

Chapter 10. Smallpox and its Eradication, 1969 to 1980

Introduction

Why have a whole chapter on smallpox? The reader will know when he reads this chapter and portion of the next. For almost the whole of my career at the laboratory bench—excepting my time as a pathologist during my army service—I worked on poxviruses. Initially, with Macfarlane Burnet at the Walter and Eliza Hall Institute, I worked on infectious ectromelia, which we were able to rename ‘mousepox’. From 1950 until 1965, I spent most of my time working and writing about myxomatosis, and have written and lectured about it, off and on, ever since. In 1957, I began work on the genetics of vaccinia virus as a simpler laboratory model, with the ultimate goal of studying the genetics of virulence in myxoma virus. This gave some very interesting results, but the problem was much too complex to be solved by the techniques then available. In 1967, I was appointed Director of the John Curtin School of Medical Research and gave up research at the bench and the supervision of research students.

The World Health Organization (WHO) Intensified Smallpox Eradication Program was initiated in 1967, and in 1969 WHO set up a small committee of scientists expert in the laboratory study of poxviruses, called the ‘Informal Group on Monkeypox and Related Viruses’. I was appointed a member of that committee and served as rapporteur at its first meeting in Moscow in 1969 and Chairman for the meetings in 1976, 1978 and 1979. I missed the meetings in 1971 and 1973.

Clearly, as countries appeared to have succeeded in stopping transmission of smallpox within their jurisdictions, there needed to be an independent assessment of these claims, and International Commissions for the Certification of Smallpox Eradication were established. In April 1977, I served on the International Commission for the Certification of Smallpox Eradication in India, where I was appointed rapporteur for the final meeting. In March 1978 I was a member of the International Commission for Certification in several African countries, including Malawi. There were 23 such International Commissions and a few less formal investigations that needed to be consolidated; in October 1977 a large ‘Consultation on the Worldwide Certification of Smallpox Eradication’ was established, and I was appointed Chairman of the Consultation and later, in December 1978 and December 1979, of its successor, the Global Commission for the Certification of the Smallpox Eradication. At its second and final meeting, the Global Commission affirmed that smallpox had indeed been eradicated and produced a substantial report which contained 19 recommendations for WHO responsibilities post-eradication. As Chairman of the Commission, I presented the report and its recommendations to the 33rd World Health Assembly in May

1980, where it was approved unanimously. To put this work into context, I set out below a brief account of the disease and efforts to control it before describing my own involvement in this program.

Smallpox: the Disease

Some thousands of years ago, for humankind as a whole, smallpox was an emerging disease, and it certainly followed this pattern during the European-American exchanges and African-American exchanges that followed the discovery of the Americas by Europeans.

Clinical Features

There were several forms of the disease, with different case-mortality rates. Here I will describe only the commonest form (Figure 10.1). Infection occurred via the respiratory tract but there were no signs for 10 to 12 days after a person was infected and, during this incubation period, he or she was quite well. Then there was a sudden onset of fever, malaise, headache and backache (1 to 3 days),



Figure 10.1. The Smallpox Recognition Card, showing a child with smallpox at the pustular stage

followed by the development of a rash through stages of macules (2 to 4 days), progressing through vesicular, pustular and crusted stages over the following two weeks. All the lesions were at the same stage of development and there was

a greater concentration on the face and limbs with a predominantly centrifugal distribution; each lesion was full of virus particles.

Epidemiology

Smallpox was a specifically human disease, and the vast majority of infections resulted in disease with obvious clinical manifestations. Patients became infectious at the onset of fever and infectivity increased when the rash appeared, because lesions on the buccal mucous membranes broke down and virus was excreted in the saliva and pharyngeal secretions. Infectivity declined rapidly as these healed and the rash scabbed. Although there was a large amount of virus in the scabs, they were not an important source of infection. Recovery was followed by lifelong immunity and recurrences never occurred. These features meant that smallpox could be maintained as an endemic disease only in rather large populations, of the order of 200,000, so that small isolated populations—for example, of Amazonian Indians or the inhabitants of oceanic islands—never constituted a continuing focus of infection.

Infection occurred by close face-to-face contact, such as is common between members of the same household. Rarely, smallpox could be spread by fomites and, even more rarely, if the index case had a severe cough early in the course of the disease, infection could be airborne over moderate distances, within a bus or, rarely, a hospital, for example.

The History of Smallpox

We know a good deal more about the history of smallpox than about most diseases, because all infections resulted in a disease with a characteristic rash, which left visible pockmarks in many of those who recovered. Smallpox did not occur in the Americas, or most of Africa south of the Sahara, until these places were invaded by Europeans or people from the Middle East. It was probably endemic in the Ganges and Indus basins from as early as 500 BC, and is thought to have entered China from the west in 48 AD, moving to the Korean peninsula in 583 AD and occurring for the first time to Japan two years later. To the west of the Eurasian landmass, the major spread of smallpox occurred during the great Islamic expansion across North Africa and into the Iberian Peninsula in the 8th and 9th centuries.

