

1 A Tale of Two Diseases

Smallpox and Cowpox

In Jamaica in 1801, Lady Maria Nugent was seeking to start a family. Born in New Jersey in 1771, she was the daughter of Cortlandt Skinner, who raised a regiment to serve on the British side in the American War of Independence and sent his family as refugees to Britain. In late 1797, she married Sir George Nugent, fourteen years her senior, who after rising through the ranks in America served as commander of the British forces in the northern sector during the Irish Rebellion of 1798 and was appointed Governor of Jamaica in spring 1801. Though Britain was at war with France, and the Caribbean was a theatre of conflict, Maria went with her husband to assume the role of governor's wife. Amidst her pert observations of Jamaica, however, there began to appear in her journal, month by month, more sombre reflections and, at year's end, a confession of her 'misery that the dear name of mother will never greet my ear'. In early 1802, however, she became pregnant and, after an anxious confinement, gave birth to a healthy boy in October. A week later, she recorded her thanks to God for 'the great blessing' and 'the joy that now fills my heart'. She embarked on a note-book 'to keep an account of my dear baby's health, and know, from hour to hour, how he goes on, that I may be ready in case of any illness'. On 17 November, after reporting that her baby was 'prospering', she gloomily notes, 'but, alas, we must soon think of giving him the small-pox'.¹

Maria's statement is chilling and shocking. After her concern that she might never be a mother and anxieties about having her first child far from family and friends, the idea that she would give her baby smallpox appears perplexing and disturbing. It soon becomes apparent, of course, that she is referring to having him inoculated with smallpox. Over eighty years earlier, Lady Mary Wortley Montagu, the wife of another British official in foreign parts, had observed how Greek women in Istanbul inserted smallpox matter under the skin on a child's arm in the hope that the child would develop a mild case of smallpox which would then provide security against future infection. Trials of smallpox

¹ *Lady Nugent's journal: Jamaica one hundred years ago*, ed. Frank Cundall, 2nd ed. (London, 1934), pp. 65, 169, 171.

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inoculation (variola) in England in the 1720s showed that inoculated smallpox was generally less severe than smallpox acquired casually. In the second half of the eighteenth century, it became a familiar practice in the English-speaking world. Since it was used extensively during the smallpox epidemic that raged during the war in America, it is likely enough that Maria herself had been inoculated. Still, the procedure involved some risk. A mild case of smallpox could not be counted on, and a small percentage of children died of inoculated smallpox, making it an awful decision for parents. As it was not usual to inoculate a neonate, the presence of smallpox in Jamaica was probably a determining factor. Sir George may have been especially resolute, but Maria's words suggest that it was a joint decision. The Nugents could call on medical men who were experienced in the procedure as it was extensively deployed on the plantations. Their physician found a child in Spanish Town with a mild case of smallpox and brought him or her to the house to provide fresh lymph for the operation. There followed an anxious fortnight. After being advised that her son's infection was approaching the critical time, Maria abandoned a ball to hurry to his side. Shortly afterwards, she was happy to report that her child was back in good health.²

Maria's anguish about smallpox inoculation is hardly surprising, but referring to the procedure as giving a child smallpox, though apposite, is very unusual. The likely explanation is that variolation was no longer the only option for smallpox prophylaxis. In 1798, the first year of their marriage, Edward Jenner published his thesis that inoculating cowpox was a much safer and just as effective means of protection against smallpox.³ Trials of cowpox (vaccine) in London in 1799 generated publicity and cowpox inoculation (vaccination) was introduced in the British army and navy in 1800. Seeking to start a family, the Nugents would have invested some hope in the new procedure, read reports of its success in Europe, and heard about attempts to establish the practice locally with imported vaccine. In 1803, Maria was pregnant again, giving birth to a daughter in October. The likely availability of vaccine evidently eased her mind. She reported that the doctor brought 'a nice little mulatto child, from whose arm my dear baby was vaccinated'. The outcome was disappointing, raising the concern that 'perhaps, after all, we must give her the smallpox'. Fortunately, a new supply of vaccine arrived in November. 'We agreed', Maria wrote in high spirits, 'to have the puncture made in her dear little leg; for if the present fashion for excessive short sleeves lasts till she grows up, it will not be becoming to expose a scar on the arm,

² *Nugent's Journal*, pp. 173–4, 177, 179.

