THE GLOBAL ERADICATION OF SMALLPOX

Final Report of the Global Commission for the Certification of Smallpox Eradication, Geneva, December 1979

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Foreword

On 8 May 1980, the 155 Member States of the World Health Organization, represented by their delegates to the Thirty-third World Health Assembly, unanimously accepted the conclusions of the Global Commission for the Certification of Smallpox Eradication—namely, that:

"1. Smallpox eradication has been achieved throughout the world.

"2. There is no evidence that smallpox will return as an endemic disease."

Because of the uniqueness of the achievement and the effect it has already had, and will continue to have, on the lives of people throughout the world, it is important that public health officials, historians and future generations should have access to the evidence upon which these conclusions are based. This book, The Global Eradication of Smallpox, *which is the report of the Global Commission, carefully presents and discusses that evidence. It also includes recommendations on policy for the post-eradication era to ensure that this achievement is permanent.*

The eradication of smallpox has shown that resounding victories can be attained by international cooperation when the objectives are well focused, plans are realistically constructed, and the necessary resources are made available in time. Let this final report of the Global Commission stimulate us all to reflect not only on the eradication of one disease but on how this experience can help us to attack more effectively other health problems with the same enthusiasm, optimism, and sheer hard work that characterized the successful crusade against smallpox.

H. MAHLER, M.D.
Director-General

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C O N T E N T S

PREFACE

At the beginning of the twentieth century smallpox affected every continent and virtually every country in the world at one time or another. Over the first half of the century it was eliminated from most countries of Europe, North America and Oceania, but it remained endemic in most of Africa, Asia and South America.

When the World Health Organization was set up in 1948 it singled out smallpox as an important disease the control of which should be sought by all countries, but it was not until 1958 that there was an explicit call from the World Health Assembly for the worldwide eradication of smallpox. Another 28 countries became free of smallpox during the next decade, but in 1967 the disease was still endemic in 33 countries with a total population of 1200 million and in that year it caused an estimated 10–15 million cases, with some 2 million deaths.

In 1966 the World Health Assembly took the decisive step of calling for an intensified smallpox eradication programme. For the first time, too, the eradication programme received substantial support from the regular budget of WHO. As a result, country after country achieved eradication, and in 1977 global eradication appeared imminent. Some special mechanism was now needed so that the world could be assured of the reality of this unprecedented achievement.

In October 1977 the Director-General of WHO convened a group of experts from countries throughout the world to advise the Organization on the nature of the measures that should be taken to assure the Organization and all health authorities that eradication had been achieved. Such an assurance was essential if health authorities were to take the vital decision that smallpox vaccination should be terminated and that travellers should no longer be required to possess international smallpox vaccination certificates. The experts recommended that the Director-General should formally establish a Global Commission for the Certification of Smallpox Eradication: (1) to review the programme in detail; (2) to recommend such additional activities as it deemed necessary to be certain that eradication had been achieved; (3) to report to the Director-General when it was satisfied that eradication had been achieved, and (4) to recommend such additional measures as it considered necessary for the post-eradication era. The Executive Board in January 1978 and the Thirty-first World Health Assembly in May 1978 endorsed the establishment of the Global Commission.

The Global Commission met in December 1978 to review the programme and to advise on subsequent activities. It met again in December 1979 to assess progress, and at that meeting made the final recommendations that are presented in this report. The report also contains a summary account of the history of smallpox, the clinical, epidemiological, and virological features of the disease, the efforts to control and eradicate it prior to 1966, and an account of the intensified programme during the period 1967–1979. The procedures employed for the certification of eradication are described, as well as the findings of 21 different international commissions that visited and reviewed programmes in 61 countries. These findings provide the evidence for the Commission's conclusion that the global eradication of smallpox has been achieved. In recording this achievement, the Global Commission pays tribute to the international cooperation received in the programme and to the devoted work of hundreds of thousands of health workers of all levels in many countries of the world that made it possible.

1. SUMMARY

Smallpox, described by the historian Macaulay as "the most terrible of all the ministers of death", has been a scourge of mankind since ancient times. Repeated epidemics have swept across the world, decimating populations and altering the course of history. Not until Jenner demonstrated that inoculation with cowpox would protect against smallpox was there hope that the disease could be controlled. Jenner himself foresaw the eradication of smallpox, yet, 170 years later, despite improvements in the preparation of vaccine and its widespread use, smallpox persisted in many parts of the world.