By 1000 AD, smallpox was probably endemic in the more densely populated parts of the Eurasian land mass from Japan to Spain and including the African countries on the southern rim of the Mediterranean. Over the next few centuries, with the Crusades, smallpox became well established in Europe. In Africa, caravans crossing the Sahara to the densely populated kingdoms of West Africa carried smallpox as well as Islam with them, and the disease was repeatedly introduced into the port cities of eastern Africa by Arab traders.

By the 16th century, smallpox was becoming steadily more serious in European countries and statistics of smallpox deaths began to be collected at about this time, in Geneva, London and Sweden. The stage was set for the next explosive spread of the disease, with the development in Europe of ocean-going ships and the movement of European explorers and colonists to the newly discovered continents.

Smallpox played a crucial role in the Spanish conquest of Mexico and Peru and in the successful settlement of North America by the English and the French. In Africa, smallpox was introduced into Angola by the Portuguese and into Cape Town by contaminated bed-linen from a ship returning from India, with disastrous results for the aboriginal inhabitants, the Hottentots.

Immunization

As well as having an ancient history as a disease, smallpox is unique among infectious diseases in that it has a very long history of effective means of immunization. The first method was by the inoculation of pus from smallpox pustules, a process called variolation, which appears to have arisen independently in India and China in the 11th and 12th centuries. In 1721 this procedure was introduced from the Ottoman Empire into Bohemia and England, by Dr Johann Adam Riemann and Lady Mary Wortley Montagu respectively. Although it produced fearsome skin lesions at the inoculation site and had a case fatality rate of 1-2 per cent, it was deemed much better than natural smallpox, which by this time was an almost universal disease in Europe with a case-fatality rate of over 40 per cent in babies and about 25 per cent overall.

As a boy, Edward Jenner had been variolated and he was himself a variolator. But his astute observations in the early 1790s that cowpox appeared to protect milk-maids against smallpox, and then his experiments in 1796–98 showing that this was indeed the case, forever altered the history of infectious diseases. Vaccination was introduced and where it was assiduously practiced had a dramatic effect on the incidence of smallpox.

Early Attempts to Eradicate Smallpox

In 1793, just before the introduction of vaccination but at a time when variolation was widely practised in Britain, John Haygarth published a remarkable pamphlet in which he proposed to 'exterminate' smallpox from that country by a scheme that included systematic variolation throughout the country, isolation of patients, decontamination of potentially contaminated objects, supervised inspectors responsible for specific duties, rewards for the observance by poor persons of rules for isolation, fines for transgression of those rules, inspection of vessels at ports and prayers every Sunday. A few years later, shortly after publication of his *Inquiry*, Jenner had a similar vision: 'it now becomes too manifest to admit

of controversy, that the annihilation of the Small Pox, the most dreadful scourge of the human species, must be the final result of this practice.'

However, in spite of the practice of vaccination in many countries for almost a century, in 1900 smallpox was endemic in almost every country in the world. Australia, New Zealand and small islands of the Pacific Ocean and elsewhere were kept free of the disease because of their isolation and efficient quarantine services. So were the Scandinavian countries, thanks to well-conducted vaccination campaigns and containment of outbreaks.

The prevalence of the disease was greatly reduced in Europe until the disruption and mass movements of people associated with World War I exacerbated the disease in Russia, from whence it spread to Germany, Austria and Sweden—in 1919, there were some 300,000 cases in Europe. After 1923, statistics on whether smallpox was endemic in various countries was collected by the Health Commission of the League of Nations and from 1948 by the World Health Organization (WHO).

After World War II, there was a rapid fall in the numbers of endemic countries in Europe and North America, from which continents the disease was eliminated by 1953. A few of the smaller countries in Asia were also freed of smallpox, but it remained a common disease in most countries of Africa and Asia. Heartened by these results, in 1950, Fred Soper, a great enthusiast for the eradication of vector insects (*A. gambiae* and *Ae. aegypti*) and infectious diseases, persuaded the Pan American Sanitary Organization to undertake the eradication of smallpox from the Americas. Then, in 1953, the first Director-General of the WHO, Canadian Brock Chisholm, tried unsuccessfully to persuade the World Health Assembly to agree to a program for the global eradication of smallpox. The Assembly dismissed his proposal as unrealistic. Yet two years later, the same body, mesmerized by the new approach of using DDT for the control of *Anopheles* mosquitoes, agreed to a vastly more difficult program which called for the global eradication of malaria.

It was not until 1958 that global eradication of smallpox was again considered by the World Health Assembly. By that time, the malaria program, which had been strongly supported by the United States, had run into serious difficulties. The Soviet Union, which had been excluded from the Assembly for several years, returned in 1958 and, wishing to make its presence felt, put forward a carefully planned proposal for the global eradication of smallpox, which on this occasion was endorsed by the Assembly. The suggestion was that this could be achieved in 4-5 years, essentially by vaccinating and re-vaccinating up to 80 per cent of the population of each endemic country and thus producing a level of herd immunity sufficient to break the chains of transmission. The World Health Assembly resolution was accompanied by arrangements for the provision of freeze-dried vaccine to endemic countries, many of which were encouraged

to set up national smallpox eradication programs. However, no WHO funds were set aside to provide for coordination of the program.

