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## The Potato Murrain on the European Continent and the Revolutions of 1848

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**Abstract** The tale of the Irish Famine, 1845–1849, following the outbreak of potato late blight, has been told repeatedly, but the parallel story of the Continental Famine, 1845–1847, has not yet been recorded. The Continental Famine was caused by poor harvests of potatoes, due to the same late blight, but also of grain, due to frost, drought, rust, voles, inopportune rains, floods and hailstorms. The Continental Famine was enhanced by hoarding, speculation, and poor governance. Hunger was followed by infectious diseases. The demographic effects of hunger and diseases are difficult to disentangle. The number of excess deaths due to the Continental Famine cannot yet be determined with any precision, but clearly it approaches that of the Irish Famine. The harvest failures of 1845 and 1846 and the resulting famines came on top of rural pauperisation and urban discontent, and thus contributed to the revolutions of 1848 on the European Continent. The statement ‘an epidemic of potato late blight caused an epidemic of revolutions’ is, perhaps, exaggerated but it contains a grain of truth.

**Keywords** Crop loss · Drought damage · Epidemics · Famine · Financial crisis · Pauperism

### Abbreviations

~ approximately  
D Dutch  
G German  
F French  
N north  
E east  
S south

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W	west
M	middle
NL	The Netherlands
kg	kilogram
tonne	1000 kg
l	litre
hl	(hectolitre)100 litre
d	day
y	year

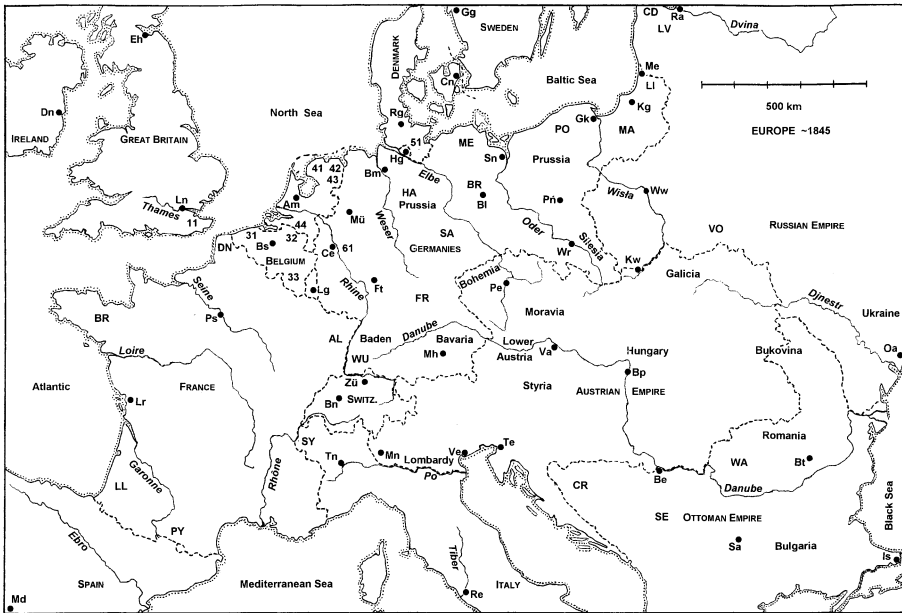
## The Continental Famine

The epidemic of *Phytophthora infestans*, at the time indicated as the ‘Potato Murrain’, destroyed the potato crop in Ireland and triggered the ‘Great hunger’ (Woodham-Smith 1962) of 1845–1847, also called the ‘Irish Famine’. The infection was imported from the Americas into Belgium on new potato breeding material and it began already to spread in 1844 (Bourke and Lamb 1993). The year 1845 was a blight year but, from a meteorological point of view, not an extreme one. Winds dispersed the inoculum in all directions over Europe, also to the NW, so that England and later Ireland were affected (Bourke 1964). The Irish crop was exceptionally promising in 1845 until the blight killed the crop, sometimes within a week, a real catastrophe. In the following year, 1846, the blight was disastrous again, due to the weather, the late planting of the crop, and – supposedly – the amount of inoculum coming from culled potatoes left about hither and thither.

The Irish were poor and they had little else to eat than potatoes. Under the ‘potato economy’ an Irish labourer ate ~5.4 kg of potatoes a day, spread equally over three meals, as long as potatoes were available, roughly from November 1st to May 1st. Then came the summer dip, with hunger and disease. Failure of the potato meant famine, and a famine was accompanied by its usual complement of infectious diseases, intestinal infections, dysentery, typhoid, typhus, and tuberculosis. We cannot differentiate the numbers killed by hunger from those killed by disease. The results of the Irish Famine are well known, with ~600,000 excess deaths and an emigration of ~1,300,000 people over the five-year period 1846/51.

On the European continent, the rural poor were, maybe, slightly better off than in Ireland. Their diet consisted largely of potatoes *and* rye. In 1845 and 1846 their subsistence was threatened by harvest failures in several major food crops, potatoes foremost. A famine followed, here called the ‘Continental Famine’. While the course of events on the continent showed some similarities with that in Ireland, its impact on society differed. In Ireland a breakdown of traditional society took place, with mass emigration but without political renewal, whereas on the Continent a renewal of societies followed the revolutions of 1848. This paper discusses the relationship of the phytopathological events in 1845–1846 and the political events of 1848.

Each section begins with some general comments, applicable to much of Continental Europe (Fig. 1), and continues to discuss the events in different countries, the Netherlands foremost.



**Fig. 1** Map of Europe, situation of ~1845. In the W we see the rather stable nations Great Britain, France and Spain. The E is covered by the Russian and Ottoman Empires. Going from N to S in the central zone we see Sweden and Denmark, ‘the Germanies’, the Austrian Empire, future Switzerland, and future Italy. ‘The Germanies’ comprised numerous states, among which Prussia (the largest and most powerful), Bavaria and Baden. Prussia reached roughly from the Netherlands in the W to the Russian Empire in the E. The Kingdom of Poland was *de facto* incorporated in the Russian Empire. The Austrian Empire comprised present Austria, Hungary, Czechia, Slovakia, and parts of present Poland, Ukraine, Romania, Serbia, Croatia, and N Italy. After Westermann (1956, maps 126 and 127, Europe 1815, the peace arrangement by the Congress of Vienna)

Letter code: COUNTRIES, Areas, Seas, Rivers

11	Kent	Am	Amsterdam	Ln	London
31	Flanders	Be	Belgrade	Md	Madrid
32	Campine	Bl	Berlin	Mh	Munich
33	Wallonia	Bn	Bern	Mn	Milan
41	Friesland	Bp	Budapest	Mü	Münster
42	Groningen	Bs	Brussels	Oa	Odessa
43	Drente	Bt	Bucharest	Pe	Prague
44	Noord-Brabant	Ce	Cologne	Pñ	Poznań (= Posen)
51	Schleswig-Holstein	Cn	Copenhagen	Ps	Paris
61	Westfalia	Dn	Dublin	Ra	Riga
AL	Alsace	Eh	Edinburgh	Re	Rome
CR	Croatia	Ft	Frankfurt	Sa	Sofia
DN	Département Nord	Gk	Gdańsk (= Danzig)	Te	Trieste
HA	Hannover	Is	Istanbul	Tn	Turin
LI	Lithuania		(= Constantinople)	Va	Vienna
LV	Latvia	Kg	Kaliningrad	Ve	Venice
SA	Saxony		(= Königsberg)	Wr	Wrocław (= Breslau)
SE	Serbia	Kw	Kraków	Ww	Warsaw
SY	Savoy	Lg	Luxemburg	Zü	Zürich
VO	Volhynia				
WA	Wallachia				

## Potato Late Blight and Other Discomforts

### Potato Cultivation and Potato Use

Between 1750 and 1850 the potato gradually gained ground upon the cereals, primarily rye (e.g., Bieleman 1987), though with considerable phase differences between countries and regions (Oliemans 1988). Yields increased considerably between 1812 and 1845 (van Zanden 1985). Providing once to twice more calories per hectare than cereals, and being a sturdy crop with regular yields, the potato became the staff of life for the poor. The fast population increase between 1820 and 1840 in the clay districts of the Netherlands may be related to the good potato crops on clay soils. In other NW European countries similar developments occurred.

Many potato varieties were in use, early, mid-late, and late. The late varieties should have a good keeping quality since storage facilities were minimal in comparison with today. Keeping quality had already become a problem in Ireland when the preferred potato variety changed from ‘Apple’ over ‘Cup’ to ‘Lumper’ in a period of about 100 years. The average per capita consumption of potatoes in Ireland was  $\sim 800 \text{ kg y}^{-1}$ , while it was only  $\sim 210 \text{ kg y}^{-1}$  in the Netherlands. The last figure seems representative for Continental Europe where calorie intake was supplemented by rye for the poor and wheat for the rich. In times of scarcity the calorie intake may have varied considerably.

The area under potato increased and part of the new produce was destined to industrial processing. Potato flour (farina) was a new product. Distilleries produced malt wine, alcohol, and vinegar. The vinegar served to savour the potatoes. The alcohol was used in the spirit burner. Malt wine was the raw material of brandy. Use and abuse of brandy were considerable. The average male in the rural town of Goes (Zeeland, NL) consumed more than half a litre of brandy per week. Pastor O.G. Heldring, deeply concerned with the condition of the poor, thought that the potato contained a ‘principle of sin’ because it was also used to produce ‘jenever’, the Dutch version of gin. He saw the punishing hand of God in the potato blight (Heldring 1845).

### Potato Diseases

The major potato disease during the late 18th and early 19th century was the ‘curl’, known since 1747 in Germany and 1764 (or 1751?) in England. Today curl is attributed to a virus disease, possibly potato virus Y (Salaman 1949). Control was difficult but not impossible. The most radical solution, though with a temporary effect only, was the selection of new varieties from seedlings (van Bavegem 1782), a current practice during the 19th century in England, the Netherlands and Belgium. ‘Renewal of seed’, i.e. importing seed potatoes from less affected areas, was practised as a control measure since  $\sim 1800$  in Belgium and England. A more subtle method of control was a form of ‘green lifting’, mentioned in Friesland (NL), 1807 and 1809, and in Scotland (van der Zaag 1999).

In the early 1840s an epidemic of ‘dry rot’ occurred Europe-wide, due to a *Fusarium* fungus (von Martius 1842). In 1844, the Belgian Government, wanting to control the diseases ‘curl’ and ‘dry rot’, planted potato material imported from North

America on a farm at Cureghem in West Flanders. Some plants showed curious brown flecks. Some of the harvested potatoes rotted in storage. This is the putative onset of the potato late blight epidemics in Europe that caused the Great Hunger 1845/51 in Ireland and the Black Years 1845/9 in the Netherlands. The story of this ‘potato murrain’, a designation used by Berkeley (1846), in Ireland has been told over and over again.

### The Late Blight Epidemics of 1845 and 1846

Münter (1846) noted a steep gradient in the wetness of 1845, from England (wet, cold, bad harvest), to NE Europe (warm, dry). The weather of the years 1845 and 1846 was studied in detail by Bourke and Lamb (1993). No specifics were found on the 1844 weather relevant because of some early reports on the disease.

*1844* Late blight first appeared in 1844 in Belgium. Desmazières, a botanist and mycologist, had seen the disease in 1844, in the department ‘Nord’, in N France; he can be considered a reliable observer. The disease was also seen in SE England (Kent).

*1845* The winter 1844/5 was extremely cold and frost may have killed culled potatoes, thus eliminating inoculum. It also killed much fall-sown cereals and winter colza (rapeseed) in the Low Countries and in M and N Europe. As a consequence farmers planted more potatoes than usual in the Netherlands, Belgium, and N Germany. Seed potatoes and groundkeepers (unharvested potatoes producing volunteer plants) may have carried inoculum through the winter. No relevant information is available. In 1845 the blight spread over Europe as a first order ‘focal epidemic’ (Heesterbeek and Zadoks 1987; Zadoks and van den Bosch 1994), wonderfully illustrated by Bourke (1964) on the basis of hundreds of original documents.

Bourke and Lamb (1993) analysed the seasonal weather for 1845. In most of NW Europe the weather, ‘drab, cloudy and cold’, was but moderately favourable to infection. Winds could disperse inoculum from the focal centre in all directions. Extreme susceptibility of the potato crops rather than exceptional weather conditions determined the severity of the epidemic (Vanderplank 1968). The blight hit the potatoes early and hard in the Belgian sea polders. In the Netherlands the alarm bells tinkled everywhere in August. The early potatoes had been lifted safely, but the mid-late and late varieties became seriously diseased, sometimes up to total loss. The sandy soils, less conducive to late blight, could still produce a crop, though even in the peat-sand area of Drenthe the yield fell from ~210 hl/ha in 1844 to ~90 hl/ha in 1845, a loss of ~57% (Bieleman 1987).

*1846* The mild winter of 1845/6 must have allowed the ample overwintering of inoculum in culled potatoes, refuse piles, groundkeepers, and seed potatoes, all over Continental Europe, but this has not been documented. Late winter and early spring were unusually mild.

The summer of 1846, with its anti-cyclonal weather pattern over the continent, was dry and hot, and, according to several contemporaries, exceptionally dry and

hot. Drought damaged many crops over large areas. The rye crops suffered much in France and in present Poland, and in several hill districts. In Lower Silesia (present SW Poland) the potato harvest failed by drought, not late blight. Similarly, the early potatoes in Bavaria – escaping the blight – could not form decent tubers by lack of water. The statement by Bourke and Lamb that the potato crop ‘suffered more from drought than from blight’ may be too strong, though.

The German daily *Allgemeine Zeitung* of 2 August 1846 wrote: ‘Everywhere the continuing heat melts the ice on the mountains. The summit of the Mont Blanc today presents naked rocks, during many years the ice there did not disappear. In consequence several rivers burst their banks, such as the Rhône, which flooded some 1000 Juchart (= ~300 ha) of cultivated fields’. Floods – destroying the crops – were reported from i.a. the Rhine in Liechtenstein and the Visłava (G: Weichsel) in present Poland. Clear skies might have led to severe night frosts damaging the young potato crops and the flowering rye crops but the information is not satisfactory. Nightly dew was probably frequent. In a band running roughly from the Netherlands to Switzerland yellow stripe rust (*Puccinia striiformis* Westend.) of rye took its toll (Zadoks in preparation).

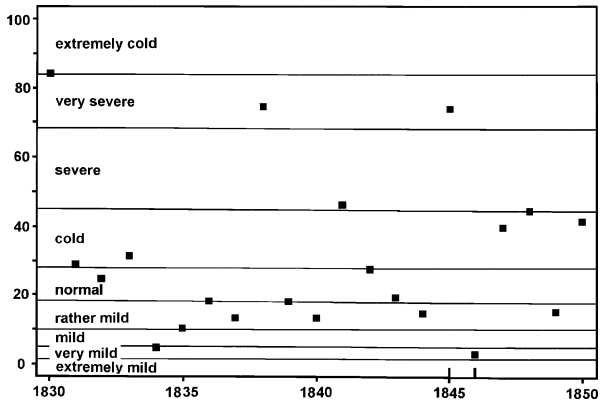
Thunderstorms interrupted the fine weather and hailstorms could be very destructive. One such hailstorm in Bavaria destroyed the food base of 15,000 people. The additive effect of these storms must have been considerable thus fuelling scarcity and distress. The thunderstorms in July provided the wetness needed by late blight to explode. Exploding it did, and around the end of July messages came in from Copenhagen and Gdańsk (G: Dantzig) in the North to the Savoy in the South, from Ireland in the West to Bavaria, and – later – Ukraine, in the East.