³ Edward Jenner, *An inquiry into the causes and effects of the variolæ vaccinae, or cow pox, a disease discovered in the western counties of England, and known by the name of the cow pox* (London, 1798).

which I now see disfiguring many pretty young ladies'.⁴ The anguish of giving a child smallpox already seemed to belong to another age.

War on Smallpox and the World Arm-to-Arm

This book is the first full-length history of the spread of vaccination around the world in the early nineteenth century. The first generation of practitioners often saw themselves as making history by introducing, establishing and promoting the practice in their communities. In seeking a supply of vaccine, in sharing observations and insights about the new prophylaxis with colleagues, they were consciously or unconsciously participating in networks that, though locally based, were ultimately transnational. The promoters of vaccination certainly looked to developments elsewhere in the world for instruction and inspiration.⁵ Writing a history of vaccination at the end of the Napoleonic Wars, James Moore included a sketch of its global career, and popular histories of smallpox and smallpox prevention, usually ranging from the earliest times until the declaration of the eradication of smallpox in 1980, have tended to include a similar outline of its early spread around the world.⁶ Over the past fifty years, there has been an impressive body of scholarship on the history of vaccination, largely national and regional studies.⁷ More recently, there has been a growing recognition of the interest of the global dimension, especially the common and the distinctive challenges and responses to the problems of delivering vaccine and embedding the practice in different climes and cultures around the world.⁸ This book draws on an immense range of primary sources, published and unpublished, and builds on the available scholarship in a dozen languages, to present a richer and more comprehensive picture of the beginnings of vaccination, one that reveals the value of seeing the connectedness of developments around the world. The approach is more that of a general historian than a historian of medicine. An inspiration was the quality and richness of the documentation generated by the cowpox discovery and the

⁴ *Nugent's Journal*, pp. 231–2, 236, 240.

⁵ James Moore, *The history and practice of vaccination* (London, 1817), pp. 226–73.

⁶ E.g. Donald R. Hopkins, *The greatest killer: smallpox in history, with a new introduction* (Chicago, 2002), first published as *Peasants and princes: smallpox in history* (Chicago, 1983); Ian Glynn and Jennifer Glynn, *The rise and fall of smallpox* (London, 2004); Gareth Williams, *Angel of death. The story of smallpox* (Basingstoke, 2010).

⁷ Early leaders in the field were Yves-Marie Bercé, *Le chaudron et la lancette. Croyances populaires et médecine préventive (1798–1830)* (Paris, 1984) and Pierre Darmon, *La longue traque de la variole. Les pionniers de la médecine préventive* (Paris, 1986). More generally see the Select Bibliography.

⁸ John Z. Bowers, 'The odyssey of smallpox vaccination', *BHM*, 55 (1981), 17–33; Ann Jannetta, *The vaccinators. Smallpox, medical knowledge, and the 'opening' of Japan* (Stanford, CA, 2007); Andrea Rusnock, 'Catching cowpox: the early spread of smallpox vaccination, 1798–1810', *BHM*, 83 (2009), 17–36.

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advent of early vaccination, and the insights and perspectives it offered on aspects of life that are otherwise rarely documented. Vaccination, like variolation before it, has to be seen not only as a medical and sanitary intervention but as a technology, a social and cultural practice and an emotion-laden rite of passage. This study seeks to explore how the new prophylaxis was not only shaped by the broader historical forces but was also constitutive of them. As some literary scholars have shown, for example, the enthusiasm for cowpox and the cult of Jenner reflect and inform the sensibilities of the age of Romanticism.⁹ The scale of the mobilisation in relation to vaccination in its first decade needs to be especially stressed. Millions of people around the world played their part in the vaccination revolution and experienced its emancipatory power.

