

**SMALLPOX** was for centuries one of the most dreaded, lethal and common of all infectious diseases. It is probably an ancient disease, but it became increasingly virulent in many parts of the world during the early modern period. The pocked and scarred faces of those who survived this horrific viral infection marked them out for life. No cure has ever been developed, but inoculation against smallpox began to be widely practised in Europe and North America in the 18th century, until at the end of the century it was superseded by vaccination. By 1979 a worldwide vaccination campaign led by the World Health Organization (WHO) achieved the ultimate goal of completely eradicating smallpox – the only disease so far eliminated by human intervention.

In the late 18th century Edward Jenner (1749–1823), a country doctor in the English village of Berkeley in Gloucestershire, became aware of a local story that cowhands and dairymaids who had contracted cowpox from infected cows' udders might be protected from the much more serious smallpox. As Jenner and other country folk observed, *'what renders the Cow-Pox virus so extremely singular ... is that the person who has been affected is for ever after secure from the infection of the Small-pox'*.

Jenner spent some years wondering whether there was a way that this link could be put to beneficial use for humankind. In May 1796 he decided to act on his hunch. He chose the son of his gardener – a healthy eight-year-old boy called James Phipps – and a young dairymaid, Sarah Nelmes, for his experiment. The dairymaid had contracted cowpox from a cow called Blossom. Jenner took a scraping of material from a cowpox pustule on her hand and then scratched it into the skin of young James Phipps. The next stage was to be the tricky one. Six weeks later, he inoculated the boy with smallpox virus taken from a pustule of a smallpox patient. It didn't 'take'. The boy did, indeed, appear to be protected against smallpox. He then went on to vaccinate his own son with cowpox and



found that he, too, was protected from smallpox. Jenner was convinced that he had found a way of preventing this terrible scourge.

Jenner's story and the discovery of vaccination has been told and retold many times, as befits a milestone in the history of medicine. In honour of Jenner's discovery, Louis Pasteur (1822–95) gave wider currency to the term 'vaccination', a word derived from Latin *vacca*, meaning 'cow'.

The eradication of smallpox was made possible through the use of a modern version of the vaccine first developed by the pioneering physician Edward Jenner, seen here vaccinating a small boy.

### timeline

**c.1187 bc** Burial of Pharaoh Ramses V. Lesions found by archaeologists on his mummified face suggest he may have suffered from smallpox.

**1112 bc** A Chinese manuscript refers to a dreaded disease that may be smallpox.

**AD 570** Bishop Marius of Avenches uses the term 'variola' to describe an

epidemic that affects both Italy and France.

**735–7** The 'Great Smallpox Epidemic' in Japan – the first of a series – claims countless lives.

**c.900** Smallpox is first clearly described by the Persian physician Rhazes (c.865–925).

**1500s** Smallpox reaches the New World with devastating consequences.

**1717** Lady Mary Wortley Montagu (1689–1762) has her six-year-old son inoculated against smallpox in Constantinople. The method subsequently becomes popular on both sides of the Atlantic.

**1796** Edward Jenner (1749–1823) tries out his cowpox vaccine on young James Phipps.

**1798** Jenner publishes a pamphlet on his experiments in vaccination.

**1800s onwards** Smallpox vaccination (the first-ever human vaccination) is undertaken in many parts of the world.

**1872** Endemic smallpox eliminated in

Iceland, followed by Sweden (1895), Norway (1898) and Denmark (1901).

**1907** Ireland is free of smallpox.

**1934** The UK is free of smallpox.

**1942** Canada is free of smallpox.

**1949** The USA is free of smallpox.

**1953** Portugal is the last European country to eliminate smallpox.

**1966** With smallpox remaining serious in parts of Africa, South America and Asia, the World Health Assembly agrees to embark on a ten-year Smallpox Eradication Programme.

**1972** Smallpox is eliminated in South America.

**1975 (October)** The world's last case of Variola major smallpox occurs in Bangladesh. The victim is a three-year old girl; she survives. The

disease is eliminated from Southeast Asia, leaving only the Horn of Africa to be cleared.

**1977 (October)** The last naturally occurring case of smallpox in the world occurs in Somalia, where a hospital cook contracts Variola minor smallpox. He also recovers.

**1979** The World Health Authority (WHO) announces the global eradication of smallpox. In 1980 it is officially removed from the list of world diseases.