*Countries* Agriculture knows good years, when everything works together in favour of the crops, ‘normal’ years, and bad years, when wrong goes what can go wrong. 1846 was a bad year. Among the mishaps were drought and excessive heat, yellow rust on rye – the staple for many Europeans –, field mice, hail storms, and floods. The potato murrain was the last of the misfortunes, picking up speed in August and becoming very destructive all over continental Europe.

*The Netherlands* The subjective ‘feel’ of a season has been captured in a single figure, the ‘frost index’ for the winter and the ‘summer index’ for the summer (Figs. 2 and 3). Temperature (monthly mean of daily temperatures) and precipitation (in mm per month) were plotted as the deviations from their 30-years’ (1831–1860) means (Fig. 4). The winter 1844/5 was bitterly cold with monthly mean temperatures ~5 °C below normal in December, February and March. But the winter of 1845/6 was warm with monthly means of 2–4 °C above normal from November through March. The summer of 1846 was hot. The winter 1846/7 was very cold again with monthly means of at least 3 °C below normal in December and January. Monthly precipitations were about normal in 1845 and 1846, with the exception of a high precipitation in December, 1845 (Fig. 5).

In the course of August people realised that a catastrophe drew near. The Dutch government reacted promptly. On 14 September 1845 the King signed an Order of Council, proposed 9 September, to withdraw import duties on food commodities. Later, 16 November, the Minister of Finance van Hall, a liberal, declared ‘All other

**Fig. 2** The Frost Index for the years 1830–1850 (IJnsen 1981). The value for e.g., 1840 should be read as the value for the winter 1839/40. The winter 1844/5 was very cold, the winter 1845/6 was exceptionally mild. Horizontal–years. Vertical–Frost Index (ranging from 0 to 100)



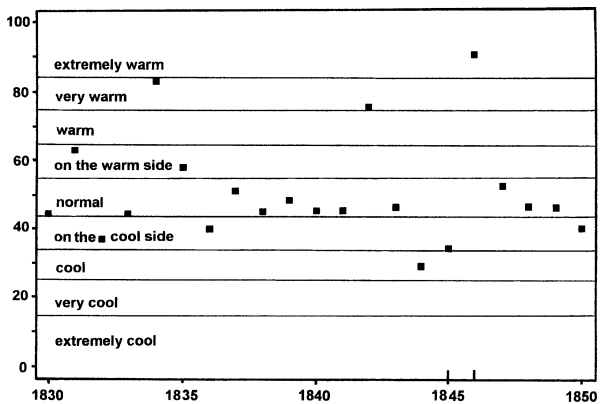
artificial measures lie, in my conviction, beyond the circle of duties of the Government’.

Dutch potato yield in 1845 was only ~0.4 million tonnes (6 million hl), nearly 60% less than needed. In 1846 the area under potatoes decreased somewhat, as in the province of Noord-Holland (van Ewyck 1847). In the province of Friesland, the blight in 1846 was worse than in 1845 (Wumkes 1934). In the province of Groningen the blight caused serious damage. Decadal average yields in hl/ha decreased from 185 (1831–1840) to 126 (1841–1850), recovered slowly to 148 (1851/60), to reach the nearly normal level of 181 (1861–1870) with considerable delay (Priester 1991).

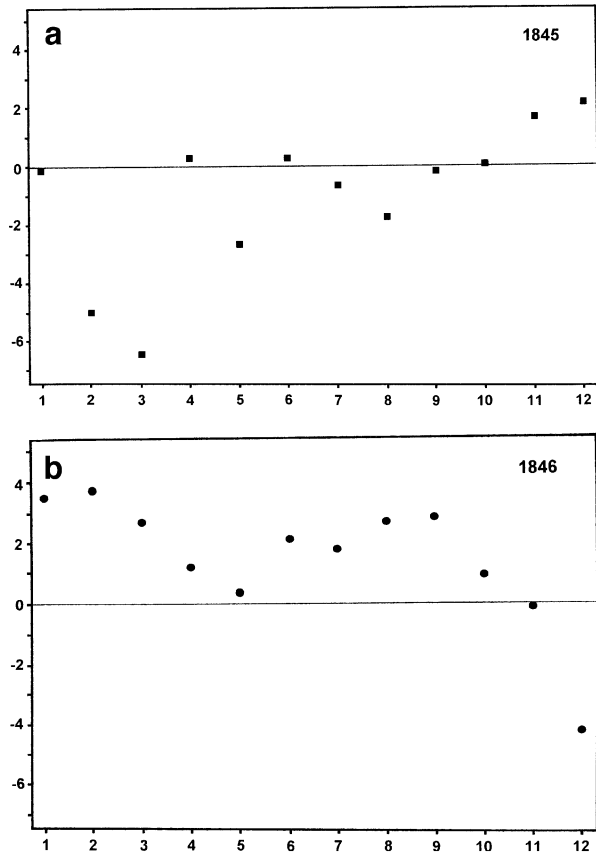
In the Netherlands the blight epidemics had several agricultural consequences.

- (1) The area under potatoes was reduced, by 35% in Groningen, by 75% in the Beijerlanden, south of Rotterdam, and by up to 100% in the hard hit area of the Bommelerwaard. The old levels were regained with a delay of some 20 years. Potatoes were replaced by leguminous crops for food and mangolds for feed.
- (2) The potato area shifted somewhat to the sandy soils of Drente and Brabant, where the micro-climate was less conducive to blight.

**Fig. 3** The Summer Index for the years 1830–1850 (IJnsen 1976). The blight year 1846 was exceptionally warm. Horizontal–years. Vertical–Summer Index (ranging from 0 to 100)



**Fig. 4 a.** Monthly means of daily temperatures at de Bilt, Netherlands, 1845, plotted as deviations from the 30-years averages (1831–1860). Temperature in °C. Horizontal—months of the year beginning with January. Vertical—Deviation of the mean monthly temperature of 1845 from its long term mean (mean monthly temperature of 1845 minus mean monthly temperature averaged over 1831–1860). **b.** Same, 1846



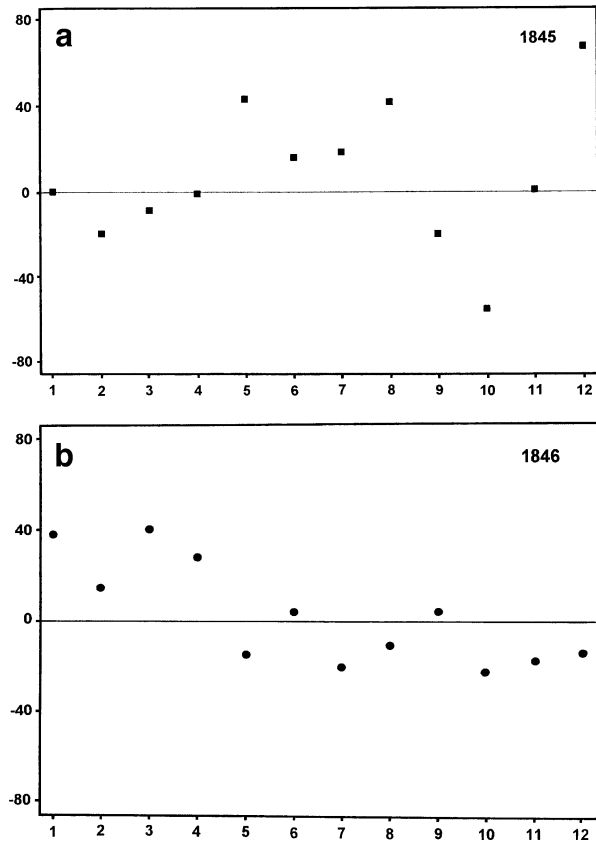
- (3) Early potatoes received more attention as they often escaped the blight. The produce was readily exported to the Dutch towns and abroad, to England foremost.
- (4) Several potato processing plants had to close down. In Groningen, only two distilleries out of sixteen survived the 1846 crisis.

*Austria* In 1845, blight arrived in the Austrian Crownlands but the amount of damage is uncertain. In 1846 the potato harvest was ruined in Silesia and Galicia (both in the S of present Poland), Bohemia and Moravia (present Czechia), and the Bukowina (present Ukraine and Rumania). In Bohemia and the Bukowina losses were  $\geq 75\%$  (Sandgruber 1978). The disease was impressive in Styria (Unger 1847). In 1847 the blight struck again (Macartney 1968).

*Belgium* In Belgium, 1845, the blight was early and severe. Tubers rotted in the soil and the 1845 harvest was negligible,  $\sim 9\%$  of the expected harvest. In the Flemish parish of Lippeloo people flocked in from all sides to invoke Saint Anthony on behalf of the potatoes; coins piled up in the choir and had to be carried away by the basket (Lindemans 1952). The population was hard hit because many grain fields



**Fig. 5 a.** Monthly means of precipitation at de Bilt, Netherlands, 1845, plotted as deviations from the 30-years averages (1831–1860). Monthly precipitation in mm. **b.** Same, 1846



had been lost by freezing in the winter 1844/5. The potatoes failed again in 1846 and 1847. Actual mean yield in 1846 was 133 instead of an expected 200  $\text{hl ha}^{-1}$ , or a country wide loss of ~33%. The worst hit province was E Flanders with a yield of 106 instead of the expected yield of 200  $\text{hl/ha}$ , a loss of ~47% (Anonymous 1850). For 1847 no useful data were found.

*Denmark* The Duchies Schleswig and Holstein suffered great losses in 1845 (Kyrre 1913). Export contracts had to be cancelled in 1846.

*France* In 1845, French growers, seeing the majority of the tubers rotted, were so depressed that they often abandoned their potato fields (Roze 1898) and even ‘believed to be obliged to abandon the cultivation of that precious tuber’ forever (Mangin 1914). Locally the 1845 losses were very high, some 90% in the Savoy and up to 100% in some districts of SW France (Eriksson 1884; Armengaud 1971). Country-wide, the potato yields in 1845 and in 1846 were 78 instead of the expected 103 million  $\text{hl}$ , a loss of 22% (Agulhon et al. 1976). In 1847 yields were normal again.

*The Germanies* The harvest of 1844 was good. In 1845 the weather had a gradient from very wet in W to hot and dry in NE Germany. Hence the losses

by blight were up to 100% in the W, where the consumption quality suffered too, and negligible in the E (Münter 1846). Münter's map clearly shows the blight gradient. In the W the tubers had been infected in the field, but in the E the disease was sometimes only found in the potato storage piles. Overall, the potato harvest was 50 to 75% below expectation in 1845 and 47% in 1846 (Wehler 1987; Table 1). Even the 1847 potato harvest was bad (33% below expectation), a promising crop being destroyed when the weather turned foul at mid-summer. In Upper Silesia the 1847 loss approached 100% (Virchow 1848).

*Norway (then under Swedish rule)* The murrain reached Norway late in 1845 (Bourke 1964). In SW Norway the potatoes rotted again in 1846 (Lamb 1995).

*Sweden* The 1845 epidemic spread N up to the area of Uppsala, with great destruction in the southernmost tip of the country (Eriksson 1884).

*Switzerland* with its rapid population growth was hit hard by a famine in 1845/6 triggered by the potato late blight (Gruner 1968), 'a warning from heaven'. In 1847 the Swiss author Jeremias Gotthelf published a tear-jerking novel 'Kathy the Grandmother' describing the disastrous effects of the 1845 and 1846 blight on her little household, a 'potato mini-farm'.

### Interaction Between Harmful Agents

A difficult and neglected subject is the interaction between harmful agents (van der Wal and Zadoks 1971). Around 1900 it was common knowledge that 'curl' enhanced the effect of potato late blight. Quanjer (1913) observed that the rather blight resistant cultivar Paul Krüger could be severely attacked by late blight when diseased by the curl. His collaborator J.C. Dorst made a pertinent remark to this effect, and he referred to an English publication of 1872, making an equally pertinent statement (Quanjer et al. 1920). It seems as if this knowledge has been lost. We have, unfortunately, no way to establish the relative impacts of the two diseases and the importance of the interaction. Accepting the statements at face value, the interaction must have enhanced the damages caused by the two diseases.

### Other Crop Damages

#### *The year 1845*

The 1845 season was a poor season for cereals, being either too cold, or too wet, or too dry. The winter 1844/5 had been long and severe and in places much fall-sown cereals had frozen all over the Continent. In the Netherlands, Belgium, France, N and M Germany winter cereals were often replaced by potatoes (sic!).

*The Netherlands* Winter wheat was poor and weedy, spring wheat did well. The rye harvest was variable. It failed in Limburg, and in some other areas about one third got lost due to wet harvest conditions (General Report 1845).

*Austria* Disastrous floods occurred in Galicia (present Poland, river Vistula), Lombardy, Bohemia, and Hungary ruining the grain harvests (Macartney 1968). Rye yields were generally low (Abel 1974).

*Belgium* Fields with winter wheat and winter colza had been destroyed (Reynebeau 2005). For that reason more potatoes had been planted than usual in Flanders.

*France* The French grain harvest was moderate, 113 million hl where 120 million hl was expected, a loss of ~6% (Agulhon et al. 1976). In places, less than 50% of the expected rye yield was harvested. It is not clear what caused the loss, possibly winter damage. In Brittany the winter grain was frozen and much cattle had died of cold (Guin 1982).

*The Germanies* Winter killing of cereals was widespread in N and M Germany (Abel 1974). In Silesia rye suffered from voles, hail and floods (Münter 1846). The wheat harvest was ~1/3 below normal in the Rhine Province and poor in W Prussia. In Silesia the wheat suffered badly from an unidentified rust.

#### *The year 1846*

The winter was mild, the grain harvest was early, the conditions were good. Mild winters are favourable to cereal rusts, especially those without (active) perfect stage, allowing to produce a few extra generations so that the new growing season begins with abundant inoculum (Zadoks 1961; Hogg et al. 1969). The summer of 1846 was extremely hot over most of Europe and disastrous thunderstorms occurred in various areas, in the alpine area accompanied by summer floods.

*The Netherlands* Grain was harvested early and under good conditions. Wheat yields were modest at best, the crops being damaged by voles, floods, birds, and (in the NE) rust. The rye harvest of 1846 generally failed. The rye became severely rusted, presumably by yellow stripe rust (*P. striiformis*). The rust, profiting from the mild winter 1845/6 (Jansma and Schroor 1987), caused losses up to 50%, sometimes even more. Yields in Drente (NL) were ~700 instead of ~1400 kg ha<sup>-1</sup>, a loss of ~50%. Some farmers in Limburg reaped less than they had sown. The damage was the more unfortunate since the poor, deprived from potatoes, now had to pay dearly for their rye bread (General Report 1846). A fitful winter followed by a dry summer often leads to an outburst of voles (field mice). This happened in 1846 (Hooijer 1847) in the Netherlands when voles and drought together caused a national wheat loss of about 30% (van der Heiden 2001). In Friesland, where fewer potatoes had been planted than usual, vole damage to cereals endangered food security (Jansma and Schoor 1987). The fall-sown crop 1846/7 was, again, damaged by voles that continued eating young sprouts in the fall and winter, sometimes under the snow cover.