The World Health Assembly, from the time of its first meeting in 1948, expressed increasing concern about smallpox. In 1958 it reviewed the question of the eradication of smallpox from the world and in 1959, emphasizing the urgency of achieving eradication, it recommended that smallpox-endemic countries should launch special programmes for that purpose. A number of countries became smallpox-free during the following years, but in the major endemic areas of Africa south of the Sahara, Brazil and South-East Asia, little progress towards eradication had been made. In 1966 the Nineteenth World Health Assembly decided that an intensified programme was necessary, financed from the regular budget of the Organization, and it requested Member States and multilateral and bilateral agencies to provide additional assistance.

The overall development and coordination of the intensified programme were carried out by a smallpox unit established at WHO headquarters in Geneva, which worked closely with WHO staff at regional offices and, through them, with national staff and WHO advisers at country level. Earlier programmes had been based on a mass vaccination strategy. The intensified campaign called for programmes designed to vaccinate at least 80% of the population within a period of two or three years, during which time reporting systems and surveillance activities would be developed that would permit detection and elimination of the remaining foci of the disease. Support was sought and obtained from many different governments and agencies.

Progress was slow in some countries but rapid in others. The countries of west and central Africa became smallpox-free in 1970, Brazil in 1971, Indonesia in 1972, and the countries in eastern and southern Africa in 1973. Major campaigns by the countries of the Indian subcontinent, with increased WHO support, achieved eradication there between 1973 and 1975. Finally, in the Horn of Africa, Ethiopia became smallpox-free in 1976 and Somalia in 1977.

Two years or more after the national programmes had achieved eradication, and following a period of intensive surveillance, each country in which smallpox had been endemic in 1967 or after, and other countries at special risk of importations of cases of the disease, were visited by an international commission. The commissions reviewed all aspects of the programmes, particularly the surveillance component, to assess the capability of the country's health services to detect continuing smallpox transmission. Among the aspects considered were the effectiveness of the reporting system, data from surveys of persons to detect facial pockmarks, and the laboratory results for specimens collected from chickenpox cases and suspected smallpox cases. The awareness of the population about smallpox and, where appropriate, their knowledge of the reward for reporting smallpox cases were also assessed. Commission members conducted field studies that extended to many parts of each country before certifying that the country was smallpox-free.

In 1978 the Global Commission for the Certification of Smallpox Eradication was formed. This Commission reviewed all previous certification activities and recommended additional programmes for obtaining sufficient information from each country to permit it to be recognized as smallpox-free. A number of countries known to have been infected in the recent past were visited by WHO consultants or staff and special programmes were developed to assess the quality of the evidence that no smallpox had occurred since the last reported case.

The Global Commission also considered the question of the possible re-establishment of smallpox infection from virus held in laboratories or from natural or animal reservoirs. All escapes of variola virus from laboratories have been well contained. Because of the great reduction in the number of laboratories holding variola virus and the strict containment conditions required of the laboratories, the risk of escapes is now considered

minimal. Dried crusts and variolators' stocks provided a natural reservoir in which variola virus could survive for some months, but the passage of several years since the last case of smallpox also renders this risk negligible.

From the outset of the intensified campaign special attention was paid to the possibility that there was an animal reservoir of variola virus. No evidence of such a reservoir has been found. However, 45 cases of a new human disease resembling smallpox clinically have been discovered since 1970 in west and central Africa. It is caused by a distinct species of orthopoxvirus called monkeypox virus. Although cases of presumed human-to-human transmission of monkeypox virus have been recorded, this virus is genetically different from variola virus and is not believed to have the potential for epidemic spread.

As a result of its deliberations in December 1979, the Global Commission concluded that global eradication of smallpox had been achieved and made a number of recommendations for WHO policy in the post-eradication era. They include the discontinuation of smallpox vaccination, continuing surveillance of monkeypox in West and Central Africa, supervision of the stocks and use of variola virus in laboratories, a policy of insurance against the return of the disease that includes thorough investigation of reports of suspected smallpox, the maintenance of an international reserve of freeze-dried vaccine under WHO control, and measures designed to ensure that laboratory and epidemiological expertise in human poxvirus infections should not be dissipated.

2. CONCLUSIONS AND RECOMMENDATIONS

2.1 Conclusions

The Global Commission concludes that:

1. Smallpox eradication has been achieved throughout the world;

2. There is no evidence that smallpox will return as an endemic disease.

2.2 Recommendations : policy for the post-eradication era

Vaccination policy

Smallpox vaccination of the general public. As smallpox has been eradicated, smallpox vaccination is no longer justified. Because vaccination may result in serious complications, which are occasionally fatal, no one except investigators at special risk should be vaccinated in any country including those where monkeypox cases have occurred.

