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## SMALLPOX VACCINATION IN THE GERMAN EMPIRE. VACCINATION BETWEEN BIOPOLITICS AND MORAL ECONOMY<sup>1</sup>

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**ABSTRACT:** After a smallpox epidemic in Germany in the early 1870s in the wake of the Franco-German War, smallpox vaccination became compulsory by Imperial Law in 1874. The act was hotly debated in parliament and in public and earlier resistance against vaccination developed into a political anti-vaccination movement. For this reason, the German government adopted a number of safety measures. The current article describes, firstly, vaccination practices, regulations and policies in the German states up to the 1870s and the biopolitical developments that led to the Imperial Law on compulsory smallpox vaccination in 1874. Secondly, the article sketches the public debate and critique regarding vaccination asking why compulsory vaccination succeeded in Germany. The article describes the measures implemented by the German government to promote compulsory vaccination and acceptance of the Imperial Law: initially, smallpox vaccines were manufactured by state-run production sites and supervised by local authorities. Empire-wide statistics were collated documenting the success of vaccination as well as related side-effects. From a government perspective, these precautions could be interpreted as a technology of trust.

**KEY WORDS:** Smallpox; vaccination; 19<sup>th</sup> Century-German Empire; medical statistics; public health.

### LA VACUNA CONTRA LA VIRUELA EN EL IMPERIO ALEMÁN. LA VACUNACIÓN ENTRE BIOPOLÍTICA Y ECONOMÍA MORAL.

**RESUMEN:** Después de una epidemia de viruela en Alemania a principios de la década de 1870 a raíz de la guerra francoalemana, la vacuna antivariólica se hizo obligatoria por Ley Imperial en 1874. La ley se debatió acaloradamente en el parlamento y en público, y la resistencia ya existente contra la vacunación se convirtió en un movimiento político antivacunas. Por ello, el gobierno alemán adoptó una serie de medidas de seguridad. El artículo actual describe, en primer lugar, las prácticas, regulaciones y políticas de vacunación en los estados alemanes hasta la década de 1870, y los desarrollos biopolíticos que llevaron a la Ley Imperial sobre la vacunación antivariólica obligatoria en 1874. En segundo lugar, se esbozan el debate público y la crítica sobre la vacunación, preguntando por qué la vacunación obligatoria tuvo éxito en Alemania. Se describen las medidas aplicadas por el gobierno alemán para promover la vacunación obligatoria y la aceptación de la Ley Imperial: inicialmente, las vacunas contra la viruela se fabricaban por centros de producción estatales supervisados por las autoridades locales. Se recopilaban estadísticas de todo el imperio que documentaban el éxito de la vacunación, así como los efectos secundarios relacionados. Desde la perspectiva del gobierno, estas precauciones podrían interpretarse como una tecnología de confianza.

**PALABRAS CLAVE:** Viruela, vacunación, Imperio alemán del siglo XIX, estadística médica, higiene pública.

On 6 June 1909, a young boy from Elberfeld, Willy Otto, died after he had come down with a feverish rash, followed by pneumonia and cerebral inflammation. The boy had been vaccinated against smallpox in mid-May and critics quickly attributed his death, like that of many others, to his vaccination. The German anti-vaccination movement misused the boy's death in their own agitation against compulsory vaccination.<sup>2</sup>

After a smallpox epidemic in the early 1870s following the Franco-German War, smallpox vaccination became compulsory in the German Empire. During the public debate about the law and after the introduction of compulsory vaccination in 1874, the anti-vaccination movement became increasingly influential as a social group, comprising an important part of the so-called *medizinkritische Bewegung* (a social movement including life-reform activists or natural healers who criticised scientific medicine). But neither the death of Willy Otto, nor other casualties and protests about the procedure, had any effect on compulsory vaccination, which remained in force until the 1970s. Why were these critics so unsuccessful?

More than twenty years ago, Eberhard Wolff cited the case of Willy Otto in his study about the anti-vaccination movement in Germany (Wolff, 1998). Wolff focussed mainly on the opponents of vaccination, comparing their claims to those of the vaccinators. By contrast, the following article will take a closer look at the state's abiding role in implementing vaccination programs.

Peter Baldwin has described the reactions of various European states to the threat of contagious diseases between 1830 and 1930 and has analysed differences in the implementation of public healthcare policies. In the case of smallpox epidemics, Baldwin embeds the politics of prevention in a broader socio-cultural and political context, concluding that a clear national style is difficult to identify – and this applies in particular for the German states (Baldwin, 1999, esp. pp. 548-556). Histories of smallpox epidemics and prevention, like inoculation and vaccination, focus mainly on Britain – and for good reason: Lady Mary Wortley Montague first adopted (and popularized) Middle Eastern techniques of inoculation to Britain, and Edward Jenner established and propagated the technique of vaccination in Britain at the end of the 18<sup>th</sup> century; furthermore, the English anti-vaccination movement became a role model for other groups in Europe.<sup>3</sup> Soon, inoculation and vaccination

practices were adopted in German territories and vaccination became and remained compulsory,<sup>4</sup> in spite of much scepticism as well as political and social resistance. But the history of smallpox epidemics and prevention (especially) in Germany has only rarely been described in detail<sup>5</sup> and only incorporated into larger histories of epidemics (or immunisation).<sup>6</sup> A recent study on immunisation in Germany focuses on public discourses (of medicalization) and broader social and cultural aspects of immunisation.<sup>7</sup> However, on a practical level, little is known about the production, regulation, and distribution of smallpox vaccines in Germany. And so the following article provides an overview of the history of the smallpox vaccine, specifically its production and state regulation in 19<sup>th</sup> century Germany. I will discuss and revisit the entangled relationship between the state and public healthcare<sup>8</sup> and describe how German states and the German Empire sought to control the risks posed by contagious diseases like smallpox. Specifically, I will examine the introduction of compulsory vaccination, delineate how governmental authorities reacted to criticism and resistance, and finally answer the question of *why* compulsory vaccination wasn't abandoned and its critics unsuccessful. While taking stock of the existing literature, the article also relies on contemporary sources published by the Imperial Health Office. Although the article first explores the establishment of vaccination in Germany around 1800, it focuses on the last third of the 19<sup>th</sup> century.

After exploring vaccination practices, regulations, and healthcare policy in the German states up until the 1870s, I will summarize the biopolitical rationale behind the Imperial Law on compulsory smallpox vaccination in 1874. Thereafter, I will sketch the public debate about the law and describe the sanctions imposed by the German government in support of the law's implementation and public acceptance. Finally, I will assess the safety measures put in place to reduce public health risks and analyse the moral economy of vaccination in Germany.

## 1. SMALLPOX VACCINATION IN THE GERMAN STATES BEFORE 1870

As elsewhere in Europe, in 18<sup>th</sup> century Germany smallpox was well-known and feared as a major threat to individual and public health, as well as to public order. At least two third of the population had

contracted smallpox, which especially afflicted children (Huerkamp, 1985; Vasold, 1991, p. 181; Winkle, 1997; Wolff, 1998, p. 101). Mortality rates in German territories occasionally rose to between twenty and thirty per cent, and in the last decades of the 18<sup>th</sup> century an estimated 60,000 to 70,000 people died annually of smallpox (Huerkamp, 1985, p. 621; Wolff, 1998, p. 101).