During the next few years country-wide elimination was achieved in several more countries in Asia, Africa and the Americas, but by 1966 it was clear that progress along these lines would never achieve global eradication. The countries in which smallpox remained endemic were the hard core of the problem; the Indian subcontinent, Ethiopia, sub-Saharan Africa, Indonesia and Brazil.

The Intensified Smallpox Eradication Program, 1967 to 1977

In 1966, the World Health Assembly adopted, by a narrow margin, a resolution which included acceptance of the need for coordination of the programs of individual countries and for WHO finance from its regular budget. This resolution was put into effect in 1967, by the establishment of the Intensified Smallpox Eradication Program, to be coordinated by a Smallpox Eradication Unit at WHO Headquarters in Geneva and with the goal of global eradication within 10 years. The men who led this effort were Donald A. Henderson and Isao Arita. Success was achieved by October 1977, just a few months after the target date. What problems did the Intensified Program encounter, what were the strategies used to solve them and what were the features of smallpox that made this feat possible?

The Extent of the Problem

In 1967, the disease was still very common. Although surveillance and reporting were initially very poor, data gathered during the Program showed that smallpox was then endemic in 31 countries and imported cases had been reported in another 11 countries, and there were about 20 million cases of smallpox and two million deaths annually.

The Vaccine

Although potent and stable freeze-dried vaccine had been available commercially since 1955, in 1967 many of the endemic countries still used liquid vaccine whose stability under tropical conditions was such that only 15–20 per cent of the vaccine used in the field was of acceptable potency. To solve this, the Smallpox Eradication Unit undertook a major campaign to upgrade the quality and increase

Donald A. Henderson

Born in Cleveland, Ohio in 1928, D. A. Henderson graduated from Oberlin College and the University of Rochester School of Medicine, later receiving a Master's Degree in Public Health from the Johns Hopkins School of Hygiene and Public Health. After three years of residency training he joined the Communicable Disease Center of the US Public Health Service in 1955, serving successively as Chief of the Epidemic Intelligence Service, Chief of the Surveillance Section and, finally, as Chief of the Centers for Disease Control (CDC) Smallpox Eradication Program. In 1966, he was appointed Chief Medical Officer for the WHO Smallpox Eradication Program, a position he held until 1977, when he resigned from WHO to become Dean and Professor of Epidemiology of the Johns Hopkins School of Hygiene and Public Health. In 1990, he was appointed by the first President Bush as Associate Director for Life Sciences in the White House Office of Science and Technology. From 1993-95, in the Clinton administration, he served as Deputy Assistant Secretary for Health and Science Adviser to the Secretary of the Department of Health and Human Services. On return to Johns Hopkins in 1995, he founded a Center for Civilian Biodefense Strategies and played a central role in highlighting the need for medical and public health expertise to assume major responsibilities for the development of public health emergency preparedness. In November 2001, the Secretary of Health and Human Services asked him to direct the new office of Public Health Emergency Preparedness in the Office of the Secretary. With a budget of \$3 billion, major initiatives were taken to strengthen all components of the health infrastructure and to do the needed research in development of diagnostics, vaccines and anti-microbial agents. He returned to Baltimore in 2004, where he is now Resident Scholar at the Center for Biosecurity of the University of Pittsburgh Medical Center (the former Hopkins Center for Civilian Biodefense Strategies) and Professor of Medicine at the University of Pittsburgh. As well as sharing the Japan Prize in 1988, he is a recipient of the Presidential Medal of Freedom (2002), the National Medal of Science (1986), and other awards and symbols of recognition from a number of governments and institutions. We have been very good friends for many years, and I always stayed with him and Nana when I visited Baltimore.

Isao Arita

Born in Kumamoto, Japan, in 1926, Isao Arita graduated in medicine at Kumamoto Medical School in 1950. Between 1951 and 1961, he was employed as Medical Officer in Infectious Disease Control in the Ministry of Health and Welfare in Japan. In 1962, he joined the World Health Organization and worked in Africa. In 1966, he became a member of the newly established Smallpox Eradication Unit, becoming Chief of the Unit when D. A. Henderson resigned in 1977 and continuing in that position until 1985, when he retired and returned to Kumamoto. He was active in the work of the Unit at Headquarters and in the field, being responsible, among other things, for the supply and quality control of smallpox vaccine used in the eradication program, related poxvirus research, and development of the epidemiological surveillance and containment system, notably in the last endemic country in the world, Somalia. After the declaration of the global eradication of smallpox in 1980, he was responsible for overseeing the operation of the 19 recommendations made by the Global Commission, and for the production of the book *Smallpox and its Eradication*. In 1988, he shared the Japan Prize (with Henderson and Fenner) for this work.