*Austria* In the Austrian realm the cereal and hay harvests failed again, leading to great shortages all over Central Europe and hunger typhus in Styria, Bohemia and Silesia. A thunderstorm caused great damage in Bohemia on July 6th.

*Belgium* Flanders (W Belgium) saw its rye harvest reduced by ~60%, from 18 to 7 hl/ha (Lamberty 1949). On the poor soils of the ‘Kempen’ (N Belgium) loss was about 50% (Vanhaute 1992). Two historians ascribed the loss to rust, identified as yellow stripe rust (*Puccinia striiformis*; Zadoks in preparation).

*France* In France, the prolonged dry and hot spring of 1846 and the heavy summer rains caused important losses in cereals. The grain harvest amounted to 91 instead of an expected 120 million hl, a loss of ~24%.

*The Germanies* Grain harvests were miserable in the Kingdom of Prussia with a rye yield of 43% and a wheat yield of 23% below the mean yield 1841/5 (Wehler 1987; Table 1). A traveller reported the terrific effect of drought on rye in the NE of Prussia (von Viebahn 1848). Grain prices were excessively high because of the dearth. Thunderstorms hit the country; in Bavaria hail storms completely destroyed the harvest of 15,000 people. The Poznań area (present S Poland) was struck by famine in July, 1846. In some areas the countrymen, without potatoes, bread and salt, had to eat weeds boiled in water.

*Switzerland* The alpine valleys were threatened by floods. The principedom of Liechtenstein was flooded by the river Rhine.

### *The year 1847*

1847 was a year of recovery in most European countries but not in parts of Austria, where the grain harvests failed for the third time in succession, primarily due to floods (Macartney 1968). In W Europe grain prices plummeted in 1847 when a good harvest announced itself.

### Scientific Interest

Turner (2006) aptly described the scientific efforts after the famine, 1845 to 2000. Here we focus on scientific efforts during the Continental Famine. Scientists in various countries immediately zoomed in on the blight problem in a nearly feverish activity, producing a flurry of lectures and publications. The battle between the ‘fungalists’ and their opponents, depicted with a lovely touch of drama by Large (1940), Ordish (1976), Peterson (1995), and Semal (1995), needs not be discussed here. Many explanations of the disease were proposed (Box 1). For a while the anti-fungalists had the upper hand. In the end, the fungalists won.

In 1845 governments responded quickly to the emergency and ordered both seed potatoes and potato seeds from abroad for experimentation. They also requested their scientists to look into the matter and suggest methods of control. Two lines of research were developed. One line was to save whatever usable was left in the diseased tubers, by dry storage, producing dry potato chips, extracting the untouched starch, or feeding the diseased lots to either cattle or distilleries. Were diseased tubers poisonous? The other line was to control or prevent disease by appropriate storage methods for healthy seed potatoes, selection of more resistant potato lines, correct

dosage of manure, and – in the long run – selection of new varieties from seedlings. Several scientists observed varietal differences in susceptibility to the blight.

Diseased foliage should be cut and burnt (Morren 1845a). Chemical control was recommended by treating soil, seed tubers or plants with diluted sulphuric acid or by chalking them. Morren was near to the mark with his recommendation to treat soil or tubers (not plants!) with a mixture containing copper sulphate. He observed the progress of the disease from foliage to tuber and he demonstrated experimentally the infection from tuber to tuber. Morren (1845b) noted that the metallic fumes of the zinc factories had completely protected the potato crop, but the observation did not lead to further action.

*The Netherlands* Dutch scientists showed a keen interest in the new disease. Bergsma (1845) inspected ‘several hundreds of hectares’. He wrote ‘Not rarely one saw a potato field completely changing in appearance within a few days and one perceived, especially in the evening, an unbearable stench that was dispersed over a considerable distance’. ‘The observation that the disease in its spread often has followed the direction of the wind becomes the more probable as some potatoes, growing behind hedges or trees, remained unaffected and only later contracted the disease’. He believed in the fungal origin of disease and became convinced ‘that the *curl*, *rust* and *cancerous disease* do not differ from each other’. His recommendations were those generally given to control the potato dry rot. Moleschott and von

**Table 1** Weekly budget of an average family of rural poor, consisting of three adults and three children, according to Heldring (1845). He compared the new prices, after the blight of 1845, with the current prices before the blight. Prices are in Dutch cents

Item	Old price	New price, fall 1845	Increase in per cent
Bread	90	140	56
Fat	35	35	
Butter	50	50	
Meal and buttermilk	50	75	50
Coffee	10	11	10
Treacle	5	5	
Oil	12	12	
Soap	5	5	
Cloth, thread, buttons	10	10	
Tobacco	5	5	
Salt	10	10	
Milk	7	7	
Pepper	3	3	
Vinegar	5	5	
Fuel	50	50	
Rents	50	50	
Clothes	100	100	
Pots, pans, ironwork	15	15	
Potatoes, pulp or groats	50	140	280
Totals	542	708	31

The casual labourer usually earned 5 cents per hour, in times of unemployment (as in 1845) even less. This budget dates from the fall of 1845; prices peaked in the spring of 1847

Baumhauer (1845), studying the new disease in their spare time, found what we call now the sporophores and the oval spores of *P. infestans* but could not convince themselves that the new fungus was the cause of the disease. They gave the usual recommendations. Harting (1846) looked into the botanical side of the blight. Before the 1845 epidemic had run its full course Vissering (1845) already discussed the economic implications of the potato murrain.

At the request of the government Vrolik (1845) published his ad hoc field observations. The Dutch government collected potato seed from several origins and invited knowledgeable gentleman-farmers to grow the seeds. Mr H.C. van Hall gave a sensible opinion on the 1846 tests, 'That the experiments, though, as regards the disease, not having answered objectives, however, by producing new sorts on very different soils ... not have been without importance, in many respects instructive and

Numerous explanations of the potato disease were proposed, supported by more or less serious argumentation. An overview was found in Rüter (1950) quoting 1845 reports from provincial governors to the Dutch Home Secretary. Here follows a brief summary of some opinions from the European Continent.

**Atmospheric influences.** A special weather constellation was a current, non-committal explanation proposed by several committees (the Brussels and Groningen Commissions: *ex Berkeley*, 1846) and by Dumortier (1845), Schacht (1856), and others.

**Excess nitrogen.** An excessive multiplication of nitrogenous substances in the parenchyma in the above- and below-ground parts of the potato plant is the source of the recent epidemic (Unger 1847; and others).

**Heat.** Mauz (1845), a country physician, experimented extensively with potatoes. He concluded that the summer heat in July, 1845, was the cause of the disease. The potatoes might have been sensitised by a hidden agent in 1845, in view of the poor flowering of the potatoes in that year.

**Wetness.** Many authors attributed the disease to excessive wetness, more or less in accordance with the 18th century humoral theory of disease. Professor Blume from Leiden University proposed the term 'hydropisy' (= dropsy), in agreement with Unger's (1847) 'stagnated plant sap'.

**Inner Life.** The learned Director Gebel presented his opinion to the Prussian Academy, Session 53, 30 January 1847. He ascribed the disease to 'the weakened inner life of the potato'.

**Dry rot.** Several scientists confused late blight (wet rot) with dry rot, due to a *Fusarium*, that had caused epidemics just before 1845 (von Martius 1842), stating that the new disease was just another form of the old one (a.o. Bergsma 1845; Dumortier 1845; Harting 1846).

**Cryptogamic entity.** One of the mycologists, maybe the very first one, attributing the disease to a (new?) fungus, was the Belgian lady-mycologist Marie-Anne Libert, who published a good symptom description on 19 August 1845, and proposed the name *Botrytis vastatrix* (*ex Semal* 1995). More or less simultaneous and independent were statements to this effect by Morren in Belgium and Montagne in France, both in 1845 (*ex Berkeley* 1846).

**Box 1.** Contemporary explanations of the 'potato murrain'

promising not entirely unfavourable results for the future' (Vrolik et al. 1846). The results were of little avail but we need not doubt the selection, in time, of new and (slightly) more blight-resistant varieties (van der Zaag 1999). Grootegoed (1853) regretted the loss of several delicious potato varieties and the necessity to eat varieties grown as cattle fodder; English potatoes had to be planted, less susceptible to blight. The pre-scientific selection was apparently successful reasoned Vanderplank (1968).

*Belgium* Much publicity was given to the blight, 1845 and 1846, in newspapers, trade journals, and in the Proceedings of the Royal Academy of Sciences. Bourson (1845) probed into the origin of the potato murrain. Dumortier (1845) published his field observations with a good symptomatology. He had seen the *Botrytis* which he considered to be the *consequence* of a disease, more specifically the wet form of dry rot which was epidemic during the early forties. Morren (1845a) was a convinced fungalist. The palm of honour goes to a lady mycologist, Marie-Anne Libert, the first to identify a fungus as the cause of the disease, *Botrytis vastatrix* (Semal 1995).

*Denmark* The Danish authorities were quite alarmed in 1845. They sent out enquiries about possible protective measures and requested some of their embassies to find information and seeds. Three professors of the Polytechnical School in Copenhagen began research on disease control, without obtaining useful results; the causal agent was not yet known to them (Kyrre 1913).

*France* The blight was the subject of a lively discussion in the *Comptes Rendus de l'Académie* (Proceedings of the Academy), Paris, see its volume of 1845 and the contemporary list of references in Decaisne (1846). Decaisne was a good microscopist who saw the same sporophores and spores as did Montagne. Nonetheless he decided that the '*Botrytis*' was but the consequence of the disease. Decaisne quoted Desmazières, an able mycologist from Lille, who in 1844 already had seen an outbreak of '*Botrytis*' on the variety *Blanche tardive* in N France and had described the symptoms.

*The Germanies* The Royal Prussian Academy of Sciences requested the botanist Münter (1846) to study the blight. He carefully collected national and international information on the 1845 outbreak and on the response of various authorities to the emergency. Many authors discussed the blight, see e.g., the 1846 volume of the *Botanische Zeitung* (Botanical Journal). The focus was often on the processing of infested lots of potatoes to preserve the remains as potato meal, alcohol, or cattle fodder. The detailed examination of the sporulation process, with elegant drawings of the fungus sprouting forth from the stomata, brought Unger (1847) near to the fungalist theory, though he was unable to sacrifice his ideas on the exanthematic origin of plant disease (Unger 1833).

*Sweden* Several scientists took an interest in the new disease. The Royal Agricultural Academy asked professor Wahlberg (1847) to report on the disease. The famous mycologist Fries participated in the debate from the beginning and, interestingly, was against the fungal theory of disease causation (Eriksson 1884).

## The Quality of the Information

The quality of the information on potato yield losses tends to decrease with the distance from the Netherlands, the bibliographic centre of this study. The information provided by historians passed through several filters, with the risk of distortion. Fortunately, the Official Newspaper of the Dutch Government of 1845 contained an unusually high number of scraps on agriculture, obviously important to a nation obtaining its wealth from international trade and shipping (Appendix 1). This contemporaneous information confirmed the data provided in the more general history books quoted in this paper.

Similarly, the German daily newspaper *Allgemeine Zeitung*, July 1846, contained scattered pieces of useful information, thus providing contemporary confirmation of the historians' data. Its July message was simple: the potato crops were just fine. In contrast, the July issues of the Dutch daily *Nieuwe Rotterdamsche Courant* reported that the blight was popping up again, with local appearances scattered all over the Netherlands. The newspaper was even accused of needless alarmism but the editors took a firm stand stating that their task was to provide good information.

## Social Consequences

### General Setting

In the Netherlands the position of the rural poor, and of the landless labourers foremost, had deteriorated considerably between the mid 18th and mid 19th century. Wages were sadly low, 'the labourer earns too little to live, too much to die' (Brugmans 1929). Most labourers of the large-scale farms in Zeeland (NL) actually lived in abject poverty (Priester 1998; Hoogerhuis 2003). Farm workers often rented small plots, sometimes at usurious prices, to grow potatoes with and for their family. Thus they could carry their family through the winter when they were without work and income, and sometimes they even could feed a hog. Potatoes are relatively poor in protein but the protein is of a good nutritional quality. Potatoes contain much vitamin C so that the health situation of the underprivileged could improve, with e.g., scurvy disappearing.

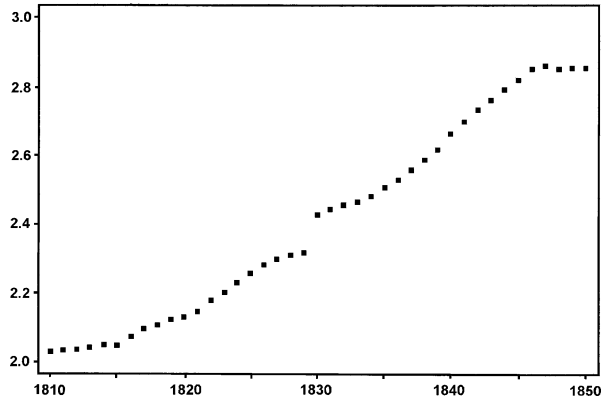
The blight brought destruction of the potato, hunger and famine to the already destitute country dwellers. Whereas the situation in 1845/6 was bad but not unbearable (Hooijer 1847; Bourke 1993) it became really disastrous in the winter of 1846/7. The Dutch situation is thought to be representative of Continental Europe at large.

### Demographic Effects

The period 1750–1850 was characterised by a rapid population growth in many European countries, including Belgium, England, France, Ireland, Prussia and Switzerland. During the half-century following the Napoleonic period the annual growth rate of the Dutch population oscillated around 1%, most of the time (Fig. 6). Mouths had to eat and hands had to work. The masses could be fed because potato growing became popular, potatoes producing two to three (even up to four) times more calories per ha than rye. Rye remained the number one in the popular diet and



**Fig. 6** Population growth in the Netherlands from 1810 to 1850. Growth begins ~1815 and continues up to 1847, followed by a slight but telling decline in 1848. The sudden rise in 1830 cannot be explained. Data from Hofstee (1978), excluding the province of Limburg



potatoes came second, occasionally even first. Work for the hands declined on the countryside because the cottage industry, spinning and weaving, was gradually replaced by textile factories. The competition by modern industry caused a loss of labour opportunity and of purchasing power to both cottiers and rural craftsmen.

Among the demographic effects of the famine were an increase of the death rate, especially of children and elderly, and a decrease of the marriage and birth rates (Table 2). In some areas as in Austria, Flanders, and the Netherlands (e.g., Zeeland) the population decreased in absolute numbers. Areas that had recently seen a rapid population increase, such as the Dutch clay soils, suffered most. As in Ireland, it is impossible to differentiate between deaths by hunger and by disease, since epidemics were the normal corollary of famines (Sen 1981; Dyson and Ó Gráda 2002).

