

# **THE HEALTH OF NATIONS**



# **THE HEALTH OF NATIONS**

**The Campaign to End Polio and  
Eradicate Epidemic Diseases**

**KAREN BARTLETT**



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*For my mother*



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The grumpy country doctor, Edward Jenner, changed the course of medicine by vaccinating local villagers in his 'Temple of Vaccinia', situated in his idyllic English country garden.

# INTRODUCTION

## *A Gloucestershire garden*

**T**ucked away in the farthest corner of a country garden in Gloucestershire sits an unprepossessing summerhouse, shaded and quiet, calmly anchored to the cool English earth. There is scarcely a whisper that, in this spot, scientific innovation shook the world and changed the course of human history. This is the ‘Temple of Vaccinia’, a tiny mushroom-shaped building, with bark-covered walls and a thatched roof. Although its silence now speaks of quiet neglect, this was once a hive of activity, with a line of people snaking around the garden, waiting to be vaccinated against smallpox by their local doctor, Edward Jenner.

Edward Jenner was not the first person to understand that exposure to cowpox led to immunity against the far more serious disease of smallpox but he was the first truly to understand the consequences of vaccination and to seek to prove them and publicize it in the medical community. Much to his chagrin, he believed he received insufficient thanks or appreciation for his work in his lifetime. Astonishingly, his reputation derived more from his work

in understanding how cuckoo chicks pushed other birds from the nest than from being the founding father of vaccination. Nonetheless, his discovery would prove to be a profound turning point; the beginning of a centuries-long endeavour to save millions of people from smallpox and other diseases. The success of vaccination gave rise to the idea that certain diseases could not only be controlled but wiped out entirely, as the eradication of smallpox, in 1979, would eventually prove.

The success of the smallpox campaign inspired legions of doctors, scientists and health workers to believe that disease *eradication* was possible. However, thirty-seven years later, smallpox remains the only disease to be successfully eradicated. It has taken decades to bring the world tantalizingly close to the eradication of another fearsome disease: polio, which once killed, crippled and ruined the lives of millions and struck terror into the hearts of families around the world. If polio is finally wiped out, the eradication of other well-known diseases, such as measles, could be within reach. Even the eradication of malaria is on the table.

The words ‘polio eradication’ sound clinical and medical, perhaps even underwhelming and technical. The truth, however, is costly, messy and sometimes heartbreaking. Success would be a staggering victory; polio eradication could inspire and embolden scientists to make other, even more momentous, breakthroughs, making medicine as inspiring for the twenty-first century as the moon landings were for the twentieth.

A world without just one or two of its terrifying epidemic diseases would be radically different to the one we live in. First world countries could save billions of dollars in health spending and foreign aid, while developing nations could see a boom in their productivity and economic output. Our already-bulging planet could have many more human beings to feed, house and employ.

## *Introduction*

The balance of global power would alter in ways we cannot yet envisage.

These arguments are not new and nor is the human effort to eradicate disease. This book explores the complicated history of vaccination and our efforts to tackle some of the diseases we have most feared. It tells the story through one disease, polio, and describes first-hand the final stages of one of the biggest health campaigns in history, as well as the stories of those who risk their lives to achieve what can seem an impossible aim.

Giving all children the polio vaccine has required creative solutions and massive collaboration. To reach remote communities, the Global Polio Eradication Initiative (GPEI) has delivered vaccine to some of the most inaccessible parts of the world, using helicopters, motorbikes, boats and camels. The scale of the task is mind-blowing: when polio still naturally occurred throughout India, each round of national immunizations involved 640,000 vaccination booths, 2.3 million vaccinators, 200 million doses of vaccine, 6.3 million ice packs, visits to 191 million homes, and the immunization of 172 million children. Innovations developed in India included house-to-house vaccine delivery plans and finger-marking. Messages were painted on the chimneys of brick kilns to encourage migrant workers to vaccinate their children; mobile health teams vaccinated nomadic populations; vaccination posts were established at borders and transit points, and in bus and railway stations; strategies that were used again on the Afghan-Pakistan border and in the Horn of Africa.