But the disease was feared not just because of its high mortality rates, but especially because of its distressing symptoms, including painful and itching nodules that mutated into pustules that could cover the entire body and sometimes even induce blindness. Because of its severity, efforts had been undertaken since antiquity to prevent smallpox's onset or at least alleviate its symptoms. Dating back to early modern times in the Middle East, where smallpox was endemic, laymen and especially older peasant women applied fresh lymph or dried crusts, taken from convalescing patients who had suffered a milder form of smallpox, under the skin of children who hadn't yet been infected.<sup>9</sup> After this procedure, the children tended to manifest milder symptoms, avoid severe pockmarks and blindness, and were considered to have lifelong protection against the disease.<sup>10</sup>

Lady Mary Wortley Montague observed this practice between 1716 and 1718 in Constantinople, where her husband served as English consul. Convinced that the inoculation practice worked, she had her son inoculated by the embassy's surgeon. A few years after she and her family returned to London, England experienced a severe smallpox epidemic and she now also had her daughter successfully inoculated. Lady Montague promoted the inoculation procedure and in subsequent decades, despite much scepticism, variolation gained wider acceptance (mainly among well-to-do families) (Smith, 1987; Hopkins, 2002, pp. 47-50; Winkle, 1997, pp. 868-70). In German territories, inoculation was first practiced in the 1720s, but it only became more popular in the second half of the 18<sup>th</sup> century and it was a preventive measure available only to social elites.<sup>11</sup>

Various factors and risks delayed the establishment and wide use of variolation. Initially, inoculation conducted by a physician and often accompanied by a dietary regime was very expensive and unaffordable for most people. Furthermore, the course of disease after variolation was unpredictable and inoculated children sometimes developed severe symptoms or side effects and a small percentage even died. And

although the risk was reduced, there was no guarantee that inoculation would provide absolute protection against smallpox. In addition, rumours and accusations abounded that variolation itself was responsible for the outbreak of smallpox epidemics (Wolff, 1998, pp. 102-8; Kübler, 1901, pp. 122-41).

As an alternative to prevent the outbreak of smallpox, it was observed in some areas of Britain and Holstein that people – mainly dairy workers – who had once been infected with cowpox were immune to smallpox. That lymph from cowpox blisters could be used to prevent smallpox was already known by the last third of the 18<sup>th</sup> century. But the medical and lay practice was limited to small local areas.<sup>12</sup> It was only after Edward Jenner published accounts of his experiments on the inoculation of cowpox that vaccination became public knowledge. Jenner had applied material from the cowpox blisters of a dairymaid to the healthy boy, James Phipps. A few days later the boy showed local reactions at the injection site and typical symptoms of cowpox, but no general signs of illness. And after the blister disappeared, he was infected with smallpox matter but showed no symptoms of smallpox (Jenner 1798). Jenner's experiments not only demonstrated that cowpox protected from smallpox, but also that cowpox could be transmitted from human to human. With the publication of his observations and his description of the procedure, he transformed lay practice into medical knowledge. Despite criticism from the medical community, vaccination was soon accepted and practised in Britain and elsewhere (cf. Crookshank, 1889; Kübler, 1901, chap. VII; Parish, 1965, pp. 25-7; Winkle, 1997, pp. 880-5; Williams, 2011).

Soon after Jenner's publication, several physicians in German states, among them Samuel Thomas von Soemmering in Frankfurt, August Christian Reuß in Stuttgart, and Christoph Wilhelm Hufeland in Berlin, promoted vaccination within the German medical community and vaccinated patients themselves.<sup>13</sup> One of the problems facing these advocates of vaccination was that cowpox was not a common cattle disease and relatively rare. As a result, dried or conserved cowpox lymph had to be sent to colleagues and often lost its potency. Not least for this reason, physicians also preferred to vaccinate from arm-to-arm. Such limitation made it necessary to organize the entire vaccination process. In London, for instance, St. George Hospital soon became a centre of vaccination. Elsewhere, children in orphanages were

used: eight days after vaccination, once one child's blisters had fully developed, another child could be vaccinated. Physicians working as vaccinators also organized weekly public meetings in schools, hospitals, or parish halls, where previously vaccinated people returned for a check up and served as a new source for those who had not yet been (and wanted to be) vaccinated.<sup>14</sup> The difficulties involved in such procedures help to explain two developments: First, the creation of private-public institutions and societies, like the Royal Jennerian Society or the London Vaccine Institute, in order to organize vaccinations. And second, the relatively slow progress made in implementing vaccination procedures. For Württemberg, Eberhard Wolff has illustrated that, although the first vaccinations had been performed in January 1801, it took nearly twenty years before a majority of children had been vaccinated and procedures were established to ensure comprehensive and on-going vaccinations.<sup>15</sup>

State officials in Germany discussed the potential risks and benefits of vaccination. In Prussia's capital Berlin, a so-called Royal Vaccine Institute (*Königliches Schutzpocken-Impfungs-Institut*) had been established in 1802. The institute, first conceived as part of the Royal Charité Hospital, was affiliated with an orphanage, the *Friedrichs-Waisenhaus*. Under the auspices of the *Collegio Medicio et Sanitatis*, the institute vaccinated children free of charge, kept records and compiled statistics about the number of vaccinated children, and promoted vaccination (Kübler, 1901, pp. 178-9; Münch, 1995, pp. 230-4). Other institutes were also established, for instance in 1804 in the Electorate of Hesse (Landgrafschaft/Kurfürstentum Hessen-Kassel) in Kassel.<sup>16</sup> And plans to found a similar institution, affiliated to a hospital or an orphanage, had also been discussed in Württemberg in 1803 and 1814, but Wolff is unsure whether these plans ever came to fruition (Wolff, 1998, pp. 135-7).

Initially, German officials promoted vaccination by publishing brochures about its salubrious effects or by providing vaccination services for free. But soon vaccination became, direct or indirect, compulsory. Orphans and other children cared for in public institutions, as well as army recruits, were vaccinated if they had not yet been infected with smallpox or had already been vaccinated. In Bavaria, Baden, and Westphalia, prospective students and apprentices had to be vaccinated.<sup>17</sup> In several German states, vaccina-

tion became compulsory: in the Grand Duchy of Hesse (Großherzogtum Hessen-Darmstadt)<sup>18</sup> and Bavaria in 1807, in Baden and the Electorate of Hesse (Landgrafschaft/Kurfürstentum Hessen-Kassel) in 1815, in the Duchy of Nassau and Kingdom Württemberg in 1818, and in Hannover in 1821 (Kübler, 1901, p. 179). State employed physicians usually acted as vaccinators and mainly vaccinated cowpox from child to child. These medical officers also issued the vaccination certificates required by students and apprentices, kept records about the vaccination, compiled statistics, and sometimes monitored whether all infants of their districts were vaccinated.

Jenner was convinced that vaccination provided lifelong immunity from smallpox. But in the 1820s, relapses occurred and people who had been vaccinated as children came down with smallpox. This at once called into question the efficacy of cow lymph (and especially of "humanised" cow lymph) and vaccines,<sup>19</sup> but also revealed that relapses involved much milder forms of the disease. Hence, experts confirmed that vaccination protected against smallpox, but only for one or two decades, thus necessitating re-vaccination. In German territories, vaccination remained commonplace and re-vaccination was recommended; and in the largest German states, re-vaccination of military personnel became compulsory: 1829 in Württemberg, 1834 in Prussia, 1837 in Hannover, 1840 in Baden, followed by smaller Saxon states and, belatedly in 1868, in the Kingdom of Saxony.<sup>20</sup> With the exception of the army, however, only three (small) German states made re-vaccination compulsory (Hessen-Nassau, Saxony-Anhalt, Saxony-Meiningen) (*Blattern und Schutzpockenimpfung*, 1896, p. 57).

## 2. THE SMALLPOX EPIDEMIC AND THE FRANCO-PRUSSIAN WAR OF 1870/1871

By the second half of the 19<sup>th</sup> century, government officials had long recognized the importance of diseases in wartime. The Prime Minister of Prussia and later German chancellor, Otto von Bismarck, as well as leading Prussian military commanders complained after the Austro-Prussian War of 1866 that they had lost more troops to cholera than to combat operations.<sup>21</sup> In this context, the compulsory re-vaccination of Prussian soldiers against smallpox was first and foremost a measure of military strategy and planning. This became obvious during the Franco-Prussian War

in 1870/1871. In the late 1860s and early 1870s, a relatively severe smallpox epidemic afflicted most central European countries. Especially in countries without strict vaccination laws or regulations, the number of people suffering from smallpox rose. In Paris, the number of people who died from smallpox was only 119 in December of 1869, but rose to 983 by the following summer.<sup>22</sup> Smallpox appeared in various French cities, spreading throughout France and into Italy, Switzerland, and other neighbouring countries (Kübler, 1901, pp. 282-3, 287-90; Matzel, 1977, pp. 19-23, 46-51). During the Franco-Prussian War, from the summer of 1870 to the spring 1871, the movement of troops and people had a huge impact on the spread of the epidemic (Matzel, 1977).