From 1985 to 1992, he was the Director of the Kumamoto National Hospital, and on retirement in 1993 he established the Agency for Cooperation in International Health (ACIH), which for many years organized meetings, in which I often participated, designed to promote the use of vaccines against communicable diseases, especially in Third World countries. I have the happiest memories of working with him at WHO Headquarters subsequently and at meetings of ACIH.

the quantity of vaccine. WHO Reference Centers for Smallpox Vaccine were established at the Connaught Laboratory in Toronto and the National Institute of Public Health in Bilthoven, The Netherlands. An international meeting of producers was held, training courses established and regular quality control testing of all vaccine was introduced. In a way that was unprecedented—and was opposed by some WHO administrators on the grounds that it breached national sovereignty—quality control testing by the WHO Reference Centres was applied not only to vaccine donated through the WHO, but to that donated under bilateral aid programs and to vaccine produced in the endemic countries themselves. By 1970, the testing program had ensured that most of the vaccine used in both developed and developing countries had reached WHO standards for potency, heat stability and bacterial content.

Priorities

With a fixed sum of only \$2.4 million a year guaranteed from the WHO Regular Budget and no assistance from bodies like UNICEF, which had been disillusioned by the failure of the malaria eradication program, the Smallpox Eradication Unit had to decide upon regional priorities. The Pan American Health Organization program had been successful in reducing the endemic countries in the Americas to one, Brazil. Assistance here was a top priority. In Africa, the US Agency of International Development had already initiated a 'measles control and smallpox eradication program' in a group of 18 countries in West and Central Africa, for which WHO was able to provide assistance of a kind not possible under a United States bilateral arrangement. Smallpox had been eliminated from the Dutch East Indies (since 1949, Indonesia) in 1937, only to re-enter and spread after the War. Assistance here held out hopes for early success. However, the major attention of the program had to be concentrated on the ancient strongholds of the disease in the Indian subcontinent, with the still-endemic countries of Africa as another continuing problem. When smallpox had been eliminated from the whole of Asia and most countries of Africa by early 1975, the full resources of the Program were concentrated on the Horn of Africa, where the disease remained endemic in Ethiopia and had been exported to Somalia.

Strategies for Eradication

There were a number of factors in the strategy developed by the Smallpox Eradication Unit that led to the ultimate success of the program. The major change from that enunciated by the Soviet Union delegation a decade earlier, which relied on mass vaccination, was the elevation of surveillance and containment to a pre-eminent place. This required that in every endemic country programs for surveillance and notification had to be set up or greatly strengthened. Discovery of a case was to be followed by containment by vaccination of all contacts, in ever-increasing distances from the affected household, and the discovery and follow-up of the sources of infection. In India in particular, nation-wide 'house-hold searches' were carried out periodically, which revealed vastly more cases of smallpox than had previously been suspected. Then, as the incidence of smallpox fell to a low level, a system of rewards for reporting cases, offered to both the general public and the public health workers, ensured that the great majority of cases of smallpox were reported.

Certification of Eradication

By systematically applying these strategies, and by dint of a great deal of hard work and some good luck, smallpox was progressively eliminated from each of the countries in which it had been endemic in 1967.

Concurrently with the elimination of smallpox from countries, groups of countries or continents, a system of certification of eradication by teams of independent international experts was developed, culminating in 1977 with the establishment of the Global Commission for the Certification of Smallpox Eradication, of which I was elected Chairman. On the afternoon of Sunday December 9, 1979, after four days of intensive discussion, all members of the Commission accepted its final report, which stated that the world had been freed of smallpox and made 19 recommendations concerning the post-smallpox world, on vaccination, vaccine stocks, monkeypox, publications and the like. Five months later, on 8 May, 1980, I had the honour of presenting this report to the World Health Assembly, where it was accepted without change.

Informal Consultations on Monkeypox and Related Viruses

First Meeting, Moscow, 26–31 March 1969

10 outbreaks of a poxvirus disease had occurred in laboratory colonies of primates in Europe and North America between 1958 and 1966, which investigations showed to be caused by an Orthopoxvirus and the disease had been called 'monkeypox'. To exclude the possibility that it might represent an animal reservoir of smallpox virus, WHO organized a meeting of poxvirus experts from Australia, Japan, the Soviet Union, the Netherlands and the United States, called an 'Informal Group on Monkeypox and Related Viruses', which met first in Moscow in April 1969 and biennially thereafter. The first meeting, for which I acted as rapporteur, agreed that monkeypox virus could be readily distinguished from all other orthopoxviruses by its biological properties. A year later, sporadic cases of a human disease clinically very similar to smallpox were discovered in Côte d'Ivoire, Liberia, Nigeria and Zaire, all in areas where there had not been a case of smallpox for over a year. All of these were shown to be caused by monkeypox virus.

Fourth Meeting, Geneva, 10–13 February 1976

I had missed the second and third meetings of the Informal Group on Monkeypox and Related Infections in 1971 and 1973, but was asked to be chairman of the meeting in Geneva in 1976. The group had been expanded from nine to 17 experts in poxvirus virology and epidemiology. During the interval, there had been 21 cases of human monkeypox in six countries in West and central Africa and these had all been carefully investigated. Two were possibly transmitted from one person to another. Blood had been collected from monkeys and other wild animals, notably squirrels and rodents in the vicinity, for serological tests and attempts to isolate virus; antibodies had been detected in several species of monkeys and in rodents.

