands had a mixed workforce.[25] The reason for this was probably that the Philips factory in Eindhoven could not get all the women it needed to fill its vacancies. A number of tasks, previously done by women, were in a certain sense upgraded; the wage was raised and men were employed.

On average, adult women at Philips received 60 per cent of the wage of unskilled adult men. Women's and men's hourly wages depended on their age, and the number of years they were employed. Boys and girls started at the same wage, at the age of fourteen, and earned equal wages until the age of eighteen. Between eighteen and twenty, wage differences were introduced. At twenty, women reached their maximum wage, whereas the wages of men went on rising until they were twenty-four.

After the onset of the economic crisis in 1929, Philips introduced its own version of the

[23] Van der Waerden, *op. cit.*, 210.

[24] Later, Philips used the same method in Great Britain; Glucksmann, *op. cit.*, 175.

[25] *ibid.*, 206.

Bedeaux system. As in rayon, this increased production. For example, in 1929, a chain-gang of thirteen girls produced 780 lamps per hour. Under the Bedeaux system, a supervisor with a watch in his hand occasionally sat with them and encouraged them to work faster. After a while, only eight girls were needed to produce 1050 lamps per hour.

The labour turnover at Philips was very high. From 1925 to 1928 it was 20 per cent, in 1929 it rose to 27 per cent and in 1930 it peaked at 33 per cent. The reason for the high turnover was the number of juveniles Philips employed. In 1930, 8000 of the nearly 20,000 labourers at Philips were under eighteen. Boys left the moment they went into military service, and most girls left at the moment of marriage.

CONCLUSION

Wages are difficult to compare, because men and women seldom did exactly the same work. However, on average, 'unskilled' female workers received between two-thirds and half the wages of 'unskilled' male workers. Moreover, as most women's work was considered 'unskilled', it was unlikely for women to earn more than the lowest wage. From a cost perspective, and given the opportunity, it was advantageous for employers to designate as much as possible as women's work. This gendering was a batch-wise process. Tasks or departments were set apart as male or female. When a mixed workforce did exist, as at Philips's assembly line, a distinction, albeit artificial, was created to separate men's work from women's work.

Given the flexible nature of the new industries, and considering costs, most work in these industries should thus have been allocated to female workers. However, competition in fact mainly arose between juvenile workers, among whom wage differences were not that large. The employer could gain by employing girls instead of boys, but this would not halve the wage costs.

What work in the new industries was allocated to women? It was not all unskilled work. Women's work is usually seen as unskilled. However, as has been pointed out by several authors, whether a job is labelled 'skilled' or 'unskilled' is mainly determined by the social negotiations that surround the definitions of jobs and skills. Social negotiations are more important than any measurable ability.[26] In all industries discussed here, women's work was seen and paid as unskilled work. From the descriptions above, however, it becomes clear that this was not the right label. Women's work was valued less because it was done by women, not because of the training it required. As shown above, the work women did required training and experience, and more importantly perhaps it was not less skilled than the work of most male production workers.

Technological change provides an opportunity to regender work, and has often been claimed to deskill and thus feminize jobs.[27] However, if skill has no meaning, neither has deskilling. Technology frequently changed in the new industries. After each change, however, the work was as likely to require more skill as it was to require less. Furthermore,

[26] Paul Thompson, *The nature of work. An introduction to debates on the labour process* (London, 1983), 92.

[27] Gertjan de Groot and Marlou Schrover (eds), *op. cit.*: Harry Braverman, *Labor and monopoly capital: the degradation of work in the twentieth century* (London, 1974).

technological change did not lead to the replacement of male workers by female workers. In the margarine industry, the introduction of the wrapping machines coincided with the expansion of the labour force, mainly with female workers. Further changes led to a reduction of the overall labour force: female workers were replaced by machines. In the rayon industry, changes were more gradual, and the production process was automated step by step. Reeling and sorting were different processes, and needed different kinds of machines. As a result there was no sudden replacement of women by machines, but a more moderate change. At Philips, women were not replaced by machines at all. Instead, they moved from one department to the next, leaving the departments that were automated for those that were still in a take-off phase.