Unlike German troops, French soldiers were not consistently re-vaccinated and as a result thousands of French soldiers came down with smallpox. Whereas few German troops fell ill and only 278<sup>23</sup> died, the French army lost over 23,400 soldiers. French civilians also suffered: over 200,000 people probably died of smallpox in France between 1869 and 1871 (Winkle, 1997, p. 894). The outbreak of smallpox in the French army was regarded as one reason for the success of the German forces.

But the smallpox epidemic was not limited to France. Fleeing civilians, French migrants and soldiers carried the disease to Switzerland and Belgium. In addition, the epidemic spread to Italy, England, and Sweden where it lasted until 1875. Behind the front lines, French prisoners infected the German civilian population that was often not re-vaccinated regularly or vaccinated at all (*Blattern und Schutzpockenimpfung*, 1896, pp. 63-6). The outbreak of smallpox in the aftermath of the war was the last smallpox epidemic in Germany, causing more than 181,000 fatalities; by contrast, only 41,210 people died in the war itself.<sup>24</sup>

In addition to reducing the population, epidemics also posed other biopolitical threats that concerned the Imperial Health Office. The smaller pool of potential soldiers presented a major threat to national security. And epidemics doubtless also threatened public order. In addition, epidemics had economic consequences and hence needed to be prevented by any means necessary, as the Imperial Health Office's publication "*Blattern und Schutzpockenimpfung*" emphasised: "Caring for the sick and controlling the disease demanded much money; during the epidemic, the labour force shrank and disease-related invalids

had to be supported for the rest of their lives; and in total, the exchange of goods dropped and the national economy suffered as a consequence of the epidemic" (*Blattern und Schutzpockenimpfung*, 1896, p. 75-6, translation by ACH).

### 3. THE IMPLEMENTATION OF THE IMPERIAL VACCINATION LAW

In light of the catastrophic experiences of the last epidemic, government officials and parliamentarians debated compulsory (re-)vaccination against smallpox after the war. Although some German states had laws compelling the vaccination of children and while many governments promoted re-vaccination, regulations were not strictly followed and violations went unpunished. Only when faced with epidemics did state officials become more assertive. Accordingly, the initial bill compelling vaccination and re-vaccination of all residents allowed authorities to enforce rigid measures after the outbreak of a smallpox epidemic. The implementation of these measures was supposed to have been enforced by fines or prison sentences for those who objected to preventive measures.

Debate in the new German parliament and the press was heated. The National Liberal Party campaigned for the individual rights of every person and complained that vaccination abridged people's rights and well-being. Politicians of the Progressive Party discredited opponents of the compulsory vaccination law as reactionary, backward-looking, and anti-modernist. Furthermore, conservatives and the military doubted whether illiterate rural and lower classes could assess the benefits and risks of vaccination and emphasized that the state had the paternalistic duty to shield itself and the people from harm. The objections and arguments raised against coercive sanctions during the parliamentary debates led to various modifications that mitigated the bill. After long debate and many revisions, the bill passed into law and went into effect in 1874.<sup>25</sup>

The compromise found in the formulation of the Imperial Vaccination Law was typical of the consensual tradition that characterized post-unification relations between German states and political factions. At first glance, sanctions were reduced and mainly directed against vaccinators. At the same time, however, stricter laws in the federal states, for example

**Fig 1.** Cover of a legal commentary (by Jacobi, 1875) to the Imperial Vaccination Law



in Prussia, remained in effect.<sup>26</sup> What was in the law? First, it required every infant to be vaccinated within a year of birth. Children were then re-vaccinated at around twelve years of age.<sup>27</sup> As required by state law, every man entering military service was automatically re-vaccinated. Second, the law stipulated that only trained physicians could vaccinate. Exceptions or deferments were only allowed for children in verifiably poor health. Eight days after the vaccination, every child had to be presented to a physician to check whether the vaccination had succeeded. Furthermore, the physician had to certify the vaccination and record it on official lists (*Impflisten*) to ensure that all the children in a district had been vaccinated. Both parents and vaccinators could be sanctioned. Non-authorized vaccinators could be fined up to 150 Mark or imprisoned for 14 days; vaccinators who failed to maintain adequate records or lists were fined up to 100 Marks; if the vaccination was conducted carelessly or in a grossly negligent manner that harmed the children, vaccinators could

be imprisoned for three months or fined up to 500 Marks,<sup>28</sup> while anyone issuing false vaccination certificates could be prosecuted for forgery. On the other hand, parents unable to present a vaccination certificate (if requested) for their children were subject to fines of twenty Marks; and those who prevented their children from being vaccinated could, after an official reminder, be fined fifty Marks and imprisoned for three days.<sup>29</sup> The law remained in force until the 1970s.<sup>30</sup>

While most German states could avail themselves of compulsory education to help carry out the law, the registration of births, marriages and deaths was still in the hands of the church. But this too changed during the so-called *Kulturkampf* between the German government and the Catholic Church in the mid 1870s. But as of 1876, following the enactment of the Civil Status Act of 1875, the state assumed responsibility for registering births, marriages and deaths. And since then, vaccination lists could be compiled using the public register of births maintained in every municipality (for a general overview Nipperdey, 1998).

Aiming to immunize the entire population against smallpox, the measures enacted were designed to prevent an epidemic. The Imperial Law and compulsory vaccination manifested a significant shift in emphasis from individual to public welfare. Whereas before 1874 citizens themselves assessed the advantages and risks of vaccination, the new law saw public welfare trump personal choice. Adolf Kußmaul, a physician in the state of Baden, described this shift from individual choice to mandated coercion by way of an analogy: Wooden houses with incendiary thatch roofs were no longer allowed in cities not only because they endangered the owner's home, but also primarily because they endangered the neighbouring houses and the city as such (quotation in Winkle, 1997, p. 895). When vaccination was again called into question in the 1920s, the president of the Imperial Health Office continued to insist on compulsory vaccination. Effective protection of the *Volkskörper* (public body) against a [small pox] epidemic could only be guaranteed by area-wide vaccination. „In preventing diseases, the common good takes precedence over individual rights“<sup>31</sup>

#### 4. DISCUSSIONS AND CRITIQUE OF COMPULSORY VACCINATION

Passage and implementation of the law in 1874 was accompanied by harsh criticism from various social and political groups who vilified the law as a “compulsory vaccination law” (*Impfzwanggesetz*).<sup>32</sup> Anticipating these critics, both the legislators who drafted the law and the government officials who enforced it tended to avoid direct compulsory measures, for instance against parents who failed to comply with follow-up examinations after the vaccination of their children or against individuals who, after the outbreak of an epidemic, had not yet been vaccinated. Instead of relying on the police to enforce these measures, officials preferred instead to fine people who resisted vaccination. Physicians became the primary agents of the measures. On the one hand, legally restricting the practice of vaccination to physicians helped drive medical professionalization (see Huerkamp, 1985; currently Thießen, 2017, 25-30). But as vaccinators, physicians also had to keep accurate records and lists and were held responsible for deleterious outcomes. The Law was designed to prevent physicians from issuing false certifications (to those objecting to vaccination) and to co-opt them into the state’s coercive vaccination policies, holding them responsible for ensuring that people on the vaccination lists showed up and were vaccinated.