### THE SPECKLED MONSTER

The origin of smallpox remains an enigma. It is likely that it is a disease of great antiquity, possibly spreading from person to person around the time of the first agricultural settlements in the river valleys of Egypt, the Middle East, India and China. Smallpox has no animal reservoir, although it may in the dim and distant past have evolved from an animal virus such as cowpox, horsepox or (the most likely candidate) 'camelpox'. But once established as a solely human disease, smallpox can be spread only when there is a sufficient number of infectious people in the population in close proximity to a reservoir of people who have no immunity. To what extent smallpox was present in ancient Egypt or responsible for some of the great epidemics and 'plagues' of the Greek world and the Roman empire is a topic of lively scholarly debate.

We arrive at a more scientific historical basis of the disease in the tenth century, when the Persian physician ar-Razi (c.865–925), known in the West as Rhazes, wrote an account in which he differentiated measles from smallpox. At this time it seems that smallpox was a common childhood disease, and not as severe as measles. Certainly, over the next few centuries, smallpox did not carry the same

fear as bubonic plague – indeed, it was not until some 200 years after the Black Death of the mid-14th century that smallpox emerged as one of the major killers of the early modern world.

In Europe by the 16th century, smallpox had become the dreaded 'speckled monster', attacking princes and peasants alike, and accounting for some 10 to 15 per cent of all deaths. It established itself as an endemic disease in cities and as a frightening periodic epidemic in towns and villages. At least 80 per cent of its victims were under the age of ten, and it could kill between 25 and 40 per cent of its victims. Survivors were left scarred and sometimes blind for life.

### SMALLPOX AND THE NEW WORLD

The most devastating impact of smallpox at this time was in the New World. Shortly after the arrival of Columbus in 1492, smallpox crossed the Atlantic from Europe and Africa. It spread rapidly and quite likely contributed to the collapse of the Aztec empire in Mexico and the Inca empire in Peru. The Native Americans had never before experienced smallpox and, as a 'virgin' population, they were exceptionally vulnerable. Estimates vary, but it is possible that 90 per cent of the indigenous population of the New World (amounting to between 50 and 100 million people) may have been wiped out by a combination

of factors, including 'new' diseases (especially smallpox and measles) and superior European military technologies (guns, steel swords and cavalry).

Accounts tell of masses of corpses piled up along the roadsides, of the stench of death pervading the villages, of dogs and vultures devouring the dead. The Mayans called smallpox *nokakil* – the great fire. One chronicler of the destruction of the civilization of the Aztecs wrote:

*'More than half the population died ... in heaps, like bedbugs. Many others died of starvation, because, as they were all taken sick at once, they could not care for each other, nor was there anyone to give them bread or anything else. In many places it happened that everyone in a house died, and, as it was impossible to bury the great number of dead, they pulled down the houses over them in order to check the stench that rose from the dead bodies, so that their homes became their tombs.'*

Another observer wrote that *'a man could not set his foot down unless on the corpse of an Indian'*.

However, few of the Spanish conquistadors appear to have caught smallpox in the Americas. It may have been introduced, initially, by Europeans, but many of them may have already experienced smallpox and acquired immunity, protecting them from further attacks. The psychological impact on the indigenous populations was as devastating as the physical harm, as the hideous infection sapped their will to resist. Tribes and communities broke up and scattered, spreading smallpox far and wide, and the mighty empires of the Aztecs and the Incas crumbled amidst fear, anguish and panic.

Wave after wave of smallpox continued to devastate the indigenous inhabitants of the New World, carried across the Atlantic by traders, soldiers, sailors, slaves and settlers. The disease also hit the newly founded colonial settlements along the eastern seaboard of North America. Boston experienced eight epidemics during the 18th century, and in some of these epidemics more than half the population were infected.

*'The streets, the squares, the houses ... were covered with dead bodies; we could not stop without treading on them, and the stench was intolerable ... all the causeways were full, from one end to the other, of men, women and children, so weak and sickly, squalid and dirty, and pestilential that it was a misery to behold them.'*