A more puzzling observation was that four isolates of a poxvirus that was indistinguishable from variola virus (called 'whitepox' virus) had been made from the kidneys of a chimpanzee, a monkey and two rodents in an area of Zaire near where seven cases of human monkeypox had occurred. The isolates had been made by virologists, headed by Dr S. Marennikova, in the Moscow Research Institute for Viral Preparations, which was one of the two WHO Collaborating Centres on Smallpox and Other Related Infections which had been established by Henderson in 1967.

Fifth Meeting, Geneva, 9–10 November 1978

The main objective of this meeting, of which I was again Chairman, was to discuss the findings of Dr Marennikova's group that viruses having some of the characteristics of whitepox virus arose as variants of monkeypox virus. Comparisons were drawn between the known white pock mutants of both cowpox and rabbitpox viruses, on which I had carried out a lot of work. It was pointed out that in those studies every mutant appeared to be different, whereas all the reported monkeypox 'white pock mutants' were identical, and, like the original 'whitepox' isolates, indistinguishable from variola virus. Arrangements were made for a virologist from the Moscow laboratory to work on the problem in the other WHO Collaborating Centre on Smallpox and Other Related Infections, in Atlanta, Georgia.

Study Group on Orthopoxviruses

First Meeting, Atlanta, USA, 26–28 June 1979.

This group was appointed by WHO on the recommendation of the meeting of the Global Commission for the Certification of Smallpox Eradication in December 1978 (see below), to continue investigations into possible animal reservoirs of variola virus and determine the importance to humans of monkeypox and whitepox viruses. It was reported that application of the relatively new technique of restriction endonuclease analysis had shown that all the 'whitepox' viruses and some of the white variants of monkeypox virus isolated in the Moscow laboratory were indistinguishable from variola virus. However, none of a large number of white variants isolated from monkeypox virus by Dr K. R. Dumbell in London had the restriction endonuclease maps or phenotypic characteristics of 'whitepox' virus. Plans were made for continued research on these problems.

Certification of Smallpox Eradication

With the imminent eradication of smallpox from Brazil, the last endemic country in the Americas, in 1971, it became necessary for the Smallpox Eradication Unit to develop procedures for assessing claims that smallpox had indeed been eradicated. Because of the widespread use of variola virus in laboratories in many parts of countries where smallpox had been endemic, it was decided that

eradication should not mean ascertainment that no virus remained but rather that transmission had been interrupted. It was decided that this should, wherever possible, be undertaken by groups of independent public health experts, epidemiologists and virologists, with assistance from WHO and from the health authorities of the country involved. To allow the country's health authorities to prepare detailed documentation of freedom from smallpox, it was decided that such independent assessments should be made not less than two years after the last known case in the country concerned. 22 International Commissions for the Certification of Smallpox Eradication operated between August 1970 and October 1979. I served on two of these Commissions, and also, with help from one other person in each case, assessed the situation in South Africa and in the People's Republic of China.

India, 4–23 April 1977

It was generally agreed among those involved in the eradication campaign that, if smallpox eradication could be certified in India, the prospects for global eradication were very good. The largest of all of the 22 formal International Commissions, with 16 members from as many different countries, assembled in New Delhi to plan field visits. During these, each member was accompanied by national and WHO personnel who had either been members of the Indian National Certification Commission or were WHO epidemiologists who had worked in India during the pre-certification activities. Each small group then visited different areas in one or two states or union territories over a period of some two weeks before reassembling in New Delhi. I went to Himachal Pradesh and Rajasthan. It was a wonderful experience, travelling through countryside I had never been able to visit in previous trips to India, with temples and palaces and the planned city of Chandigarh. We stopped wherever there were local health authorities, at state, district, or municipal primary health care levels, who had assembled data on the gradual elimination of smallpox from their area of responsibility. I was also able to go to any place I chose; in Rajasthan I picked the most isolated and primitive place that could be imagined.

All members of the team then reassembled in New Delhi and the brief reports produced by various Commission members or teams were discussed. I had been appointed rapporteur for this session, so I was kept busy all Thursday and that evening preparing a draft report. In the main, this was accepted next day, and a redraft late that morning brought it to a state that was acceptable to all members, and we had a celebratory dinner that evening. The next day, the Commission assembled in the Health Minister's office and presented him with the declaration that smallpox had been eradicated from India.

Malawi, Mozambique, Tanzania and Zambia, 6–29 March 1978

I met with other members of the International Commission in Maputo, the capital of Mozambique, on 6–7 March to discuss our program; I acted as rapporteur. We split into four groups and arranged to meet again for final discussions in Zambia on 27–29 March. Over the intervening two weeks a WHO official, Dr Abou-Gareeb, and I, together with two European medical scientists who had been assisting the local health authorities prepare for our visit, travelled around Malawi. There was particular concern about a suspected case of smallpox in 1972 in a very remote area of the country. After a long drive over 'non-roads', in heavy rain, we arrived at the village and found Mary Joseph, the suspected case. She had facial pockmarks from an attack of smallpox in 1972, which had never been reported. We found three other children in a nearby village who also had facial pockmarks, probably also dating from 1972, but there was no evidence of any more recent cases. During the next few days we drove all over Malawi, calling in at villages and hospitals, and by 19 March I was able to begin my report. We then drove to Lusaka, the capital of Zambia, and met the other members of the Commission. After a meeting lasting two and a half days (as usual I acted as rapporteur) we agreed that on the evidence that we were able to obtain, smallpox transmission had been interrupted in all four countries.