Recommendation (1). Smallpox vaccination should be discontinued in every country except for investigators at special risk.

Smallpox vaccination certificates for international travellers. With the certification of global eradication of smallpox, no country should now require vaccination certificates from international travellers.

Recommendation (2). International certificates of vaccination against smallpox should no longer be required of any travellers.

Reserve stocks of vaccine

Although human-to-human transmission of smallpox has been interrupted everywhere and the Global Commission believes that the likelihood of reintroduction of smallpox from laboratories or natural or animal reservoirs is negligible, it is prudent for WHO and national health authorities to be prepared for unforeseen circumstances. One measure that should be taken is to ensure that adequate reserves of potent freeze-dried vaccine are available. This vaccine should be stored at $-20^{o}C$ and its potency periodically checked. Seed lots of vaccinia virus for the further preparation of vaccine should be maintained, and stocks of bifurcated needles should be available.

Recommendation (3). Sufficient freeze-dried smallpox vaccine to vaccinate 200 million people should be maintained by WHO in refrigerated depots in two countries, together with stocks of bifurcated needles.

Recommendation (4). The stored vaccine should be periodically tested for potency.

Recommendation (5). Seed lots of vaccinia virus suitable for the preparation of smallpox vaccine should be maintained in designated WHO collaborating centres.

Recommendation (6). National health authorities that have vaccine stocks should be asked to inform WHO of the amount of vaccine maintained.

Investigation of suspected smallpox cases

Experience in many countries indicates that reports of suspected cases of smallpox can be expected to be received from many sources for several years after the certification of global eradication. The importance of thorough investigation of these reports, if necessary with laboratory testing, is illustrated by the fact that one such report led to the recognition of human monkeypox. It is also important that public confidence in the fact of eradication should be maintained by thorough and prompt investigation of all reports and disclosure of the results to health officials throughout the world.

Suspected smallpox cases should therefore be investigated by experienced personnel. WHO should provide an effective system to promote, coordinate, and participate in the investigation of suspected smallpox cases. The international smallpox rumour register that was established by WHO in Geneva in January 1978 should be maintained.

The reward of US$ 1000 established by the Director-General in 1978 in accordance with resolution WHA31.54 should be discontinued, since global eradication has now been certified.

> Recommendation (7). In order to maintain public confidence in the fact of global eradication, it is important that rumours of suspected smallpox, which can be expected to occur in many countries, should be thoroughly investigated. Information should be provided to WHO, if requested, so that it can be made available to the world community.
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> Recommendation (8). WHO should maintain an effective system to coordinate and participate in the investigation of suspected smallpox cases throughout the world. The international smallpox rumour register should be maintained.

Laboratories retaining variola virus stocks

A committee of experts meeting in February 1979 advised the Global Commission that it was necessary for scientific reasons to preserve stocks of variola virus in a few laboratories, but that the position should be reviewed in 1982. In view of the potential danger of reintroduction of smallpox from variola virus stocks held in laboratories, no more than four WHO collaborating centres should be approved as suitable for the storage of and work with variola virus in accordance with WHO safety standards. These WHO collaborating centres should report annually to WHO and their containment facilities should be periodically inspected to ensure that storage is secure and that safe operating conditions are maintained. All other laboratories should be asked to destroy any stocks of variola virus that they hold, or to transfer them to an approved WHO collaborating centre.

> Recommendation (9). No more than four WHO collaborating centres should be approved as suitable to hold and handle stocks of variola virus. A collaborating centre would be approved only if it had adequate containment facilities. Each such centre should report relevant information on its safety measures annually to WHO and be inspected periodically by WHO.
>
> Recommendation (10). Other laboratories should be asked to destroy any stocks of variola virus that they hold, or transfer them to an approved WHO collaborating centre.

Human monkeypox

Human monkeypox is a rare zoonosis that was not recognized until smallpox was eliminated from the area where it occurs. Clinically it resembles smallpox. Human cases can be expected to appear where the ecological conditions are appropriate and perhaps to show some increase as smallpox vaccination ceases and immunity wanes. Because it is caused by a poxvirus distinct from variola virus and has a limited capacity to spread between humans,

monkeypox virus does not constitute a threat to the permanence of smallpox eradication. However, it is important that close surveillance of human cases should continue and that further investigation should be made into the natural history of the disease.

> Recommendation (11). In collaboration with country health services, WHO should organize and assist a special surveillance programme on human monkeypox, its epidemiology, and its ecology in areas where it is known to have occurred. The programme should continue until 1985, when a further assessment of the situation should be made.