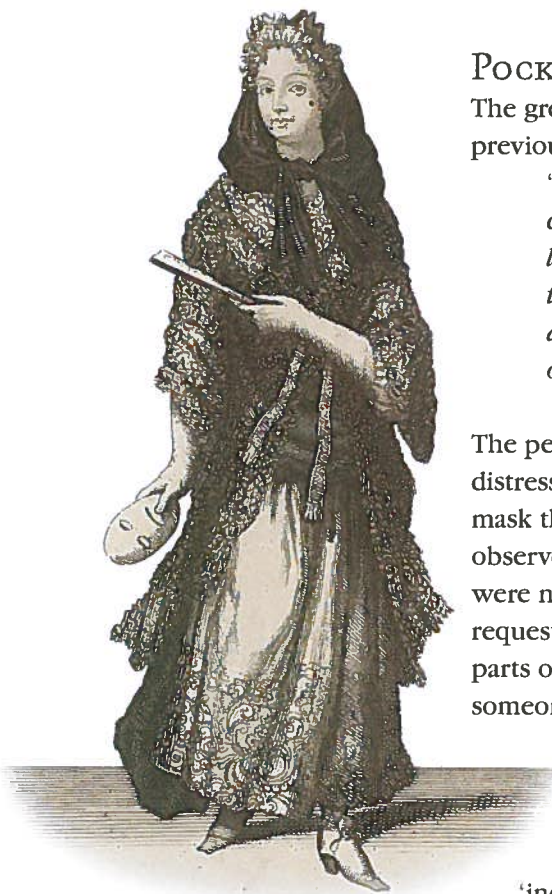
THE SPANISH CONQUISTADOR BERNAL DÍAZ DEL CASTILLO OBSERVES THE EFFECTS OF SMALLPOX IN THE NEW WORLD, 1521

**South American Indians** were devastated by diseases such as smallpox, for which they had no immunity. This engraving from c.1591 shows tribespeople attempting cures using traditional healing methods.



### WHY THE 'SMALL' POX?

The term 'smallpox' came into general usage in the 16th century, replacing the word 'variola' (from the Latin *varius*, 'spotted'). 'Pox' (the plural of 'pock', a pustule, from the Old English word 'poc') was used widely in Medieval times to describe a number of 'pestilences', including plague, variola and other diseases with pustular eruptions on the skin. There are two main types of smallpox – *Variola major* and the milder *Variola minor* – and prior to the 16th century the milder form may have been the more prevalent of the two. The disease was possibly called 'small' pox to differentiate it from the 'great pox', or syphilis, which struck across Europe with alarming consequences from the late 15th century. Perhaps the pockmarks of smallpox, though many, seemed 'small' in comparison with the repulsive pustules that spread over the entire body of the earliest victims of syphilis. It is also possible that at the time smallpox seemed the lesser of the two evils.



A London courtesan from about 1688 with her beauty spot, mask and fan. Such 'beauty aids' were used to hide scars from smallpox or venereal disease.

### POCKMARKS, PUS AND INOCULATION

The great historian Lord Macaulay (1800–59), writing about England in the previous century, made this sombre observation:

*'The smallpox was always present, filling the churchyards with corpses, tormenting with constant fears all who it had not yet stricken, leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden the objects of horror to the lover.'*

The permanent pockmarks suffered by survivors often caused considerable distress, and fashionable ladies, robbed of their smooth skins, did all they could to mask their scars with paints, potions and beauty spots. At the same time, it was observed that those who carried the telltale signs of once having had smallpox were not likely to catch the dreaded disease again. Adverts for servants often requested that they had already had 'the smallpox in the natural way', and in many parts of the world, parents were anxious that their children should only marry someone who had previously had the disease.

These observations regarding what we would now call acquired immunity inspired a method of preventing the disease. This was known as 'variolation' (after variola, the scientific name of the disease) or 'inoculation'. Might it be possible to take some of the infectious agent and transmit it to someone who had not yet caught the disease, in the hope that they might get a milder – rather than the full-blown and potentially fatal – form and thus become immune?

The technique of inoculation probably originated in India and then spread to other countries. In the tenth century the Chinese removed scabs from the drying pustules of a smallpox patient, pounded them into a powder, and then blew a few grains into the nose of people who had not had the illness – up the right nostril for a boy and the left one for a girl. In other parts of Asia and the Arab world, pus from the 'pocks' of an infected person was inoculated into a scratch in the skin of healthy people.

'I went and made a visit to Mrs Graham ... her eldest son was now sick there of the smallpox, but in a likely way to recovery, and other of her children ran about and among the infected, which she said she let them do on purpose that they might whilst still young pass that fatal disease she fancied they were to undergo one time or other, and that this would be for the best ...'

