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THE BEGINNINGS OF THE MODERN MILK AGE IN GERMANY

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DOCUMENTS concerning milk go very far back, yet scientific processing starts only about 1870 when the dairy industry comes into being. Above all, it was Benno Martiny, one of the most enterprising milk propagandists of all time, who managed to awaken a wider interest[1] through his book, *Milk, its substance and utilisation*. He, as well as authors after him, dwelt above all on questions concerning production techniques, optimal production and manufacture of milk. Knowledge about breeding and care of dairy cattle, about milk physiology as well as butter and cheese production was so limited compared to today, that in retrospect the concentration on these gaps in knowledge seems understandable. Therefore, a flood of specified scientific-technical dissertations and handbooks with suitable directions for practical use[2] appeared during the later part of the last century. There were papers on fodder growing, the setting up of cowsheds, illustrations and descriptions of useful tools for the dairy farmer, explanations about the composition of milk etc. These first scientific authors on milk were not interested in anything that happened to the milk after its production.

The heightening of social problems, the rising cost of living and growing urbanisation meant that after the turn of the century people began to become interested[3] in the problem of urban milk supplies and in the economic questions of a milk market as a whole. Intensive investigations by the 'Association of social policy' covered, especially, the factors of pricing and the price-lowering role a co-operative dairy retail market would play. But here, too, the forms of milk consumption and its actual extent were hardly considered. The predominantly scientific-technical or purely market-orientated approach has propagated itself right up to modern times in literature concerned with the

science of milk, as can be seen, for instance, in the latest handbook, *The German milk economy throughout history* (1974), as well as in the publications brought out by the Federal Institute for milk marketing, in Kiel.[4] The almost revolutionary break-through of fresh milk as a modern beverage for the masses within a few decades, against a background of a politically legitimate, economical and socio-cultural development in the course of industrialisation, however, remained to a large degree untouched. Newspaper snippets on cultural history, and chance notes in the literature of agrarian history cannot cover up these deficiencies in research.[5] This paper tries nevertheless to clarify, for the first time, innovation phases of modern milk consumption in the economic and socio-cultural overall development, which is so important to a general history of food and food ethnology.

The period before the start of modern milk economy

Ever since the utilisation of domestic cattle, milk has been used in fresh, stale or in processed form, as far as can be seen in early historical and anthropological research. The roots of the linguistic, symbolic and literary pursuit of this food product are lost in the earliest beginnings of agriculture and are therefore difficult to assess. To select just one relatively well-researched aspect, milk played a special role[6] in the culture of classical times. Aristotle, Virgil and Pliny the Younger already debated its ingredients and curdling qualities, as well as its application as a tonic, a medicine, or as a cosmetic. At that time, of course, only sheep-, goat's- or donkey's milk came under discussion, as beef cattle were still used as draught animals, and cow's milk was hardly drunk at all. Likewise, butter was only used as anti-burn ointment or hair cream. Sheep and goat cheese, however, used in various forms, was already a well known food product of the people.[7] According to the Roman authors Caesar, Tacitus and Pliny the Elder, it is agreed that beef cattle counted among the most valuable belongings of the Teutons, and that they 'in many cases, did not live from grain, but far more often from meat and milk'.[8] Here again, the milk was, of course, not usually drunk fresh, but as curdled milk (*lac concretum*).[9] Butter was known in the upper classes, but served according to Roman example, more as a medicine or cosmetic.

From the rare sources of the following centuries we learn that milk and its products were counted both as part of the farm contribution to the medieval lord of the manor and as part of the food that had to be

given up for religious fasts, and that growing towns tried to control supply problems and especially price-profiteering.[10] According to a much considered statement of the world historian Sebastian Muenster in 1543, 'the common people' did not however live from milk: 'their diet is black rye bread, oat porridge or cooked peas or lentils; water and whey is almost their only drink'.[11] Whey, continuing old traditions, was not only regarded as a drink, but also as a folk medicine, especially against leprosy, kidney-, gall- and intestinal diseases.[12] Butter was mostly a luxury food, which could only be afforded by rich households.[13]

Between the twelfth and sixteenth centuries new beginnings of a specific milk economy developed in the Allgäu as well as in the marshlands of Schleswig Holstein. This meant that for the first time in these areas, milk, butter and cheese became main foods, and small quantities were marketed.[14] The Thirty Years War, of course, decimated cattle in many parts of the Empire to such an extent that not sufficient milk could be produced. Even in children's diets milk porridges were by no means in standard use everywhere. In contemporary household literature one did not for a long time have more than a naive reception of classical authors. Later on, there was no lack of practical instructions, for butter and cheese production, but the real spread of dairy farming cannot be inferred from this. Altogether, domestic milk production was exclusively seen as women's work and thus an economically inferior concern.[15] If one interprets rightly the scattered references in literature, the interest in milk was extraordinarily small, if one disregards the special problem of milk adulteration, which will be discussed later. The following reasons can be given for this: milk never experienced a spectacular introduction, as did sugar, coffee, potato, schnaps and a few spices. It was regarded far more as a natural, old food and medicine, which could be drunk like water without being treated or changed. Because of its extreme perishability it had to be processed mostly on the spot, which however required no particular technical skill.

Therefore, for many centuries, no craft or far-reaching trade could develop from it. Instructions for milk utilisation, in daily use, and handed down from mother to daughter, from one generation to another, seemed hardly worth writing down. Like other perishable products for domestic use, milk was exempt from all taxes and duties, so that it is difficult to calculate the consumption, due to lack of sources. For such reasons, milk, and especially the history of milk con-

sumption, has hardly been touched upon by scientific literature up to now.

The transition to an efficient milk economy in the era of agrarian reform, 1750–1850

Apart from the dairy farming of the alpine pastures of the Algäu and the marshlands in Schleswig-Holstein, a milk economy producing for larger markets could not develop, mainly because the farmer in the old feudal system always remained in the village community and therefore in a uniform economical order. But that meant, as a rule, three- or even two-field farming which hardly left room or sufficient acreage to feed larger herds of dairy cattle. Part of the cattle had to be slaughtered regularly in the autumn because of lack of fodder. The remaining animals, laboriously reared through the winter, were often so weak by the spring that they had to be pulled to the pastures by their tails, because they could not walk by themselves any more, which is why one spoke of 'tail cattle'. Regular cultivation of 'black fallow land' with clover, rape, root crop, and potatoes, as well as the construction of 'artificial pastures' had actually succeeded already on a few model estates in Saxony, Prussia and Hannover, and Brunswick during the late eighteenth century, but the majority of German farmers only accepted this hesitatingly and with suspicion during the second third of the nineteenth century.[16] As can be seen, from later estimation, 'summer cultivation' of the fallow land with fodder crops remained, until towards the end of the Napoleonic Wars in 1815, as a very rare exception. In 1840, 20%, in 1867, 10% and in 1913, only 2.7% of the cultivated agricultural land lay fallow in the rotational system.[17] The rapid decline of the medieval fallow field, though, varied considerably, regionally, when it happened. While in Bavaria, around 1869, 19% of the agricultural land was left fallow regularly every three years, only 1% remained that way at the same time in the Kingdom of Saxony.[18] The rotation of crops system, which was brought over from England, was accepted even more hesitatingly by the individual German Federal States. This has to be taken into account with every consideration given to the development of cattle farming and milk yield. Without suitable fodder in winter from the improved cultivation of fields, no increased cattle-holding was possible and therefore no increase in milk production. In agriculturally less developed areas of Germany, which constituted up to the middle of the nineteenth century a definite

majority, beef cattle was considered more or less of an evil, which one had to come to terms with, mainly because of the indispensable manure.[19] Apart from that, its main role was that of meat producer and draught animal. The milk yield was far too small to be considered a real income source. The small amount of milk produced served mainly for domestic self-supply. Anything produced above this belonged to the farmer's wife after the sale as her 'milk-penny', e.g. pocket money. Not only the milking and processing, but also the sale, was left exclusively in the hands of the female members of the family. Dairy farming, as is shown quite clearly in household literature, counted as a part of the smaller housekeeping and not as an actual agrarian occupation.