Up until 1874, re-vaccination was voluntary in most federal states and the German Empire, even though state officials encouraged vaccination and introduced incentives and rewards to promote it. Even where vaccination was compulsory, it was not rigorously enforced (unless there was an epidemic) and people could still avoid having their children vaccinated. But after vaccination became obligatory in 1874, organized resistance grew. Whereas earlier resistance against inoculation and vaccination had been limited to small, local groups,<sup>33</sup> by the second half of the 19<sup>th</sup> century and especially after passage of the Vaccination Law these groups collaborated to form a larger and well organized anti-vaccination movement that promoted public lectures and published pamphlets.<sup>34</sup> Members of the anti-vaccination movement hailed from both the working and educated classes – and many of the educated members were prominent in the so-called life-reform movement.

Opponents of vaccination reiterated long-standing arguments, some of which dated back to the 18<sup>th</sup>

century. They justified their opposition by stressing that vaccination undoubtedly had undesirable side effects, such as rashes, exanthema, erythema, inflammation, or general symptoms of infection like fever, to say nothing of reported cases of death. In addition, child-to-child vaccination risked cross-infection: vaccinated children might also be infected with other pathogens like tuberculosis or syphilis.<sup>35</sup> And more generally, young children also came down with measles, diphtheria, and other diseases after the vaccination procedure.<sup>36</sup> Sometimes opponents even argued that vaccination did not work at all and that children were harmed by the vaccine which in fact made them sick. These accusations were sometimes combined with conspiracy theories, for instance that vaccination was a plot to eradicate the working class. Opponents also repeatedly cited cases of severe side effects or sudden death, to the point where such cases began to take on a life of their own.<sup>37</sup>

Eberhard Wolff has examined several of the medical concerns raised by opponents, including the vaccine’s side effects, especially in young children, its quality and efficacy, and generally its presumed necessity. Wolff also discusses non-medical arguments, including opposition to state interference, the cost of vaccination, a reputed desire on the part of (lower class) parents to see their children die, or religious claims that vaccination was against God’s will.<sup>38</sup>

Supporters of vaccination, including state authorities and members of the Progressive Party, described and defamed opponents as careless and selfish (because they valued their own individual principles and interests above those of the common good), as illiterate and ignorant (for not knowing the background and necessity of vaccination), and as stubborn enemies of progress (for heeding religious objections).<sup>39</sup>

The whole story of vaccination has often been told as a story of medicalization, biopolitics, and biopower.<sup>40</sup> Historians have recounted stories of the sick being disregarded as humans and treated as mere patients, of unvaccinated children threatening public health, as citizens being overpowered by physicians in coalition with state authorities (or by the state in coalition with physicians). That said, smallpox vaccination has also been written as a story of medical success. Without doubt, people were medicalized, and both the expanding bureaucratic nation-state as well as institutionalized medicine took advantage of this process. But, from the

state's perspective, the question arises as to how officials managed to generate trust in the very same vaccination measures that also provoked strident resistance?

How did the German government react to this movement? How did medical officials react to reports about severe side effects and children who had died after vaccination? It was not enough simply to launch a public relations campaign.

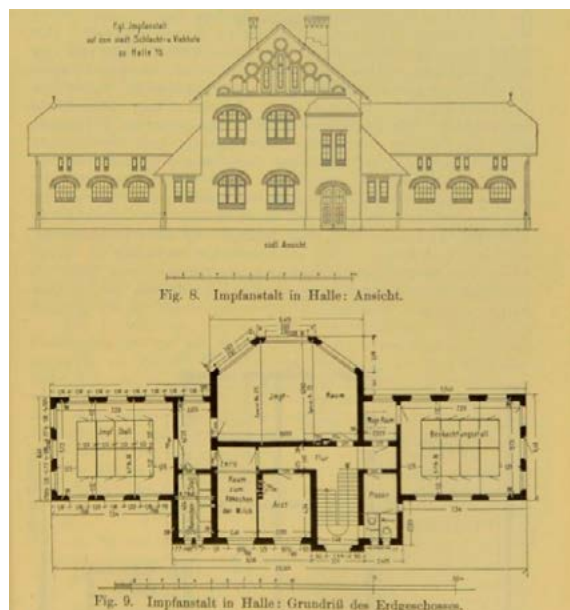
## 5. THE IMPERIAL HEALTH OFFICE AND THE CONTROL OF VACCINE PRODUCTION

Discussions about compulsory vaccination took place against the backdrop of a German Empire that had been re-united in 1871 during the Franco-German war. The empire was, as Thomas Nipperdey emphasises, above all a federal state. In other words, most of the political power resided in the hands of the German states, for instance in domestic, cultural, and public health affairs. Initially, the Empire had relatively little (legislative and executive) authority, but over time it expanded its influence over the federal states (Nipperdey, 1998). The Empire and its institutions focussed mainly on foreign affairs, defence, commerce, and standardization. Health care policy and the control of epidemics were left largely to the empire because epidemics often concerned more than one single state (Hüntelmann, 2008).

Prior to unification, German physicians had discussed the need for a federal public health agency to coordinate the activities of individual states. After the war, advocates petitioned Parliament, which resolved to found a public health institution what would later become the Imperial Health Office. In establishing that office, planners decided that it should also compile official statistics about compulsory vaccination and – after its establishment – to supervise the production of smallpox in the German Empire.<sup>41</sup>

Smallpox vaccines had generally been produced at various sites, such as semi-private companies or universities. But by the 1890s, smallpox vaccine was being produced in regional, state-run corporations regulated by law. The directors of these small farm-like facilities were medical officers, responsible to the District President and ultimately to the federal states' government.<sup>42</sup>

**Fig 2.** Plan of the Royal Vaccination Institute (provincial vaccine production site) in Halle (Source: *Medizinische Anstalten*, 1907)



Critics of vaccination charged that instead of being protected from one disease, children could become infected with another. Human vaccine and arm-to-arm infection risked not only cross-infections but also unreliable quality and unpredictable side effects. Dating back to the 1820s, and especially after the epidemic in the 1870s, the mitigation of the humanised cowpox vaccine had been observed in a less developed pockmark (Kübler, 1901) – and was often indicated in many epidemic victims. But vaccinated individuals reacted more strongly to original cowpox vaccine, still rarely available, and showed slight signs of infection and scarring. Furthermore, it was difficult to obtain cowpox lymph because the epizootic occurred only sporadically. Although a procedure to transmit cowpox in cattle had been developed in the 1840s in Italy, it took time before the animal lymph was produced systematically and in larger quantities. Since the mid-1860s, commercial institutes in France, Belgium, the Netherlands, Prussia (Berlin), and Hamburg had produced and distributed animal lymph. Similar institutes had been founded in Stuttgart, Munich, and Leipzig at the end of the 1870s. They produced a vaccine using calf-lymph. Diluted in water and conserved with glycerine, this vaccine was easy transferable and regarded just as effective as human lymph.<sup>43</sup> At this point, the Imperial Health Office entered the scene.



State medical officials, under the guidance of Robert Koch, investigated effective and safe modes of production, established and implemented procedures to test vaccine quality and efficacy, and evaluated the potential risks and side effects of the new vaccine. In 1884, an Imperial Health Office commission recommended the introduction of vaccine based on animal lymph throughout the Empire; and one year later the Federal Council resolved that eventually only animal lymph should be used for smallpox vaccination. In addition, the Council decided to create state-run institutes to supply enough animal lymph to meet the country's demand for smallpox vaccine.<sup>44</sup>

A number of biopolitical measures were implemented to limit the prospective public health risks of small pox vaccination. These measures were implemented (and justified!) to protect the population from harmful vaccine (or harmful vaccination procedures), to ensure the supply of sufficient and effective vaccine, and thus to prevent the outbreak of smallpox epidemics. But these safety measures were also implemented to stabilize smallpox vaccination as a prophylactic and biopolitical measure. Each new report of side effects or a child's death – terrible as they were – damaged the reputation of vaccination as a preventive public health measure. From the government's perspective, the anti-vaccination movement's exploitation of these reports threatened public vaccination policies. Testing the quality and efficacy of animal lymph and producing standardized vaccine in state-run institutions were thus key public health policies.