Laboratory investigations

There are still some important unsolved virological problems that are relevant to smallpox eradication, especially in relation to the "whitepox" viruses. The solution of these problems and preparedness for unexpected problems that might arise in relation to smallpox or other poxvirus diseases of man call for the maintenance of suitable virological expertise.

Besides encouraging scientists in various nations to continue research on orthopoxviruses, WHO has responsibility for the regular testing of the potency of the WHO vaccine reserves and for the provision of laboratory diagnostic facilities for suspected smallpox cases. It can best discharge this responsibility by continuing the system of WHO collaborating centres. If competent research workers from laboratories not approved by WHO for work with variola and whitepox viruses wish to conduct experiments with these viruses, facilities should, if possible, be provided by a suitable WHO collaborating centre. These experiments must be approved by the appropriate WHO committee.

> Recommendation (12). WHO should continue to encourage and coordinate research on orthopoxviruses.

> Recommendation (13). WHO should maintain the system of WHO collaborating centres for carrying out diagnostic work and research on orthopoxviruses.

> Recommendation (14). Research workers who do not work in a WHO collaborating centre and who wish to carry out experiments with variola or whitepox virus that are approved by the appropriate WHO committee should be offered the use of the special facilities in a WHO collaborating centre.

> Recommendation (15). Research on poxviruses other than variola or whitepox viruses should not be performed under circumstances where there is any possibility of cross-contamination with these two agents.

Documentation of the smallpox eradication programme

The eradication of smallpox is a unique event in human history and a signal achievement of WHO. It should be fully documented by the publication of a comprehensive book. Further, it is essential for future historians that all relevant documents covering matters of scientific, operational, or administrative interest should be catalogued and preserved in suitable archives. The feasibility of distributing copies of this archival material to several centres, perhaps as microfiche, should be explored.

It is important that the experiences of the smallpox eradication programme that are applicable to other health programmes should be defined and elaborated, in order to help public health officials develop strategies and tactics for the conduct of other programmes, especially those for the control of infectious diseases. However, the problem is complex since the lessons learnt from the smallpox eradication programme need to be evaluated in each instance by the health programme to which they may be applied.

Recommendation (16). WHO should ensure that appropriate publications are produced describing smallpox and its eradication and the principles and methods that are applicable to other programmes.

Recommendation (17). All relevant scientific, operational and administrative data should be catalogued and retained for archival purposes in WHO headquarters and perhaps also in several centres interested in the history of medicine.

WHO headquarters staff

The foregoing recommendations cannot be carried out successfully without central coordination, which should be provided at WHO headquarters. Since it is expected that the Global Commission for the Certification of Smallpox Eradication will be dissolved after the World Health Assembly in 1980, another mechanism is needed to enable the headquarters staff to obtain advice and assistance from scientists. This could be achieved by setting up a committee on orthopoxvirus infections.

Recommendation (18). An interregional team consisting of not less than two epidemiologists with past experience in the smallpox eradication campaign, plus supporting staff, should be maintained at WHO headquarters until at least the end of 1985. At least one additional field officer should be assigned to cover areas where human monkeypox is under investigation.

Recommendation (19). WHO should set up a committee on orthopoxvirus infections.

3. HISTORY OF SMALLPOX, VARIOLATION, AND VACCINATION

3.1 Possible origin of smallpox and history of its global spread

It is not known when or where smallpox first appeared. Current knowledge suggests that one of the poxviruses of animals may gradually have become adapted to man. Because of the need of the virus to spread continually from person to person in order to survive, historians speculate that smallpox may have first emerged in one of the agricultural settlements of north-east Africa, China, or the Indus valley some time after 10 000 B.C. A suggestive rash on the mummy of Ramses V (1160 B.C.) and descriptions in ancient medical and religious texts of uncertain age in China and India are consistent with such a speculation.

Few countries, and no continents, escaped being at some time affected by smallpox. By the eighth century A.D. the disease was already established in southern Europe and had been introduced from China into Japan. Arab armies carried it across north Africa from Egypt in the seventh and eighth centuries; outbreaks occurred in Arabia and Ethiopia in 570 A.D. and in Alexandria shortly before 641 A.D. The earliest specific reference to smallpox in Africa south of the Sahara was in the sixteenth century, but the disease almost certainly had existed there centuries before. Southern Africa was apparently spared until the disease was imported into Capetown from India in 1713. It was introduced into Iceland for the first time in the thirteenth century, and spread from there to Greenland in the fifteenth century.