The early global spread of vaccination involved more than the flow of information and a simple technology. It required the distribution of cowpox (vaccine) in a good state of preservation, its successful propagation on arrival, and measures to maintain the supply of vaccine. Even in England, cowpox was found only occasionally on dairy-farms, and from the outset the supply of cowpox lymph depended on the vaccination process itself, that is lymph drawn from the vaccine vesicle that had risen on the arm of a child vaccinated around nine days previously. Often enough, the previously vaccinated children would be put, almost literally, arm-to-arm with the next batch of children. It may be that many mothers found the use of vaccine that had passed through other children, without obvious harm, somewhat reassuring. To extend the practice and set it on the firm foundations, of course, required the collection and preservation of vaccine for future use. Cowpox lymph in its liquid state did not survive long, even when stored in a sealed glass bottle. The standard method for maintaining a supply of vaccine was to soak cotton threads in the cowpox lymph, allow the cowpox-imbued threads to dry, wrap them in paper, and perhaps even store them in bottles. In the early years of vaccination, packets of dried vaccine threads were dispatched from London and other centres of early practice in almost diasporic profusion. Dried vaccine wrapped in paper, however, had a short life span, especially in conditions of heat and humidity. There were remarkable successes, especially in sending dried vaccine to Vienna in 1799, but it proved surprisingly difficult to deliver vaccine in any form to France. There was a rapid address, in which practitioners around the world contributed, to the technical problems of storing and transporting vaccine. State-of-the-art solutions, like sealing lymph between sealed plates or in vacuum sealed capillaries, were expensive, not easily transported, and delivered only marginally better results than sending large numbers of threads

⁹ Tim Fulford, Debbie Lee and Peter J. Kitson, *Literature, science and exploration in the Romantic era: bodies of knowledge* (Cambridge, 2004), ch. 9.

in packets. As Andrea Rusnock has shown, the spread of vaccination was more than a matter of the world, in her happy phrase, simply ‘catching cowpox’.¹⁰

One method for delivering vaccine over long distances and in challenging environments was to move children under vaccination. It built on the routine practice of using a previously inoculated child as the source of vaccine for other children. As early as 1800, children were being taken to be vaccinated in towns where the practice was established and brought home to go arm-to-arm with other children. It was found that on a sea-voyage it was possible to maintain a supply of fresh lymph for delivery at the destination by the successive vaccination of young people who had not had smallpox. Within a few years, vaccination chains were being used to introduce and extend the practice in many parts of the world, most notably in the Spanish empire. Although it drew on the techniques used for storing and variolous matter, vaccination faced the new challenge of needing to have to hand a supply of a virus that was hard to find in England and not available at all in most other parts of the world. The maintenance and extension of the practice therefore depended on a higher level of organisation. The availability of vaccination as an option to the individual depended on other people adopting the practice. The spread of vaccination around the world required massive mobilisation, rarely coercive but often involving a degree of pressure and hustle. Millions of people were to be enlisted or dragooned into the war against smallpox. Unlike variolation, which kept smallpox alive, vaccination offered the prospect of a world free from smallpox.

As historians of medicine, health policy analysts, and philosophical patients have often observed, the language of wars and battles against diseases can have unfortunate connotations. It is noteworthy, though, that the use of military metaphors in medicine gained traction in the eighteenth century with the perception of smallpox as an invasive agent, and the idea that inoculation assisted bodily resistance. Although he confided his thoughts to a manuscript unpublished until modern times, Cotton Mather was probably not alone in imagining ‘unseen armies of numberless things, ready to seize and prey on us’, figuring smallpox as an enemy that the body needs to be ‘very strong’ to resist, and inoculated smallpox as attacking only the ‘outer works’ of the citadel.¹¹ The coincidence of the beginnings of vaccination with the Revolutionary and Napoleonic wars may have further encouraged the use of military metaphors in the new form of prophylaxis. Jenner, no enthusiast for the war, used them very often. In a letter to two ladies inoculating cowpox in Wales, he congratulated them on opening ‘the vaccine campaign so successfully’ and

¹⁰ Rusnock, ‘Catching cowpox’, 17–36.

¹¹ Cotton Mather, *The Angel of Bethesda*, ed. Gordon W. Jones (Barre, MA, 1972), pp. 47, 94, 112.

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continued, 'May this species of warfare never terminate till you have driven from your country the most formidable foe that ever invaded it'.¹² The prospect of banishing smallpox led naturally to the language of war and conquest. In Napoleonic France, Minister of the Interior Chaptal wrote in martial tones about disputing 'every inch of ground with the enemy whom we wish to exterminate'.¹³ In embattled Britain, some of the most bellicose language was used not about smallpox itself, but about the men who sought to undermine confidence in vaccination and spread smallpox by inoculation. Jenner's cowpox discovery proved to be the occasion of the first great confrontation in Britain and elsewhere between expert opinion and popular denialism. Still, in promoting the new prophylaxis in an age of global warfare, Jenner could be presented as a humanitarian hero, who saved lives rather than sacrificed them.