JOHN EVELYN (1620–1706), DIARY, 1685

In the early 18th century Lady Mary Wortley Montagu (1689–1762), wife of the British ambassador to the Ottoman court, learned of this practice from the locals during her residence in Constantinople (now Istanbul). Her own stunning beauty had been destroyed by an attack of smallpox when she was 26 years old, leaving her badly scarred and without eyelashes. In a letter to



a friend she described the 'smallpox parties' in which peasant women would routinely perform inoculation:

*'Apropos of distempers, I am going to tell you a thing that will make you wish yourself here. The smallpox, so fatal and so general amongst us, is here rendered entirely harmless by the invention of engrafting, which is the term they give it. There is a set of old women who make parties for this purpose ... an old woman comes with a nutshell full of the matter of the best sort of smallpox, and asks what veins you please to have open'd. She immediately rips open that which you offer her with a large needle (which gives you no more pain than a common scratch) and puts into the vein as much of the venom as can lie on the head of her needle ...'*

In 1717 Lady Mary decided to have her six-year-old son inoculated, and in 1721, back in England, her three-year-old daughter was inoculated by the eminent surgeon Charles Maitland (1677–1748). This aroused much publicity. Princess Caroline (1683–1737), wife of the future King George II, was also keen to have her two daughters inoculated. But first she took the precaution of having six condemned felons in Newgate Prison inoculated on the promise of reprieve. She also had 12 charity schoolchildren inoculated and, once reassured that the attacks were mild, went ahead with the two little princesses. Catherine the Great of

This cartoon from 1802 depicts Edward Jenner at the Smallpox and Inoculation Hospital at St Pancras, London, vaccinating the local population with cowpox. According to the original caption, the treatment had 'Wonderful Effects!' In some quarters, there was initial concern about vaccination and the introduction of an animal disease into humans.

'Medicine has never before produced any single improvement of such utility. You have erased from the calendar of human affliction one of the greatest ... future nations will know by history only that the loathsome smallpox has existed and by you has been extirpated.'

THOMAS JEFFERSON, LETTER TO EDWARD JENNER, 14 MAY 1806, SOME 170 YEARS BEFORE SMALLPOX WAS FINALLY 'EXTIRPATED'

practitioner Zabdiel Boylston (1680–1766) to inoculate those not yet infected. Although some of those inoculated died, the numbers were few by comparison with those who died of smallpox 'in the natural way'.

Inoculation gradually became popular on both sides of the Atlantic, especially in the latter half of the 18th century when the technique was made safer, cheaper and easier by a number of practitioners, including Robert Sutton (1708–88) and his son Daniel (1735–1819) of England, and James Kirkpatrick (1676–1743) of South Carolina. Nevertheless, there were still many who questioned the efficacy and safety of inoculation. One of its main problems, apart from a 1–3 per cent risk

of death, was that during the mild attack of smallpox people were actually infectious, and needed to be isolated. Thus inoculation was only a partial solution, and at the end of the 18th century smallpox was still exacting a huge toll across the world.

For example, smallpox devastated the Aboriginal population in Australia after the disease arrived there in 1789, possibly from Indonesia, just a year after the first European settlement in New South Wales. Eyewitnesses described the horrors of finding corpses washed up on the shore. About half of those who had contact with the British settlement of Port Arthur (Sydney) died, and it was probably one of the greatest demographic and psychological shocks in the history of Australia.

#### VACCINATION IS ADOPTED ACROSS THE GLOBE

When Edward Jenner sent his first report of his cowpox vaccination experiments on young James

Russia (1729–96) had her family inoculated by Thomas Dimsdale (1712–1800), an English surgeon who was awarded £10,000 and a Russian barony for his services. With these royal marks of approval, the technique attracted huge attention in Europe.

Meanwhile, in Boston, Massachusetts, Reverend Cotton Mather (1663–1728) had learned of the same practice from one of his African slaves. He inoculated his own son, but the idea of interfering in this way with Divine Providence led to outrage amongst many Bostonians. Nevertheless, during a severe epidemic of smallpox in Boston in 1721, Mather persuaded the medical

practitioner Zabdiel Boylston (1680–1766) to inoculate those not yet infected. Although some of those inoculated died, the numbers were few by comparison with those who died of smallpox 'in the natural way'.