Early in the sixteenth century smallpox was imported from Spain or Africa into the New World to the Caribbean island of Hispaniola. In 1520 it spread from Cuba to the Aztec empire of Mexico, where it reportedly killed over three million persons. It devastated the Peruvian empire, over two thousand miles to the south, less than five years later. North of Mexico, the first accounts of smallpox among natives of the American mainland originated from Massachusetts early in the seventeenth century.

The disease reached Australia in 1789, a year after the first European settlement there, and finally invaded New Zealand and Hawaii around the middle of the nineteenth century. Just as variola major completed its sweep around the globe, variola minor was first noted in southern Africa early in the nineteenth century and in the West Indies later in the same century. Subsequently, variola minor spread throughout North America and Europe. In the twentieth century the more benign variola minor was the predominant type of smallpox in Brazil, North America, and southern Africa.

In the course of its lethal wanderings smallpox exercised enormous influence on human affairs. In Asia it killed emperors of China and Japan and disrupted wars in colonial Ceylon. Prayers for relief were made to goddesses of smallpox in Africa, China, and India. Following the death of one Chinese emperor from smallpox, one of his sons was elected as the new emperor expressly because he had already had the disease. Yoruba-speaking people in West Africa worshipped a god of smallpox. In Africa it killed two kings of Dahomey and devastated the Hottentot tribe in southern Africa. In Europe smallpox killed five reigning monarchs in the eighteenth century alone, ended the English royal House of Stuart, shifted the Austrian Habsburg line of succession four times in as many generations, and caused a violent pandemic after the Franco-Prussian War of 1871. The disease killed an estimated 400 000 Europeans a year and caused over a third of all the blindness in Europe at the end of the eighteenth century. In the Americas smallpox facilitated the European conquest and colonization by decimating native American populations. It also prevented an American army from capturing Canada in 1776.

Smallpox and religion were intertwined in many ways. Smallpox was first introduced into Japan from China with Buddhism, carried across North Africa with Islamic armies, and reintroduced into Europe by returning Crusaders. Fear of the disease is said to have been a significant force in encouraging the early growth of Christianity, just as scarring from smallpox sent many medieval European girls and women into nunneries. In parts of Africa burial rites for victims were responsible for spreading the disease among mourners.

There has never been a specific treatment for smallpox. Of the many treatments used to combat smallpox none was so curious or persistent as the belief, which evolved in tenth-century Japan, that red coloured objects would help cure victims. Treatment with red light was the subject of clinical trials in Africa, Europe, and North America early in the twentieth century, but like all other treatments it failed.

3.2 Early efforts at control

3.2.1 Variolation as a method of control

Deliberate inoculation (variolation) of susceptible persons with smallpox virus was practised in Africa, China, and India for centuries before being introduced into Europe and North America in 1721. The aim was to induce immunity by a less severe infection than that experienced by persons contracting smallpox by the natural respiratory route. In ancient India Brahmin priests travelled the countryside in spring, the smallpox season, reciting prayers to the smallpox goddess and inoculating susceptible persons. Accounts of inoculation in China ascribe its first appearance to the eleventh century A.D., although it may have been practised much earlier. Variolation spread across Asia to Persia and Turkey. Lady Mary Wortley Montagu, wife of the British ambassador, observed inoculation in Constantinople and introduced it as medical practice in London in 1721, although it may have existed already as a folk practice in the rural areas of several European countries. In America another non-medical person, Reverend Cotton Mather, learned of the practice from his African slave and introduced it in Boston in 1721; he made a survey of slaves in Boston who had come from different parts of Africa at the beginning of the eighteenth century and showed that inoculation had been practised widely in Africa for some time. Variolation spread slowly to other parts of Europe and North America in the two generations before Jenner discovered vaccination. Unlike those who had been vaccinated, variolated persons could transmit smallpox to unprotected persons in the same community. While inoculation may have decreased the toll of smallpox in some parts of Europe and North America in the eighteenth century, there is no evidence that it had a major public health impact in Africa or Asia in the centuries before.

During the smallpox eradication campaign the practice of variolation continued in remote rural areas of Africa and Asia. In Afghanistan and Ethiopia in particular it caused many outbreaks. The practice was gradually discontinued as smallpox disappeared. The last known variolation was recorded in Bale Province in southern Ethiopia in August 1976 and was associated with the last smallpox outbreak in that country.