This history, then, is a story of humanitarian endeavour. From the outset, cowpox was presented as a boon to mankind, both a providential blessing and fruit of the Enlightenment. It was obvious that just as smallpox was a near universal affliction so there was no reason to doubt that cowpox would be a universal panacea. The moves to make vaccine available more broadly, in terms of geographical range, and more deeply, in terms of social reach, were by no means wholly philanthropic. There were material interests at play in protecting colonial enclaves and plantation economies as well as in projecting images of western superiority and imperial paternalism. Closer to home, the need to propagate a supply of vaccine, the economic benefits of suppressing smallpox and the reputational return on aristocratic and professional philanthropy were important motives for sponsoring vaccination. A harder edge was only revealed when popular prejudice and apathy made it hard to maintain the supply of vaccine on which the practice depended. In general, the enthusiasm with which cowpox was promoted, and the delight in what was seen to be a common good are all too apparent. The idea of vaccination as a humanitarian cause is most evident in the manner that, in a time of war, no advantage was taken to restrict access to information about the practice, and considerable efforts were made to make it available across enemy lines and among peoples of different races and religions. Even in the age of war and imperial rivalry, cowpox found in English dairies and propagated on English children was sent both to Austria, Britain's ally, and France, its mortal foe. From Vienna, vaccine lymph was communicated through intermediaries to Moscow and Bombay, and provided the stock for vaccination in the Russian empire and British India, passing through the

¹² W. W. Francis and L. G. Stevenson, 'Three unpublished letters of Edward Jenner', *JHM*, 10 (1955), 359–68, at 361–3.

¹³ *Circulaires, instructions et autres actes émanés du Ministère de l'intérieur, ou relatifs à ce département de 1797 à 1830 inclusivement*, 2nd ed. (Paris, 1821), 1, p. 309.

bodies of Europeans and non-Europeans, Christians, Moslems, Hindus and animists. From Paris, vaccine was made available in Spain, and three years later a Spanish expedition was launched to carry vaccine, by the successive vaccination of children, across the Atlantic, through South America and across the Pacific. Vaccination discloses connection and trust even in an age of imperial conflict and exploitation. Between 1800 and 1805, millions of the people around the world came together, almost literally, arm-to-arm. For the first time, smallpox's empire was brought within bounds and the means became available, given sufficient resource and application, to eradicate it. In a letter to Jenner in 1806, President Thomas Jefferson assured him that he had 'erased from the calendar of human afflictions one of its greatest'.¹⁴

The study considers the first phase in the history of vaccination, which saw the introduction and the establishment of the practice, the wide acceptance of the potential of the new prophylaxis and millions of people vaccinated. By the last decade of Jenner's life, however, the initial momentum had been lost. The early expansion of the practice had been carried forward with a great deal of enthusiasm and after the first few years it proved hard in many places to make vaccination a routine practice. Some governments provide support and some even sought to make it compulsory. Pockets of anti-vaccination sentiment were often inflamed rather than soothed by medical hectoring or government pressure, especially when the populace had little trust in the elite. By the 1820s, medical men were starting to acknowledge that vaccination did not provide life-time protection and that periodic revaccination might be necessary, making it more difficult to promote. The main problem, then as perhaps now, was not active denial of the value of vaccination but complacency and apathy. The success of vaccination in the first decade of its adoption had played a part in suppressing the disease and, in turn, in making it less feared and less pressing. Lady Nugent may not have been untypical as a parent in moving from fear of smallpox, anxious acceptance of the calculated risk of giving smallpox by inoculation, to expectation of the availability of vaccination and the less serious concern about the vaccination mark. It would be all too easy and all too common for parents to move to the next step and not to assign vaccination any priority at all. Thomas Jefferson's vision of smallpox eradication would be realised only slowly. There were advances, punctuated and then accelerated by smallpox epidemics, through the nineteenth and early twentieth centuries in the western world. It would take a well-funded international campaign to suppress smallpox in its last redoubts in the 1970s, making it possible for the WHO to formally announce the global eradication of smallpox in 1980. 'Future nations will know by history only that the

¹⁴ John Baron, *The life of Edward Jenner*, 2 vols. (London, 1827 and 1838), 2, p. 95.

loathsome smallpox has existed', Jefferson pronounced in 1806.¹⁵ It is to that history that it is now necessary to return.