Liberal agrarian reforms which came into being in the late eighteenth and especially in the early nineteenth century, which stretched over two to three generations and in isolated areas even longer, created the necessary prerequisites for the gradual transition to an improved, and, at the same time, increased cattle stock as well as an increase in milk yield. Various causes, in particular, can be recognized for this: the farmer, released from his ancient servitude, could now, for the first time, quite freely choose the particular branch of agriculture from which he expected the most profit. Summer cultivation of the fallow land and especially the new rotation of crops system, with its rotation sequences, made the discontinuation of fodder-crops and an increased cattle stock almost a duty, which in its turn meant additional accumulation of manure and, therefore, improved ground yields, off which, amongst other things, more cattle could live. This succession of advances laid the foundation for the 'Agrarian Revolution' and thus also for the beginning of the milk-era. Nevertheless, only after the middle of the nineteenth century did a real intensification of cattle stock begin, when crop prices rose only insignificantly, compared with the previous two decades, while meat and milk prices tightened considerably, due to the beginning of urbanization and industrialization.[20] More and more people lost their agrarian self-supply in the second half of the century and especially after 1870, and, as home-workers, in the country or in the quickly growing cities, became a new source of demand for agricultural produce. After the notable delay in the rationalization of agriculture, there now followed the modernization of cattle-breeding and milk-production.

More and more farmers felt bound, especially after 1860, to cut down on grain crops which up to then had taken up most of the culti-

vated land, in favour of pasture land. The growing shortage of farm-workers also, which pushed up wages, contributed to speed up the change from arable land, requiring a lot of work, to pasture land, employing a considerable amount of capital. A 'green-land movement' came into being, which thought about grass- and fodder-growing, pasture fencing, watering places and milking parlours. A 'theory about the properties of hay', advanced by the agrarian pioneer Albrecht Thaer, and later improved by others, gave farmers for the first time exact scientific and ingenious guidelines for an optimal cattle-feeding system, which was eventually taken over by the developing modern animal physiology.[21]

There were hardly any improvements in cattle breeding up to the eighteenth century. The many small local breeds were relatively undemanding, but did not give much meat or milk either. Now, within a short time, breeders managed, especially in the traditional pasture areas of the marshlands, not only to reduce the number of the 'native breeds' (majority breeds) drastically, but also to produce substantially more productive cattle breeds. Swiss, Tyrolean, Dutch and especially selected English cattle breeds served to improve the large estates in Saxony, Silesia and Hesse.[22] The growth of cattle stock showed that milk production, up to then looked upon as unimportant, presented the farmer with quite new advantages. Demand was not at all seasonal, and production among the good dairy cattle breeds fluctuated only to a small degree. It represented a constant source of income, rising parallel with urbanization, which provided financial solvency especially in the unprofitable spring months.[23] In many areas the 'milk farmer' or the 'milk woman' became a well-known figure, who sold the milk to the consumers in their homes, without wholesale trade. Regular and growing income allowed for better budgeting on the farms.

For the first time the idea of a completely economical milk production was considered in books concerned with systematic improvement of animal breeding and cattle holding, where, in a way, even the animal has to be made into a machine, intended to change the given fodder into the largest possible amount of milk in the shortest time and in the smallest possible space.[24] The agrarian author, J. von Schreibers, stated prophetically as far back as 1847 that 'milk economy presents basically only a branch of business, that could proudly stand side by side with any other in industry'.[25] The departure from the theory of the old self-sufficient household towards a capitalistically-orientated milk economy could hardly be expressed more clearly.

The success of such a way of thinking and acting was soon reflected in an increasing milk production: to go by the first contemporary assessments, a cow in Prussia, at about 1860, yielded between 1300 and 1400 Prussian Quarts (1560-1680 kg) of milk per year; from which can be calculated an annual pro-capita production of 321 Quarts or 385.2 kg.[26] According to the careful information by the leader of Prussian statistics, Georg von Viebahn in the mid-nineteenth century, a cow of an inferior breed gave an average 3.6 kg of milk per day, or 1296 kg per year; one of a higher breed 4.8 kg or 1728 kg; and in the large dairies near the towns record yields of 2400 kg and more per year were reached.[27] But as individual statistics show, milk yield in individual German Federal- and Customs Union cities varied quite considerably, i.e. to the extent of between 500 kg and 5000 kg in annual yield. There were also strong seasonal variations: two-thirds of the milk was obtained in the summer months with fresh fodder, while in winter the yield decreased to an equal extent. Above and beyond this, one must not forget that in some areas of western and southern Germany as well as in parts of Saxony, Poznan and Silesia, cow- and ox-teams were still the rule in the middle of the last century, because on small farms there was not enough work to keep a horse for a whole year. For this reason, the milk yield on such farms with fragmented small-scale agriculture was bound to remain small. On the basis of an extensive statistical calculation, Viebahn believes that one should assess the average milk yield in all Prussian states around 1860 at 1500 kg per year.[28] But as Prussia contained a great many areas of progressive agriculture, these first estimates cannot, as they stand, be transferred to the rest of Germany in this period. According to new calculations by Count Finckenstein, a Prussian cow in 1816 gave around 640 kg of milk per year, in 1864 around 1100 kg and not until 1883, 1800 kg, i.e. about half of today's average yield in the Federal Republic.[29]

Of course, these production figures do not correspond to the actual milk consumption. Because of high perishability and bad transport facilities, a large amount of the fresh milk, as in old times, had to be processed on the spot into curd cheese, butter and cheese. The consumption of fresh as well as stale milk is, therefore, estimated by Viebahn around 1860 as only 164 Prussian Quarts (196.8 kg) per head per year, that is as half the annual production, which would mean 0.6 litres per person per day. Elsewhere he estimated the average consumption of an urban family of five as 800 Prussian Quarts or 960 kg per annum, which would be about the same amount for the individual.

Nevertheless, these remain rough and schematic estimates, based on cattle stock and an uncertain average yield, which was divided on a pro capita basis. The actual amount of milk consumption for drinking still remains vague. Neither the amount of skimmed milk, which was chiefly used as pig-swill, nor that of waste was taken into account. It is also not certain what amounts were processed into butter and cheese, which obviously varied both regionally and seasonally. Nothing is known about the distribution across age-groups, social classes and occupational categories. Viebahn was an experienced agricultural expert and undertook his consumption assessments on the basis of numerous enquiries of agrarian associations etc. However, it will require much more regional and local study to attain more certainty about differences in consumption. According to the well-known Munich doctor, Johannes Ranke, a family of three in 1870 (father, mother and a five-year-old son) from the poorer population consumed ordinarily only 'the smallest amounts of milk'.[30] This statement can be confirmed by various other reports. Thus, in the household budget of an urban factory worker, one constantly hears about coffee (chicory coffee), beer and water but only comparatively rarely about milk.[31] Probably these small amounts of milk were mainly used for small children. The army provisions of the German troops in France in 1870-71, which were expressly designed to be an exemplary combination, although containing half a litre of wine or beer per day, showed not a drop of milk. Proceeding on this assumption, we can conclude that all institutional diet in Germany before 1870 was still completely without milk. Viebahn explains the milk consumption of around a half a litre per person per day, of the Prussians, by saying that in 'the working classes' milk often had to replace meat dishes. It was consumed cold or hot, on its own or mixed with other dishes, fresh or soured, at all meals. A common form was sour milk (Stippmilch, thick milk or Schlippermilch). This was prepared in open earthenware bowls, in which the milk was left overnight. In this form it made a well-loved refreshing dish especially in the summer. Viebahn specifically pointed out that milk or cream was only used in isolated cases in wealthy urban families; 3% of milk consumed came, incidentally, from the goat, 'the poor man's cow'. It was much easier in earlier times to winter a goat than a cow and they required less space and care. Fresh goat's milk, which could be processed into cheese and not into butter, was reckoned from time immemorial to be particularly healthy for those suffering from dysentery or spleen disorders.[32] In the *Hamburger Fremdenblatt*

advertisements still appeared in 1890 offering Altenburger goat's cheese' for sale, which apparently enjoyed a particular popularity. The miners of the Ruhrgebiet (district of the Ruhr) were well known for the fact that they often kept a goat for their domestic supply in a shed in their small gardens. With the growing improvement of urban milk supply, this particular form of milk consumption, however, soon sank to insignificance.