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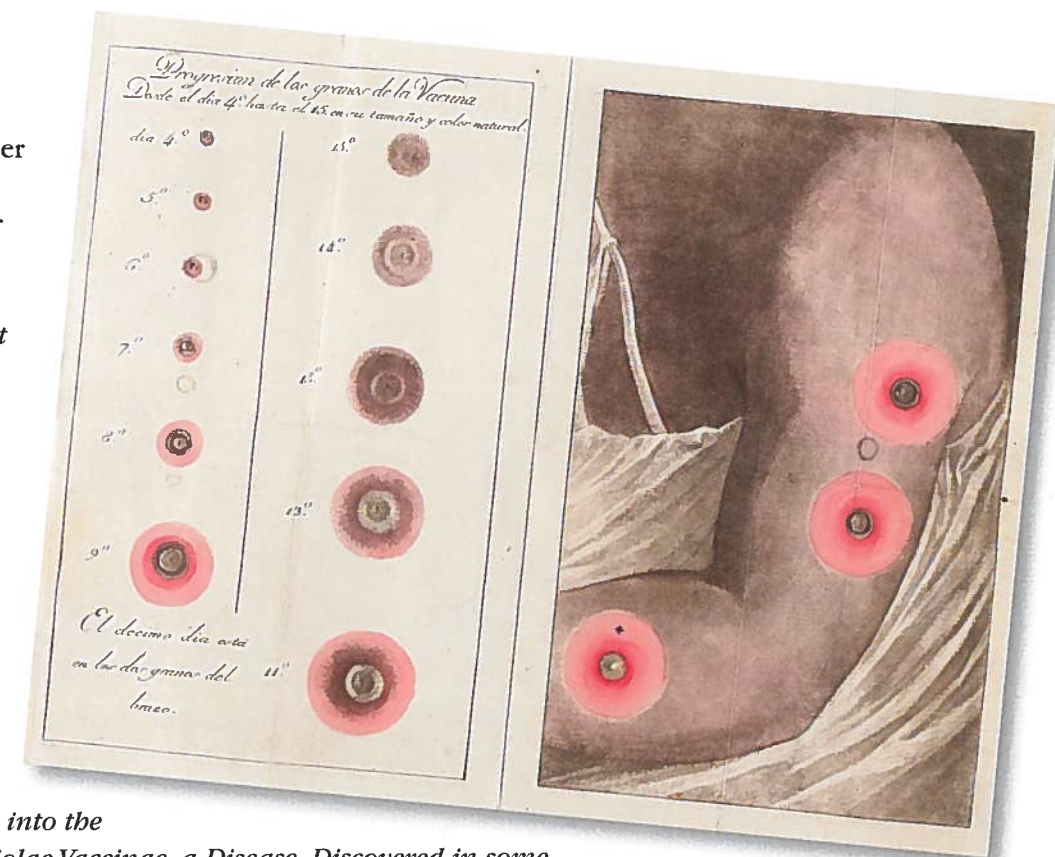
When Edward Jenner sent his first report of his cowpox vaccination experiments on young James

Phipps to the Royal Society of London in 1797, it met with a cold reception. Although Jenner had already been elected a Fellow of the Royal Society for his work on cuckoos, the Society rejected his paper on the grounds that Jenner 'ought not to risk his reputation by presenting to the learned body anything which appeared so much at variance with established knowledge, and withal so incredible'.

The following year, with more cases and evidence to support his theory, Jenner privately published a pamphlet entitled *An Inquiry into the Causes and Effects of the Variolae Vaccinae, a Disease, Discovered in some of the Western Counties of England, particularly Gloucestershire, and Known by the Name of The Cow Pox*. Although there were some critics (especially those who feared the consequences of transferring an animal disease to humans), the speed with which vaccination was subsequently adopted around the world was extraordinary. By 1801 more than 100,000 people had been vaccinated in England, and by 1811 over 1.7 million in France: the emperor Napoleon managed to have half his army vaccinated. Between 1804 and 1814, 2 million were vaccinated in Russia, and in the USA the practice was taken up with great enthusiasm by Dr Benjamin Waterhouse (1754–1846) of Boston. By the 1820s vaccination against smallpox had spread to much of the world. Its benefits for humankind were quickly recognized, and Jenner was richly honoured and rewarded.

One of the most remarkable aspects of the story is the way in which the vaccines were transported around the world. Dried vaccine on quills and lancets, dried scabs, or cotton threads impregnated with matter from pustules, were just some of the methods used. For long sea voyages the 'serial method' was adopted, in which children were successively vaccinated, one after the other, using ripe pustular matter, until the destination was reached. Between 1803 and 1806 Don Francisco Xavier Balmis (1753–1819) used this arm-to-arm technique to take the vaccine from Spain across the Atlantic to Spanish America, on to the Philippines and China, and then back to Spain, vaccinating en route possibly 450,000 people. From one small village in Gloucestershire, the vaccine circumnavigated the globe.