South Africa, 23 January to 18 February 1978

The most populous country in southern Africa, since the end of World War II only variola minor had occurred there and it was regarded as a trivial disease. Because of their apartheid program, at the time South Africa was not represented on the World Health Assembly. Henderson went there in 1972 to persuade them to cooperate with the WHO program, but they did not establish a national smallpox eradication program. In October 1977, the Director-General of WHO wrote to the South African Minister of Health suggesting that I should visit them early in 1978, a proposal they accepted. The purpose of the visit was threefold: (1) to advise South African health officials on how to prepare a country report for submission to the Global Commission; (2) to emphasize the importance of chickenpox surveillance and make arrangements for the collection of specimens for laboratory examination by WHO Collaborating Centres; and (3) to obtain an impression of the recent history of smallpox and rural health services in South Africa (including in some of the 'black homelands').

I arrived in Johannesburg on 23 January and was met by Dr James Gear. The next day I visited the National Institute of Virology. I discussed the problem of destroying stocks of variola virus with Gear and the Institute Director, Professor O. W. Prozesky. On 24 January, I talked at length to members of the Health Department to work out an itinerary for my visit to South Africa and Namibia (Figure 10.2).

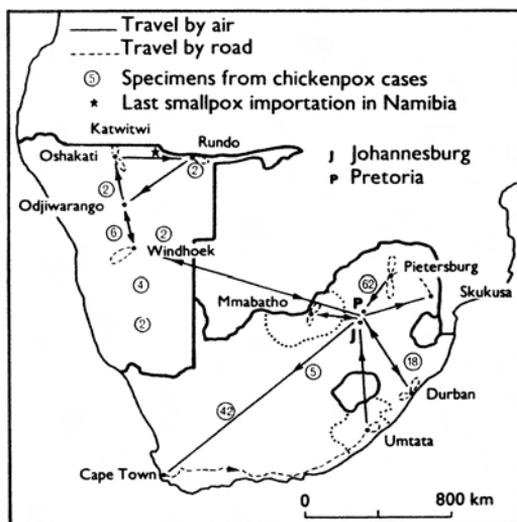


Figure 10.2. Map showing my travel by air and road around South Africa and Namibia in 1978

As I reported to WHO when I went to Geneva on 20 February:

Everywhere that I went I was received with great cordiality, and there were frequent expressions of satisfaction that WHO had arranged the visit. No effort was spared to enable me to see what I regarded as vulnerable areas, such as the more densely populated parts of Namibia, near the Angolan border and the northern parts of Transvaal (Lebowa) and Bophuthatswana, near Botswana. I was driven around the countryside and to clinics and hospitals by senior health officials, health inspectors or nursing sisters over a distance of more than 3,000 kilometres, and a chartered plane was made available for three days. Such travel provided opportunities for extensive informal discussion of the health conditions and the complex policies of these parts of Africa, as well as observation of the countryside and living conditions in the rural areas, and the rural hospitals and clinics.

Although the United Nations had terminated the South African mandate over Namibia in 1966, that country was still controlled and administered by South Africa, under the name 'South West Africa'. I spent five days there (see Figure 10.2), and met health officers and staff in hospitals and laboratories, obtained information on health services, especially the surveillance and control of communicable diseases, visited schools and conducted a limited vaccination scar survey.

South Africa, Second Visit, 11–12 October 1978

WHO had suggested to the South African authorities that they should submit their national report on smallpox by 1 June, 1978. Since nothing had arrived by September, Dr Arita asked me to revisit South Africa briefly in mid-October. I flew there across the Indian Ocean and was met, as usual, by my good friend Dr James Gear. As well as stimulating Dr de Beer, the Secretary for Health, about getting their report to Geneva soon, I discussed at some length the disposal of their stocks of smallpox virus. I then went to Geneva, where I talked with Arita and Dr Nicole Grasset about the latter's proposed visit to South Africa in November to collect their national report.

People's Republic of China, 14–31 July 1979

In the 1970s, the People's Republic of China was not recognized by WHO, and it was not possible to arrange a visit by an International Commission. Dr Joel Breman was an American who served as a member of the Smallpox Eradication Unit from 1977–80. It was decided that he and I should visit China, make extensive enquiries and arrange for a national report on the situation to be sent to WHO in Geneva as soon as practicable. Guided by Dr Jiang Yu Tu, who had trained at the Johns Hopkins School of Public Health, we spent two and a half weeks there, travelled extensively around the country, and consulted with health authorities in Beijing. Detailed records (in Chinese) were sent to WHO, translated and examined by staff of the Smallpox Eradication Unit.