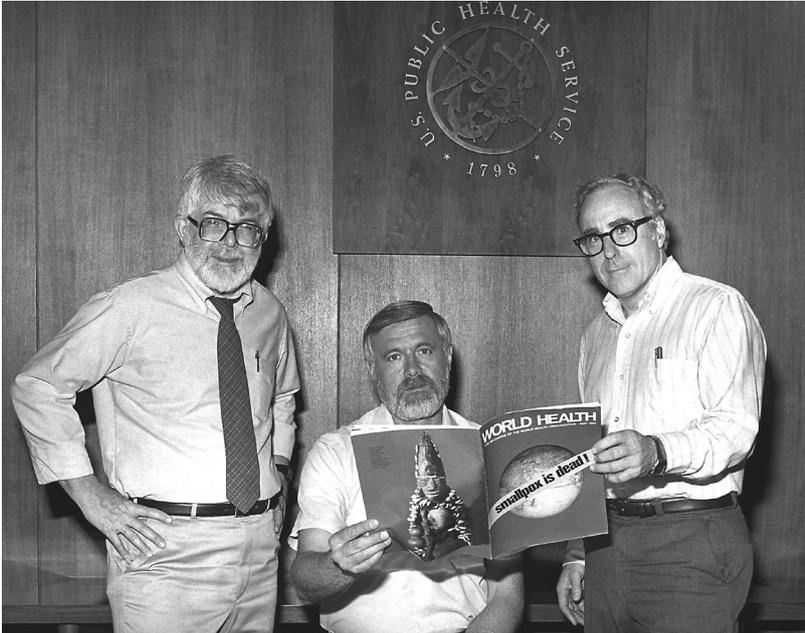
The polio eradication programme has worked in times of peace and war, developing strategies to vaccinate children during conflicts and humanitarian emergencies and establishing 'Days of Tranquillity' to interrupt conflicts in the Americas and later in the Democratic Republic of Congo (DRC) and Afghanistan. In 2013,

vaccine manufacturers delivered an astonishing 1.7 billion doses of the oral polio vaccine (OPV). Experts estimate the cost of the final push towards eradication between now and 2019 will be \$7 billion.

Yet although polio has now been beaten back and is endemic in only three countries in the world, eradication is far from certain. Immense logistical difficulties, political intrigue, war and cultural and religious beliefs form immense obstacles to disease eradication; in the case of polio, this final goal has been set back decades.

The history of disease eradication campaigns demonstrates that the final stages are by far the hardest. An almost Herculean effort of will is required to maintain the immense momentum and funding needed to be channelled towards a tiny number of cases. The history of disease eradication in the twentieth century is largely the story of falling at the final hurdle. After billions of dollars, decades of work and the deaths of hundreds of health workers – deliberately targeted for their work in saving children from disability and death – the future of a world without epidemic diseases might come down to a team of polio workers determined to deliver the final few drops.





The medical missionary Bill Foege (centre) was crucial in developing the surveillance and containment strategy that played a key part in ending smallpox. Here, he celebrated the eradication of the disease in 1980, with two other former directors of the programme at CDC in Atlanta, Dr J. Donald Millar (left) and Dr J. Michael Lane (right).

## THE HIPPIES WHO BEAT SMALLPOX

*Smallpox eradication really is one of the greatest accomplishments in health in the twentieth century and those of us who have come after live with the most important legacy of smallpox eradication, which is infinite benefits from there being no more smallpox. All the people that would have got smallpox and would have suffered and all of the resources that would have been spent on managing smallpox, are now saved. So the great benefit of eradication is absolute prevention. It guarantees that you've got that stream of benefits, in perpetuity, into the future.*

Tim Evans<sup>1</sup>

**O**n Wednesday, 18 November 1863, as Abraham Lincoln was travelling by train up the eastern seaboard of the United States, he told his personal secretary, John Hay, that he felt weak and unwell. Those symptoms were followed by a high fever, a headache and then backache and within a week his skin had erupted in scarlet blisters. He was almost certainly suffering from smallpox. Had his symptoms worsened a couple of days earlier the course of American history might have been very different, for Lincoln was travelling to Pennsylvania, to deliver what became known as the Gettysburg Address: his pledge to save and preserve the United

States. Although Lincoln recovered, smallpox continued to wreak havoc across the globe for another century, claiming lives and terrifying people.