The great advantage of vaccination over inoculation was that the former not only left the recipient non-infectious and immune, but also involved a far milder and



A fold-out colour plate from 1803, published in Spain, illustrating the scars left by smallpox vaccination.

### DID JENNER INVENT VACCINATION?

Some 20 years before Jenner's 1796 experiment on James Phipps, a farmer in Dorset, Benjamin Jesty (1736–1816), had come up with the same theory about the protective nature of cowpox. He had rubbed matter from cowpox pustules into scratches on the arms of his wife and two children using a darning needle.

However, he did not subsequently expose them to the smallpox virus. It may be that Jesty was the first person to use this technique, but it was certainly Jenner who put vaccination into everyday medical practice.

less dangerous reaction. (It was realized some time later, however, that vaccination did not give lifelong protection, and people needed to be re-vaccinated after several years.) In some countries, mass vaccination centres were set up. There were objectors to the practice - on ethical and religious grounds - and a number of anti-vaccinationists fought hard to suppress it.

Especially unpopular was the policy in some countries of making vaccination compulsory, at least for infants. There was also the possibility of transferring other infections, such as syphilis, via the vaccine, and the risk of complications, such as

post-vaccinial encephalitis. But on the whole vaccination proved highly successful, especially with the refinements and improvements made to the vaccine in the later 19th century.

It is difficult to document the success of smallpox vaccination in terms of number of lives saved, but it is likely that millions of people in the 19th and early 20th centuries were spared the horrors of the disease - not only death and disfigurement, but also blindness. In the late 18th century, about one-third of cases of blindness in Europe were probably from smallpox.

**THE ERADICATION OF SMALLPOX**

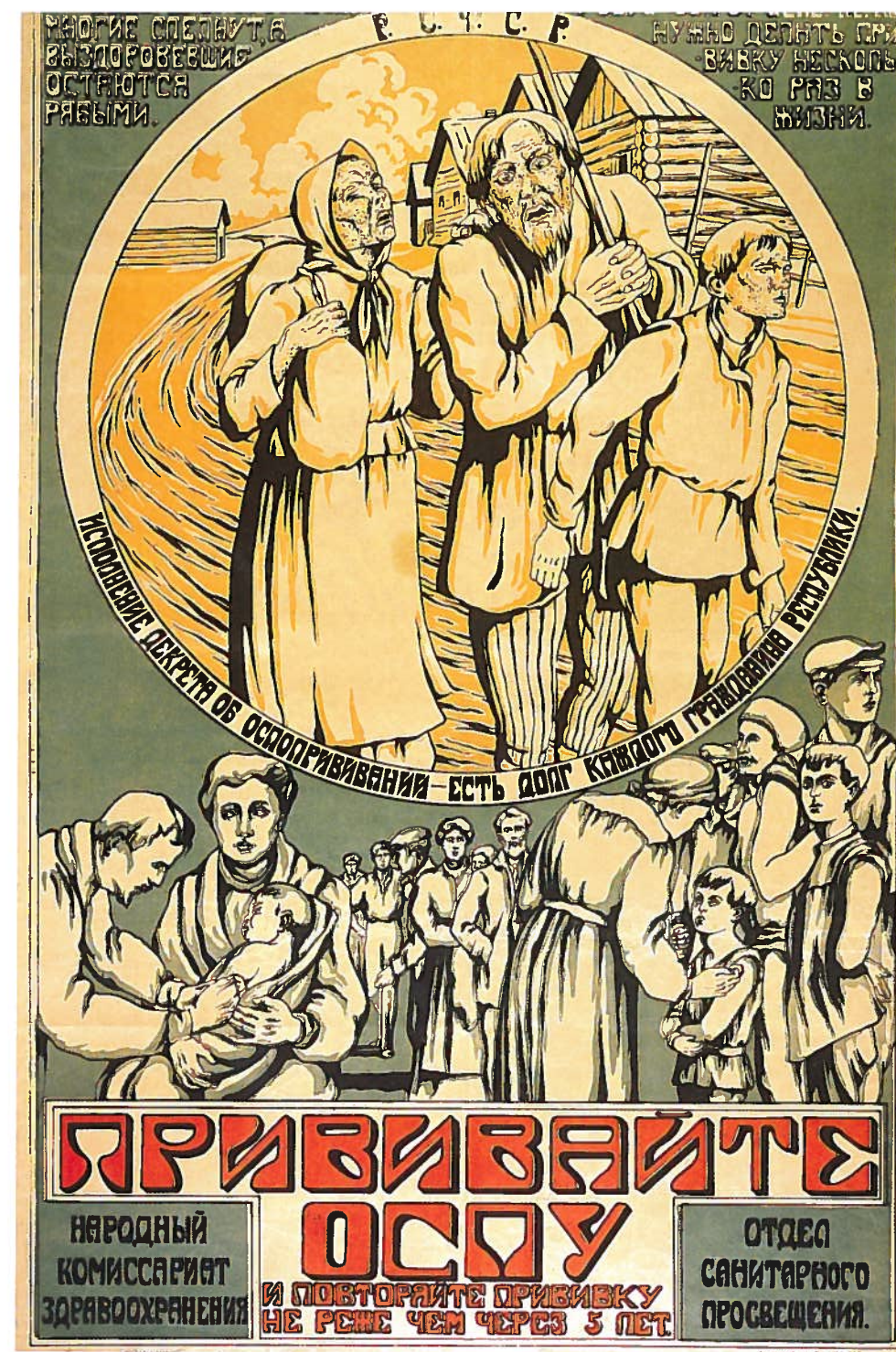
The widespread practice of vaccination against smallpox was undoubtedly a major