3.2.2 Vaccination as a method of control

One practitioner of inoculation was Edward Jenner, a country doctor practising in south-west England. Jenner asserted that over two decades before his momentous discovery he had heard a country girl remark that she could not be infected with smallpox since she had already had the cowpox. This belief had existed in England for decades. Benjamin Jesty, a cattle breeder in Dorset, England, actually inoculated his wife and two sons with cowpox in 1774 to protect them during an outbreak of smallpox. In his own practice Jenner observed that some persons who had had cowpox were refractory to smallpox inoculation. Jenner's own signal contribution was not that he inoculated a few persons with cowpox but that he then proved that such persons were immune to smallpox by subsequently inoculating them with smallpox. He then showed that cowpox could be transferred from one person to another by inoculation. He administered his first "vaccination" with cowpox on 14 May 1796. Two years later he announced his findings in a privately published pamphlet entitled An Inquiry into the Causes and Effects of Variolae Vaccinae, a Disease, Discovered in Some of the Western Counties of England, Particularly Gloucestershire, and Known by the Name of Cow Pox.

In London Dr George Pearson, who performed a few vaccinations himself, conducted a nationwide survey of English doctors, soliciting more evidence of persons resistant to smallpox or variolation or both after cowpox infection. Dr William Woodville, who was in charge of London's smallpox and inoculation hospital, obtained cowpox material during a local outbreak in cattle and vaccinated several hundred persons early in 1799. Woodville, unfortunately, carried out his vaccinations in the smallpox hospital, and many of those he vaccinated were also infected with smallpox, an unfortunate occurrence that caused some of the vaccine lymph he supplied to other physicians to be contaminated with smallpox. In spite of sometimes confusing observations, scepticism, and hostility, vaccination was nevertheless quickly recognized as a safe and effective way to protect against the deadly smallpox. As a consequence, the practice spread more rapidly than inoculation had.

By 1801 more than 100 000 persons had been vaccinated in England, and Jenner's Inquiry had been translated into five languages. Pearson shipped vaccine to over a hundred physicians in Europe in 1799. Jenner made special efforts to send vaccine to India and to

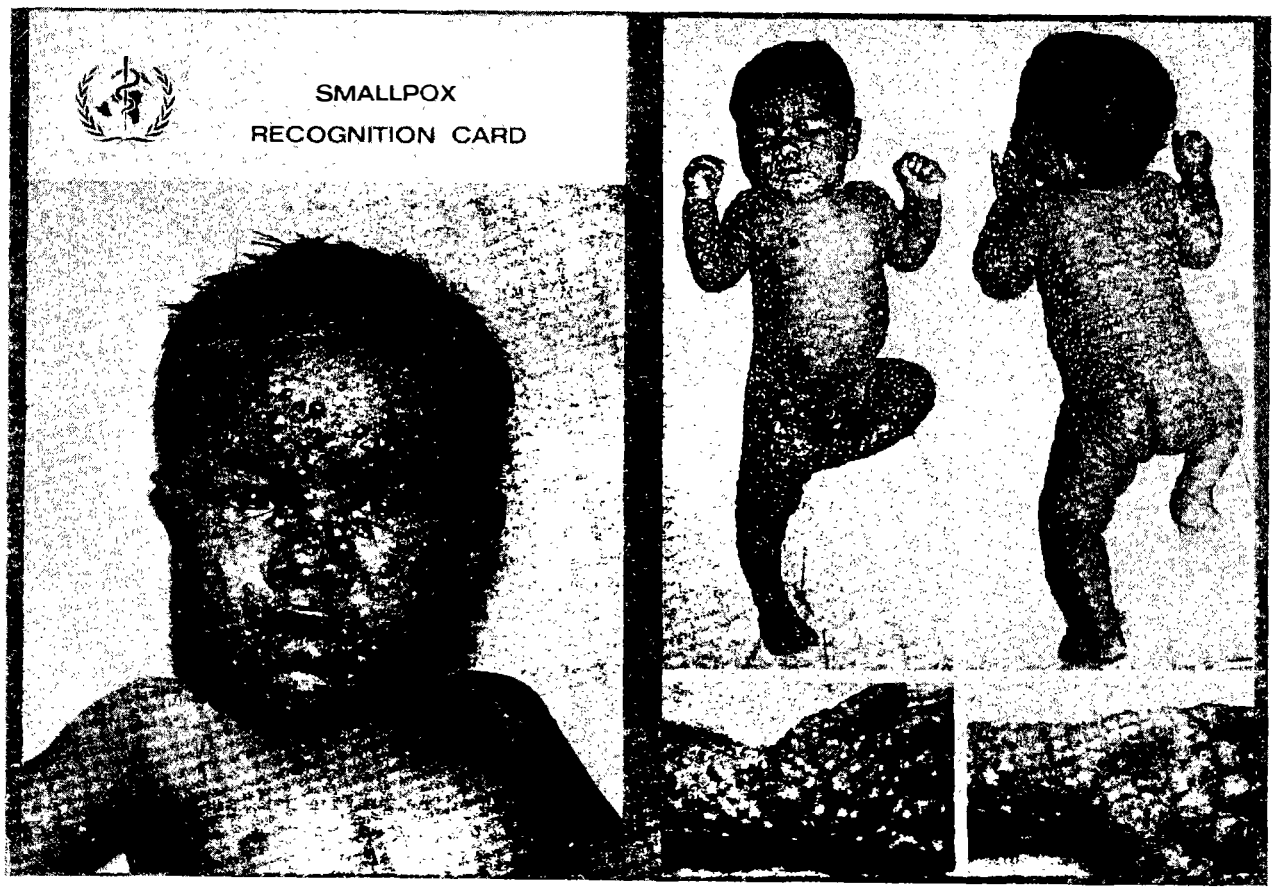
North America. But the most spectacular efforts to promote vaccination were made by Charles IV of Spain, who in 1803 dispatched vaccine to his farflung dominions around the world by means of children vaccinated arm-to-arm in succession during the voyages.