The Rise of Smallpox

Smallpox (*orthopoxvirus variola*) is known to be an ancient disease. It flourished in the civilisations in the Fertile Crescent and the Indus Valley three thousand years ago. The first historical record of a disease clearly identifiable with smallpox occurs in China in the second century CE. It was neither distinctly described nor named in the Greek or Roman world, but the plague that swept westward from Persia into the Roman empire in 166–172 CE was probably smallpox.¹⁶ In China, clinical descriptions of the disease date back to the fifth century CE. Five centuries later, the Persian physician known as Rhazes offered a description of the disease that remained influential in Europe into the seventeenth century. Over this period smallpox gained in profile throughout the Old World. The growth of population and the locking together of systems of trade and empire from the twelfth century made it possible for smallpox to become endemic in core regions, especially in China, India and the Middle East, and to circulate with increasing frequency through large areas of Asia and Europe. It was carried along the caravan routes across the Sahara and on Arab dhows down the east coast of Africa, eventually gaining hold in the African kingdoms on the savannah grasslands either side of the Equator. In Europe, it was believed that smallpox came from the Arab world at the time of the Crusades. During the later middle ages, it appeared more regularly in the more densely settled regions and became increasingly associated with children. Though a nasty disease, distinguished by fever, pain and, above all, its 'pox', it was probably milder than it later became. In the sixteenth century, the arrival of syphilis in Europe brought a new scourge often described as the 'great pox'. The English term 'smallpox', and its equivalents in other languages, was then applied to the more persistent and troubling of the lesser poxes. By this time, however, the *variola* virus was not only spreading more rapidly, but also acquiring a new virulence.

Smallpox arrived in the New World not long after Columbus, proving a potent ally of the Spanish conquistadors in the conquest of the Aztec empire. Scholars have generally assumed high rates of infection and mortality in 'virgin-soil populations' in Mesoamerica and South America.¹⁷ The size of the original population of Mexico, the scale of the demographic collapse and the role of smallpox in the devastation, however, are matters of some debate.

¹⁵ Baron, *Life*, 2, p. 95. ¹⁶ Vivian Nutton, *Ancient medicine* (Abingdon, 2004), p. 24.

¹⁷ E.g. Alfred W. Crosby, *Ecological imperialism. The biological expansion of Europe, 900–1900* (Cambridge, 1993), pp. 200–1.

Early Spanish sources may have given undue emphasis to smallpox because of the visibility of the disease, and because the high susceptibility of the indigenous people could be presented as a providential mandate for European rule.¹⁸ It has been rightly observed that smallpox was ‘not a cloud of infection that descends from on high’ and did not move ‘with seven-league boots’.¹⁹ Still, even if less cataclysmic than has often been assumed, the epidemic in Mexico in the 1520s almost certainly involved higher mortality rates than in Europe.²⁰ Furthermore, it spread widely, though largely dependent on colonial commerce and penetration. In the mid-1520s it ravaged Peru, de-stabilising the Inca empire and making it more vulnerable to Spanish adventurism.²¹ There is little evidence of its spread northwards beyond central Mexico before the eighteenth century.²² Epidemic smallpox reappeared several times in Mesoamerica and South America in the sixteenth century. ‘They died by scores and hundreds’, a colonist reported of an epidemic in Peru in 1585, ‘Villages were depopulated. Corpses were scattered over the fields or piled up in the houses or huts’.²³ Over the course of the seventeenth century, it appeared more regularly and spread more widely, though with the colonial activity still providing the crucial links in the chain of infection. In the early decades of the eighteenth century, its lethal impact is well documented in the Jesuit missions in Paraguay, where there was a severe epidemic in 1738–40.²⁴ The importation of African slaves increased the opportunities for disease transmission. Brazil was especially exposed to infection brought on slave ships from west Africa.²⁵

By 1600, *variola* virus was entrenched in the heartlands of Asia and Europe. It was long endemic in the cities and flood plains of China, where it became largely a childhood illness. The peoples beyond the Great Wall, who were still highly susceptible to smallpox, lived in fear of the contagion, describing China as ‘a house on fire’.²⁶ In their campaigns in Ming China in the early

¹⁸ Francis J. Brooks, ‘Revising the conquest of Mexico: smallpox, sources and populations’, *Journal of Interdisciplinary History*, 24 (1993), 1–29.