factor in the decline of mortality rates in the Western world over the past 200 years. In the early 20th century, although the incidence of smallpox was significantly less in the industrialized world than it had been a century earlier, smallpox remained endemic in almost every country, with periodic outbreaks of *Variola minor* (a milder form of the disease) in parts of Europe and North America. By the 1950s smallpox was no longer endemic in Britain and the United States, and by 1967 it had been eliminated from both Europe and North America, as well as China, Japan and Australia.

However, smallpox persisted in parts of Africa, Asia and South America. In the 1960s, 10 to 15 million people in some 43 countries across the world contracted the disease each year, with about 2 million deaths. In a trailblazing decision, the 19th World Health Assembly meeting at Geneva in 1966 agreed (albeit by just two votes) to embark on what they called an Intensified Ten-Year Smallpox Eradication Programme. At the time there were many doubts as to its feasibility, and even the director-general of the World Health Organization (WHO) was not optimistic that it would succeed. The programme was nevertheless launched the following year, with the backing of a small multinational team led by Donald Henderson (b.1928) of WHO.



An early photograph shows a nurse tending a smallpox sufferer at an isolation hospital - possibly at Ilford, Essex, a small town outside London. Smallpox is an acute infectious disease caused by an *Orthopoxvirus* and transmitted by airborne droplets or the pus from pustules of an infected person. It produces a distinctive pustular rash. The scabs which form fall off after three or four weeks, leaving permanent pitted pockmarks.



Pockmarked and blinded peasants who have suffered from smallpox are contrasted with children and adult citizens who are vaccinated against the disease in this Russian poster dating from the 1920s.

A successful programme of mass vaccination - made easier with the development of a freeze-dried vaccine that remained stable in tropical climates - led to the eradication of smallpox from South America by 1972. In parts of Africa and Asia, however, the task remained formidable. Health workers faced technical, logistical and cultural barriers. They crossed jungles, deserts and mountain ranges, worked in countries scarred by civil war and transcended political boundaries (this was one field in which the USA and the Soviet Union fully co-operated). 'Surveillance' and 'containment' were the operative words. Wherever they went their aim was to search for active cases of smallpox and trace and vaccinate contacts, as well as vaccinating the local population, so imposing a 'ring' around each outbreak.



This poster from about 1977, with red and yellow circles (smallpox pustules) in the form of an open-mouthed face, offered a reward to 'the first person reporting an active case of smallpox resulting from human-to-human transmission and confirmed by laboratory tests'. This reward – the last and highest ever offered – was never claimed, and the eradication of smallpox was certified just two years later.

Messages about the campaign were spread via newspapers, radio and posters, and rewards were offered to those who reported active cases of smallpox. Technological developments also played their part: new jet injector guns could vaccinate a thousand people in an hour, while the special bifurcated needles, needing only a tiny amount of vaccine, enabled thousands of people to be vaccinated by local health workers.

In October 1975 the last case of *Variola major* smallpox on the Indian subcontinent made headline news. The victim was a three-year-old girl in Bangladesh, and she survived. The last naturally occurring case in the world was a hospital cook in Somalia who contracted *Variola minor* in October 1977. He also recovered. In 1979 WHO felt confident enough to announce that smallpox had been completely eradicated from the world. Jenner's goal, 'the annihilation of the Small Pox – the most dreadful scourge of the human species', had finally been realized.