Jenner himself understood the importance of his discovery and in 1801 predicted that "the annihilation of smallpox - the most dreadful scourge of the human race - will be the final result of this practice".

As the effectiveness and safety of vaccination became appreciated, governments began to require citizens to be vaccinated. By 1821 vaccination was legally compulsory in Bavaria, Denmark, Hanover, Norway and Sweden. Problems arose as a result of the arm-to-arm passage of cowpox virus, which sometimes spread syphilis and hepatitis. Failure of vaccination required that new strains should be obtained. Nor did the natural disease of cattle occur everywhere; Dr Negri in Naples solved this problem in the mid-1840s by passing vaccine material from cow to cow and then inoculating persons from the infected cattle. Negri's discovery laid the groundwork for more plentiful supplies of vaccine. A further improvement was made in 1850 when Cheyne found that mixing vaccine lymph with glycerol would prevent decomposition and allow prolonged storage of the vaccine.

As the nineteenth century progressed many countries in Europe adopted compulsory vaccination and the incidence of smallpox gradually fell. The problem of the stability of vaccine, particularly important in tropical areas, stimulated the development of dried vaccine preparations in France and Germany. In Indonesia room-dried vaccines contributed to eradication in the late 1930s. In the 1950s the development of a method for the large-scale production of freeze-dried vaccine solved the problem of vaccine for use in tropical areas.

Fig. 1 The smallpox recognition card used during surveillance activities shows a typical case of variola major



4. CLINICAL FEATURES AND DIAGNOSIS OF SMALLPOX

4.1 Clinical course

The incubation period is 10-12 days from exposure to the onset of illness, with a range of 7-17 days. During this period the patient is well. The pre-eruptive stage of the illness then starts abruptly with fever, headache, muscular aching, prostration and, often, nausea and vomiting. These symptoms persist and, two or three days later, the rash begins its characteristic development. The earliest lesions are small macules, which progress over the period of a week to form vesicles and then pustules (Fig. 1). During the next week scabs form and fall off over 1-2 weeks leaving depigmented areas. Most cases are easily recognized during the acute phase, and for weeks or months after recovery the characteristic distribution of pigmentary changes makes it possible to discover recent cases. Later on, facial pockmarks identify persons as former victims of smallpox. A detailed description and a classification of the clinical features, including the various types of rash and of haemorrhagic smallpox, are presented in Annex 2.

4.1.1 Case fatality rate

The reports of case fatality rates over the years are difficult to interpret because the completeness of the reporting of either the number of cases or the number of deaths is in doubt, and adjustments are usually not made for important factors such as the age and vaccination status of the patients. Regardless of the country, the case fatality rates were highest in the early years of life, particularly infancy, and in older persons, and were far higher in the unvaccinated than in the vaccinated. In the outbreaks listed under India in Table 1, the case fatality rate was 6.2% among persons with vaccination scars, compared with 26.5% in the unvaccinated. The figures listed in Table 1 were collected during the eradication campaign after active surveillance had been organized and from outbreaks where the case finding was reasonably complete. The overall case fatality rates are distributed over a wide range from 20% to 0.2%, suggesting that the division of smallpox into a major and a minor form is an oversimplification. It seems likely that there were variola viruses in circulation covering a wide spectrum of pathogenicity; this is in accord with virological observations made during the eradication programme. Viruses of differing pathogenicity might have been present in a country at different periods or even simultaneously, thus further complicating the interpretation of the country's case fatality rates. The case fatality rates shown for the countries of the Indian subcontinent are considerably lower than those reported in the past. The differences can be largely explained by the fact that reporting became more complete, so that many mild nonlethal cases not previously recorded are included in the data; earlier series were compiled from hospitalized cases.