No less important was the actual administration of the vaccine. Since 1874, only trained physicians were allowed to perform vaccinations – preferably medical officers and district physicians. One of them, M. Schulz, District Physician and head of the Royal Vaccine Institute in Berlin, published a manual about the “vaccination policy” (*Impfgeschäft*).<sup>45</sup> Physicians were assigned districts in which they were allowed to perform vaccinations.<sup>46</sup> At the beginning of each year, police and the civil registry office compiled so-called vaccination-lists of all new-born children, of children who had been deferred for medical reasons, and of families who had recently moved to the district. Furthermore, officials compiled re-vaccination lists of twelve-year-old children. Official dates for vaccinations and follow-up examinations were set and the lists were then handed over to the physicians.<sup>47</sup> In

villages and districts that had been plagued with diphtheria, scarlet, measles, spotted fever, or other infectious diseases, vaccination was suspended. Furthermore, children of families (or homes) that had been affected by these or other diseases, or that suffered from smallpox, were also excluded from vaccination for the year (Schulz, 1891, pp. 50-2; Kirchner, 1911, pp. 48-52).

From the 1890s, physicians were supplied with animal lymph from state-run institutes.<sup>48</sup> After a physical examination, the children were vaccinated using at least four incisions. Martin Kirchner emphasized that physicians needed to take the same precautions they did for surgical operations, including the disinfection of hands, surfaces, and instruments (Jochmann, 1913, pp. 182-4; Kirchner, 1911, pp. 47-8). After vaccination, there was a follow-up examination some six to eight days later. If at least one of the four incisions developed a full blister, the vaccination was deemed a success (Jochmann, 1913, pp. 182-4, 187; Kirchner, 1911, pp. 47-8, 52; Schulz, 1891, pp. 57-8).

Fig 3. Form for vaccination certificate (Source: Medizinische Anstalten, 1907)

Formular I.

**Impfschein.**

Impfbesitz \_\_\_\_\_ Impfliste N. \_\_\_\_\_  
 geboren den \_\_\_\_\_ 18 \_\_\_\_\_, wurde  
 am \_\_\_\_\_ 18 \_\_\_\_\_ zum Male \_\_\_\_\_ Erfolg geimpft.  
 Durch die Impfung ist der gesetzlichen Pflicht genügt\*.)  
 N. N. am \_\_\_\_\_ 18 \_\_\_\_\_  
 N. N.  
 Arzt (Impfarzt).

The whole procedure was accompanied by paper work. As mentioned, the vaccinator issued a vaccination certificate to the parents (see Fig. 3). He also wrote a report about the vaccination locale, whether families with infectious diseases were reported, whether and how many children failed to appear, whether the original lists compiled by the civil registry office had been in proper order, or whether any unforeseen difficulties had arisen. In addition, he completed a vaccination list with the names of the vaccinated children, the type and source of lymph used (enabling traceability), and whether any complications or side effects arose. The lists were then revised and compiled by district physicians and submitted to the Imperial Health Office.<sup>49</sup>

Based on these submissions, Imperial Health Office officials wrote annual reports and compiled “vaccina-

**Fig 4.** Results of Vaccination Statistics for babies up to one year old (those vaccinated for the first time – *Erstimpfungen*), summarized in *Blattern und Schutzpockenimpfung*, 1896, p. 89. The first column shows the German federal states and Prussian provinces; the second column shows the number of total registered vaccine recipients; column 3 shows the number of vaccine recipients that had to be vaccinated for the first time; column 4 shows the number of those who were vaccinated (and column 5 the percentage in relation to column 3); column 6 showed the number of those that were considered to be vaccinated successfully (and column 7 the percentage in relation to those vaccinated); and the last two columns showed the number of those that were vaccinated with animal lymph. Another statistics (p. 90) summarized the results for school children (those re-vaccinated)

1.	2.	3.	4.	5.	6.	7.	8.	9.
Staat	Vermittelte waren 1893	Davon waren erstimpf-pflichtig	Davon wurden geimpft	in %	Davon wurden erfolgreich geimpft	in %	Mit Thier-impfen geimpft	in %
<b>Erstimpfungen im Jahre 1893</b>								
Preußen:								
Ostpreußen	83.947	82.489	56.245.969,91	68.199,96,31	56.236	99,98		
Westpreußen	31.105	50.278	44.138.97,78	87.780,96,36	44.132	99,998		
Berlin	43.303	42.768	34.293.89,18	80.420,91,62	29.877	69,88		
Brandenburg	82.680	78.195	67.029.85,72	85.820,93,09	67.003	99,96		
Pommern	46.617	44.486	40.965.92,06	91.905,92,25	40.735	99,42		
Polen	59.480	58.875	54.486.92,55	92.598,99,29	54.496	100,00		
Schlesien	140.607	129.292	118.166.91,39	91.387,72,02,02	118.071	99,82		
Schlesw.-Holst.	39.884	37.724	32.714.86,72	86.514,98,32	31.871	97,423		
Hannover	69.293	62.763	57.035.90,87	90.644,98,91	56.822	99,63		
Sachsen	96.584	91.945	81.362.88,49	84.121,93,79	80.458	95,89		
Sachsen-Altau	52.653	49.849	42.160.84,58	80.478,96,01	41.218	97,77		
Sachsen	169.890	165.191	140.403.84,39	84.531,96,10	139.862	99,61		
Sachsen	1.770	1.669	1.543.89,45	87.191,96,53	1.526	98,93		
Zusammen	1.007.584	960.565	842.480.87,71	84.911.95,54	825.078	97,30		
Bayern	161.955	147.943	137.420.92,89	92.902,98,82	150.589	99,32		
Sachsen	125.116	120.507	94.052.78,05	75.819,97,80	94.052	100,00		
Württemberg	61.184	58.302	48.976.80,00	81.488,98,40	48.950	99,85		
Baden	48.850	42.580	38.491.90,40	90.615,95,13	38.491	100,00		
Sachsen	29.038	26.409	23.432.80,76	87.270,98,32	23.378	99,77		
Sachsen-Schlesien	18.477	18.192	14.881.81,90	81.327,96,26	14.873	99,85		
Sachsen-Meiningen	10.441	10.193	8.801.86,34	84.499,96,00	8.814	94,47		
Sachsen-Straßburg	2.844	2.811	2.637.93,81	93.505,98,41	2.637	100,00		
Oldenburg	10.971	10.004	8.813.80,09	80.406,98,11	8.813	100,00		
Braunschweig	12.834	12.659	11.548.91,22	91.323,98,05	11.548	100,00		
Sachsen-Meinungen	7.189	6.923	6.011.86,43	83.934,98,72	6.011	100,00		
Sachsen-Altenburg	8.076	7.841	4.789.59,54	60.171,98,99	4.783	100,00		
Sachs.-Kob.-Gotha	7.150	6.895	5.252.76,45	73.010,95,29	5.199	98,82		
Anhalt	6.294	5.528	5.184.83,78	82.478,97,96	5.184	100,00		
Schwarzburg-Son-derhausen	2.228	2.292	2.113.92,19	92.056,97,39	2.113	100,00		
Schwarzburg-Rudolst.	3.240	2.865	2.322.81,05	71.891,99,19	2.322	100,00		
Sachsen	1.638	1.595	1.421.94,42	89.741,99,51	1.421	100,00		
Reuß a. L.	2.550	1.982	1.604.80,75	63.224,98,42	1.604	100,00		
Reuß g. L.	4.908	4.836	3.515.72,58	71.598,98,15	3.514	99,97		
Sachsenburg-Erpe	1.137	1.042	995.95,49	87.499,99,90	995	100,00		
Erpe	4.209	3.972	3.773.94,99	89.659,99,52	3.773	100,00		
Meißen	2.585	2.496	2.133.89,50	82.997,99,82	2.133	100,00		
Sachsen	5.010	4.488	3.987.89,23	79.248,98,42	3.989	99,55		
Hamburg	31.496	31.406	16.408.79,65	52.009,99,39	15.984	99,83		
Hessen-Vertrungen	40.907	38.813	35.741.89,09	92.097,98,20	35.727	99,86		
Deutsches Reich	1.601.654	1.518.793	1.326.754.87,80	89.083,96,35	1.321.124	98,54		

tion" statistics (*Impfstatistik*) that accounted for the number of people vaccinated, side-effects, and deaths and that were published in the scientific journal of the Imperial Health Office as "Results of vaccination policy" (*Ergebnisse des Impfgeschäfts*). Besides the "Vaccination Statistics" another "Statistics on small pox fatalities" existed that was published since 1905 simply as "Smallpox Statistics".<sup>50</sup> The production facilities were also audited by Imperial Health Office officials, who reported on the annual activity of the vaccine plant, the production process, and vaccination campaigns.<sup>51</sup>