In some ways, smallpox was easier to deal with than some other infectious diseases. Vaccination had been available and proved effective since the early 19th century. Smallpox had no reservoir outside the human population – so there were no complex life cycles to crack, no dormant animal reservoirs of the virus to contend with, no insect vectors to transmit the disease. Within the human body, the smallpox virus has an incubation period of 12 to 14 days; it spreads only during the time of the rash, making it possible to trace contacts,

isolate them prior to the infectious stage and thereby break the chain of transmission. In addition, smallpox has no long-term latency – once a person is over the attack, he or she is no longer infectious and there are no 'silent' carriers. Finally, the disease makes such distinctive marks on the skin that it was easily recognized, diagnosed and contained. The vaccination procedure also left its distinctive scar, so it was relatively easy to observe who had or had not been vaccinated. Despite all these advantages, Donald Henderson of the WHO recalled that the great campaign he co-ordinated 'only just succeeded'.

**THE VIRUS LIVES ON**

Following the global eradication of smallpox, there was one further case of smallpox – in Birmingham, England, in 1978. A photographer was working above a smallpox research laboratory, and somehow the virus escaped – possibly through the ventilation system – and infected her. The young woman died. Her mother also came down with the disease, but she survived. The laboratory director committed suicide while in quarantine. There has been no known case of smallpox since.

Whether stocks of the smallpox virus and the vaccine should be kept in laboratories has remained a contentious issue. In 1995 governments began to destroy the stores of smallpox virus and the vaccine, and it was finally agreed that only two heavily guarded labs – one in Atlanta, Georgia, and one in Koltsovo, Siberia, in the Russian Federation – would keep the virus frozen in liquid nitrogen.

**SOME FAMOUS VICTIMS OF SMALLPOX**

King Henry VIII's fourth wife, Anne of Cleves, survived the disease, but was left scarred. Henry divorced her soon after their marriage had taken place, repelled by her physical appearance.

smallpox in 1700, at the age of 11. Tsar Peter II of Russia died of smallpox in 1730, when aged 14.

Tsar Peter III of Russia suffered an attack of smallpox in 1744. The 1911 edition of *Encyclopaedia Britannica* commented: 'Nature had made him mean, the smallpox had made him hideous, and his degraded habits made him loathsome'.

In 1562 Queen Elizabeth I of England became seriously ill with smallpox, but recovered. Rumour had it that her refusal to marry arose from an unwillingness to reveal her scars.

Wolfgang Amadeus Mozart contracted smallpox during an epidemic in Vienna in 1767. He became delirious and was lucky to survive. 'Te Deum Laudamus!' wrote his father. 'Little Wolfgang has got over the smallpox safely!'

Pocahontas, the daughter of a Virginian chief, died in 1616 aged 21 on a visit to England, possibly of smallpox.

Mary II, queen of England, Scotland and Ireland, and wife of William of Orange, died aged 32 in 1694 of 'black' smallpox – one of the very worst forms, with massive haemorrhaging into the skin, lungs and other organs.

President Abraham Lincoln suffered a mild attack of smallpox in 1863.

The Soviet dictator Joseph Stalin was badly scarred by a youthful bout of smallpox. He would often have photos retouched to hide his pockmarks.

Prince William, the only offspring of the future Queen Anne of Great Britain to survive infancy, died of



Queen Elizabeth I of England, seen here in her robes of state, was a victim of smallpox. She painted her face with white lead and vinegar to cover up her smallpox scars.

It has been argued that there is a need to keep such stocks in case there is ever a recurrence of smallpox – for example, if terrorists should use the smallpox virus as a biological weapon. The outcome could be disastrous, as many young people today have never been vaccinated, and those who were vaccinated before the 1970s may no longer have the necessary immunity to fight off an attack. Those who oppose the maintenance of existing stores of the virus point out that with available stocks of cowpox, it should be possible for scientists to reintroduce the vaccine quickly. The completion of the genome map of the smallpox virus has also led to questions about the need for maintaining the existing stocks of smallpox.

We can only hope that, following the enormous efforts over the past centuries to eradicate one of the most dreadful diseases of history, there will be no reappearance of this deadly virus – either naturally or through the deliberate use of the pathogen for bio-terrorism.