It would be another hundred years before the author of *One Flew Over the Cuckoo's Nest*, Ken Kesey, typed an editorial for his local newspaper in Eugene, Oregon that urged local people to gather at his farm, join the Peace Corps and get on a bus to go to West Africa to fight smallpox. Kesey might have been more famous for his cross-country, LSD-fuelled bus trip with the Merry Pranksters but the hippies who responded to his editorial were about to set off on an even more extraordinary adventure. As one remembered, it was about 'life, and living it for real, man'.

In 1963, the World Health Organization (WHO) started a smallpox eradication and education programme. Run from an under-funded office in Geneva and driven by the determination of one man, the American doctor and epidemiologist D. A. Henderson, the smallpox programme motored on little more than the fumes of 1960s' idealism. As Larry Brilliant, a young doctor who joined the campaign on the advice of his Indian guru, Neem Karoli Baba, remembered: 'We didn't have cell phones or phones; we barely had a photocopy machine. There were no computers.'<sup>2</sup>

Brilliant travelled to Asia on a bus bought from the proceeds from starring in a film, *Medicine Ball Caravan*. His bus eventually took him all the way from his ashram to the UN office. 'I had never seen a case of smallpox,' Brilliant told an interviewer in 2000:

I had hair down the middle of my back and I was wearing a white robe. Everybody in the United Nations was over fifty and wearing a business suit . . . I walked in and said: 'My mystic sent me to cure smallpox.' I was told to go

*The Hippies Who Beat Smallpox*

home. I took the seventeen-hour bus ride back to the ashram and told Baba that I had failed.

After making the journey many more times, ‘slowly, the robe gave way to pants, then to a shirt, then to a tie, then to a haircut and then to a CV,’ Brilliant said. ‘I learned to look like a diplomat.’<sup>3</sup> Not everyone on the smallpox programme was as eccentric as Larry Brilliant but many had something of a maverick spirit that drove them on in the face of opposition, both on the ground and from international agencies and institutions who believed they were aiming for the impossible. It would take fourteen years but eventually, on 9 December 1979, the disease that had been a major killer for centuries was wiped out through what one volunteer described as ‘common sense, teamwork and love’. Actually, it took a little more than that.

Smallpox had long been one of the deadliest diseases in human history. When the mummified body of Pharaoh Ramses V, who died in 1157 BCE, was discovered, his face was clearly ravaged by the pockmarks of smallpox’s horrific rash of pustules. By 1775 CE, it was estimated that ninety-five per cent of the world’s population had been exposed to smallpox and one in seven had died from it. For those who lived, the personal consequences were dire, including scarring and disfigurement, or ‘rotting face’ as the Native Americans called it.

The political repercussions of the disease that Thomas Macaulay called the ‘most terrible of the ministers of death’ were equally profound. A smallpox infection brought to Central America by an African slave killed millions of Aztecs, and in part accounted for the successful Spanish conquest of Mexico. Smallpox wreaked similar devastation in other countries, wiping out nearly forty per

cent of the population of Iceland in 1241, when the infection broke out on a visiting Danish ship. Smallpox claimed the life of Louis XV in France and ended the Stuart dynasty.

Once a person caught smallpox the progress of the disease was well-understood. Approximately ten days after infection, the sufferer began to feel very ill, with headache, fever and backache. Two days later, the fever subsided and a rash appeared, starting in the mouth, throat and face. For the next two weeks, the fever would return and the rash would spread across the upper body and down to the hands and feet. What began as flat spots turned into raised hard spots and eventually into soft pus-filled scabs. After two weeks, the fever receded and the scabs dried and fell off, usually leaving unmistakable pockmarks. If this was followed by a bacterial infection of the pockmarks, or an infection of the bone, the sufferer died.