**Fig 5.** Cover page of the report „Results of vaccination policy“ for 1884 (Source *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 2 (1887), pp. 298 summarizing the number of vaccinated and re-vaccinated persons

**Ergebnisse des Impfgeschäftes im Deutschen Reiche**  
im Jahre 1884.

Zusammengefaßt aus den Mittheilungen der einzelnen Bundesregierungen.

Hierzu Tafel 6.

Im Deutschen Reiche waren im Geschäftsjahre zur Impfung vorgehalten:

Erstimpfungen	1.469.799
Wiederimpfungen	1.119.961
<b>zusammen</b>	<b>2.589.760.</b>

Davon waren von der Impfpflicht befreit:

Erstimpfungen	117.866
Wiederimpfungen	11.924
<b>zusammen</b>	<b>129.790.</b>

Impfpflichtig blieben demnach:

Erstimpfungen	1.351.933*)
Wiederimpfungen	1.107.937
<b>zusammen</b>	<b>2.459.870.</b>

gegen 2.336.436 im Vorjahre.

Geimpft wurden:

Erstimpfungen	1.210.279
Wiederimpfungen	1.065.904
<b>zusammen</b>	<b>2.276.183.</b>

Es blieben demnach ungeimpft 183.996 Kinder, von denen 46.506 (gegen 45.129 im Vorjahre) vorschichtwidrig der Impfung entzogen worden sind, und zwar 31.926 Erstimpfungen und 14.633 Wiederimpfungen.

Mit Menschenlymphen wurden geimpft:

Erstimpfungen	964.942
Wiederimpfungen	872.802
<b>zusammen</b>	<b>1.837.744.</b>

mit Thierlymphen:

Erstimpfungen	345.017
Wiederimpfungen	138.956
<b>zusammen</b>	<b>483.973.</b>

gegen 241.930 im Vorjahre.

\*) Hierunter sind 508 in Hamburg bereits im Vorjahre mit Erfolg geimpfte Kinder.

**6. THE MORAL ECONOMY OF VACCINATION IN THE GERMAN EMPIRE**

Twenty years after the law on compulsory vaccination was implemented, the Imperial Health Office published a memorandum on smallpox and preventive vaccination, evaluating its benefits and discussing its risks and public criticisms. Unsurprisingly, the office concluded that compulsory vaccination had been very successful: new epidemics had not been registered ergo had been prevented, and smallpox cases were few and far between (and could often be traced back to foreigners or opponents of vaccination). Even though side effects were registered, except for a few unclear cases of death, none of them could be attributed to vaccination. These tragic accidents were chalked up as sacrifices for the common good, just as citizens had come to accept the small risk (1 in 2.000 cases) of dying under chloroform anaesthesia (*Blattern und Schutzpockenimpfung*, 1896).

Following the controversial public and parliamentary debates in the lead-up to the law on compulsory vaccination, strong public scepticism about vaccination remained after the bill was passed. But neither in the 1890s nor after the turn of the century, when

compulsory vaccination in Britain had been scrapped, or during the 1920s, when heated debates about compulsory vaccination arose again, critics were successful and compulsory vaccination remained valid. So, why were critics not able to convince public and parliament or, why were German authorities successful with its vaccination politics of prevention?

After the last smallpox epidemic in Germany, the contrast between those re-vaccinated (mostly soldiers) staying well and healthy and those, who had not been (re-)vaccinated and fell ill, was striking, and the absence of smallpox epidemics later on and the decreasing number of infections in the following years might have convinced some critics. Further on, critics of interventionist public health measures usually originated (in countries other than Germany) from the political left. But in the German Empire, Social Democrats and members of the Progressive Party endorsed in large parts bacteriological hygiene measures and only smaller political groups criticized compulsory vaccination. And although vocal, the anti-vaccination movement represented only a marginal subcultural movement, according to Baldwin (1999, p. 548-9).

For sure, the sources asserting a decreasing number of infections and emphasizing the success of vaccination, were official reports or written by authors working in governmental institutions and they represent the views of state officials advocating vaccination. They argued that epidemics claimed the lives of many peoples, undermined military strength, and threatened public order and the national economy. Epidemics not only cost many lives but also substantial amounts of money due to lost production or the collapse of regional markets. These costs were balanced against those of the administration of smallpox vaccinations and other healthcare policies: salaries of district physicians and medical officers, the costs of compiling and evaluating lists and data, and of establishing and maintaining the institutes producing animal lymph (see also Baldwin, 1999, p. 534, 550). From the perspective of the German government, these costs paid for themselves. The number of smallpox infections decreased rapidly and only rarely figured in the statistics. Whereas in 1889 about 200 people were still dying of smallpox, after 1894 fatalities in the Empire never rose above 100 (in 1910: 33 out of a population of 65 Mio) (Kirchner, 1911, pp. 60-2).

But next to an economic rationale existed a moral economy concerned with the most convincing argu-

ments.<sup>52</sup> Officials hoped that research on vaccination techniques, the supervision of production sites, as well as the annual publication of statistics would counter scepticism about vaccination. Transparent government policies, they hoped, would engender public trust.<sup>53</sup> In addition, statistics could help demonstrate the positive effects of the vaccination campaign as rates of infections and fatalities fell after the introduction of compulsory vaccination.<sup>54</sup> Statistics also helped the government evaluate and legitimate its own policies by weighing the costs of vaccination against its benefits. And finally, the government could point to putatively objective statistical figures in debunking rumours and countering the baseless assertions of the anti-vaccination movement.

Theodore M. Porter has argued that the use of statistics, as a social technique of producing objectivity, arose in the 19th century (Porter, 1986; Porter, 1995). Although the pros and cons of medical statistics were still being hotly debated in the 1870s (Hüntelmann, 2019), the collection, compilation, and transformation of data according to exact mathematical rules, as well as the use of those data in public discourse, created its own (convincing) moral economy of arguments (Daston, 1995). In this respect, the collection of data, the analysis of mortality rates, and their public discussion worked as a technology of trust (Porter). Alongside coercive measures, the German state tried to convince the population by using „objective“ arguments (as a concession to growing demands for democratic governance). As a consequence, debates about compulsory vaccination became debates about quantitative facts and figures; whoever could best marshal not just convincing arguments, but also numeric figures stood to gain politically.<sup>55</sup> The statistical production of knowledge on which these arguments rested was a complex and elaborate process, but in the end the efforts seem to have paid off: within a scientifically grounded moral economy, medical officials simply had the more convincing arguments.