Eradication from Africa, 16 October to 6 November 1979

I had been selected to be a member of the last International Commission, that devoted to the certification of smallpox eradication in Somalia, where the last field case in the world had occurred in October 1977. This took place in October 1979. However, a preliminary medical clearance was required, and my physician had reported that I had an inguinal hernia, and because of the rough terrain and distance from medical facilities, WHO refused to allow me to take part, to my great disappointment. However, it had been decided that the certification of eradication from Somalia, and therefore Africa, and the world, was an event not to be missed, and special celebrations were planned to take place in Nairobi. Although the celebratory function was to be held on 26 October, I arrived there on 19 October, because there were also a number of other important meetings, among them a meeting of the four International Commissions that had worked in Africa in October 1979: Djibouti, Ethiopia, Kenya and Somalia. I attended those meetings part of the time, but also met and talked with Henderson, Arita and Gordon Meiklejohn, who had a contract with WHO to prepare a draft Final Report of the Global Commission. I spent most of my spare time reading through Meiklejohn's report, but also met with Svetlana Marennikova and told her that on the grounds of genome mapping, I thought that her 'whitepox' viruses and

most 'white mutants' of monkeypox virus that had been described by her laboratory were due to laboratory contamination with variola virus.

The celebratory function was held in the main hall of the Kenyatta Centre, a very impressive room, on Friday 26 October. There were speeches by the Director-General of WHO, Halfdan Mahler, and Jan Kostrzewski, who had chaired the meeting of the four International Commissions, followed by a press conference. Later, an ABC reporter came to my hotel room and taped a discussion for use in Australia. Then there were speeches by the Ministers of Health of Somalia and Kenya, some impressive Kenyan dances and a fine meal. I flew to Geneva on the Sunday for a meeting with the Director-General of WHO, in preparation for the Global Commission meeting in December and the World Health Assembly meeting in May 1980.

Consultation on the Worldwide Certification of Smallpox Eradication, 11–13 October 1977

Coincidentally with the later certification visits, just described, I was involved with the larger committees set up by the Director-General of WHO, Dr Mahler, to consolidate the picture and ultimately to produce a report which could be presented to the Governing Body of WHO, the World Health Assembly, hopefully at their meeting in May 1980.

Following the usual WHO pattern, the Director-General initially called together a group of experts who might participate in the large committee as a 'Consultation' on the Worldwide Certification of Smallpox Eradication, to be held in October 1977. I spent the day before the meeting discussing the situation with Dr Henderson and Dr Arita, and they outlined the position and suggested that I should chair both the Consultation and the subsequent Global Commission.

The next day I was 'elected' Chairman of the Consultation; the participants included 17 experts on epidemiology, virology and public health from 15 countries: three from Africa, three from the Americas (including Henderson, who had resigned from WHO earlier in 1977), four from Asia, one from Australia and six from Europe, plus eight WHO advisers, from Geneva and Regional offices, and five other members of the Smallpox Eradication Unit, of which Isao Arita had succeeded Henderson as Chief. Unlike the meetings of the smaller WHO committees with which I had been involved, this meeting, and subsequent meetings of the Global Commission, adopted the United Nations convention of having all discussion translated into each of the six UN official languages: Arabic, Chinese, English, French, Russian and Spanish, although all papers were in English and most speakers used English in their presentations.

The aim was to reach, as quickly as possible, a situation at which it could be certified that smallpox had been eradicated globally. After four days of intensive

discussions it was decided to divide the countries of the world into four categories:

Category 1—those countries requiring formal certification by international commissions of experts, who would visit the countries concerned and assess their smallpox-free status by examining records and making field visits to determine whether surveillance activities would have been adequate to detect a case of smallpox if one had occurred during the previous two years.

Category 2—those countries requiring the visit of selected experts to verify and document the smallpox incidence since 1960, the last known outbreak and control measures employed, and procedures for handling suspected cases.

Category 3—certification through submission of detailed country reports.

Category 4—official statements by countries declaring their smallpox-free status during the previous two years and signed by government health authorities.

It was planned to have a meeting of the successor to this Consultation, the Global Commission for the Certification of Smallpox Eradication, in December 1978. The next two years were largely devoted to collecting the material outlined above in time for what was hoped would be the final meeting of the Global Commission in December 1979.

First Meeting of the Global Commission for the Certification of Smallpox Eradication, 4–7 December 1978.

I had been in Geneva early in November 1978 at the fifth meeting of the Consultation on Monkeypox and Related Viruses, and took the opportunity to discuss the arrangements for the First Meeting of the Global Commission with Isao Arita and Joel Breman. Then, after a week in England and a visit to Nairobi for meetings of SCOPE (see Chapter 9), I went back to Geneva for the First Meeting of the Global Commission. As for the Consultation, this was a large committee, with 20 members, eight WHO advisers, eight WHO Regional Office staff and 13 WHO Headquarters staff, including nine from the Smallpox Eradication Unit. I acted as Chairman, except when I reported on the situation in South Africa and Namibia, Jan Kowsczewski of Poland was Vice-Chairman, and Arita served as secretary.

We met for four days and considered the numerous reports that had been received from International Commissions and from and about individual countries which had been listed in categories two, three and four (above). In the majority of cases, eradication was certified; reports by International Commissions were expected in 1979 for 10 countries, mostly in Africa, and additional information was sought from five countries: China, Democratic Kampuchea (Cambodia), Iraq, Madagascar and South Africa. In addition, all countries which had not been asked to provide detailed information—for example, all countries in Europe and

the Americas—were asked to provide formal statements detailing when the last known case of smallpox had occurred in their country.