Benno Martiny's works and the decisive formulative years

As has already been mentioned in the introduction, Benno Martiny's book, *Milk, its substance and utilisation* (1871), forms something of a milestone in the development of German milk economy from self-supply to an industrialised and commercialised agrarian craft. In this extensive volume, which has become a classic, the author claimed for the first time 'to describe the total knowledge about milk and its utilisation scientifically, economically and technically in its historical development'.[33] In this, as has been said, he meant only its production. 'There is little to be said about the utilisation of milk through immediate sale,' says the author and continues: 'It depends on delivering the fresh milk as unchanged as possible to the retailer.'[34] Consumption was of no interest at all to Martiny. On 1st October 1871 he published the first edition of his *Milk-Newspaper* in Danzig, Germany, and initiated the founding of a Dairy-farming Association, which came into being at an international agricultural exhibition in 1874, with himself as chairman. Emperor Wilhelm I, in his old age, still allowed himself to be persuaded by Martiny to become a member of the Association himself, in order thus to advance the milk idea in Germany.[35] It is thanks above all to Martiny's manifold initiatives that manufacture and consumer alike came to realise increasingly the significance of milk, especially in its fresh form.

Already after 1850, before the start of milk-pasteurisation, 'milking farms' opened near the towns as a first step towards the dairies and milk-cooperatives which came later. They consisted of individual farmers who specialised in supplying the urban population with fresh milk. As the milk would not survive a long journey, it was obvious that the cows would have to be brought to the edge of the town instead. This must be seen as the first indication that the numbers of cows and goats kept in the towns would begin to fall noticeably. In 1871 the first real cooperative milk utilisation establishment was founded in

Koenigsberg. Obviously the cooperative concept which was carried through with difficulty, if at all, in other branches of farming in Germany complied especially well with the requirements of large-scale dairy-farming: in 1900 there were already 2,905 cooperative dairies in the German Empire which took over the processing of the milk from the farmer.

The delivery of larger amounts of milk made the purchase of labour-saving tools and equipment economically viable. Already in 1877, the milk-separator invented by Wilhelm Lehfeldt (1836-1913) could be used in the cooperative dairy in Kiel. Here also Martiny, who was friendly with the inventor, was the driving force behind putting the separator into practice. Antonin Prandtl worked successfully in the same field in Munich.[36] The separator skimmed the cream off large quantities of milk in the shortest time, using the principle of centrifugal force, and made the utilisation of milk independent for the first time of weather factors, which had earlier played a not inconsiderable role here. The running costs could already be reduced below those of manual production by the processing of 330 kg per day. The decisive step towards mechanisation had now been taken. As the cheap Australian wool- and American grain-imports were beginning, after 1860, increasingly to depress the German market and to cause corresponding slumps in prices, German agriculture was looking for means by which to compensate for this loss of profit. Along with the increase in pig-breeding, an intensification of the dairy industry suggested itself above all for this purpose. Pigs also proved to be the best consumers for dairy waste products. While the stock of sheep between 1873 and 1900 decreased from 25 million to 9.7 million, the stock of pigs rose from 15.8 million to 18.9 million. The increase in beef-cattle stock, surprisingly, did not keep up with the sudden growth in population, so that in 1900 there were only 18.6 cows per person, compared to 21.8 in 1873. However, this was partially compensated by the above-mentioned increase in milk production per cow. If one surveys the innovations in German dairy-farming, which have been described, it becomes apparent that they all fall between 1870 and 1880. Thus, this decade, as is substantiated by other evidence, must be regarded as the real breakthrough to the modern milk-era in Germany.

The problem of accidental and intentional adulteration of milk

Already in 1847, Josef von Schreibers, as one of the earliest milk-

experts, wrote: 'With a product, which is consumed in such large quantities, which is dispensable, and yet which cannot be brought to the place of consumption from too great a distance, a constant market and a reasonable price is assured. However, this circumstance often induces greed and reprehensible desire for larger profits and to increase the quantity or quality of the milk by various forms of adulteration. Unfortunately, the adulterations will actually be perpetrated.'[37]

The problem of contamination, adulteration or even poisoning of food and drink runs through the whole history of human food. Together with flour, sausage, coffee, tea, spices and wine, milk and butter lend themselves particularly well to intentional adulteration. Even Martiny, the new 'Milk Pope', had to admit in 1871 that: 'The difficulty of judging the quality of the milk purely through sensorial perception, is, in such quantities, such a temptation to tolerable adulteration of the milk that we very rarely come across a pure, unadulterated milk in our merchandise, at least where the sale of milk is established on a commission basis.'[38] In other words, the adulteration of milk was the rule and explains why, in some places, the urban authorities opposed the sale, in particular of skimmed milk, and why this was so unpopular in the poorer households, that even in the First World War, despite general food shortages, people preferred to feed the skimmed milk to the pigs.[39]

We can see from various sources that milk was intentionally diluted with skimmed milk or pure water, and in order to maintain its consistency it had flour and sugar, but also brain, rubber or glue added to it. Soda, bicarbonate of soda, boric acid, and peroxide[40] were used to delay the fermentation of the lactic acid. In addition to this came the numerous possibilities for accidental contamination. Schreibers found it necessary in 1847 to instruct that 'the place where the churns, cream or butter are to be kept, should be inaccessible to mice, rats, toads and other reptiles'.[41] Even at the turn of the century, at a course for prospective dairy farmers, the participants decided, at a milk tasting session, that something was missing in the milk. When the course-leader added some cow-dung to it, they decided that it now had the 'proper' taste.[42] Due to the lack of hygienic appliances, it was an everyday occurrence that directly after milking, the milk was contaminated with all sorts of impurities. Not much greater care was taken while transporting it to the dairy. Added to this was the frequent changing of container. 'It would be desirable,' stated a dietetic expert in 1917, 'to win a mark for milk, which would allow everyone, everywhere to recognise the un-

changeable, original state of the milk.'[43] This was the first articulation of the idea of a particular quality mark; such as are often used today in the food industry.

Conditions in milk production and especially in the rapidly expanding urban milk retail trade, with all its defects, were plainly crying out for some form of legal control. Numerous German towns published orders and regulations concerning the combating of milk adulteration, rampant everywhere, as well as of the profiteering which went on in the months of low yield or in inaccessible places. The spreading trade inspections also found a sphere of activity here. For example, the Swiss factory inspector, Fridolin Schuler, stated at the end of the century, in one of his regular reports, that random samples of milk were examined by his authority and care was taken that the dairies did not increase the quantity of the product too much to combat slackening supplies from the farmers.[44] The controlling authorities of some German states endorsed this action.

The intentional and accidental adulteration of milk, which at first considerably hindered a wider consumption, was not however a typically German problem: thus already since the beginning of the nineteenth century in England a fierce battle was being fought against 'Food Adulteration', to which the works of the German-born chemist Frederick Accum had formed a decisive prelude.[45] Up to the middle of the nineteenth century, according to contemporary English statements, almost half of all milk and nearly all butter was intentionally adulterated in some way.[46] The battle against milk adulteration also began around this time in the USA, under the influence of the spreading 'Scientific Nutrition'. Milk adulteration was flourishing, particularly in large cities such as New York.[47]

Of course there is also pasteurised whole-milk, from specially fed cows, under the supervision of a veterinary surgeon. It was obtained, for example, from private 'milk cure institutions' the first of which was set up in Stuttgart in 1875. This highly nutritive milk was much too expensive for everyday use in an ordinary household. In the 'milk cure institution' on the Kreuzberg, in Berlin, in 1888 a litre of this certified milk cost 0.60 RM: about three to four times as much as ordinary milk. As much as 0.80 RM was asked for sterilised milk. It was no wonder that around this time in Berlin, as in other places, the beer-mug and coffee-pot continued to prevail in the houses of the working classes.[48] The 'milk cure institutions', designed as money-making organisations for children, invalids and anaemic ladies of 'good society', show clearly

that scientific knowledge about the special nutritive value of milk was beginning to contribute to its commercial utilisation. The great majority of infants and small children had, of course, still to content themselves with adulterated, thinned-down milk, or with other drinks, especially brown chicory-water. Already before the First World War, a special milk for infants came on to the market, which however was still semi-skimmed and thinned down with water. Nonetheless the suppliers charged 0.15-0.16 RM extra per litre for it.[49]

Milk supply to the growing cities

From 1875, the milk-economy underwent an ever-increasing expansion, as the following data show:

Factories and Employees in the milk-economy from 1875-1895

Year	1875	1882	1895
Factories	2 769	3 818	1 895
Employees	4 718	9 470	23 200

Ref: *W. von altrock*, 'Dairy-farming and Dairies'. In: *Concise Dictionary of Political Science* 4th ed., Jena 1925, p. 580.