The number of excess deaths due to the famine and its corollary diseases is heavily debated. The numbers for Ireland, 1845/9, vary from 500,000 (Dupâquier 1980) to two or three millions (Woodham-Smith 1962). Critical demographers now seem to prefer the lower number of 500 to 600 thousands. The numbers of excess deaths in Continental Europe can only be guessed at, examining population numbers and death rates. The numbers provided here (Table 3) are calculated as excess deaths in 1846, 1847, and 1848 by subtracting the average number of deaths over 1841–1845 from the number of deaths in the given years. The result must be considered cautiously and further demographic analysis would be needed. The data in Table 3 include deaths by hunger and corollary diseases (mainly typhus). The year 1849 was not included because an epidemic of cholera spread over Europe killing many people, especially the undernourished, and so the total may have been under-estimated.

*The Netherlands* Excess deaths due to hunger have been estimated at  $\geq 53,000$  on a population of ~three millions. Among the corollary diseases were typhoid, dysentery, cholera, and malaria (Jansma and Schroor 1987). Symptoms of dysentery are recognisable in the description of the wretched poor dying in the Bommelerwaard, a district in the Netherlands where people were as dependent on potatoes as the Irish (Box 2). Malaria was then common in the coastal areas of the Netherlands. The brackish waters along the coast provided a good breeding habitat for malaria mosquitos. Malaria was a nuisance rather than a killer but it killed those debilitated

**Table 2** Birth rate, death rate, and population growth rate in six countries, data in per mill, averaged over 5-year periods

Country	Birth rate		Death rate		Population growth rate <sup>7</sup>	
	1841/45	1846/50	1841/45	1846/50	1841/45	1846/50
Austria <sup>1</sup>	13.0	11.2	29.6	35.8	9.7	1.5
Belgium <sup>2</sup>	32.1	28.5	23.2	25.2	8.9	3.3
France <sup>3</sup>	28.1	26.7	22.7	23.9	6.8	2.2
Netherlands <sup>4</sup>	36.3	33.6	25.7	30.2	13.3	13.8
Germany <sup>5</sup>	36.8	35.6	26.1	27.4	1.0	0.2
Switzerland <sup>6</sup>	32.3	29.4	24.3	23.0	8.0	6.4

The increase in mortality and the decrease in birth rate from 1841/45 to 1846/50 are seen in all six countries. Among the causes of excess mortality are hunger, typhus, and cholera. Dead-borne children are excluded or ranked under mortality (Switzerland). Migration is disregarded

<sup>1</sup> Bolognese-Leuchtenmüller (1978); Sandgruber (1978); emigration negligible

<sup>2</sup> André and Pereira-Roque (1974)

<sup>3</sup> Braudel and Labrousse (1976); usually immigration surplus. Population growth rate data in Armengaud (1971) slightly different; the period 1846–1851 showed a net emigration of 276,000 persons.

<sup>4</sup> Hofstee (1978); high growth rate because of immigration

<sup>5</sup> Estimated from Bolognese-Leuchtenmüller (1978) and Sandgruber (1978)

<sup>6</sup> Bickel (1947)

<sup>7</sup> Emigration was of little importance in the numerical sense but emigration to other continents was of great significance from a political point of view. Transmigration within Europe was important

by lack of food (Jansen and de Meere 1982; Priester 1998). At the time, the death rate in Zeeland could be over 4%, children, elderly and itinerant labourers, all with little immunity, dying first. In some Zeeland communities infant and child death peaked in the famine years (Hoogerhuis 2003).

**Table 3** Tentative estimates of excess mortality due to potato late blight and its corollary diseases, 1846–1848

Country	Population size	Excess mortality	Annual excess mortality
	1846 (thousands)	1846–1848 (thousands)	1846–1848 (per mil)
Austria <sup>1</sup>	17.902	371	7
Belgium <sup>2</sup>	3.933	30	3
France <sup>3</sup>	36.097	109	1
Netherlands <sup>4</sup>	3.054	26	3
Germany <sup>5</sup>	33.197	213	2
Switzerland <sup>6</sup>	2.330	0	0
Total	96.513	749	3

For the calculation see text. I did not consider 1849 in order to avoid most of the mortality due to cholera. Cholera swept over Europe 1848–1849 and lingered on for years. Starved patients will succumb earlier to cholera than well-fed persons, but it is questionable to consider cholera as a ‘corollary’ disease

<sup>1</sup> Estimated from Bolognese-Leuchtenmüller (1978)

<sup>2</sup> Hofstee (1978); present borders

<sup>3</sup> Estimated from Dupâquier (1988); excess mortality mainly because of cholera epidemic

<sup>4</sup> Hofstee (1978), mortality excluding ~22,000 cholera victims

<sup>5</sup> Estimated from Bolognese-Leuchtenmüller (1978)

<sup>6</sup> Based on Bickel (1947)

For some of the diseases the temporal relationship with the famine years is more evident than the causal one. The hot and dry summer of 1946 created horrible conditions in crowded cities such as Amsterdam, leading to a high death rate. During the cold winter of 1847/8 influenza struck the population (Terlouw 1971). In 1848/9 a wave of cholera swept over Europe, causing ~22,000 deaths in the Netherlands, and reached Ireland in 1849. Malnutrition may have sensitized cholera patients but here we consider the cholera epidemic as independent from the 1846/8 famine. Poor nutrition had the usual effect on the growth of youngsters. The percentage of undersized conscripts (less than 1.57 m tall) was 14.2 in 1821 and 19.8 over 1850–1861 (van Zanden 1991).

*Austria* Annual population growth rates were  $-0.69$  for 1847/8 and  $-1.28$  for 1848/9 (Bolognese-Leuchtenmüller 1978). Mortality data suggest excess deaths amounting to several hundred thousands, primarily in Galicia (present Poland) with excess deaths of

The parson C. Hooijer made a passionate plea in favour of the deprived in the Bommelerwaard, a river clay area West of Arnhem (NL) where typical 'Irish' conditions prevailed among which

- (1) potatoes were the dominant crop with ~26% of the arable area, in some communities even 60% (Bieleman 1992);
- (2) the poor depended on potatoes for food;
- (3) labourers rented small potato plots at high, often usurious rents.

I translated some selected remarks.

1. During the winter 1845 farmers gave potatoes to the poor. These ate only potatoes, cooked at noon, porridge in the evening, baked in the morning.
2. 1846 ... large groups of beggars, who could no longer be fed by the citizens ...
3. Because of the dearth relief paid only one quarter of the food needed. People consumed things green from the land, boiled in water with some barley meal. Dung-hills were searched for eatables.
4. ... chew willow bark to silence hunger. ... steal and cook cats and sick goats ...
5. ... people wither away ... hovels with in a corner nearly naked boys who, in their third year, cannot yet walk.
6. ... dry mother breasts with crying sucklings ...
7. ... in dark huts spectre-like persons who, in the most disgusting filth, with the most dismal indifference laid down to die as beasts ...

**Box 2.** Quotations from the Reverend C. Hooijer (1847)

up to 300,000 and in Bohemia-Moravia (present Czechia) with excess deaths of up to 100,000. Hunger typhus was a major cause of death. The Wadowiczer Comitatus in Galicia (then under Austrian rule, present S Poland), counted 60,000 to 80,000 deaths in 1847 due to hunger and typhus, the typhus epidemic hitting somewhat earlier than in neighbouring Upper Silesia (Virchow 1848). In Austrian Silesia thousands ‘had nothing to eat except grass and nettles, coltsfoot, clover and blood’. In the big cities of Austria maize and/or clover were added to the wheat flour (Macartney 1968).

*Belgium* counted nearly 4,000,000 inhabitants in 1846/50. From 1845 to 1846 a famine raged and many people died. Death rates exceeded birth rates in several communities. The province of West Flanders recorded a peak death rate of 3.93% in 1847 (Hofstee 1978). In Belgium the death rate was highest in 1847 with 2.77% against an average of 2.33% over the period 1841/5, suggesting excess deaths of  $\geq 35,000$  from hunger and disease (André and Pereira-Roque 1974). All of Flanders was said to have  $\sim 50,000$  deaths in excess (Ó Gráda 1989) including the  $\sim 12,000$  killed by typhus in 1846/8 but excluding the nearly 6,000 deaths by a cholera epidemic in 1848 (Lamberty 1949).

*France* Marriage and birth rates decreased and death rates increased. Population growth slowed down considerably. Migration from the countryside to the cities intensified. Emigration exceeded immigration (Table 2).

*The Germanies* Excess deaths in the Kingdom of Prussia can be tentatively estimated at  $\sim 140,000$ . The province of East Prussia recorded 40,000 deaths from disease, winter 1847/8 and spring 1848. In Upper Silesia (Prussia, present Poland)  $\sim 80,000$  people suffered from hunger typhus, with  $\sim 16,000$  deaths (others say 30,000), and  $\sim 50,000$  deaths in total. Data about numbers and diseases are not quite consistent.

Though this is not the place to discuss the medical aspects of the hunger epidemics that followed the harvest failures, one exception has to be made. The Prussian Government had sent R. Virchow, a young and ambitious surgeon at the Charité Hospital in Berlin, to Upper Silesia in early 1848 to investigate the ongoing typhus epidemic. He wrote an extensive scientific report (Virchow 1848) in which he left little doubt as to the nature of the major disease, which we now call typhus (caused by a *Rickettsia*). Virchow was as critical of the Prussian government as the circumstances allowed. He referred to an anonymous brochure on ‘The hunger pest in Upper Silesia’ (Anonymous 1848), which really is an indictment of government policy. Besides a high scientific motivation Virchow had a strong social interest.

*Switzerland* During the blight years the marriage and birth rates went down, but the death rate was not affected (Bickel 1947).

## Pauperism

Pauperism stands for the chronic poverty of the lower classes in a region and/or period. Toward the mid 19th century pauperism was widespread in Europe, where many states slid into economic recessions in the 1840s. Rural pauperism was a rather

new phenomenon with causes differing according to region: (1) wages in rural areas hardly increased during the first half of the 19th century, probably because of the relatively rapid population growth, as in the Netherlands, Belgium (Flanders) and Prussia; (2) the rise of modern textiles industry caused a sharp decline of the cottage industry, as in Austria, Flanders and Prussia; (3) division of the commons increased the gap between estate owners and peasant farmers, as in Prussia; and (4) extreme parcellation of land led to great poverty among peasant farmers as in SW, M and W Germany, and in Switzerland.

The bad times caused a decrease in demand so that craftsmen, then quite numerous in villages and rural cities, went out of business. They too had to apply for relief or to go begging. Continent-wide the behaviour of the poor followed more or less the same pattern (Box 3).

*The Netherlands* At a time when class distinctions were an accepted phenomenon pauperism in itself was not rejected. Only revolutionaries could foster different ideas. The 'haves' should be nice to the 'have-nots', do relief work, and feel good. In 1844 the country experienced a slump, factories were closed. Labourers lost their jobs and became dependent on poor relief funds (Brugmans 1929). The year 1846, with blight, rust, voles and drought, deepened poverty, increased unemployment, and awakened slumbering unrest in the cities.

Begging and theft increased considerably from 1845 to 1848. Hungry people roamed the streets. Those having something to loose became afraid of group begging, with extortion under threat. The police had much more work to do. Indeed, more convictions for begging were pronounced in 1846 and 1847 than in all twenty years before in some parts of Zeeland. In the relatively prosperous province of Friesland over 14% of the rural population was on the dole and, in the parts with arable land mainly, over 20% (van Zanden 1985).

*Austria* Industrialisation led to underemployment and impoverishment on the countryside, with pauperism of a 'rural proletariat' (Rumpler 1997) as the result. Many migrated to the cities where, eventually, their situation became worse than ever.

*Belgium* Over 400,000 Flemish persons lived of the textile industry (Lamberty and Lissens 1951). On the Flemish countryside the cottage industry, mainly linen spinning and weaving, was yielding to industrial production, ensuing loss of income and purchasing power. In one Flemish parish with 225 households a hundred had to go begging (Lindemans 1952). Bands of people marauded the fields and roamed the streets, begging and stealing. Windows were smashed with the sole purpose to be incarcerated and fed (Lamberty 1949). The Walloon provinces in Belgium were hardly affected because of their industrial expansion.

*France* 'Endemic misery' reigned during the 1840s. Land owners had begun to invest in industry and movables rather than in agriculture (Droz 1967). The French estate owners began to loose their grip on the peasantry. Peasants and landless poor obstinately struggled for independence by all means, legal and illegal, as vividly depicted by the novelist Honoré de Balzac in '*Les paysans*' ('The peasants':1844?). A departmental governer (F: *préfet*) in the SW reported on the winter 1845/6 that at

The flour for bread making, if available, was mixed with several admixtures among which bran, clover meal, *Faba* bean meal, and meal of queck grass roots (*Elytrigia repens*), maybe also with meal from wood or hay as in other famines.

Most decent people went through a period of denial, sparing whatever food was available. First the size of the meals was reduced, then the number of meals was reduced to two or one per day. Whatever money available was spent on food and house rent and no goods were bought. Jewellery, cloths, furniture, household utensils and professional equipment were sold. Families moved to cheaper dwellings. Desperate people pilfered bakeries and food stalls. Members of town families roamed the countryside to buy food at usurious prices.

Country people, who anyhow had little to sell, tightened their belts. If they were out of regular food they collected whatever eatables they could find, browsing the fields, stealing standing crops, searching the refuse piles and dunghills, stealing sheep or goat, killing dogs, cats and rats, slaying diseased animals, and digging for buried animals. Grass, nettles, clover, coltsfoot (*Tussilago farfara*), fungi, and the bark of trees were on the menu. Some items, including rotten potatoes, were eaten raw but, preferably, they were cooked in a stew that got thinner and thinner.

The able-bodied tried to find work, often relief work, e.g., heavy digging at low wages. The disabled, by hunger and sickness, died rapidly from hunger typhus or slowly from intestinal afflictions, tuberculosis, or physical exhaustion. Farmers dropped dead in their fields.

Many jobless people found food with relief organisations, parishes, municipalities, private institutions, often created for the purpose, or with private persons. Relief funds were always too limited, and sustained people partially and for a limited time only, until the funds were exhausted. 'Relief fatigue' with the sponsors was mentioned several times.

Setting aside their pride, people went begging, first individually, sometimes following a prescribed route through town. Bands of beggars were formed by men, women, even children. These bands were threatening and meant to threaten. They visited farmsteads and, if they did not get their alms, they might set farm or mill afire. They stopped the grain traffic on the roads intercepting and plundering the grain-loaded carts.

Crime rate soared because of the many petty thefts. The 'haves' on the countryside became afraid and fear spread over the country. The police, sometimes assisted by the military, could no longer meet the situation. Vagabonds were happy to be arrested, because in jail they were fed at least. Once in jail, or in the workhouse, they ran the risk of dying from typhus or dysentery, or being infected by tuberculosis.

In the typhus-stricken areas thousands of children were orphaned. If lucky, they were found, placed in an orphanage, washed, given clean cloths, fed and taught. They had a fair chance to survive and start a new life, without relatives.

On the countryside violence was frequent in France, quiet resignation dominated in the Netherlands and in Belgium, inertia in Silesia, and sullenness in Austria.