If the progress of the disease was evident and devastating, understanding remained hazy. The eminent Baghdadi physician, Al Rhazi, argued in 910 that smallpox was due to a latent contagion in the body but was less serious than measles (he probably encountered the less serious strain of the disease). Some doctors and scientists, including the Dutch physician, Hermann Boerhaave, understood as early as the 1700s that smallpox was a contagious disease, spread from person-to-person, but this theory faced opposition from proponents of the 'miasma theory', who believed that the disease was one of many conditions caused by the 'clashing elements' of bad and foul air and could be cured by greater sanitation.

Not until 1931, when the invention of the electron microscope made it possible to see such tiny organisms, was the smallpox (*Variola*) virus described. Shaped like an 'undistinguished rounded brick',<sup>4</sup> it belongs to the same pox virus family as cowpox, vaccinia, monkeypox and taterapox (smallpox's nearest genetic ancestor,

## *The Hippies Who Beat Smallpox*

which exists only in wild gerbils). Unlike other pox viruses, Variola (in both its two strains, major and minor) affected only humans. This was an essential factor for an eradication campaign, as the disease could be wiped out in human hosts without the risk of it living on within an animal reservoir.

The concept of inoculation had been known in some parts of the world for centuries. India and Africa had their own customs to offer protection, while the Chinese understood that infecting children with a weak, mild form of the virus – using a silver tube to blow a dried sample up the nose – would inoculate them against catching a more serious and deadly form later in their lives. Famously, Lady Mary Wortley Montagu popularized the practice and brought it to European attention.

Born Mary Pierrepont in London, probably in early 1689, Lady Mary contracted smallpox in 1715, when she was twenty-six years old. The infection left her deeply scarred and stripped of her eye-lashes. Her disfigurement did not prevent her from scandalizing London society by eloping with Edward Wortley Montagu and joining him in Constantinople, where he was British ambassador. From that posting, Lady Mary wrote to her friend Sarah Chiswell that she had heard of a practice carried out on the women of the Sultan's harem in Circassia in the North Caucasus, which involved 'engrafting' the pox into the women, leaving the disease 'entirely harmless'.

An article in the *Philosophical Transactions of the Royal Society* in 1714 describes the process of variolation, in which a surgeon scratched a patient's arm with a lancet until he drew blood, mixed those blood droplets with some

smallpox pus and then reapplied the mixture to a fresh cut on the arm, binding it tightly to make sure no liquid leaked out.

Lady Mary instructed Charles Maitland, the Scottish surgeon to the British Embassy, to 'variolate' her six-year-old son Edward. When that proved successful, he went on to inoculate her three-year-old daughter in London in 1721. This was the first known variolation carried out by a medical professional in England; it aroused the interest of the intelligent and well-read Princess of Wales, Caroline of Ansbach, who asked the king to order what became known as the 'Royal Experiment'.

In August that year six prisoners held under sentence of death in Newgate prison were offered a life pardon if they agreed to be inoculated. After a brief illness the condemned men, who had no doubt jumped at the chance of a reprieve, began to feel better, prompting the Princess of Wales to order a further experiment on six orphans of the parish in London. Eventually, she was satisfied that the practice would be safe for her own children. The procedure was successfully carried out on the eleven-year-old Princess Amelia, nine-year-old Princess Caroline and the teenaged Prince Frederick. Variolation became a popular practice in Europe, even though the fatality rate could be as high as one in five.

Despite the high death rate, variolation was seen as a vast improvement on any previous medical procedure connected with smallpox. Voltaire himself lauded Princess Caroline's efforts, writing that: 'This princess was born to encourage the arts and the well-being of mankind; even on the throne she is a benevolent philosopher; and she has never lost an opportunity to learn or to manifest her generosity.' (Voltaire's Eleventh Letter: On Smallpox Inoculation.)

The success of variolation would eventually grow dim, however, in the face of the safety and success of vaccination. The key difference between the two procedures is that variolation involved infecting a patient with a mild form of the human smallpox virus, which could potentially turn into full-blown smallpox or infect other people, but vaccination – as pioneered by Edward Jenner – used a sample of cowpox and so could not cause smallpox.

*A country doctor*

Like many of the other key figures in the history of disease eradication, Jenner was something of an oddball and outcast. He was a complex man whose many, and very varied, interests, combined with a difficult personality and his estrangement from the London medical establishment, meant that his truly great achievements were often overlooked, much to his immense frustration. Even today, the condition of his large but slightly gloomy and neglected Gloucestershire home gives the impression that the status of his work has yet to be fully appreciated.