Small enterprises with less than five employees predominated. In other words, 90% of the milk was still produced, as had always been the case, by farming family-establishments. At the turn of the century, there were only 32 factories in the German Empire which employed over 50 people, and which could thus be regarded as large-scale milk-producers. This structure was still retained in milk production at the start of the twentieth century. As the places of production still mainly remained in the country, the problem of supplying milk to fast-growing industrial cities was one which was becoming increasingly urgent. Because of the shorter distances, the inhabitants of the small country towns could easily be supplied by the farmers of the surrounding area. However, in the industrial agglomerations which were growing both in area and in population, regular hygienic supply was difficult. According to Viebahn, in the mid-nineteenth century, three miles was the furthest that fresh milk could be transported with a horse-drawn vehicle without spoiling. If there was a railway connection, the milk could be transported from a radius of 30 and later even 60 km around a town. In the long run even the farmers who lived further away could make use of the opportunity of a larger milk market, but because of the distance a middle-market was required for

this. Apart from the 'milk farmers' and 'milk-women' from the immediate neighbourhood who peddled from door to door, in the large cities more and more specialised milk retail shops began to appear. In order to open one of these shops, one did not need either a lot of capital or particular expert knowledge, so that virtually anyone could take up this business. Inadequate equipment in milk selling was the rule of the day. Only a few large dairies with a lot of capital, such as Bolle in Berlin and Pfund in Dresden, as well as specified Milk Marketing Organisations, for example in Hamburg, succeeded early in building up wholesale businesses with their respective subsidiaries, which guaranteed an efficient and hygienic supply. The Association for Social Policy, the influential centre of the German economic- and social-sciences at the time, thus felt obliged just after the turn of the century to critically examine milk supply, in the framework of its examination of general living standards, in order to bring about specific improvements.[50]

The scientists charged with the empirical examinations had great difficulties to overcome, as the urban milk business kept no records of how much milk it sold as fresh milk and how much it processed into curd cheese, sour milk or butter. The means of transport and the supply sources were also difficult to reconstruct.[51] The organisation and development of urban milk supply were obviously quite different in different towns. However, the following picture may be built up from the examination of milk-supply in several towns in northern, central, northwestern, and southern Germany between 1900-1914:

In Hamburg, or what were then the neighbouring towns, Harburg, Altona and Wandsbeck, and also in the rural communities of the city-state of Hamburg, 198,371 people, or 15.8% of the total working population, worked in farming industries in 1895. In 1907, it was still 194,947 or 12%, which had by then to supply 1.1 million workers in other branches of industry and their families with food, as opposed to 834,000 in 1895.[52] As, in addition to this, the number of cows per thousand inhabitants had fallen from 14.6 in 1873 to 8.9 in 1907, it meant that now, despite an increasing milk-yield per cow, more milk had to be brought in from greater distances. In 1907 only 3% of the milk required could still be produced in the actual area of the town, 34% had to be brought by horse and cart, 55% by rail, and 8% by sea, and the supply area stretched to within a radius of about 65 km. At about the same time in Karlsruhe, 12.5% of the milk was still produced in the town itself, 19.8% was brought in by horse-drawn vehicles, and

67.7% by rail. Although the maximum distance the milk could be transported using horse-power was 15 km, the maximum by train was about 60 km.[53] The methods of transport may be differentiated as follows:

Milk supply to Karlsruhe in 1910 by horse-drawn vehicle or rail in percentage

Distance in km	Horse-drawn vehicle	Rail
under 5	9	3.4
5-10	82	—
10-15	9	—
15-20	—	44.5
20-30	—	15.1
30-40	—	15.2
40-50	—	12.7
50-60	—	9.1

Ref: Berg, *Milk Supply to the Town of Karlsruhe*, p.129

These general tables show that farmers working in the vicinity of large towns had to support a constantly growing part of the urban population, whilst their own work force was shrinking. The more extended the supply area of a town, the greater the amount of milk which had to be brought in daily by rail.

Hamburg used around 440,000 litres of milk daily, but Karlsruhe only 64,000; however, the supply area for milk was about the same size in both towns. Hamburg was very near to Schleswig-Holstein, which was rich in milk, and could for the most part still support itself from direct trade with the farmers. In contrast to this, the supply to Karlsruhe was far less convenient. Obviously the amount of 'railway-milk' corresponded to the number of urban milk-dealers. The 'cart-milk' was predominantly brought by farmers from the immediate vicinity, whereas the traders were usually supplied from greater distances by rail. Thus, a milk retail trade could best arise in those places where the supply of the dairy farmers was not sufficient, and the supply area extended to more than 15 km.

In contrast to the rural dairy farmer, parallel to whom he had developed since the mid-nineteenth century, the urban milk-trader gave rise to much complaint. He was said to have forced himself, 'as a parasite', between the old relationship between the farmers and their customers and to be 'terrorising' the dairy farmers.[54] A normal milk retailer did not usually sell more than 100 litres per day, so that he was usually forced to sell other goods in his shop or from his milk-cart,

which did not particularly aid the purity of the milk. In Hamburg the milk-carts were pulled through the streets by dogs, as it seemed to be too expensive to keep a horse. With milk supplies, as with grocery shops, sale on credit was very common. The trader often had to extend interest-free credit over long periods, in order not to lose his customers. Even the 'better classes' bought 'on tick' from long habit, so that the milkman, who usually lived from hand to mouth, would often have difficulty in remaining solvent in face of these dilatory modes of payment.[55] Also, new milk businesses would often try to undercut the competition with give-away prices, so as to ensure, in this way, their first customers. 'The almost inevitable consequence is the compulsion to dishonesty,' states one examination on this point.[56] Here we find the chief explanation of the manifold adulteration of milk. As yet there were hardly any means of detecting milk adulteration, nor was there any legal administration of regular checks. Milk adulteration was further encouraged by the fact that most housewives were more concerned with the quantity than the quality of the milk.[57] One of the scientists examining this was thus driven to the accusing statement that, 'if one only gave the same care to milk, as one does to beer, then a great step forwards would already be made.'[58]

As this remark indicates, the encouragement of milk consumption in the cities was conceived at the same time as a battle against alcoholism, which was very common. The Movement for Living Reforms for the Citizen, which was spreading in the 1890s and which gave the old temperance bands, which had predominantly been run by the church, a new civilising, scientific basis and through this a powerful stimulus, saw in milk a welcome medium for their agitation. Thus, in 1903, the 'Charitable Association for the Retail of Milk in Rheinland and Westphalia' and in 1908 even a 'German Society for the Charitable Retail of Milk' were brought into being, in order to restrain the misuse of alcohol in this way.

At the same time the production of special milk for infants, and certified milk, which had up till then been beyond the financial means of most people, was being provided experimentally on a specific social basis. Various towns introduced school-milk in addition to their school-meals and destitute mothers could obtain the particularly nutritious pasteurised whole-milk at low prices at a central charitable milk retail establishment.[59] But such well-meant attempts often came to nothing. The public milk-kiosks on busy streets or in public parks were not nearly as well-frequented as the inns, street-corner pubs or beer-

gardens. The fact that canteens were often leased out to breweries worked against the sale of milk in factories and public institutions.[60] School-meals as well as charitable milk-retailing were mostly claimed by children from more well-to-do families, because the realisation of the particularly nutritious value of milk had won recognition much sooner from them. When the town authorities then demanded medical or official certificates attesting to destitution before supplying lower-priced milk, many people stayed away because, understandably, they had inhibitions about having to prove themselves needy. Milk now took on the aura of the old soup for the poor, and this ran counter to milk promotion activities.