**Box 3.** The fate of the poor during a famine, as stated by various authors. The patterns described here were common to most *crises de subsistance*. The crisis sparked by the potato murrain was the last in Continental Europe (Scandinavia and the Soviet Union excepted)

one town 'Over 25,000 come to the point of having nothing left to eat' and at another town two thirds of the inhabitants 'lack every thing, no money, no bread, no potatoes and, finally, no credit' (Armengaud 1971). The catastrophic grain and potato harvests of 1846 (Newman and Simpson 1987) caused widespread distress (except, maybe, in S France) and great social disturbance.

*The Germanies* gave a similar picture. In the neat archduchy of Baden people in town and countryside lived soberly, in mutual dependence, without many reserves. The failure of the potato and grain harvest in 1846 caused a famine and an economic crisis among all strata of society (Real 1983). No wonder that ‘decent artisans’ without work or money went begging, to the amazement (and irritation) of the Dutch reverend O.G. Heldring (1847) vacationing along the river Rhine in 1847, at cherry picking time, just before the grain harvest.

### Hunger Riots

Throughout history the common people, when threatened in their subsistence by food scarcity, had only one way to show their discontent to the ruling authorities: rioting. Food riots are of all times.

*The Netherlands* Generally speaking the Dutch rural workers were a subdued lot (Terlouw 1971), suffering in silence. ‘Labourers were powerless and slow, although not unwilling’ (Brugmans 1929). They had neither voice nor representation. On Sundays they were told to trust in God. Pilfering was rare and it was severely punished. Nonetheless, quiet, complacent Holland had its ‘potato riots’ in September, 1845, when townspeople protested against the high potato prices. An eye witness mentioned the 1845 riots in Delft, where groceries and bakeries were looted (van der Hardt Aberson 1893). Riots also occurred in Leyden and even in The Hague, the seat of the Dutch government.

At the time, the Netherlands had changed from a grain eating to a potato eating nation, with an annual production in the early 1840s of 1 million tonnes (~14 million hectolitres). In the first blight year, 1845, the national production was less than 0.3 million tons (<4 million hl), a loss of over 70%. Grain was rapidly imported and the consumption of legumes increased. The winter of 1845–1846 was mild, funds for the relief of the poor had plenty of money, and relief-work was organized. Things were under control.

Unfortunately, the blight struck again in 1846. The severe and long winter of 1846/7 added immensely to the misery of the cottagers. A National Day of Prayer on May, 2nd, 1847, may have silenced the wretched poor but not for long since grain prices soared in the early summer of 1847 and potatoes remained expensive (van der Heiden 2001). Unrest flared up again in June, 1847. In the port of Harlingen a ship with destination England, the ‘Magnet’, had been loaded with potatoes (Jansma and Schroor 1987), possibly from the early varieties of the 1847 harvest. A mob protested, molested officials, and turned to looting. The insurrection spread to the towns of Leeuwarden and Groningen. In Groningen the dragoons had to restore order at the price of some five casualties (van der Heiden 2001). The general discontent was exploited by radical politicians.

‘Liberals’ came into power in 1848. Concerned about the social unrest, they arranged investigations into the morality of the working class. Provincial reports were published in 1851 (van Zanden 1991). The results were gloomy as e.g., families taught their children to beg and steal firewood. The liberal answers were not oppression and charity but good upbringing and school education, in the spirit of the Enlightenment.



*Austria* Unrest occurred everywhere in the Austrian realm, in the major cities but also on the Polish countryside, where national politics and nascent liberalism added to the general dissatisfaction with Austrian rule, enhanced by the dearth of the times. In the suburbs of Vienna bakeries and market stalls were plundered (Lutz 1985).

*Belgium* The rural population of Flanders appeared to be an ‘amorphous mass’. As an exception, a few bakeries in the city of Ghent were pilfered (Lamberty 1949).

*France* In France the poor harvests of 1846 caused a slump in consumer demand that triggered an economic crisis. Gangs of hungry people roamed the countryside. Farmers, millers and grain merchants were threatened with arson and extorted, sometimes by masked persons (Jardin and Tudesq 1973). Grain transports were held up, often by enraged women (Vigreux 1998). At times the rural masses burst out in fury (Agulhon et al. 1976), with destructions and smashing up of tax archives. Smouldering unrest finally exploded in the February revolution, Paris, 1848 (see below). France was the only country where rural unrest contributed to radical political change.

*The Germanies* In the German speaking countries hunger riots occurred in the spring of 1847 in Berlin, Hamburg, Stuttgart, Ulm and various other towns (Lutz 1985; Wehler 1987).

## Migration

Nothing in Continental Europe paralleled the massive emigration from Ireland to North America (~1,000,000) and England (~300,000) during and after the hunger years. Transmigration within and between W European countries must have been intensive, but data are not easy to find. Many in Continental Europe packed up and moved, or simply went adrift. Others migrated to N America, among which disillusioned and police-threatened political activists of whom several went digging in the recently found (1848) goldfields of California.

Migration from the land to the city is of all times, but it was intensified under the pressure of the circumstances. People in search of work, that was hardly available in the 1840s, added to a new urban proletariat, jumping out of the frying pan into the fire.

*The Netherlands* Discontented families migrated to North America. Poverty, lack of prospects, and religious dissidence were among the reasons. Emigration peaked in 1846 and 1847, but we speak of only thousands of Dutch, not the hundreds of thousands of Irish. Migration from countryside to towns may have intensified in the late 1840s.

*Austria* Impoverished country dwellers flocked into the cities in search of work. In Vienna they only met with more misery and awful housing conditions.

*Belgium* In Belgium, an exodus took place from hungry Flanders to the booming industrial areas of francophone Belgium and N France. The numbers involved are estimated at tens of thousands (Lamberty 1949).



*France* France experienced an intensified ‘rural exodus’ of day labourers, craftsmen, construction workers, and outworkers to the cities amounting to ~800,000 persons over the period 1831/51 (Agulhon et al. 1976). Net emigration over the years 1846/51 was ~276,000 (Armengaud 1971). Many emigrated to Mexico, North America, and Algeria. Thousands of Germans, stranded penniless at Dunkirk, were shipped to Algeria by the French authorities.

*The Germanies* Emigration to North America in the years 1840/4 averaged ~22,000, in the years 1845/9 ~62,000, increasing in the 1850s to hundred thousands (Marschalck 1973).

*Switzerland* There was immigration and emigration but the numbers were feeble.

### Official Relief

The new liberal thinking with its *laissez-faire* was not much in favour of relief, at least at state level. Governmental actions were usually limited to adjustment of levies and taxes with a view to limit the price of rye (the food of the poor), by facilitating grain imports and, sometimes, reducing exports. Intermediate levels (province, department) showed more readiness to act. At municipal level many authorities, in face of the want of their citizens, felt compelled to take action. Churches had relief systems stand-by. Private people, individual or organised, readily stepped in to help.

*The Netherlands* The Dutch Parliament discussed the withdrawal of the Dutch Corn Law dispassionately, technically (Ising 1892; Bergman 1967; Terlouw 1971). Import duties on food commodities were suspended, first temporarily, later definitively. The provincial governors were not allowed to provide money for relief, not even on loan. The municipalities were discouraged to provide relief but, inevitably confronted with the misery, they used existing poor-relief funds. They provided public works, food, and price control of rye bread (the affluent ate wheaten bread). They reduced municipal bread excises and milling taxes, and even went so far as to subsidise rye bread. Soon their funds were exhausted. Some municipalities tried to supplement their funds by imposing a levy on the well-to-do. Generally speaking, the municipalities did what they could do. In the province Noord-Holland some 25% of the population lived on the dole in 1848 (Kossman and Krul 1977).

The Dutch Government showed its compassion by declaring 2 May, 1847, a national day of prayer. There is no evidence of any effect other than keeping the poor quiet and poor. The day yielded a collection of sermons that showed how wide a social gap stood between the reverends, ‘haves’ usually, and their suffering flocks.

*Austria* Some measures were taken to avoid a market catastrophe and a famine (Wehnelt 1943) but public works had to be stopped because the government went out of money (Macartney 1968). The poor were referred to the parishes and to private charity.

*Belgium* The state provided credit for work, purchase and transportation of grain, and subsidies on bread prices (Abel 1974). Communal bakeries, bread coupons, and public kitchens were among the means to reduce the misery in the towns but they

were of no avail on the countryside (Pirenne 1932). In 1847 about one third of the Flemish people lived on charity (Lamberty 1949).

*France* Departments and municipalities sometimes voted money for public works and support of the poor (Abel 1974). The cities of Toulouse and Bordeaux distributed bread coupons (Jardin and Tudesq 1973).

*The Germanies* Münter (1846) gave an overview of immediate actions taken in 1845, among them public works, credit, export bans, and the opening of military stores. In Upper Silesia official relief was late. In the Rybnik area one third of the population received aid in the form of a pound of meal per person per day (Virchow 1848). Cologne, not a poverty-stricken city, had 25,000 out of the 95,000 inhabitants registered on the poor list (Lutz 1985).

*Ireland* Robert Peele, Prime Minister of England during the early phase of the Irish Famine, was a conservative with rather liberal ideas. Facing the emergency he did what he could do. He bought maize from the American colonies to provide for the hungry. His successor (June 1846), lord John Russell, stopped grain imports and public works, but in 1847 he felt compelled to import food for the ‘soup kitchens’.

#### Private Relief

Private relief was very active and took many shapes. Existing organisations, primarily the churches, usually acted first. Citizens organised themselves in *ad hoc* societies, or took action individually. Here follows a somewhat arbitrary selection of examples.

*The Netherlands* In the Netherlands charitable institutions, primarily the churches, were very active. In the course of 1846, unfortunately, their funds became exhausted. During the mild winter of 1845/6 private persons, farmers and manufacturers, could provide work so that the poor farm worker could earn some money. Most of this work was for improvement of roads, waterways, and ditches. The severe frost of the winter 1846/7 made such work impossible and the poor were left without income (Hooijer 1847; Terlouw 1971).

Of course, a national campaign was organised for the relief of the poor, though too late to prevent early deaths (Bergman 1967). Private initiatives sprang up unexpectedly. Towards the end of 1845 some wealthy retired tradesmen in Amsterdam bought a few shiploads of grain and sold the grain at reasonable price in an attempt to lower grain market prices. In the small Frisian village of Irnsum ‘... the bread for the common folks had been down-priced to five pennies, for which the expenses are found in a collection among the most dignitary residents’ (Hoekstra 1879). In Dokkum, a Frisian town, a committee collected ‘generous gifts’ to provide the poor with reduction coupons so that they could buy their rye bread at a fixed price below the current retail price.

*Austria* The poor had to rely on parishes and on private charity. Some estate owners made food from their stores available to the villagers, other did not.

*France* In many places private money was collected in order to avoid food shortages (Houssel 1976) and to keep the people quiet. In the town of Lille a private association distributed aid in cooperation with the town's welfare office (Jardin and Tudesq 1973). At the local level, the poor often received support.

*The Germanies* In the severely affected area of Upper Silesia, where the officials did not want to see the misery, the 'Breslau Committee', which first had to beg for money in all of Germany, was on the spot well before the government!, wrote a bitter Virchow. The very active chairman, Prince Biron von Curland, contracted typhus and died. In the city of Koblenz, 1849, a 'Society for the Procurement of Cheaper Food' bought Russian grain in the ports of Amsterdam and Rotterdam.

*Ireland* Sheer numbers made relief a nearly hopeless enterprise but various charities took action. The 'Society of Friends', the Quakers, operating from England, should be mentioned explicitly (Bourke 1993; Woodham-Smith 1962).

#### Access to Credit

In today's developing countries access to credit for the poor, in the form of micro-credit, is a hot item. Around the mid-19th century Continental Europe was a developing world where (micro-)credit would have been useful, as proposed by some enlightened thinkers. Early initiatives in England led to the establishment of the first co-operatives.

*The Netherlands* of 1845 hardly participated in these developments. Social motivation, so successful in the 20th century, was scarce among the 'haves' of the mid-19th century. O.G. Heldring (1845), parson in a hard-hit area, discussed the need of small local credit banks for the poor. His plea remained without response. Ph.A. Bachiene, a tax administrator in Sluis, worked hard to organise small loans for the poor with remarkably little result (Bouman 1946). Micro-credit was not a successful issue (Bosch Kemper 1851). At the time, the Netherlands were not yet ready for modern banking, borrowing money here and lending it out at a premium there (Brugmans 1929).

*Austria* Credit was one of the themes discussed at the Tenth Meeting of German Farmers and Foresters in Grätz (Styria), 18 September 1846 (Mentzel 1848).

*France* The head of the 1848 interim government, General E.L. Cavaignac, wanted to provide cheap credit to peasants. His proposals were rejected by the Assemblée Nationale (Newman and Simpson 1987). Cavaignac had some modern ideas. He wanted to promote producer co-operatives and farm schools.

*The Germanies* A warm plea for credit to small farmers was made by Lette (1847) after a visit to the province Prussia in 1846. But it was F.W. Raiffeisen, mayor of a rural town in Westfalia, who initiated farmer co-operatives, inspired by the misery of the late 1840s. He wrote 'As to the history of the loan societies, their birthplace is the lower Westerwald, in the Prussian Rhine Province, the time proper of origin the emergency

year 1847' (Seelman-Eggebert 1928). What began as an informal 'consumer society' (rather a charity committee), that provided cheap bread and later seed potatoes for the 1847 planting season, developed gradually into rural banks, strictly local, non-profit, governed by village notables. Later these village-level banks were knitted together into the German Raiffeisenbank. Neighbouring countries followed the example. In the Netherlands the RABO-bank (the RA remembers Raiffeisen) has become one of the largest Dutch banks, still basically a co-operative, a bank with AAA status.

## The Economic Depression of the 1840s

### Mercantilist Attitudes

The mercantilist policy of the 18th century, implying protection of the national production against cheap imports by means of tariff walls, was continued by several nations until far into the 19th century. One example were the English 'Corn Laws' protecting the English grain producers by means of flexible import duties, high when grain prices at home were low and low when they were high.

*The Netherlands* followed the example by the law of 29 December, 1835, 'to promote the interests of agriculture', introduced after fierce resistance of the grain trade. A relaxation of this protectionist measure occurred by the law of December 18th, 1845, under the pressure of the grain merchants, and in recognition of the shortages caused by the potato blight (Terlouw 1971).

*Austria* Austria distanced itself from the German Federation and maintained its tariff walls (Wehler 1987).

*Belgium*, independent since 1839, had a commercial regime with few restrictions to international trade (Pirenne 1932).

*France* The Emperor Napoleon III mitigated the mercantilist regulations only around 1860.

*The Germanies* The German Federation (G: *Deutsche Bund*) had a comparatively liberal Customs Agreement (G: *Zollverein*), promoting within-federation trade and facilitating international trade (Wehler 1987). Prussia was a wheat exporter.

### The 'Commercial Crisis' in NW Europe, 1847/8

An eye-witness of the 'commercial crisis' sketched the 'career of the crisis' as a three-tier process (Morier-Evans 1848).

- (1) The 1840s were the hey-days of railway construction. A 'railway-mania' reached its peak in 1845 but in October of that year a panic in the share-market punctured the bubble leaving many speculators penniless.

- (2) The poor harvest of 1846, of potatoes in particular, necessitated the purchase of food abroad. Money was tight, interest rates became high. Grain speculation was rampant. Corn prices declined in May, 1847, and caused the ‘food and money panic’.
- (3) On top of all this came the ‘French Revolution’ of 1848 causing a loss of trust.