¹⁹ Brooks, ‘Revising the conquest’, 12; Paul Kelton, *Cherokee medicine, colonial germs: An indigenous nation's fight against smallpox, 1518–1824* (Norman, OK, 2015), pp. 21–2.

²⁰ Robert McCaa, ‘Spanish and Nahuatl views on smallpox and demographic collapse in Mexico’, *Journal of Interdisciplinary History*, 25 (1995), 397–431; Mark Harrison, *Disease in the modern world: 1500 to the present day* (Cambridge, 2004), pp. 74–5.

²¹ Hopkins, *Greatest killer*, pp. 208–12. ²² Kelton, *Cherokee medicine*, p. 25.

²³ Hopkins, *Greatest killer*, p. 213.

²⁴ Robert H. Jackson, *Missions and the frontiers of Spanish America: a comparative study of the impact of environmental, economic, political, and socio-cultural variations on the missions in the Rio de Plata region and on the northern frontier of New Spain* (Scottsdale, AZ, 2005), pp. 337–8.

²⁵ Dauril Alden and Joseph C. Miller, ‘Out of Africa: the slave trade and the transmission of smallpox to Brazil, 1560–1831’, *Journal of Interdisciplinary History*, 18 (1987), 195–224.

²⁶ Hopkins, *Greatest killer*, p. 119.

seventeenth century, the Manchus saw the disease as a more formidable obstacle than fortifications and armies.²⁷ Crossing to Japan as early as the sixth century, smallpox became endemic in major population centres from the fourteenth century. The Dutch observed its heavy toll of children in Nagasaki in the 1640s. Even in the mountainous provinces of Honshu, where it reappeared every three or four years, it was becoming a disease of childhood.²⁸ In the seventeenth century, there were serious smallpox epidemics in the Philippines and the Indonesian archipelago.²⁹ On the western edge of the Eurasian landmass, smallpox was also appearing more often and with greater severity. It was becoming endemic in London, roaming the English countryside, and making forays into remote parts of the British Isles. After the Great Plague of London in 1665, smallpox displaced bubonic plague as the most feared scourge. Around this time, the author of *Medela Medicinæ* claimed that smallpox had been quite mild until about forty years earlier.³⁰ From the mid-seventeenth century, other European countries experienced epidemics of increasing virulence. An outbreak in 1736 is regarded as the first very severe epidemic in Sweden.³¹ The eighteenth century in Europe began and was to end in the shadow of smallpox.

Smallpox was also becoming fully global. In 1733, a student returning from Denmark unwittingly carried the virus across the north Atlantic to Greenland. The consequences were cataclysmic. In one settlement missionaries found no survivors other than a small girl and her infant brothers. After burying his neighbours, their father ‘had laid himself and his youngest child in a grave of stones, bidding the girl to cover him with skins’ and to share the remaining food with her brothers until help arrived.³² The expansion of the Russian empire east of the Urals facilitated the spread of smallpox from central Asia to the nomadic peoples of Siberia and across the Bering Strait to Alaska. In the late 1770s, smallpox was carried westwards from the British colonies and northwards from Mexico into the interior of North America, along the Mississippi-Missouri river system and across the Prairies. In the early 1780s the Hudson’s Bay Company began to receive reports of the dreadful mortality spreading northward. In visiting Nootka Sound in 1792, George Vancouver

²⁷ Jiafeng Zhang, ‘Disease and its impact on politics, diplomacy, and military: the case of smallpox and the Manchus (1613–1795)’, *JHM*, 57 (2002), 177–97.

²⁸ Jannetta, *Vaccinators*, p. 19.

²⁹ Hopkins, *Greatest killer*, pp. 112–13; Peter Boomgaard, ‘Smallpox, vaccination, and the *Pax Neerlandica*, Indonesia, 1530–1930’, *Bijdragen tot de Taal- en Volkenkunde*, 159 (2003), 590–617, esp. 591–5.

³⁰ R. A. Anselment, *The realms of Apollo. Literature and healing in seventeenth-century England* (Newark, NJ, 1995), p. 174.

³¹ Peter Sköld, *The two faces of smallpox. A disease and its prevention in eighteenth- and nineteenth-century Sweden* (Umeå, 1996), p. 61.

³² Hopkins, *Greatest killer*, p. 52.