Born in 1749 in Berkeley, Gloucestershire, Jenner was orphaned at the age of five and brought up by his sisters. His father had been the vicar of the small town and the family enjoyed the patronage of the influential Earl of Berkeley. They were neither the richest nor the most important family in the town; that privilege belonged to the Berkeleys, but life was very comfortable. After five years at boarding school, Jenner was apprenticed at the age of thirteen to a surgeon, Daniel Ludlow, in nearby Chipping Sodbury and spent six years learning about the life of a local doctor. Ludlow had himself trained at St George's Hospital in London and in 1770, his young pupil moved to the capital and spent two years living and studying with the eminent Scottish surgeon, John Hunter, who, with his brother William, was instrumental in teaching human

anatomy using fresh human specimens rather than stylized drawings.

Although he could have stayed in London, in a pattern that would become familiar, after two years Jenner decided to return to Gloucestershire to begin life as a country doctor. In Berkeley, Jenner was quite the dilettante: writing poetry, dressing in the latest fashions and playing the flute. Life before his 'great discovery' was varied, fun and challenging and his scattergun achievements were not underrated (not least by Jenner himself, who always had a very high opinion of his talents). To satisfy his academic curiosity he joined the Convivio Medical Society, which met once a week at the Ship Inn in the nearby village of Alveston. He pursued various intellectual interests, including organizing one of the first unmanned flights by a hydrogen-filled balloon and producing a seminal study on how cuckoos infiltrated other birds' nests and pushed out the existing eggs. This discovery led to him being elected as a Fellow of the Royal Society in 1788, at the age of forty. Jenner deserves additional credit for being the first doctor to identify that angina was caused by narrowing and hardening of the coronary arteries. There is no doubt that he could have furthered his career and made more money by staying in London, but Jenner liked being a country doctor, which would ultimately be fortunate for humankind.

Jenner was familiar with variolation and indeed variolated his son Edward, two servants and numerous ordinary people in his care for free, when a smallpox epidemic threatened in 1789. Jenner's biographer John Barron claimed that a milkmaid had told the young Jenner: 'I cannot take that disease [smallpox] as I have had the Cow Pox.' While variolating milkmaids, Jenner recognized that this folk wisdom was true; when milkmaids were variolated, the result was often only a small blister, rather than the expected illness.

Jenner was not the first to understand the link between cowpox and smallpox. He had first heard of the connection decades earlier and made detailed sketches of cowpox pustules to discuss with colleagues in London in 1788. His colleague John Fewster wrote a paper for the London Medical Society in 1765 entitled 'Cowpox and its ability to prevent smallpox', which they discussed at the Convivio Medical Society. Neither was Jenner the first to understand that inoculating patients with cowpox would protect them from contracting smallpox; a Dorset farmer, Benjamin Jesty, made that connection in 1774, infecting two of his children and his wife with cowpox using a darning needle.

Jenner's contribution was to establish the connection and the procedure as a proven medical practice. Famously, he experimented on James Phipps, the eight-year-old son of his gardener, using cowpox pus from the hand of a milkmaid, Sarah Nelmes and from Blossom the 'Gloster' cow. This historic event took place on 14 May 1796 but Jenner took his time to come to his conclusions. This tardiness was another reason why his discoveries were often not given the attention they deserved.

Fortunately, the experiment was successful. James Phipps complained about discomfort in his armpit and felt generally unwell. Gradually, however, these mild symptoms faded and he made a full recovery. Seven weeks after inoculating Phipps with cowpox Jenner variolated him with smallpox. James had only a very small reaction, typical of the reactions of patients who were already protected against the disease. On 19 July 1796 Jenner wrote to his friend Edward Gardener: 'I have at length accomplished what I have so been long been waiting for, the passing of the vaccine Virus from one human being to another by the ordinary mode of inoculation.'<sup>5</sup> (Although Jenner uses the words 'vaccine' and 'virus' here, he did not understand either of them in the sense that we do today.)