Asset values plummeted on the Stock Exchanges of London and of the Continent. The list of failing traders, merchants, money dealers and bankers is long. Crisis sprawled over the Continent. Investment in railways, an investment in new communication comparable to the ICT hype of the 1990s, became risky business in continental Europe.

The English treasury remained in fair shape but several continental treasuries were in a critical state (Lutz 1985), due to warfare and/or poor management, as in the Netherlands, Austria, France and Prussia. The Netherlands and Prussia, floating big loans, made a narrow escape. The other Continental States had no way to meet the financial crisis.

The industrialisation of England in the first part of the 19th century was not matched on the Continent. Rapid population growth and the dissolution of the cottage industry produced a supply of labour that could not be absorbed by the national economies of the Continent. Pauperism and the rise of a rural as well as an urban proletariat were among the consequences.

On the Continent the harvest failures caused a steep rise in food prices, especially in the towns, and this entailed a sharp dip in the demand for industrial products that, in turn, led to dismissal of personnel, more unemployment and more poverty. The young surgeon Rudolf Virchow in Berlin wrote to his father ‘every day new masses of manual workers lose their means of support, the factories close down one after the other and all of us are disturbed in our livelihood’.

*The Netherlands* At the time the Netherlands were a somewhat self-contained nation, relying on agriculture and commerce, but with little industry. The country was on the verge of bankruptcy (Bergman 1967). In the fall of 1845 speculation in grain caused a temporary lack of capital, though without serious consequences (Terlouw 1971). Factories came to a stop and unemployment rose rapidly. Between January and April, 1848, Dutch shares lost ~40% of their value, several foreign shares over 50% (Anonymus 1849). At least a dozen Amsterdam money dealers of good renown suspended payments.

*Austria* Spending much money on the military, Austria endured an acute financial crisis in 1847/8. Grain speculation and hoarding boosted food prices, and because of the high food prices people could no longer pay their taxes and other debts. Due to the lack of purchasing power of the public several manufacturers could no longer sell their products, dismissed their labourers, and shut down. The famous bank Rothschild at Vienna, the Emperor’s financier, stopped its payments on March 6th, 1848, thus informally acknowledging the bankruptcy of the Imperial government (Lutz 1985; Rumppler 1997). A run on the banks occurred. Share values on the Vienna stock market plummeted, especially of the railway shares.

*Belgium* The Paris revolution caused a rush on the banks; share values were halved (Pirenne 1932). The government, however, stayed level-headed.

*France* The catastrophic potato and grain crops of 1846 increased the food prices, forced up by speculation, and caused a sudden fall in the demand for industrial products, leading to unemployment. The nation slid into an acute depression, thought to be caused first and foremost by the harvest failures (Furet 1988). The 1847 harvest was relatively good but made no end to under-consumption. Bankruptcies and unemployment spread, shares dropped in value, credit became expensive or unavailable, and trust was lost. Some banks had to stop their operations (Braudel and Labrousse 1976).

*The Germanies* Prussia experienced an economic crisis due to population growth, massive unemployment, and extensive pauperism. The failed potato harvest of 1846 deprived the poor from their staple food, not to mention the poor rye harvest of that year. Food and credit became expensive, unemployment increased, demand fell, industries and crafts suffered. The Frankfurt Stock Exchange plummeted overnight. A highly respectable bank, the *Schaafhausensche Bankverein* at Cologne, went bankrupt and closed its doors in March, 1848, dragging along some 40,000 clients. The archduchy of Baden reached a state of emergency (Riegger 1998).

### Economic Liberalisation

Clearly, the authorities in many countries could no longer handle the explosive combination of circumstances. Many of those in power adhered to classical liberalism with its '*laissez faire*' as the leading doctrine. In their hands it was a cruel doctrine since the common people were left to starve whereas some persons made much money in hoarding, grain speculation, wheat exports (e.g., Prussia) and grain supply to distilleries (Prussia again). Brandy was the last consolation of many poor and hungry people. Rudolf Virchow having visited Upper Silesia in early 1848 wrote 'the child at its mother's breast is already fed with brandy'.

*The Netherlands* The Finance Minister F.A. van Hall, who had just saved the nation from bankruptcy by floating a large loan at modest interest, is sketched as a sturdy non-interventionist. He kept his stand against the pressure of many, even of King William II. In Parliament, however, he defended the bill to suspend import duties of agricultural commodities in order to stimulate the importation of potatoes and grain. As the high food prices asked for a concession by the Dutch Government, the Dutch 'Corn Laws' were suspended by law of 18 December 1845 (see above). The suspension was prolonged until 1 October 1847 since the bad harvests of potatoes and rye in 1846 emphasized the importance of a free grain trade (Terlouw 1971). Thus the turn from protectionism to free trade, a first victory of economic liberalism in the Netherlands, was made thanks to blight and rust.

### Causes of Famine

An extensive literature exists on the famine as a socio-economic phenomenon (e.g., Sen 1981; Rotberg and Rabb 1983, Drèze and Sen 1989). Let it suffice here to recall that two major causes have been identified. The first is a strong 'food availability decline' (FAD), obvious in the years 1845 and 1846 with their harvest failures. The

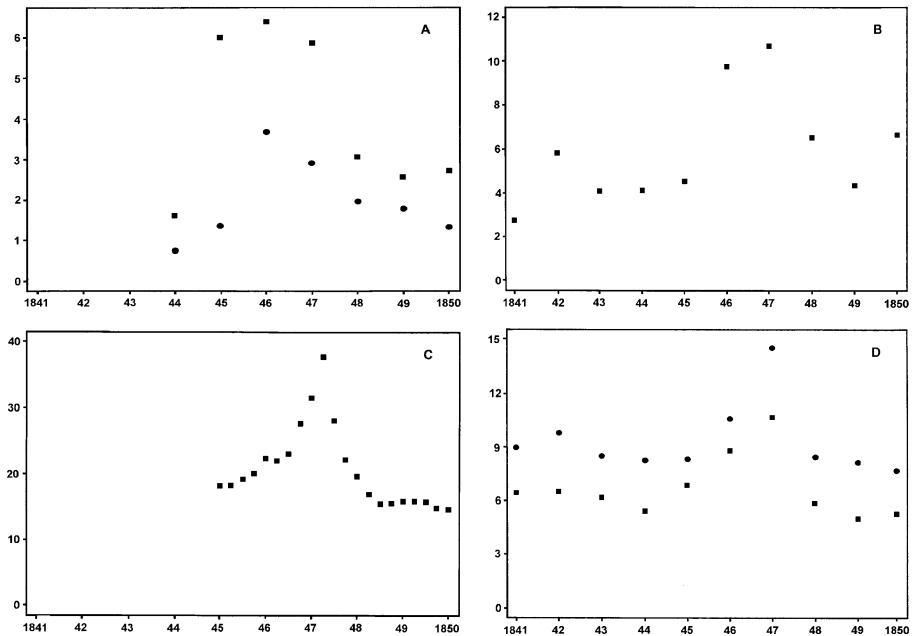
second is the lack of purchasing power to buy whatever food is available when food prices soar (Fig. 7). Simplified, the farmers had nothing to sell, they had no money to buy services of craftsmen or to purchase industrial products, so that the manufacturers could not sell their produce and had to close down. The jobless craftsmen, construction workers and industrial labourers could no longer pay for their food. In the late 1840s the two causes were clearly interrelated.

The actual situation was far more complicated and should be considered in terms of countryside versus town, land owners versus day labourers, farming community versus craftsmen in villages and rural towns, and so on. In some areas, among which E Prussia, food exports and hunger existed nearly side by side.

## The Events of 1848

### Political Aspects

The Treaty of Vienna (1815) reorganised Continental Europe after the Napoleonic Wars, restoring monarchism in old and new nations. Rulers of several reconstructed German principalities donated constitutions to befriend their, often new, subjects. Prussia and Austria continued as absolute monarchies, without constitutions. The



**Fig. 7** Prices of major food commodities on the European Continent to illustrate the dearth in the years 1845–1847. Panel A. Prices of late potatoes (maximum and minimum) at Leiden, Netherlands, in Dutch Guilders per *mud* = Dutch bushel = ~70 kg (after Terlouw 1971). Panel B. Potato prices in Zürich, Switzerland, in Swiss Francs per 100 kg (after Brugger 1956). Panel C. Wheat prices in France, in French Francs per hl (modified after Abel 1974). Panel D. Wheat (●) and rye (•) prices in the Netherlands in Dutch guilders per hl (after Staring 1860)



Netherlands were a newly created nation composed of the present states the Netherlands, Belgium and Luxemburg. In 1815 it became a constitutional kingdom with an agrarian north (present Netherlands) and an industrialising south (present Belgium and Luxemburg). In 1839 this nation fell apart. Belgium proclaimed independence and found a king willing to rule under its new and very liberal constitution of 1831. Luxemburg became independent in 1867.

In many capitals intellectual life was fermenting in the 19th century. The Enlightenment of the 18th century had its political culmination point in the French revolution of 1789. Two main streams of political thinking built on that revolution's credo 'freedom, equality, fraternity'. One stream, leading to socialism and communism, sought to realise its ideals by propagating common property of production means. Many of its proponents addressed the street, wanting revolution. Marx and Engels published their 'Communist Manifesto' in 1848. Another stream, liberalism, wanted civil rights for individual citizens under protection of the law. Supported by entrepreneurs, middle class people, academics and, often, high-placed civil servants, it sought to attain its objectives by evolution. A third stream of political thought, nationalism, was fed by Romanticism. These interconnected streams formed an explosive mixture.

*The Netherlands* In the Netherlands the government suppressed all unrest, primarily the relatively innocuous hunger riots, with undue force. When a crowd had collected on the Dam Square in Amsterdam, in front of the Royal Palace, King William II felt the threat of revolution and apparently panicked (Jansma and Schroor 1987). A conservative, he became a liberal in one night. He invited a Member of Parliament, Professor J.R. Thorbecke, to chair a committee and write a new constitution. This constitution, for the time quite liberal, was written within four weeks (van Schie 2006). Though liberals were a small minority in Parliament, the Constitution was accepted in 1848, not without pressure by the King. The constitution was so modern that, with some inevitable modifications, it remained basically unchanged until today.

*Austria* Protests and demonstrations in Vienna, capital of the Austrian/Hungarian double monarchy, followed the hunger winter of 1847/8 and, in the end, induced the Emperor to proclaim a Constitution in 1848.

*Belgium* The liberal constitution of 1831 stood out as an example. Thanks to its liberal climate several revolutionaries flocked together in Brussels, among them Marx and Engels, during the late 1840s. In 1848 an incipient revolution was crushed by the Brussels police (Eskens 2000). A relation between the revolutionary spirit in Brussels and the rural misery, in Flanders especially, was not found.

*France* The general discontent of the 1840s burst out in violence, first in Paris, 22 February, 1848. The Bourbon King was chased away on 24 February 24th. On 10 December 1848 Prince Louis Napoleon Bonaparte was chosen President of the Second Republic. 'The collapse of authority unleashed a massive wave of direct action in towns and villages where capitalist industry and agriculture and state politics had threatened livelihood' (Newman and Simpson 1987). The causal relationship between harvest failures and revolution is most obvious in France.



*The Germanies* The spark of revolution jumped over to Berlin (Prussia) where it ignited the ‘March Revolution’, which was suppressed by force. Nonetheless, Prussia received its first constitution in 1848. Events were milder in the kingdom of Bavaria and the Archduchy of Baden (Riegger 1998), in the same year.

*Hungary* Hungarian liberals, revolting in Budapest, wrote and accepted a liberal constitution for Hungary in 1848.

*Ireland* Inspired by the news from the Continent, a small band attacked the police station of Tipperary but this minor rebellion was crushed by the police. Taking a long shot, Ordish (1976) commented ‘The blight ... nourished the seeds of the Republic of Eire’.

*Other Countries* Revolts with a more nationalistic touch occurred in several city-states of present Italy, 1848, Prague (Bohemia, then under Austrian rule), Poznań (in present Poland, then under Prussian rule), and several other places, without much success. Switzerland, a confederation of relatively independent democratically governed cantons, made a special case. After serious inter-cantonal quarrels a liberal constitution was accepted in 1848, notwithstanding the admonitions of the pious mister Gotthelf (1847). King Fredrick VII of Denmark announced the introduction of parliamentary democracy on January 20th, 1848, leading to the constitution of 1849. England, with its archetype of a constitutional monarchy, Spain and Russia remained untouched by the 1848 revolutions.

*Counter-revolutions* ‘The revolution of 1848 was not the product of an intentional revolutionary action: it was rather the implosion of a traditional form of government on the European continent, of which the legitimate validity has collapsed and of which the fight for its maintenance had at once been felt as hopeless’ wrote Mommsen (1998). Many new rights had been obtained by the people in 1848.

When the worst was over countervailing forces tried to undo the results of revolution by means of ‘counter-revolutions’. In Prussia and Austria and their dependent areas, and in various German principalities, rulers withdrew several of the newly acquired rights, 1848 or 1849. France followed in 1851. Some innovations, however, survived such as voting rights for at least part of the male population, and other civil rights. Serfdom was abolished. Economic power was transferred from the nobility to the middle classes, a definitive change ‘from feudalism to capitalism’ Gieysztor et al. 1979).

## The Potato Blight and the Revolutions

An epidemic of potato late blight was followed by an epidemic of constitutions, more or less liberal. Was there a causal relationship? Yes and no!

No, since the roots of liberalism reached far beyond 1845 when the blight struck first. No, as the general discontent in the capitals, towns and rural areas had built up in the 1840s due to a variety of reasons, economical and political.

Yes, as the fall of share values in 1846 was not only coincidence; it was also due to the high price of credit needed to finance large grain imports. Yes, because the dearth and famine following the poor potato and grain harvests deepened the discontent

(Riegger 1998). Hunger makes rebels and insurgents. Yes, because the blight and, again, the poor grain harvest in France, where the revolts began, triggered an acute economic depression that led to revolution. I quote a few authors with different backgrounds.

Wehler (1987), a German historian, had some reservations. ‘To assume a direct connection between hunger crisis, grain riots and potato revolts on the one hand, and the revolution of 1848 on the other hand, would be to prefer a simplifying shortcut to more complicated interrelationships’ but he considered ‘the crisis from 1845 to 1848 the prelude of the 1848 revolution in all of Europe’.

Pirenne (1932), a Belgian historian, stated ‘the economic crisis was soon complicated by a food crisis’.

The German historian Lutz (1985) wrote ‘The structural economic crisis of the forties, characterised by population pressure, massive unemployment and pauperism, was sharpened by an acute crisis in 1846/7. Potato blight and harvest failures led to a famine manifested by epidemics and a reduced birth rate’. ‘So grew, from famine and hunger epidemic, oppositional criticism and public awareness formation’ and ‘A direct relationship between the hunger unrest 1847 and the revolution was also assumed by non-socialist contemporaries’.

The Dutch publicist van der Heiden (2001) stated ‘The story of the, after all peacefully achieved 1848 revision of the Constitution ... should, strictly speaking, begin with *Phytophthora infestans*’. Apparently he followed the Dutch historian of agriculture Sneller (1943) who wrote ‘it [the potato blight] gave an additional impulse to the peaceful revolution of the national government in the year 1848’.