The effects of skill and deskilling on the gendering of work are mainly derived from studies based on the traditional industries. In the new industries, these concepts cannot explain the gendering of work.

If it was not just unskilled labour, nor all unskilled labour, that was allocated to women, maybe it was all work that did not offer a career prospect. Women workers were assumed to leave their work at marriage, and as a result to be ready to accept jobs with little or no career structure.[28] There are two complications when comparing the turnover of men and women. First, turnover is strongly age dependent. Female workers, as a group, were younger than male workers. Younger workers, both men and women, change jobs more often. Second, in a highly gender-segregated labour market, it is difficult to compare the turnover of male and female workers, because men and women were engaged in entirely different work.[29]

The connection between high turnover, lack of career prospects and the female labelling of work is largely derived from the traditional industries, where men were indeed offered some career structure. In the industries discussed here, there was little career structure for either male or female production workers. Like women, some of the men could become overseers, but this prospect was reserved for a minority of the workforce.

Physical requirements cannot explain segregation in the new industries either. Certainly men did the tasks which were generally considered to require physical strength. However, there were some women who did equally hard work and, more importantly, numerous men who did work that did not require much strength at all.

Why did the new industries not employ more female workers? Was it the employers' middle-class ideas about female labour, as Jordan has suggested, or the availability of other cheap labour, as Savage found, or the tendency to find analogies for new work in existing work, as Bradley has put toward, or were there simply not enough women offering themselves for this kind of work, as Glucksmann suggested?

Jordan neglects the fact that most of the new industries thrived on the employment of women and therefore fails to explain why the industries employed women for some tasks, and not for others. It is highly unlikely that these entrepreneurs, who derived their success from their innovative behaviour, would have been held back in deciding who to hire for jobs by middle-class ideas. In the margarine industry, for instance, they hired girls and

[28] T. Dublin, 'Women workers and the study of social mobility', *Journal of Interdisciplinary History*, IX: 4 (Spring 1979), 647–65.

[29] S. H. Slichter, *The turnover of factory labor* (New York and London, 1919).

women for wrapping, which had originally been done by boys and men. Although wrapping now has a clear feminine label attached to it, it was not considered women's work at the time. When they were willing to change the gendering of one job, it is highly unlikely that middle-class ideas withheld them from hiring women for other tasks within the factory.

All industries discussed here dominated their local labour markets. Disadvantaged ethnic groups, which Savage suggests could influence the employment of women, did not play any part in the Dutch labour market during this period. In the case of Jurgens's margarine factory, the employer encountered a shortage of young male workers before hiring girls. In the other two cases, the employers had an explicit preference for young female workers over young male workers, even when disregarding the cost. In all three industries, there was a period when the employers encountered problems because they could attract less female labour than they would have liked to employ. This could support Glucksmann's thesis. The shortages were, however, of an extremely temporary nature. The solution was not to hire men, but to use more or different machines, and to improve infrastructural arrangements. The employers did not choose between women and men, but between women and machines. The supply side may therefore have had its effect, not in the sense of regendering work, but rather in speeding up automation.

In the new industries, the analogy with women's work within the household, or in a proto-industrial phase of production, is rather hard to sustain. The work women did on electrical appliances does not resemble any task within the household. Before 1870, butter production on farms had been women's work. Margarine production was, however, from its onset a male profession; only the entirely new work of wrapping was women's work. Women's work in the rayon industry is as far detached from home spinning as car mechanics is from stable work.

The work in the new industries could not be labelled by analogy but, as the descriptions above showed, the new industries tended to branch out to include many auxiliary tasks. The work on these tasks, such as building and printing, was in no sense new. It already had a male label attached to it. Employers could not tamper with the gender-label of these jobs without running the risk of coming up against union or general resistance. In the case of Philips, it is very clear that it was this tendency of branching out that restricted and decreased the percentage of female workers. As the new industries branched out, they started to include work that was by no means new, and thus already had gender-labels. This restricted the employment of women. We therefore conclude that the potential possibility to use female labour may be largely exaggerated. Moreover, as we have shown, the profits in terms of wage cuts were smaller than they appear because of the low age of the workers.

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