Success was experienced where, besides the farmers' production co-operatives, particular marketing co-operatives also appeared. Around 1900 in Hamburg, the 'Central Registered Association of Milk Producers for Hamburg and the surrounding Area' was founded, which brought into being a forerunner of the later milk-marketing rules; for the first time a standard price was laid down for milk, below which members were not allowed to sell. If the milk could not be sold at this price, the Association took over the remainder and processed it in its own dairies. The lower profits, as opposed to fresh milk sales, were refunded to the supplier, so that he was protected from the temptation of passing on the loss to his customers, by way of milk adulteration. Lastly, the milk cartel proved itself to be advantageous to the consumer because, in its own interests, it had to pay attention to the quality of the milk. But obviously such foundations were not possible everywhere.[61]

Local milk-traders did not often possess enough capital and training to form themselves into an effective organisation. There was often a bad relationship between the dairy-farmers in the immediate vicinity of a town and the urban milk retailers, for competitive reasons, which could occasionally degenerate into a sort of 'Milk War'.[62] The disagreements were of course chiefly about the price of milk. This had hardly changed in comparison to other foods. On the one hand, this lay in the constant demand and the growing independence of production from seasonal influences. But the small price-elasticity was also connected with the fact that milk could be used as a substitute for other drinks, if these rose in price or vice versa. However, above all milk appeared so independent in price because milk consumption in the late nineteenth century correlated strongly with income classes, i.e. wealthier families did not only drink greater quantities and more expensive milk, but also

used it for other purposes in the kitchen. Understandably, price changes of a few Pfennigs had no effect on consumption here. Whereas the general food-price index, between 1875 and 1900, with the change-over from the highly liberal free trade phase to the agricultural protective-duty policy, showed in general a considerable rise, milk prices remained relatively stable until around the turn of the century.[63] They only began to move when the farmers, following the sharply rising general cost of living, tried for the first time to effect a drastic rise. The retailers who had a trade margin of around 30% of the final retail price, and who let the dairy farmers bear all the transport costs, were, at first, against a price rise and proved to be the stronger party in this, as they could simply leave the farmers stranded with their highly perishable milk and organise supplies from somewhere else. Finally, before the First World War milk price rises did occur, so that a litre of whole milk cost 0.20 RM; of semi-skimmed milk, 0.18 RM; and of skimmed milk up to 0.10 RM. A more or less standard price level arose from this, in which, of course, the traditional price gaps between large and small towns and between west and east Germany remained to a lesser extent than before.

Assessments of the average milk consumption

The rise in German milk production and processing must primarily be seen in connection with the rapid population growth and with urbanisation: more and more people slipped away from self-supporting agriculture and became dependent on the urban grocery shops and thus on the milk retailers. In other words they changed from the role of small-scale milk producers or partners in domestic milk production into the role of milk customers. It is more than doubtful if the average milk consumption per head had already increased in this period of the late nineteenth century. On the contrary there are contemporary complaints of a worrying decrease in milk consumption in the country, as the farmers realised what a lucrative and constant source of income could be secured from the fresh milk which had scarcely been considered up to then, and sold almost all their produce to the dairies which were springing up everywhere. Wilhelm Fleischmann, one of the leading milk experts, along with Martiny, criticised this development thus: 'The efforts of some cattle farmers to sell as much milk as possible, at the cost of their own domestic requirements is unfortunate. In time, such negligence, if it should spread, must endanger the nourishment and health of the rural population.[64]

Fleischmann estimated that average yearly consumption, according to town and area, in 1910, as between 55.4 kg and 181.1 kg, while another milk writer reckoned the average yearly consumption per head in 1904 to be around 140 kg.[65] Both authors, in contrast to Viebahn, did not just concern themselves with Prussia, but, for the first time, with the average for the Empire, which partly helps to explain the low consumption in comparison to 1860. Nonetheless the discrepancy between the calculations remains conspicuous, as Viebahn had given the average consumption as 196.8 kg. It may be that the Prussian statistician used different methods of calculation, and over-estimated in particular the amount of milk, from the total milk production, which was used for human consumption. However, it is more likely that the total milk consumption did not actually decrease to begin with at all, but just per capita consumption. Today's statistics only assume a yearly per capita consumption of 113 kg for 1910. It is notable that Eric Hobsbawm also maintains that there was a decrease in average milk consumption in England.[66] He connects this with the decrease in the number of cattle which was both relative and absolute, which was also noted in Germany, and which, in turn, can be explained as a consequence of urbanisation. Of course, here we must not overlook the rise in milk yield per cow which occurred at the same time, and which partly compensated for this decrease. In any case, this reason alone is not sufficient to explain the possible relative fall in milk consumption.

The remarkable contradiction between a fast-expanding dairy-economy on the one hand and a relative decrease in milk-drinking on the other could of course also be explained by the fact that butter and cheese consumption increased considerably in the same period. A number of known facts confirm this hypothesis: thus, from references, it becomes clear, again and again, that milk was not a very popular drink with the adult population, the less so as it was mainly drunk in the form of adulterated skimmed milk. Beer and coffee were normally preferred because of their taste and stimulating effect. It is true that in scientifically educated circles, under the influence of food science which was becoming fashionable, an awareness of the particular nutritive value of milk, and the role it has in health, was spreading, but this first reception was certainly in no way identical to a general acceptance. Milk adulteration must have formed a major obstacle to the quick spread of the milk idea. As workers' household accounts show, it was especially here that milk consumption remained way behind the nutritiously and physiologically desirable quantities. In these circles,

milk was seen as food only for children, old people and invalids, representing a very old food behaviour pattern.[67] As the following example of a medium-sized German town shows, milk consumption rose noticeably at first only in the higher social classes. The percentage spent on milk in the household budget decreased again after a certain point, according to Engel's law:

The annual milk consumption of various income groups in Halle and the proportion of the total food expenditure spent on milk, 1909/10

Annual Income in RM	Milk consumption in kg	Growth in %	Expend. on Food		Expend. on Milk	
			in RM	in %	in RM	in %
1200-1600	235	—	697,34	50	46,89	6.7
1600-2000	353	50.0	685,35	38	70,72	10.3
2000-3000	454	28.0	931,92	37	90,80	9.8
3000-4000	641	41.0	923,86	26	128,20	13.9
4000-5000	713	11.0	1011,49	22	142,45	14.0
5000-6000	746	4.6	1220,01	22	149,14	12.2
6000-7000	811	8.7	2157,49	33	162,12	7.5
				33	162,12	7.5

Ref: Franz Thieme, 'Price development and its significance to the economic state of the population in the town of Halle', *Documents of the Association for Social Policy*, Vol. 145, Part 1, München/Leipzig 1914, p. 84 ff.