And the French historian Le Roy Ladury (2004) said in one of his inimitably intricate but highly precise sentences ‘Raged after all, always with accidentality and variability, the long and hot drought of the spring and summer of 1846, which, with the potato disease, notably in Ireland, carries certain responsibilities by way of the economic depression of 1847 born from that poor harvest; she implies effectively a kind of climatic guilt, though partial, in view of the ultimate outbreak of the revolutions in France and then in West and Central Europe, beginning February, 1848, in the environment of an economic crisis that indeed sprouts from the difficult post-harvest year 1846–1847; in the environment, also, correlating, of a certain discontent of the various populations’.

The number of excess deaths due to potato blight, failed grain harvests, and corollary diseases, ‘hunger typhus’ foremost, cannot (yet) be established with any accuracy. Continental Europe suffered a terrific blow with ~700,000 victims (Table 3), a terrific number approaching the Irish catastrophe, though spread out over a larger area with a larger population.

### The Fate of the Farmers

The fate of the farmers in the ‘Black Years’ is not our topic, but a few words may be said. Landless labourers and rural craftsmen were hard hit by scarcity, hunger, death, sale of possessions, and loss of self-esteem. So were the millions of peasants living at the margin of self-sufficiency. Farmers with a surplus to be sold were better off as food prices soared. The Dutch farmers as a class fared reasonably well during the years of crisis. During the discussion on the ‘Bill to encourage the importation of food commodities’ the Hon. Hoffman stated ‘farmer, who finds in the high prices of his grain,

more than compensation for the failure of his potatoes' (Ising 1892). The Governor of Groningen reported 'The past year [1845] has been, on the whole, very advantageous to the agriculture in this province, not so much through a rich and abundant harvest, as through the high prices of all products' (Rüter 1950). The large semi-industrial estates in E Germany did exceedingly well, providing the needy cities, exporting grain overseas, and selling potatoes or grain to distilleries rather than to citizens.

Where cash was scarce on the countryside usurers took their chance. Many farmers became indebted and were, eventually, evicted. Social relations between labourers, farmers, and landowners came under stress. The situation was particularly serious (or well studied?) in France where the structure of rural society was uprooted and changed forever (Houssel 1976).

## Conclusions

1. The invasion of the European Continent (N of the Alpine Ranges and into W Russia) by *Phytophthora infestans* in 1844/5 had a tremendous impact because of the crop failure it caused, with famine and pestilence in its wake.
2. On the European Continent the harvest failures of 1845 and 1846, due to late blight on potatoes, rust on rye, voles, frost and drought, caused scarcity, hunger, and famine, leading to a recession with a drop in the demand of industrial products and a subsequent loss of employment, thus exacerbating the existent poverty and discontent.
3. Continental Europe suffered badly from crop failures in 1845 and 1846, leading to dearth, hoarding and speculation, rising prices, and finally resulting in an excess loss of lives tentatively estimated at ~700,000, a number yet uncertain but approaching that of Ireland.
4. Emigration overseas from Continental Europe seems to be in the order of one or a few hundred thousand persons, far less than the Irish emigration. Transmigration, from the countryside to the cities and the industrial areas, may have exceeded the transmigration of the Irish (~300,000) to England by far.
5. In Continental Europe existed a substratum of discontent, related to widespread rural pauperism and incipient urban proletariat, economic depression and empty treasuries, loss of trust, value loss of shares and real estate, bankruptcies, social unrest, and new political thinking. A general recession, with causes varying per state, came on top of the widely felt discontent and prepared the ground for the 1848 revolutions.
6. The course of events in Continental Europe differed from that in Ireland. Ireland lost about one quarter of its population by death and emigration, but its political situation hardly changed. On the Continent the 1848 revolutions reshaped the political landscape, now determined by national Constitutions.
7. The 'potato murrain' was not the immediate cause of the revolutions, its pernicious consequences being rather the 'straw that broke the camel's back'. The epidemics of potato late blight, 1845 and 1846, together with many other agricultural misfortunes in those two years, contributed in an indirect way, but strongly, to the great political changes in Continental Europe, 1848.

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## **Appendix 1. Contemporaneous information as published in The Official Newspaper of the Dutch Government of 1845.**

‘Disease’ = potato late blight. Expected or estimated yields are given in fractions of normal yield, arranged per country or area and per date (day-month-issue):

### *Austrian Empire*

23–10–251 Trieste – no disease.

10–11–266 Austria – disease present in Galicia, Vorarlberg, Upper and Lower Austria.

19–11–274 Galicia – disease progressed, most of harvest rotting, storability low.

### *Belgium*

19–09–222 Harvest largely lost. Export of grain and potatoes forbidden.

01–11–259 No seed potatoes available – purchases in Scotland.

### *Denmark*

28–10–255 Disease extending on late varieties – exports suspended.

08–11–265 Rendsburg [presently Germany] – harvest 1/2.

05–11–262 Hardly any healthy lot available, cheap delivery to distilleries, exports suspended.

25–11–253 Holstein – harvest 1/4.

### *The Germanies*

17–10–246 Bavaria hopes for normal harvest.

28–10–255 Bavaria – exportation forbidden.

17–10–246 Bremen – harvest 2/3.

28–10–255 Frankenland – yield good, rarely diseased.

08–11–265 Frankfurt [am Main] – harvest adequate but disease in storage.

17–10–246 Hannover – little surplus for export.

23–10–251 Königsbergen [Kaliningrad] – harvest good but disease present, ship loads lost by rotting.

03–12–286 Königsbergen [Kaliningrad] – harvest abundant, disease incidental. Storage rot, potatoes unfit for shipping.

03–12–286 Lithuania – harvest good.

03–12–286 Mazuria [Mazowze in present Poland] – harvest good.

01–11–259 Mecklenburg – Wismar – harvest < 1/2.

18–12–299 Oldenburg – harvest 1/3, storability very poor.

23–10–251 Prussia – destruction.

01–11–259 Stettin [Szczecin, present Poland] – harvest abundant but generally diseased.

28–10–255 Württemberg – exportation forbidden.

*France*

- 27–11–281 – General overview – in 36 out of 86 departments harvest failure.  
 05–11–262 Brittany - Brest – crops diseased – seed potatoes should be imported.  
 23–10–251 Brittany - Le Havre - harvest 1/4.  
 28–10–255 Alsace – harvest 2/3 to 3/4, rotting in storage.  
 01–11–259 La Rochelle – harvest abundant and free from disease.  
 28–10–255 Les Landes – poor harvest, sometimes diseased.  
 23–10–251 Loire Valley – expected harvest 2/3.  
 28–10–255 Pyrenees– poor harvest, sometimes diseased.

*Norway*

- 01–11–259 Bergen – Just enough for home consumption, no exports.  
 08–11–265 Norway – Crop lost.

*Russia*

- 01–11–259 Memel [Klajpeda in present Lithuania] – harvest pending, no disease, yield moderate.  
 04–12–287 Russia – Exportation from Livonia [present Estonia and Latvia] and Kurland [Kurseme, present Latvia] forbidden.

*Sweden*

- 05–11–262– disease near Göteborg – export forbidden.  
 08–11–265 Sweden – harvest was average.

*Switzerland*

- 28–10–255– Yield about 1/2, delivery to distilleries forbidden, prices low because of poor storability.

**References**

- Abel W (1974) Massenarmut und Hungerkrisen im vorindustriellen Europa: Versuch einer Synopsis. Parey, Hamburg
- Agulhon M, Désert G, Specklin R (1976) Histoire de la France rurale de 1789 à 1914. Seuil, Paris
- Allgemeine Zeitung, Augsburg edition. Cotta, Stuttgart
- André R, Pereira-Roque J (1974) La démographie de la Belgique au XIX<sup>e</sup> siècle. Editions de l'Université de Bruxelles, Brussels
- Anonymous (1848) Die Hungerpest in Oberschlesien: Beleuchtung oberschlesischer und preussischer Zustände. Heinrich Hoff, Mannheim
- Anonymous (1849) Staatkundig en staathuishoudkundig jaarboekje voor 1948. Müller, Amsterdam
- Anonymous (1850) Statistique de la Belgique. Agriculture. Recensement general (15 Octobre 1846). I-V. Bruxelles
- Armengaud A (1971) La population Française au XIX<sup>e</sup> siècle. Presses Universitaires de France, Paris
- Bergman M (1967) The potato blight in the Netherlands and its social consequences (1845–1847). *Int Rev Soc Hist* 12:390–431
- Bergsma CA (1845) De aardappel-epidemie in Nederland in den jare 1845. van Terveen, Utrecht,
- Berkeley J (1846) Observations, botanical and physiological, on the potato murrain. *Journal of the Horticultural Society of London* 1:9–34. Reprinted in *Phytopathological Classics* 8(1948): 1–108

- Bickel W (1947) Bevölkerungsgeschichte und Bevölkerungspolitik der Schweiz seit dem Ausgang des Mittelalters. Guteberg, Zürich
- Bieleman J (1987) Boeren op het Drentse zand 1600–1910. Een nieuwe visie op de ‘oude landbouw’. A. A.G. Bijdragen 29, Wageningen
- Bieleman J (1992) Geschiedenis van de landbouw in Nederland 1500–1950. Boom, Meppel
- Bolognese-Leuchtenmüller B (1978) Wirtschafts- und Sozialstatistik Österreich-Ungarns. I. Bevölkerungsentwicklung und Berufsstruktur, Gesundheits- und Fürsorgewesen in Österreich 1750–1918. Verlag für Geschichte und Politik, Vienna
- Bosch Kemper J (1851) Geschiedkundig onderzoek naar de armoede in ons vaderland, hare oorzaken en de middelen die tot hare vermindering zouden kunnen worden aangewend. Historische en letterkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen, Haarlem, 1e deel. Loosjes, Haarlem
- Bouman PJ (1946) Geschiedenis van den Zeeuwschen Landbouw in de negentiende en twintigste eeuw en van de Zeeuwschen landbouw-Maatschappij, 1843–1943. Veenman, Wageningen
- Bourke A (1964) Emergence of potato blight, 1843–1846. *Nature* 203:805–808
- Bourke A (1993) ‘The visitation of God’? The potato and the great Irish famine. Lilliput Press, Dublin
- Bourke A, Lamb H (1993) The spread of potato blight in Europe in 1845–6 and the accompanying wind and weather patterns. Meteorological Service, Dublin
- Bourson P (1845) Exposé analytique de diverses opinions sur les causes probables de la maladie des pommes de terre, présenté à la commission instituée près du Ministère de l’Intérieur, Brussels (ex Decaisne 1846)
- Braudel F, Labrousse E (eds) (1976) Histoire économique et sociale de France. Vol 3/1. L’avènement de l’ère industrielle (1789 – années 1880). Presses Universitaires de France, Paris
- Brugger H (1956) Die schweizerische Landwirtschaft in der ersten Hälfte des 19. Jahrhunderts. Huber, Frauenfeld
- Brugmans IJ (1929) De arbeidende klasse in Nederland in de 19e eeuw, 2nd edn. Nijhoff, The Hague
- de Balzac H (1844?) Les paysans. Ed. 1928. Flammarion, Paris
- Decaisne MJ (1846) Histoire de la maladie des pommes de terre en 1845. Dusacq, Paris
- Drèze J, Sen A (1989) Hunger and public action. Clarendon Press, Oxford
- Droz J (1967) De la restauration à la révolution, 1815–1848. Armand Colin, Paris
- Dumortier BC (1845) Notice sur la cloque des pommes de terre. Bulletin de l’Académie Royale des Sciences et Belles-Lettres de Bruxelles 12 (Vol II) 285–299
- Dupâquier J (1980) Les aventures démographiques de la France et de l’Irlande (18<sup>e</sup> – 20<sup>e</sup> siècles). In: Cullen LM, Furet F (eds) *Irlande et France XVIIe – XXe siècles. Pour une histoire rurale comparée*. École des hautes études en sciences sociales, Paris, pp 167–180
- Dupâquier J (ed) (1988) Histoire de la population française. Vol. 3. De 1789 à 1914. Presses Universitaires de France, Paris
- Dyson T, Ó Gráda C (2002) Famine demography. Perspectives from the past and present. Oxford University Press, Oxford
- Eriksson J (1884) Om potatissjukan, dess historia och nature samt skyddsmedlen deremot. Norstedt, Stockholm
- Eskens E (2000) Filosofische reisgids. Voor Nederland en Vlaanderen. Contact, Amsterdam
- Fuchs JM (1970) Amsterdam een lastige stad. Rellen, oproeren en opstanden in de loop der eeuwen. de Boekerij, Baarn
- Furet F (1988) La révolution, de Turgot à Jules Ferry, 1770–1880. Hachette, Paris
- Gebel XX (1848) in: *Annalen der Landwirtschaft* 11:156
- General Report (1845, 1846) Algemeen Verslag wegens den Staat van den Landbouw in het Koninkrijk der Nederlanden. Loosjes, Haarlem
- Gieysztor A, Kieniewicz S, Rostworonski E, Tazbir J, Wereszycki H (1979) History of Poland. Polish Scientific Publishers, Warszawa
- Gotthelf J (Albert Bitzium) (1847) Käthi die Grossmutter. Reprint 1965. Rentsch, Erlenbach/Zürich
- Grootegoed H (1853) Bijdragen tot de kennis van den akker- en tuinbouw van het Westland in Zuid-Holland. Tijdschrift ter Bevordering van Nijverheid 16 (2<sup>e</sup> reeks #1):24–39
- Gruner E (1968) Die Arbeiter in der Schweiz im 19. Jahrhundert. Soziale Lage, Organisation, Verhältnis zu Arbeitgeber und Staat. Francke, Bern
- Guin Y (1982) Histoire de la Bretagne de 1789 à nos jours. Maspero, Paris
- Harting P (1846a) Recherches sur la nature et les causes de la maladie des pommes de terre en 1845. Verhandelingen der 1e Klasse van het Koninklijk Nederlandsch Instituut van Wetenschappen etc.,