Vaccination was a preventive measure used to control smallpox. The control of epidemics (the protection of citizens, the maintenance of public order and the national economy) was regarded as a pre-eminent task of the modern state and compulsory vaccination as a serious infringement of individual rights was, like other public health measures, driven by biopolitical motives. Regardless of the immediate human cost, epidemics threatened military and economic power, public life, as well as law and order. In other words,

controlling epidemics helped stabilising the political system. Peter Baldwin has emphasized that the politics of (smallpox) prevention in Prussia (as in other countries) often were not just interventionist – compulsory vaccination was accompanied by various safety measures such as research on vaccines, the supervision of production sites and the deployment of medical statistics on smallpox. The politics of smallpox prevention encompassed preventive measures in two respects: not only did they aim to prevent the

outbreak of an epidemic but to generate trust in vaccination and prophylactic measures designed to limit the risks of compulsory measures – measures that, in turn, sought to minimize the risk of disease and thus enhance the efficacy of the wider public health system. And within a moral economy of epidemic control these measures, anticipating potential resistance, seemed to have helped to convince the public.

## NOTAS

- 1 Parts of this paper have been presented at a conference on “Vaccination, Society and Politics” in Berlin in April 2011 and at a conference about “Vaccines: Values, Past and Present” in Uppsala in November 2017. I would like to thank the unknown reviewers for their comment.
- 2 The case was reported in the first and only volume of the yearbook *Anti-Vaccinator. Illustriertes Jahrbuch des internationalen Impfgegner-Bundes*, published in Leipzig in 1911 and edited by Heinrich Molenaar, who also wrote the article on Impfschäden (vaccine damages), pp. 122-4. The case of Willy Otto has been recounted in various other publications and was analysed by Wolff, 1996, pp. 87-8.
- 3 See the classic account of Crookshank, 1889. For more recent accounts Smith, 1987; and Brunton, 2008.
- 4 In contrast to Britain, see Williamson, 2007.
- 5 Thus also Thießen, 2017, p. 13. All studies on smallpox prevention in Germany refer to the comprehensive overview of Kübler, 1901. In the 20<sup>th</sup> century some smaller medical dissertations have been published, like Matzel, 1977. With the rise of social history, historians have emphasized the influence on politics and the importance of epidemics for society and state building. See for example, Huerkamp, 1985; and Wolff, 1998, who focussed on the introduction of vaccination in Württemberg in the early 19<sup>th</sup> century; or most recently, Thießen, 2017, p. 9, who conceptualizes the history of immunisation in Germany as a history of the welfare state.
- 6 Most histories of smallpox deal with a larger period of time treating Europe as a whole, like Kübler, 1901; and recently Hopkins, 2002; and Williams, 2011. Smallpox epidemics and prevention have also been presented as part of broader histories of epidemics and their influence on politics, society, economy and culture. See for example, Vasold, 1991; Winkle, 1997; Baldwin, 1999; or Dinges and Schlich, 1995.
- 7 Thießen, 2017, doesn't begin his account until the great debates about compulsory vaccination in the 1870s. Huerkamp, 1985, has interpreted smallpox vaccination as a “first step in the medicalization of a broader public”.
- 8 Regarding the relationship between the state and disease, this contribution builds on Huerkamp, 1985; Dinges 1995; and especially Baldwin, 1999.
- 9 In China and India, other forms of prophylactic inoculation had been practised, see Parish, 1965, p. 21.
- 10 See Parish, 1965, pp. 21-2. In some regions of England, Wales, Scotland, North America, and Germany, layman also had practical knowledge about protection. See Kübler, 1901, pp. 115-8; for the USA see Kotar and Gessler, 2013, pp. 33-45.
- 11 For the German state Württemberg, see Wolff, 1998, pp. 102-8; for the USA, see Kotar and Gessler, 2013, pp. 33-45.
- 12 For further information, see Crookshank's classic text (1889), chap. V; Parish, 1965, pp. 24-5. Before Jenner in England, Benjamin Jesty and John Fewster had inoculated cowpox material to prevent smallpox, as had Peter Plett in Holstein. For Britain, see Pead, 2003; and Thurston and Williams, 2015; for Holstein, see Plett, 2006.
- 13 The concept and practice of vaccination spread throughout Europe. For German states, see *Blättern und Schutzpockenimpfung*, 1896; Kübler, 1901, pp. 174-9; for Württemberg see Wolff, 1998, pp. 109-21. By 1800, the publications of Jenner and other vaccinators like William Woodville and George Pearson had been translated into German. See the list of publications in Kübler, 1901, p. 166.
- 14 Kübler, 1901, chap. VIII; Parish, 1965, pp. 27-9; Winkle, 1997, pp. 887-8. In most German states the vaccine was free of charge for children and paupers to promote the dissemination of vaccination practices, see Huerkamp, 1985, pp. 622-3.
- 15 More systematic use of vaccination occurred in various waves. In particular, the number of vaccinated children rose after an outbreak of a smallpox epidemic. See Wolff, 1998, pp. 109-24.
- 16 According to Rupp, 1975, p. 108, the (small) institute had four beds and children stayed for 22 days to ensure that they could also serve as a lymph-donors.
- 17 See Baldwin, 1999, pp. 254-5. In 1819 for instance, Hamburg expanded compulsory vaccination from children living in public institutions to all children of families supported by poor relief. Similar rules had been promulgated for Prussia in 1835.