Together with this, there were great variations in consumption between the individual German regions, as a result of regional food habits. If, after the turn of the century in Berlin, for example, an annual consumption of 400 to 500 kg was established in a family of moderate means, in Königsberg it was only 102.1 kg in 1903, and 109.3 kg in 1912, i.e. 0.28 litres or 0.29 litres per day for a largish family.[68] In Hamburg the Central Association for Dairy Farming calculated the average annual consumption as being from 120 to 130 kg, while in the Westphalian towns it was estimated as 98 kg in Soest, 89 kg in Münster and only 81 kg in Hamm.[69] It was explicitly stressed that all these variations in the amounts consumed had nothing to do with lack of supply. This all points to the fact that a considerable portion of the increased milk production was immediately processed into cheese and butter. Unfortunately, before 1910 there were no precise annual per capita figures for either of these two important dairy products, so that one has to look at individual random figures which are not really representative, and at indirect references. Thus, the national economist Johannes Conrad ascertained that butter consumption in Berlin rose

from a probable 2.3-3 kg in 1780 to around 12 kg in 1875, and cheese consumption rose from 2.3-3.2 kg to 4.8-5 kg.[70] In 1860, according to Viebahn, a total of around 6 kg of butter and cheese together were eaten in Germany. He estimated the total average consumption of a family of five at around 30 kg per annum or 0.5 kg per week.[71]

An increased fat consumption was considered, like meat in earlier centuries, a sign of a higher standard of living. Expenditure on animal fats, which could amount to as much as 12% of a domestic budget, was falling fast all the time in the nineteenth century, owing to the increasing size of families and decreasing incomes. Thus, oil, beef suet, pork lard and — later — cheap margarine (the far-reaching role of which, on the reorganisation of folk food, is intentionally not discussed here) had for a long time to play a large role in everyday meals as a butter-substitute. In other cases, for financial reasons, simple households preferred 'lower grade butter', i.e. sub-standard farmers', barrel, or cooking butter, while the 'original- Holstein- farm butter, table- or household butter, dairy- and grass-butter, Angeener table- and Thüringian piece-butter' were exclusively reserved for the higher income classes. Understandably, little was known in humbler circles about the results of the new food science, but it had long been known from the old folk medicine that a certain amount of fat consumption was necessary for people doing hard physical work. A large proportion of animal fat was traditionally consumed in fatty meats, bacon and sausage. Now, as the separators began to lower the production-costs of butter considerably, an increased market must have switched over to the much-demanded butter, and, following on from this, also to cheese. Both these dairy products would survive long transportation or storage, which was very important both for producer and retailer. As the following figures testify, Germany changed from an exporting to an importing country, as regards butter and cheese.

Import and export of butter and cheese in the German Empire from 1874 to 1901, in kg

	Butter			Cheese		
Year	Import	Export	Balance	Import	Export	Balance
1874	11.4	17.8	+ 6.4	7.1	2.0	− 5.0
1884	3.8	13.6	+ 9.8	4.4	4.5	+ 0.1
1890	8.9	7.4	− 1.9	8.8	1.5	− 7.3
1896/1900	11.6	3.8	− 7.9	13.3	1.3	−12.0
1901	18.0	2.5	−15.5	16.7	1.5	−15.2

Ref: Goltz, *Handbook of Total Agriculture*, vol. 3, p. 560; Siedel, *Dairy Farming*, pp. 826-27.

The value of annual production of all dairy products produced in the German Empire rose, in the period from 1900 to 1905 alone, from 1625 milliard RM to 2642 milliard RM.[72] One kg of finest Holstein farm butter cost 2.77 RM in 1876 on the important butter market in Hamburg, whereas the cheapest imported Galician butter only cost 1.65 RM.[73] Ten years later the cheapest butter, which was imported from the USA, still cost 1.10 RM, while the expensive Holstein butter had been kept down to 2.00 RM. On the Berlin butter market in 1876, Galician butter cost 1.85 RM, while the best table butter from Mecklenburg cost 2.80 RM. In 1886 the prices had fallen here as well to 1.42 RM and 2.33 RM respectively. The price of the American butter, which was even cheaper, was not recorded. In 1896 the price for best butter stagnated at 2.34 RM and in 1901 it sank as low as 2.29 RM, to rise again to 2.61 RM only in 1911. In 1885 a Berlin mason with an average hourly wage of 0.45 RM had to work five hours for 1 kg of best butter (three hours for 1 kg of the cheapest butter); it was 4½ hours in 1895/96, and only 3 hours 20 min. in 1901.[74] All this information admits the hypothesis that with a generally rising real income, more and more sections of the population were eating butter, even if at first it was only of a poor quality.

Corresponding evidence about average cheese consumption before 1910 is even more difficult to reconstruct, because the expense items in household budgets show great variations and do not permit any generalising statement at all. Obviously there are good reasons for this in regional taste and economics. Some sorts of cheese had been a part of the everyday folk diet for centuries. It is no wonder that regional characteristics in production retained their relevance even during industrialisation.[75] The modern cheese dairies always tried to suit the traditional tastes. Quite apart from their fat contents, the different sorts of cheese underwent various price changes, so that here it is also difficult to get quantitative conclusions.[76] Finally, figures for consumption are also almost impossible, as the cheese was not usually sold by weight but in ready-cut pieces. According to the locality, quite different quantities could be bought for the same price. We can only guess indirectly and very tentatively, by comparing Viebahn's figures for Prussia with the first cheese statistics for the whole Empire in 1910, that in the late nineteenth century there was a gradual shift from curdled milk, curd-cheese and whey-cheese to varieties with a higher fat content, as well as an increase in total demand. The following table shows the increases in consumption and production of milk, butter and cheese, up to the

present day.

Annual per capita consumption and production of milk and dairy products from 1850 to 1965, in kg

	1850	1860	1900	1910	1938	1950	1955	1959	1962	1965
Fresh milk	—	196.8	—	113.0	137.2	120.7	132.2	123.4	119.1	114.6
Condensed milk	—	—	—	—	1.1	2.1	—	6.8	8.1	8.0
Butter	—	6.0	—	6.7	8.1	6.3	7.0	8.5	9.0	8.4
Cheese	—	6.0	—	4.9	4.4	5.3	6.1	7.0	7.5	8.2
Total milk and dairy produce	267.8	284.0	355.5	371.0	391.0	307.7	342.9	342.9	378.3	—

Ref: Teuteberg, *The Diet of the Lower Classes*, pp. 264-68, as well as the consumption information given in this study. The figures for milk, butter and cheese in 1860 are only for Prussia.

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4. Jürgen Bücker, *Die deutsche Milchwirtschaft im Wandel der Zeit* (German dairy-farming throughout history), Hildesheim 1974. The book deals both with technical methods since 1870, and, mainly, with the development of individual firms, and gives biographies of the employers. It is expressly concerned with Martiny's classic work.
5. Cf. Ulrich Neuhaus, *Des Lebens weisse Quellen (Das Buch von der Milch)* (The white springs of life (The book of milk)), Berlin 1954.
6. Karl Wyss, *Die Milch im Kultus der Griechen und Römer* (Milk in the cultures of ancient Greece and Rome), Giessen 1914.
7. Ernst Paul Herdi, *Die Herstellung und Verwertung von Käse im griechisch-römischen Alterum* (The production and utilisation of cheese in classical Greece and Rome), Frauenfeld 1918.
8. Publius Cornelius Tacitus, De originibus et situ Germanorum liber. Translated by J. Lindauer, in Rowohlts Klassiker (Rowohlt's Classicists), vol. 217, Reinbek 1968, p. 11.
9. As the Germanic people only learned cheese production gradually from the Romans, soured or curdled milk must be meant here. If Tacitus had meant cheese, he would certainly have used the Latin word 'caseus'.
10. Cf. Henri Pirenne, *La civilisation occidentale au Moyen Âge du milieu du XV^e siècle. Le mouvement économique et sociale*, Paris 1933.
11. Sebastian Münster, *Cosmographia*, Basle 1543. Quoted in Johannes Scherr, *Geschichte der deutschen Kultur und Sitte* (History of German culture and customs), Leipzig 1852, p. 222. Cf. Hans J. Teuteberg and Günther Wiegelmann, *Der Wandel der Nahrungsgewohnheiten unter dem Einfluss der Industrialisierung* (The change in food-habits under the influence of industrialisation), Göttingen 1972, p. 135.
12. In the medical school at Salerno, the whey, which is known to have a high lactose and valuable mineral content, was already regarded as a medicine. In one of the hygienics they published, it states, among other things, that 'We know this about whey: that it loosens and penetrates and often achieves a good purification of the body' (quoted in Neuhaus, *Weissen Quellen* (White springs), p. 151).
13. It is significant that in Fugger's household books, only cheese and no milk is recorded. Cf. Kurt Hintze, *Geographie und Geschichte der Ernährung* (Geography and history of food), Leipzig 1934, p. 77.
14. The Schwaige estates in Allgäu, which could not be used for cereal cultivation

because of their altitude, received cows, sheep and goats, and the necessary implements for cheese-making, from their feudal lords as early as the twelfth century. The produce was then used domestically or taken to the markets. As early as 1484, Pope Sixtus IV gave these alpine inhabitants a fasting dispensation for milk, butter and cheese which were their chief food sources. In Holstein, in the sixteenth century, Baron Rantzau ran a model dairy farm, which produced 10 tonnes of butter annually. Cf. Milchwirtschaftlicher Verein im Allgäu (Allgäu Society for dairy-farming (Editors), *Geschichte der Allgäuer Milchwirtschaft* (History of dairy-farming in Allgäu), Kempten in Allgäu 1955; Niemann, *Die holsteinische Milchwirtschaft* (Dairy-farming in Holstein), 2nd edition, Altona 1823, p. 42.