- Amsterdam. Nieuwe Verhandelingen 12:203–297 with 3 coloured plates. (*Studies on the nature and causes of the potato disease*). Also published as:
- Harting P (1846b) Extrait d'un mémoire sur la nature et les causes de la maladie des pommes de terre en 1845. *Annales des Sciences Naturelles*, 3me série. Botanique 6:42–62
- Heesterbeek JAP, Zadoks JC (1987) Modelling pandemics of quarantine pests and diseases: problems and perspectives. *Crop Protection* 6:211–221
- Heldring OG (1845) De nood en hulp der armen, in betrekking tot den arbeid, de weelde en het medelijden. Eenige praktische blikken in den toestand onzes Volks. Beijerinck, Amsterdam
- Heldring OG (1847) Opmerkingen op eene reis langs den Rijn. Beijerinck, Amsterdam
- Hoekstra ME (1879) Uit het dagboek van Mindert Everts Hoekstra (1825–1879). <http://irnsun.tmfweb.nl>. Consulted 041205
- Hofstee EW (1978) De demografische ontwikkeling van Nederland in de eerste helft van de negentiende eeuw. Een historisch-demografische en sociologische studie. Van Loghum Slaterus, Deventer
- Hogg WH, Hounam CE, Mallik AK, Zadoks JC (1969) Meteorological factors affecting the epidemiology of wheat rusts. *World Meteorological Organization, Techn. Note No. 99*, Geneva, Switzerland:1–143
- Hoogerhuis OW (2003) Baren op Beveland. Vruchtbaarheid en zuigelingensterfte in Goes en omliggende dorpen gedurende de 19<sup>e</sup> eeuw. A.A.G. Bijdragen 42, Wageningen
- Hooijer C (1847) De groote nood des hongers in en bij den Boemelerwaard. 2e druk. Noman, Zalt-Bommel
- Houssel J-P (ed) (1976) Histoire des paysans français du XVIIIe siècle à nos jours. Horvath, Roanne
- Ising ALH (1892) Verslag der Handelingen van de Staten-Generaal gedurende de zitting van 1845–1846. Nijhoff, Den Haag
- Jansen PC, de Meere JMM (1982) Het sterftepatroon in Amsterdam, 1774–1930, een analyse van de doodsoorzaken. *Tijdschrift voor Sociale Geschiedenis* 8:180–223
- Jansma K, Schroor M (eds) (1987) Tweehonderd jaar geschiedenis van de Nederlandse Landbouw. Inter-Combi van Seyen, Leeuwarden
- Jardin A, Tudesq AJ (1973) La France des notables. L'évolution générale 1815–1848. Seuil, Paris
- Kossmann EH, Krul WE (1977) Winkler Prins Geschiedenis der Nederlanden, Vol. 3:1780–1870. Elsevier, Amsterdam
- Kyrre H (1913) Kartoffelens krønike, en kulturhistorisk studie. Gad, København
- Lamb HH (1995) Climate, history and the modern world, 2nd ed. Routledge, London
- Lamberty M (1949) Geschiedenis van Vlaanderen, Vol. VI. Joost van den Vondel, Amsterdam
- Lamberty M, Lissens RF (1951/2) Vlaanderen door de eeuwen heen. Elsevier, Brussels, Vol. I – 1951, Vol. II – 1952
- Large EC (1940) The advance of the fungi. Jonathan Cape, London
- Le Roy Ladurie E (2004) Histoire humaine et comparée du climat. I. Canicules et glaciers (XIIIe – XVIIIe siècle). Fayard, Paris
- Lette, XX (1847) Auszug aus einem an des Herrn Ministers des Innern Excellenz erstatteten Reiseberichte des Präsidenten Lette über die Bereisung der Provinz Preussen. *Annalen der Landwirtschaft* 5 (Vol. 10):1–57
- Lindemans P (1952) Geschiedenis van de landbouw in België. II. de Sikkel, Antwerpen
- Lutz H (1985) Die Deutschen und ihre Nation. 2. Zwischen Habsburg und Preussen. Deutschland 1815–1866. Siedler, Berlin
- Macartney GA (1968) The Habsburg Empire 1790–1918. Weidenfeld and Nicolson, London
- Mangin L (1914) Parasites végétaux des plantes cultivées. Maison Rustique, Paris
- Marschalck P (1973) Deutsche Überseewanderung im 19 Jahrhundert. Ein Beitrag zur soziologische Theorie der Bevölkerung. Klett, Stuttgart
- Mauz EF (1845) Versuche und Beobachtungen über den Kartoffelbau und die Krankheiten der Kartoffeln, besonders im Jahr 1845. Steinkopf, Stuttgart
- Mentzel XX (1848) Bericht des Wirklichen Geheimen Kriegs-Rath Mentzel über eine nach den Oesterreichischen Staaten im Herbst 1846 unternommen Privatreise. *Annalen der Landwirtschaft* 6 (Vol. 11):75–142
- Moleschott J, von Baumhauer EH (1845) Het wezen der aardappelziekte en de middelen ter voorkoming en genezing van dezelve. Bötticher, Utrecht
- Mommsen WJ (1998) Die ungewollte Revolution. Die revolutionäre Bewegungen in Europa 1830–1849. Fischer, Frankfurt am Main
- Montagne C (1845) Observations sur la maladie des pommes de terre. L'institut. *Journal universel des Sciences*, Paris N° 609:312–313



- Morier Evans D (1848) The commercial crisis 1847–1848; being facts and figures illustrative of the events of that important period, considered in relation to the three epochs of the railway mania, the food and money panic, and the French revolution. Letts, Son & Steer, London
- Morren Ch (1845a) Instructions populaires sur les pommes de terre. Instructions populaires sur les moyens de combattre et de détruire la maladie actuelle (gangrène humide) des pommes de terre et sur les moyens d'obtenir pendant l'hiver des récoltes de ces tubercules, suivies de renseignements sur la culture et l'usage du topinambour. Périchon, Bruxelles
- Morren Ch (1845b) Bulletin de l'Académie royale des sciences, des lettres et des beaux-arts de Belgique 12 (Part 2):372–373 (Comment following the note by Martens 1845)
- Münter J (1846) Die Krankheiten der Kartoffeln insbesondere die im Jahre 1845 pandemisch herrschenden nasse Fäule. Hirschwald, Berlin
- Newman EL, Simpson RK (eds) (1987) Historical dictionary of France from the 1815 Restoration to the Second Empire. Greenwood, Westport (Conn.)
- Ó Gráda C (1989) The great Irish famine. Macmillan, London
- Oliemans WH (1988) Het brood van de armen. De geschiedenis van de aardappel temidden van ketters, kloosterlingen en kerkvorsten. SDU, Den Haag
- Ordish G (1976) The constant pest. A short history of pests and their control. Peter Davis, London
- Peterson PD (1995) The influence of the potato blight epidemics of the 1840s on disease etiology theory in plants. In: Dowley LJ, Bannon E, Cooke LR, Keane T, O'Sullivan E (eds) *Phytophthora infestans* 150. Boole, Dublin, pp 30–35
- Pirenne H (1932) Histoire de la Belgique. VII. De la révolution de 1830 à la guerre de 1914. Lamartin, Bruxelles,
- Priester PR (1991) De economische ontwikkeling van de landbouw in Groningen 1800–1910. Een kwalitatieve en kwantitatieve analyse. A.A.G. Bijdragen 31, Wageningen
- Priester PR (1998) Geschiedenis van de Zeeuwse landbouw. A.A.G. Bijdragen 37, Wageningen
- Quanjer HM (1913) Die Nekrose des Phloëms der Kartoffelpflanze, die Ursache der Blattrollkrankheit. Mededeelingen van de Rijks Hoogere Land-, Tuin- en Boschbouwschool 6:42–80, with illustrations
- Quanjer HM, Dorst JC, Dijt MD, van der Haar AW (1920) De mozaïekziekte van de Solanaceëen, hare verwantschap met de phloeomnecrose en hare beteekenis voor de aardappelcultuur. Mededeelingen van de Landbouwhoogeschool 17:1–90
- Real W (1983) Die Revolution in Baden 1848/49. Kohlhammer, Stuttgart
- Reynebeau M (2005) Een geschiedenis van België. 7th imp. Lannoo, Tielt
- Riegger W (1998) Die Badische Revolution 1848/49. [www.junggesellen.de/archiv\\_heimatabend98.htm](http://www.junggesellen.de/archiv_heimatabend98.htm) (consulted July, 2005)
- Rotberg R, Rabb TK (eds) (1983) Hunger and History: The Impact of Changing Food Production and Consumption Patterns on Society. CUP, Cambridge
- Roze E (1898) Histoire de la pomme de terre, traitée aux points de vue historique, biologique, pathologique, cultural et utilitaire. Rothschild, Paris
- Rumpler H (1997) Österreichische Geschichte 1804–1914. Eine Chance für Mitteleuropa. Bürgerliche Emanzipation und Staatsverfall in der Habsburgmonarchie. Ueberreuter, Wien
- Rüter AJC (ed) (1950) Rapporten van de gouverneurs in de provincien 1840–1849. Vol. 3. Periodieke rapporten 1844, 1845. Kemink, Utrecht
- Salaman RN (1949) Some notes on the history of curl. Tijdschrift over Plantenziekten 55:118–128
- Sandgruber R (1978) Wirtschafts- und Sozialstatistik Österreich-Ungarns. I. Österreichische Agrarstatistik 1750–1918. Verlag für Geschichte und Politik, Vienna
- Schacht H (1856) Bericht an das Königliche Landes-Oekonomie-Collegium über die Kartoffelpflanze und deren Krankheiten. Wiegandt, Berlin
- Seelman-Eggebert EL (1928) Friedrich Wilhelm Raiffeisen, sein Lebensgang und sein genossenschaftliches Werk. Kohlhammer, Stuttgart
- Semal J (1995) L'épopée du mildiou de la pomme de terre (1845–1995). Cahiers Agriculture 4:287–298
- Sen A (1981) Poverty and famines. An essay on entitlement and deprivation. Clarendon, Oxford
- Sneller ZW (ed) (1943) Geschiedenis van den Nederlandschen landbouw 1795–1940. Wolters, Groningen
- Staring WCH (1860) Huisboek voor den landman in Nederland. Kruseman, Haarlem
- Terlouw F (1971) De aardappelziekte in Nederland in 1845 en volgende jaren. Economisch en sociaal-historisch Jaarboek 34:263–308
- Turner RS (2006) After the famine: Plant pathology, *Phytophthora infestans*, and the late blight of potatoes, 1845–1960. HSPS (Historical Studies in the Physical and Biological Sciences) 35:341–370
- Unger F (1833) Die Exantheme der Pflanzen und einige mit diesen verwandten Krankheiten der Gewächse pathogenetisch und nosografisch dargestellt. Gerold, Wien



- Unger DF (1847) Botanische Beobachtungen. IV. Beitrag zur Kenntnis der in der Kartoffelkrankheit vorkommende Pilze und der Ursache ihres Entstehens. *Botanische Zeitung* 5:305–317 + Figure 6
- van Bavegem PJ (1782) Prijzverhandeling over de ontarding der aardappelen. Blussé, Dordrecht
- Van der Hardt Aberson FEC (1893) Het toenemen der ziekten in de cultuurgewassen, een dreigend gevaar voor de maatschappij. van Doesburgh, Leiden
- Van der Heiden C (2001) De aardappelmisogsten (1845–1848). *Nieuwe Rotterdamsche Courant*, 26 September
- Vanderplank JE (1968) *Disease resistance in plants*. Academic Press, New York
- van der Wal AF, Zadoks JC (1971) Interaction of fungal pathogens, and its effect on crop losses in wheat. *Proc. 2nd Int. Symp. Plant Path.*, Delhi
- van der Zaag DE (1999) Die gewone aardappel. *Geschiedenis van de aardappel en de aardappelteelt in Nederland*. Wageningen, s.n.
- van Ewyck, DJ (1847). Verslag van den Gouverneur en de Gedeputeerde Staten der Provincie Noord-Holland, aan de Provinciale Staten, in derzelve gewone vergadering, gehouden te Haarlem den 7<sup>den</sup> Julij 1846
- Vanhaute E (1992) Heiboeren. Bevolking, arbeid en inkomen in de 19<sup>de</sup> eeuwse Kempen. VUBpress, Brussel
- van Schie P (2006) The strengths and weaknesses of Dutch liberalism: a historical comparison with German liberalism. In: van Schie P, Voerman G (eds) *The dividing line between success and failure. A comparison of liberalism in the Netherlands and Germany in the 19th and 20th centuries*. LIT Verlag, Berlin, pp 35–53
- van Zanden JL (1985) De economische ontwikkeling van de Nederlandse landbouw in de negentiende eeuw, 1800–1914. *A.A.G. Bijdragen* 25, Wageningen
- van Zanden JL (1991) ‘Den zedelijken en materiëlen toestand der arbeidende bevolking te platten lande’. Een reeks rapporten uit 1851. *Historia Agriculturae* 21
- Vigreux M (1998) Paysans et notables du Morvan au XIX<sup>e</sup> siècle jusqu’en 1914. *Académie du Morvan, Château-Chinon*
- Virchow R (1848) Mitteilungen über die in Oberschlesien herrschende Typhus-Epidemie. Reimer, Berlin
- Vissering S (1845) Eenige opmerkingen ter zake van de aardappelziekte. van Kampen, Amsterdam,
- von Martius CFP (1842) Die Kartoffel-Epidemie der letzten Jahre, oder die Stockfäule und Räude der Kartoffeln. München, s.n.
- Von Viebahn XX (1848) Bericht des Geheimen Ober-Finanz-Raths v. Viebahn über eine agronomisch-technologische Reise in den Provinzen Posen, Preuzen und Pommern; vom 9. Juni bis 11. Juli 1846. *Annalen der Landwirtschaft* 6(Vol. 11):1–74
- Vrolik G (1845) Waarnemingen en proeven over de onlangs geheerscht hebbende ziekte der aardappelen. Dd 15–11–1845. Voordracht Vergadering 1e Klasse Koninklijke-Nederlandsch Instituut van Wetenschappen, Letterkunde en Schoone Kunsten. Sulpke, Amsterdam
- Vrolik G, Numan A, van Hall HC, Brandts A (1846) Omtrent de uitkomsten, welke de zaaijing van het door het departement van Binnenlandsche Zaken in den aanvang van 1846, aan de Klasse gezonden aardappelzaad heeft opgeleverd. Verslagen, bij de Eerste Klasse Koninklijke-Nederlandsch Instituut van Wetenschappen, Letterkunde en Schoone Kunsten
- Wahlberg PF (1847) Bidrag till kändedommen om potäternas sjukdom i Sverige åren 1845 och 1846. *Elmen and Granberg*, Stockholm
- Wehler H-U (1987) *Deutsche Gesellschaftsgeschichte. II. Von der Reformära bis zur industriellen und politischen „Deutschen Doppelrevolution“ 1815–1845/49*, 2nd ed. Beck, München
- Wehnelt B (1943) *Die Pflanzenpathologie der deutschen Romantik (1880–1850) als Lehre vom kranken Leben und Bilden der Pflanzen*. Bonner Universitäts-Buchdruckerei, Bonn
- Westermann G (1956) *Grosser Atlas zur Weltgeschichte*. Westermann, Braunschweig
- Woodham-Smith C (1962) *The Great Hunger. Ireland 1845–1849*. Hamilton, London
- Wumkes GA (1934) *Stads- en dorpskroniek van Friesland II (1800–1900)*. Eisma, Leeuwarden
- IJnsen F (1976) De zomers in Nederland vanaf 1706 thermisch bekeken. *KNMI Wetenschappelijk Rapport W.R. 76–15*. KNMI, De Bilt
- IJnsen F (1981) *Onderzoek naar het optreden van winterweer in Nederland*. *KNMI Wetenschappelijk Rapport W.R. 74–2*, 2nd ed. KNMI, De Bilt
- Zadoks JC (1961) Yellow rust on wheat, studies in epidemiology and physiologic specialization. *Tijdschrift over Plantenziekten (Netherlands Journal of Plant Pathology)* 67:69–256
- Zadoks JC (in preparation) A yellow rust epidemic on rye, 1846
- Zadoks JC, van den Bosch F (1994) On the spread of plant disease: A theory on foci. *Annu Rev Phytopathol* 32:503–521