- 18 According to Rupp, 1975, p. 110, in August of 1807 Hessen-Kassel was the first German territory to implement compulsory vaccination. But Hessen-Kassel is not mentioned in Kübler, 1901.
- 19 Contemporaries discussed whether and why the efficacy of humanised cow lymph had declined over time as well as with every arm-to-arm vaccination.
- 20 See Kübler, 1901, pp. 228-9. According to Kübler, in the Grand Duchy of Hessen-Darmstadt re-vaccination was not implemented until 1869. But according to Rupp (1975, p. 119), it is unclear whether soldiers were revaccinated, regularly or generally, after joining the army.
- 21 According to Bismarck, 1898/1928, p. 370, during the Austro-Prussian war 6,427 soldiers died of cholera, whereas 4,450 died in combat. See also Winkle, 1997, p. 211. According to Matzel, 1977, p. 7, during the Franco-Prussian War one quarter of all fatalities were attributable to diseases and, in general, more soldiers died of disease than in combat.
- 22 See Kübler, 1901, pp. 282-3. According to Matzel, 1977, p. 20, in Paris the number of fatalities amounted to more than 1,000 in July 1870, rising to 1,800 in November and December of 1870 (p. 22).
- 23 See Winkle, 1977, p. 894; but Matzel, 1977, p. 8 cites 297 smallpox fatalities.
- 24 See Winkle, 1997, p. 894. Matzel, 1977, reports different figures: 150,000 fatalities due to smallpox and 48,000 soldiers who died during the war, of whom 9,000 died of typhoid fever.
- 25 The debate is summarised in Baldwin, 1999, pp. 260-70; Wolff, 1996; Thießen, 2017, pp. 42-59. Baldwin, 1999, pp. 526-36, concluded that different strategies of preventive (and in this case restrictive) public health measures like vaccination could be more easily sorted along lines of political parties (liberals vs. conservative) than national states. In Germany, the Progressive Party with Rudolf Virchow as one of its leading proponents played a special role in the debate about vaccination as it was both: politically liberal and scientifically progressive, supporting vaccination. The objections and arguments against compulsory vaccination will be discussed below.
- 26 The subtitle of the commentary by C. Jacobi (1875) on the Imperial Vaccination Law illustrates this point: Das Reichs-Impf-Gesetz vom 8. April 1874. Nebst Ausführungs-Bestimmungen des Bundesraths und den in Geltung gebliebenen Landes-Gesetzen über Zwangs-Impfungen bei Pocken-Epidemien. Nach Materialien des Reichstags dargestellt.
- 27 In the first draft of the law, compulsory vaccination was foreseen upon the outbreak of an epidemic. Although this part of the law had been rejected during the parliamentary debates, the adopted law contained a passage stipulating that regulations in individual states were still valid. See *Blattern und Schutzpockenimpfung*, 1896, p. 78. On the Imperial Vaccination Law, see idem, chap. 8; and Jacobi, 1875.
- 28 And, as set forth in the Imperial Vaccination Law, they could also sued for physical injury.
- 29 For the Imperial Vaccination Law, see *Blattern und Schutzpockenimpfung*, 1896, chap. 8; and Jacobi, 1875. Although the financial penalty for parents was lower than that for physicians, fifty Marks was a lot for the working poor, whose average income barely amounted to 500 or 600 Marks per year. In addition, the fine could be imposed repeatedly after each citation. See *Blattern und Schutzpockenimpfung*, 1896, p. 85.
- 30 The last smallpox infection in Germany was registered in 1972. Compulsory vaccination for children was abandoned in 1975 and re-vaccination some years later. In 1980, the World Health Organisation declared smallpox eradicated.
- 31 Speech of the President of the Imperial Health Office, Stenographic Reports on the Proceedings of the German Reichstag, 1<sup>st</sup> Parliamentary Term, 204<sup>th</sup> Session on 6<sup>th</sup> April 1922. See furthermore the Report on the Scientific Foundations of the Vaccination Law [Denkschrift über die wissenschaftlichen Grundlagen des Impfgesetzes] in the Federal Archive Berlin, R 86/4274. Regarding the interventionist (but inconsistent) strategy of Prussia, adopted later by the Empire and supported by bacteriologists, with a tendency to emphasize the public good over individual rights, see Baldwin, 1999, p. 546-8; Thießen, 2017, pp. 42-59.
- 32 Whereas German governments and advocates of vaccination spoke of *Schutzpockenimpfung*, implying a protective smallpox vaccination, members of the anti-vaccination movement used the term *Zwangsimpfung*, meaning compulsory vaccination.
- 33 On early resistance to vaccination, see Kübler, 1901, pp. 235-48.
- 34 In his introduction, Wolff, 1996, describes a speech given by Carl G.G. Nittinger, a prominent anti-vaccination agitator, in a town hall with an audience reputed to have numbered more than 2,000 people. On this and the second half of the 19<sup>th</sup> century, see Wolff, 1996; Thießen, 2017, p. 31-8.
- 35 These side effects were discussed in Kübler, 1901, pp. 263-5.
- 36 Later in the century, officials discussed children suffering from these and other diseases, especially scrofula and tuberculosis, and the fact that outbreaks were caused by weakened immune systems following vaccination. See *ibid.* Side effects and complications during and after vaccination were also discussed in the pro-vaccination literature, for instance systematically in Schulz, 1891, pp. 27-33.
- 37 See Schulz, 1891, p. 37; for more extensive accounts, see *Blattern und Schutzpockenimpfung*, 1896, pp. 96-124; Jochmann, 1913, pp. 197-216; Wolff, 1996; on early arguments, see Wolff, 1995.
- 38 See Wolff, 1995; Wolff, 1996; on similar discussion in Britain, see Williamson, 2007.
- 39 See for instance the views of medical officers in Kübler, 1901; or Kirchner, 1911. Paul Kübler was member of the Imperial Health Office who compiled the statistics about vaccination; Kirchner also worked as medical officer in the Imperial Health Office, before moving to the health division of the Prussian Ministry of Cultural Affairs and later becoming head of that division after it was moved to the

- Prussian Ministry of Interior. Both parties, advocates and opponents of vaccination, accused one another of pursuing their own private business interests. See for example Jochmann, 1913, pp. 259-60. The debate summarized in Wolff, 1996; and recently Thießen, 2017, pp. 42-59.
- 40 See especially Huerkamp, 1985. For an overview of the historiographic debates in the 1980s and 1990s on public health and medicalization, especially in Germany and France, see Loetz, 1994. On medicalization and bio-power in relation to bacteriology, see Bashford and Hooker, 2001; Bashford 2004; and the publications of Wolff.
- 41 On the establishment of the Imperial Health Office, see Hüntelmann, 2008, chap. 2.
- 42 Kirchner, 1911 p. 40 counted 21 state-run vaccine institutes. Beside these were also private institutes under state supervision.
- 43 See Jochmann, 1913, pp. 175-6; for Hamburg Voigt, 1879.
- 44 See Jochmann, 1913, pp. 176; the federal regulations are published in Schulz, 1891, pp. 83-90; a detailed description about the production process is given in a report on the annual activity of the vaccine plant for 1894 in: *Medizinal-Statistische Mittheilungen aus dem dem Kaiserlichen Gesundheitsamte 1* (1895), p. 1-44.
- 45 See Schulz, 1891. The German term “Geschäft” denotes both a business and a practice.
- 46 The size of the vaccination districts were designed to make them easily accessible to all inhabitants of the district.
- 47 The official dates often aligned with holidays. In rural areas, officials suggested setting it after harvest time, see Schulz, 1891, pp. 48-51.
- 48 On the production of calf-lymph at the institutes, see Jochmann, 1913, pp. 177-81; Kirchner (1911, pp. 40-4). In rare cases where arm-to-arm vaccinations was still practiced, the physicians had to start early enough to vaccinate all children registered on the list.
- 49 See Schulz, 1891, pp. 59-61, including the standard forms used for vaccination certificates and lists in annex 3-11.
- 50 In the second volume (1887) of the Results/Works of the Imperial Health Office, the vaccination statistics for the previous year were published for the first time, cf. *Ergebnisse einer Statistik der Pockentodesfälle für das Deutsche Reich*. In: *Arbeiten aus dem Kaiserlichen Gesundheitsamte 2* (1887). From that point onward, vaccination statistics were published annually. Reports of the state-run vaccine institutes that produced animal lymph were published for the first time in 1889, cf. *Tätigkeitsberichte der staatlichen Anstalten zur Herstellung von Tierlymphe*. In: *Arbeiten aus dem Kaiserlichen Gesundheitsamte 5* (1889). Later on these statistics and reports were published in a new statistical journal of the Imperial Health Office, the Medical Statistical Reports (*Medizinalstatistische Mittheilungen des Kaiserlichen Gesundheitsamtes*). The statistics were introduced by a report discussing cases involving severe side effects or death. In the tenth volume of the Medical Statistical Reports in 1904, the data were presented as “vaccination statistics about fatalities” (*Pockentodesfallstatistik*), but in the following volume for 1905 the simply as “smallpox statistics” (*Pockenstatistik*).
- 51 See for instance the report for 1888: “Die Thätigkeit der im Deutschen Reiche errichteten Anstalten zur Gewinnung von Tierlymphe während des Jahres 1888. Nach den Jahresberichten der Vorstände zusammengestellt im Kaiserlichen Gesundheitsamtes”. In: *Arbeiten aus dem Kaiserlichen Gesundheitsamte 6* (1890), pp. 43-88; later on reports were published in: *Medizinal-Statistische Mittheilungen aus dem dem Kaiserlichen Gesundheitsamte*, the report for 1894 in Vol. 1 (1895), p. 1-44, including a discussion about side effects and vaccine recipients supposed to be harmed by the vaccine (p. 38-40). In general *Blättern und Schutzpockenimpfung*, 1896.
- 52 The concept of moral economy was introduced by Edward P. Thompson (1971) classic text of the English working class. Referring to Thompson, “moral economy” is used to describe an economy commonly based on principles of mutuality that emphasize an embeddedness economy is embedded in social worlds and tied in with moral principles and social norms. Lorraine Daston (1995) modified and introduced this term into the history of science to explain how scientific objects were considered important, how certain arguments and methods were balanced and valued as trustful evidence, as more convincing than others in the process of knowledge production.
- 53 Thießen, 2017, discusses statistics as machines of evidence (*Evidenzmaschinen* pp. 88-92).
- 54 This is obvious in Kirchner’s statistics on smallpox fatalities between 1825 and 1908 in the Prussian population (mortality per 100,000 inhabitants) and in the military. He clearly delineated the introduction of compulsory vaccination in the army in 1834 and the Imperial Vaccination Law of 1874, see Kirchner, 1911, p. 60.
- 55 Accordingly, Körösi, 1887; addressed the anti-vaccination movement’s critique of official statistics and rebutted their claims.

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