15. In a work of household literature from the mid-sixteenth century, it says, among other things, that 'a good and industrious farmer's wife always bears in mind/ not only how to feed and look after her children and servants/ but also how to organise her affairs/ so that together with earning her daily money/ she sees to it that her daughters and maids are industrious/ and that they treat the cow's milk so prudently/ that a good store of cheese and butter can be made . . .' From Melchior Sebezius Silesius, *Sieben Bücher von dem Feldbau und vollkommener Bestellung eynes ordentlichen Meyerhofs oder Landgutes* (Seven books about agriculture and the complete ordering of a proper farm or estate) (from the French), Strassburg 1579, pp. 98-99.
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18. Teuteberg, 'Landwirtschaft' (Agriculture), p. 44.
19. In a contemporary manual from the beginning of the nineteenth century, it states on this point: 'Cattle can only ensure a net profit in simple fertile pasture regions which are not suitable for arable cultivation and not usually on normal arable farms, where, in general, they are only kept because of their indispensability.' Cf. Friedrich Benedikt Weber, *Theoretisch-praktisches Handbuch der grösseren Viehzucht* (A theoretical and practical manual of large-scale cattle-breeding), Berlin 1810.
20. The price of 1 kg of beef rose, between 1876/80 and 1913, from 1.14 M to 1.81 M, that of 1 litre of milk from 0.17 M to 0.22 M, while the price of 2 cwt of rye fell from 16.32 M to 15.8 M in the same period. Cf. Teuteberg, 'Landwirtschaft' (Agriculture), p. 65.
21. *Ibid.*, p. 67.
22. Among others, the following contemporary writings report on the increase in German cattle-breeding: August von Weckherlin, *Die Rindviehzucht Württembergs* (Cattle-breeding in Württemberg), Stuttgart 1839; May, *Die Rassen,*

Züchtung, Ernährung und Benutzung des Rindes (Breeds, breeding, diet and use of cows), Munich 1863; Hermann Nathusius, *Über die Konstanz der Thierzucht* (Concerning the continuance of cattle-breeding), Berlin 1860; August von Weckherlin, *Landwirtschaftliche Thierproduktion* (Agricultural animal production), Stuttgart 1846; Wilhelm Settegast, and Kroker (editors), *Deutsches Heerdbuch* (German stud book), Berlin 1865 ff; Ernst Engel, 'Die Viehhaltung im preussischen Staate' (Cattle-farming in the Prussian state), in *Zeitschrift des Kgl. Preussischen Statistischen Bureaus* (Magazine of the Royal Prussian Statistical Bureau), vol. 1861.

23. Kurt Ritter, *Agrarwirtschaft und Agrarpolitik im Kapitalismus* (Agrarian economics and politics in capitalism), 2 half-volumes, part 2, East-Berlin 1959, p. 1816.
24. This important use of Albrecht Thaer's principle of rational agriculture (he was only peripherally concerned with the rise of cattle-farming) is to be found in J. von Schreibers, *Die Milchwirtschaft im Innern grosser Städte und deren nächste Umgebung* (Dairy-farming within large cities and their immediate neighbourhood), Prague 1837, p. 3. Compare similar thoughts in Wilkens, 'Die volkswirtschaftlichen Bedingungen der Viehzucht' (Economic conditions of cattle-breeding), in *Jahrbuch der deutschen Viehzucht* (German cattle-breeding almanac), vol. 1, Breslau 1864.
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26. Georg von Viebahn, *Statistik des zollvereinten und nördlichen Deutschlands* (Statistics from customs-union- and northern-Germany), vol. 3, Berlin 1868, p. 509. A Silesian landowner and agrarian author reckoned as much as 1640 Prussian quarts (1968 kg) to be the average milk-yield, but this is definitely too high. His quantitative comparisons with American agriculture are very interesting. Compare Elsner von Gronow, 'Die Konsumtion und Produktion von Milch, namentlich in Nordamerika' (The consumption and production of milk, especially in North America), in *Jahrbuch der deutschen Viehzucht* (German cattle-breeding manual), vol. 1, Breslau 1864, p. 240 ff.
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29. Hans Wolfram Graf Finck von Finckenstein, *Die Entwicklung der Landwirtschaft in Preussen und Deutschland 1800-1934* (The development of agriculture in Prussia and Germany 1800-1934), Würzburg 1964. Milk production per cow per annum, in West Germany, was 3771 kg in 1968. Compare Statistisches Bundesamt Wiesbaden (Editors) (Statistical Office, Wiesbaden), *Statistisches Jahrbuch für die Bundesrepublik Deutschland* (Statistical almanac for the Federal Republic of Germany), Stuttgart/Mainz 1969, p. 165.
30. Johannes Ranke, *Ernährung des Menschen* (Food of the people), Munich 1876, p. 237 ff.
31. Hans J. Teuteberg, 'Die Nahrung der sozialen Unterschichten im späten 19. Jahrhundert' (The food of the lower social classes in the late nineteenth century), in Edith Heischkel-Artelt (Editor), *Ernährung und Ernährungslehre im 19. Jahrhundert* (Food and food science in the nineteenth century), Göttingen 1976, p. 240 ff.

32. Moriz Heyne, *Das deutsche Nahrungswesen von den ältesten geschichtlichen Zeiten bis zum 16. Jahrhundert* (German food from the earliest historical times up to the sixteenth century), Leipzig 1901, p. 307. Incidentally, neither sheep's-, nor horse's- nor donkey's-milk ever played a significant role in Germany.
33. Martiny, *Milch* (Milk), vol. 1, p. 1.
34. *Ibid.*, vol. 2, p. 1.
35. Otto Keune (Editor), *Männer, die Nahrung schufen* (Men who made food), Hannover 1954, p. 376.
36. Wilhelm Prandtl, *Antonin Prandtl und die Erfindung der Milchentrahmung durch Zentrifugen* (Antonin Prandtl and the invention of the centrifugal milk-separator), Munich 1938.
37. Schreibers, *Milchwirtschaft* (Dairy-farming), p. 19.
38. Martiny, *Milch* (Milk), vol. 1, p. 401.
39. Compare the complaints about the small consumption of skimmed milk in Theodor Freiherr von der Goltz, *Handbuch der Landwirtschaft* (Manual of agriculture), vol. 3, Tübingen 1890, p. 539; Jahn, *Versorgung Berlins* (The supply of Berlin), p. 12.
40. Martiny, *Milch* (Milk), vol. 1, p. 401; Goltz, *Landwirtschaft* (Agriculture), vol. 3, p. 525; Siedel, *Milchwirtschaft* (Dairy-farming), p. 523.
41. Schreibers, *Milchwirtschaft* (Dairy-farming), p. 151.
42. Neuhaus, *Weisse Quellen* (White springs), p. 82.
43. Alfred Lichtenfelt, *Geschichte der Ernährung* (History of food), Berlin 1913, p. 136.
44. Fridolin Schuler, *Zur Alkoholfrage. Die Ernährungsweise der arbeitenden Klassen in der Schweiz und ihr Einfluss auf die Ausbreitung des Alkoholismus* (On the question of alcohol. The food system of the working-classes in Switzerland, and its influence on the spread of alcoholism), Berne 1884, p. 22.
45. Frederick Accum, *A Treatise on the Adulteration of Food and Culinary Poisons . . .* 2nd edition, London 1820. By the same author, *A Treatise on the Art of Making good and wholesome Bread of Wheat, Oats, Rye, Barley and other farinaceous Grains etc. . . .* London 1821; *The Domestic Chemist; comprising Instructions for the Detection of Adulteration in numerous Articles employed in Domestic Economy, Medicine and Arts . . .* London 1831; James Dawson Burn, *The Language of the Walls: and A Voice from the Shop-windows; or, the Mirror of Commercial Roguery,* London 1855; William Marcet, *On the Composition of Food and how it is adulterated, with practical Directions for its Analysis,* London 1856; The Tricks of Trade in the Adulteration of Foods and Physick; with Directions for their Detection and Counteraction, London 1859; Frederick Filby, *A Story of Food Adulteration and Analysis,* London 1934.
46. A. H. Hassall, *Food and its Adulteration,* London 1855. Compare John Burnet, *Plenty and Want. A Social History of Diet in England from 1815 to the Present Day,* London 1966.
47. Compare among others, John Mullaly, *The Milk Trade of New York and Vicinity giving an Account of the Sale of Pure and Adulterated Milk,* New York 1853; James Cheston Morris, *The Milk Supply of Large Cities,* Philadelphia 1884; George Abbott, *Milk Legislation,* Philadelphia 1893; Henry H. Wing, *Milk and its Products,* 15th edition, New York 1897; Edward H. Farrington, *Testing Milk and*