On human monkeypox, the Global Commission concluded that, although four cases of possible person-to-person infection had occurred between 1970 and 1979, this disease 'did not constitute a threat to the permanence of smallpox eradication', nor did the Commission regard the presence of human monkeypox in a country to be a justification for continuation of vaccination.

Noting that the number of laboratories holding variola virus had been reduced from 76 (in 1976) to 10, it recommended that these holdings should be destroyed or transferred to one of the two WHO Collaborating Centres and asked for a report from a group of scientific experts at the 1979 meeting. The Commission also discussed and made recommendations about the cessation of vaccination, vaccine reserves, surveillance after global certification, and documentation of the Smallpox Eradication program.

Second and Final Meeting of the Global Commission for the Certification of Smallpox Eradication, 6–9 December 1979.

As was usual with my overseas trips, this meeting came at the end of two other commitments, discussion of a UN Environment Program (UNEP) report and a meeting of the SCOPE Executive Committee in Paris. The meeting with UNEP was in Geneva, and I took advantage of this to spend several days discussing the forthcoming Global Commission meeting with Arita and Breman.

Early in 1979, Arita had arranged for Gordon Meiklejohn, Professor of Medicine at the University of Colorado, who had been a WHO consultant on smallpox almost every year from the early 1960s, had served on several International Certification Commissions and had attended the first meeting of the Global Commission, to produce a draft Final Report of the Global Commission. This was a substantial book of 65 A4 pages of text and 19 appendices, and was made available to all members before the meeting.

The participants in the meeting and the procedure were almost the same as in 1978, but the draft report was the focus of discussion. The current certification status was reviewed by Arita. Of the 79 countries considered by the Commission in 1978, 64 had been certified prior to 1979 and, of the other 15, 10 had been certified during 1979 and the action recommended by the Commission in 1978 had been completed in three of the other five. The situation in China was discussed at some length, note being taken of the fact that Fenner and Breman had spent three weeks in China in July 1979 and a substantial report had subsequently been sent to WHO. The Commission noted that the last cases in China had occurred in 1960, in the border provinces of Yunnan and Tibet, and that pockmark surveys there confirmed this. Routine primary vaccinations had

been practiced since 1950 and mass re-vaccinations at six year intervals until 1978. On the basis of the documentation provided, the adequacy of the health services at the local level, satisfactory disease reporting and the long period since the last cases, the Commission certified China free of smallpox. The other country needing consideration was Democratic Kampuchea (Cambodia) where smallpox was last reported in 1959. Although there had been some problems in obtaining formal endorsement of the country report that had been prepared by WHO, on the basis of the information supplied Democratic Kampuchea was verified as free from smallpox.

The other matters considered at some length were human monkeypox and the 'whitepox' virus. It was noted that of the 45 cases of human monkeypox reported since 1950, more than 50 per cent were among children less than five years of age, the age-group least adequately vaccinated. Of 66 unvaccinated individuals with face-to-face contact with prior cases, only four possible secondary cases occurred. WHO had just begun a six-year ecological study of monkeypox in Zaire. Preliminary results showed that 32 per cent of 234 monkey sera, from several species of monkeys, contained orthopoxvirus antibodies. It was decided that the existence of human monkeypox did not present a problem for smallpox eradication and did not justify maintenance of vaccination in African countries. The Commission noted that the other virological problem, the nature of the 'whitepox' viruses isolated from African animals, was almost certainly due to laboratory contamination with variola virus; confirmation was expected to be obtained by molecular biological experiments currently in progress.

These discussions occupied the first day of the meeting. The next three days were spent in detailed consideration of the Final Report and agreement was reached on all aspects. Commission members then signed a document indicating their agreement with the final conclusion of the report, namely that smallpox had been eradicated throughout the world.

Smallpox Eradication Program, Meeting of the World Health Assembly, May 8, 1980

I arrived in Geneva on Sunday 4 May, and spent the next few days talking with Arita, with Henderson and others visiting his new house, out in the country, looking at the conference room at the Palais des Nations where the Assembly would meet, and revising my speech. Since there had never been a ceremony like this at a World Health Assembly meeting, a number of those involved in the action had a rehearsal at 2 pm. Then, at 4 pm, we gathered for the real thing. There were hosts of photographers, television crews and the like. I sat on the rostrum with the Director-General and Deputy Director-General, the President of the Assembly and the President of the Executive Board. The President of the Assembly spoke first, to introduce me, I then spoke as Chairman of the Global Commission (Figure 10.3) and then the President of the Executive Board presented

Resolution One, accepting the global eradication of smallpox. The President of the Assembly then asked: 'Are there any objections?' After waiting for 30 seconds, during which there was no response, he banged his hammer and signed the new Assembly parchment, followed by the Director-General. Representatives of the six regions of WHO then spoke and finally the Director-General gave another short speech. Arrangements were made outside the conference room for all delegates to sign the parchment for eventual binding, and the Global Commission parchment and Resolution were placed on display in a glass case. The Director-General then hosted a reception after which I went back to my hotel and had a good sleep.



Figure 10.3. Frank Fenner addressing the World Health Assembly on 8 May 1980