its Products . . . 3rd edition, Madison, Wisconsin, 1898; George M. Whitaker, *The Milk Supply of Boston and other New England Cities*, Washington 1898; Raymond A. Pearson, *Market Milk, a Plan for its Improvement*, Washington 1901; Henry E. Alvord and Raymond A. Pearson, *The Milk Supply of Two Hundred Cities and Towns*, Washington 1913; Sarah D. Belcher, *Clean Milk*, New York 1907; W. G. Savage, *Milk and the Public Health*, London, 1912; Arthur C. Dahlberg, *Sanitary Milk Control and Its Relation to the Sanitary, Nutritive and other Qualities of Milk*, Washington 1953.

48. Ritter, *Agrarwirtschaft* (Agriculture), p. 1835; Wilhelm Treue, 'Zur Geschichte der Ernährung in Berlin im 19. Jahrhundert' (The history of food in Berlin in the nineteenth century), in *Proceedings of the Seventh International Congress of Nutrition*, Hamburg 1966, vol. 4, Brunswick 1967, p. 71.
49. Berg, *Milchversorgung* (Milk supply), p. 102.
50. Papers of the Association for Social Policy, vol. 140: *Milchwirtschaftliche Erzeugnisse* (Dairy-farming products), 5 parts, Munich-Leipzig 1912-1915.
51. Jahn, *Berlin*, p. 1.
52. Compare Meinert, 'Milchversorgung von Hamburg' (Milk supply in Hamburg), *loc. cit.*
53. Berg, 'Milchversorgung der Stadt Karlsruhe' (The milk supply of the town of Karlsruhe), p. 129.
54. Meinert, 'Milchversorgung von Hamburg' (The milk supply of Hamburg), p. 22.
55. *Ibid.*, p. 27.
56. *Ibid.*
57. Berg, 'Milchversorgung der Stadt Karlsruhe' (The milk supply of the town of Karlsruhe), p. 129.
58. *Ibid.*, p. 130.
59. Already in 1910, as many as 122 state schools were being supplied daily with 6,500 bottles of milk (0.5 litres) at a price of 0.05 RM.
60. Anna Witzenhausen, 'Die Milchversorgung der Stadt Mannheim' (The milk supply of the town of Mannheim), in *Schriften des Vereins für Sozial-politik* (Papers of the Association for Social Policy), vol. 140, Leipzig 1915. Cf. Berg, 'Milchversorgung der Stadt Karlsruhe' (The milk supply of the town of Karlsruhe), p. 100.
61. Attempts failed in Münster and Herford. Cf. Oeser, *Milchversorgung von zehn Städten der Provinz Westfalen* (The milk supply of ten towns in the province of Westphalia), p. 290.
62. When the dairy-farmers around Bielefeld, in their annoyance with the milk-retailers, tried to set up their own marketing organisation, the retailers retaliated by setting up their own dairy and boycotting the local dairy-farmers by only buying milk from distant regions. The 'milk war' was also carried on by influencing the customers and publishing newspaper articles.
63. This did not, of course, apply to the certified milk. When the Karlsruhe milk centre raised the price of 'hygienically obtained milk' by 2 pfg., the large majority of customers re-ordered this type of milk. It was also a normal occurrence for the price of milk to go up slightly in winter. Compare Berg, 'Milchversorgung der Stadt Karlsruhe' (The milk supply of the town of Karlsruhe), p. 130; Viebahn, *Statistik* (Statistics), vol. 3, p. 509.

64. Wilhelm Fleischmann, 'Milchwirtschaft und Molkereiwesen' (Dairy-farming and dairies), in *Handwörterbuch der Staatswissenschaften* (Concise dictionary of political science), 3rd edition, Jena 1910, p. 702.
65. *Ibid.*, p. 703; Siedel, *Milchwirtschaft* (Dairy-farming), p. 827.
66. Eric Hobsbawm, 'The British Standard of Living, 1790-1850', in J. Taylor (Ed.), *The Standard of Living in Great Britain in the Industrial Revolution*, London 1975, p. 79. In German: 'Der britische Lebensstandard (The British standard of living) 1790-1850', in Wolfram Fischer and Georg Bajor (Eds.), *Die soziale Frage* (The social question), Stuttgart 1967, pp. 98-99. A drop in milk consumption among Swiss workers is also shown in Schuler, *Zur Alkoholfrage* (About the alcohol question), p. 22.
67. Adolf Braun, *Haushaltsrechnungen Nürnberger Arbeiter* (Household budgets of workers in Nürnberg), Nürnberg 1901, p. 68 and p. 64.
68. Teuteberg, *Ernährung sozialer Unterschichten* (The food of the lower social classes), p. 267.
69. Oeser, *Milchversorgung von zehn Städten der Provinz Westfalen* (The milk supply of ten towns in the province of Westphalia), pp. 279, 301, and 305.
70. Johannes Conrad, 'Der Konsum an notwendigen Nahrungsmitteln in Berlin vor hundert Jahren und in der Gegenwart' (The consumption of necessary foods in Berlin, a hundred years ago and today), in *Jahrbücher für Nationalökonomie und Statistik* (Yearbooks for national economy and statistics), vol. 37 (N.F. vol. 3), 1881, p. 522.
71. Viebahn, *Statistik* (Statistics), vol. 3, p. 509.
72. Fleischmann, *Milchwirtschaft* (Dairy-farming), p. 701.
73. All the following information is from Goltz, *Handbuch der gesamten Landwirtschaft* (Handbook of total agriculture), vol. 3, p. 560.
74. Calculations from R. Kuczynski, *Arbeitszeit und Arbeitslohn in Europa und Amerika 1870-1890* (Working-hours and -wages in Europe and America 1870-1890), Berlin 1913, p. 29 and p. 255; and Goltz, *Handbuch der gesamten Landwirtschaft* (Handbook of total agriculture), vol. 3. Of course, the Berlin mason's wage selected as an example is not representative of the whole Empire, because wages differed with occupation and locality, just as the milk-prices did; a truly precise average calculation is not possible. What is important is that the tendency shown here was also evident in other income-groups.
75. Regarding cheese production in earlier centuries, compare the information in Heyne, *Nahrungswesen* (Food), p. 308 and p. 322. Concerning modern times compare Klenze, *Handbuch der Käserei-Technik* (Manual of techniques of cheese-making), Bremen 1884.
76. Thus, for example, in Hannover between 1890 and 1912 the price of Tilsiter cheese rose by 10.3%, of Swiss cheese by 46%, and of the popular local Harz cheese by 117%. Compare Teuteberg, *Nahrung der sozialen Unterschichten* (The food of the lower social classes), pp. 267-68.