Table 1. Case fatality rates in smallpox[a]
(selected data)

Country	Year(s)	Cases	Deaths	Fatality rate (%)
India	1974-75	2 826	575	20.3
Bangladesh	1975	1 127	207	18.4
Pakistan	1971	1 674	249	14.9
West Africa	1967-69	5 628	540	9.6
Indonesia	1969	11 966	950	7.9
Tanzania	1967-70	2 232	167	7.5
Uganda	1966-70	1 045	54	5.2
Sudan	1970-72	2 979	35	1.2
Ethiopia	1972-74	21 250	243	1.1
Brazil	1969	6 795	37	0.5
Somalia	1977	3 229	12	0.4
Botswana	1972	1 059	2	0.2

[a] Includes both vaccinated and unvaccinated cases.

4.2 Clinical differentiation from other diseases

Most cases of smallpox were typical and readily recognized by experienced health workers and older persons in formerly endemic areas. The disease that most closely resembled smallpox was chickenpox. Although mild cases of smallpox were occasionally difficult to differentiate from chickenpox, several features tended to separate them. In smallpox the pre-eruptive illness was longer and more severe. The skin lesions tended to appear in a single crop and lesions on any part of the body were in the same stage of development. The rash tended to be more intense on the extremities than on the body and usually involved the palms and soles. In contrast, the rash of chickenpox showed lesions in several stages of development at the same time and was distributed more heavily on the trunk than on the extremities. Papules, vesicles, and crusts were seen simultaneously on the same part of the body and new lesions continued to appear for several days. Nevertheless, even experienced observers were sometimes unable to differentiate mild or modified smallpox from chickenpox. This was the major reason for placing so much importance during the latter phases of the eradication and the certification phase on obtaining specimens from chickenpox outbreaks for a definitive laboratory diagnosis.

Other diseases that caused some difficulty in diagnosis are numerous but less important. Measles causes fever with rash and in some populations is responsible for many deaths in the young; the rash may resemble smallpox during the early macular stage, but does not vesiculate. The lesions of generalized vaccinia may closely resemble those of smallpox and help from the laboratory may be essential for diagnosis. A variety of other pustular skin eruptions caused difficulty, including syphilitic rash, infected insect bites, scabies, and drug eruptions. Monkeypox, which was first recognized after smallpox was locally eliminated, has a rash and course that are indistinguishable from those of smallpox.

4.3 Laboratory diagnosis

When smallpox was highly endemic laboratory diagnosis was of minor importance because in any outbreak there were many typical readily diagnosed cases. Cases in which the diagnosis was uncertain were treated as smallpox. Laboratory diagnosis was used extensively when cases had been reduced to a small number and during the certification process, since it was of critical importance to confirm or disprove a diagnosis of smallpox in any suspect case. Over 16 000 specimens were tested at the two international diagnostic centres in Atlanta and Moscow between 1967 and 1979 (Annex 3).

By 1967, with the introduction of the negative staining technique, electron microscopy became a rapid, accurate and sensitive method of laboratory diagnosis. Virus particles with a characteristic brick-shaped morphology (Fig. 2) could be seen in scrapings from macular or pustular lesions or in suspensions prepared from crusts. The particles were very stable and specimens in transit for many weeks retained recognizable virus particles, even when the specific antigen and the viability of the virus had been lost. An additional advantage of electron microscopy was that herpesvirus particles could be seen and so a diagnosis of chickenpox or herpes simplex could be established.

The disadvantages of electron microscopy were that the test could be carried out in sophisticated laboratories only and that the virus particles seen were identifiable only as typical of the poxvirus family. In most suspect cases this was adequate confirmation of the diagnosis, but in doubtful cases other poxviruses such as monkeypox or vaccinia could not be distinguished from variola virus.

The vesicular and pustular lesions of smallpox and the crusts contain considerable quantities of viral antigens. Demonstration of such specific antigens had been used as a diagnostic test for many years. The gel precipitation method was used by WHO collaborating laboratories, but its sensitivity was low compared with that of electron microscopy and culture and it proved to be of limited value.

Variola can be distinguished from other poxviruses only if the virus is viable so that its biological characteristics can be studied. Vaccinia, cowpox, variola, and monkeypox viruses each produce distinctive lesions on the chick chorioallantois and can easily be distinguished by this means alone. Additional biological tests were usually used to confirm the identification.

Serological tests can be used in diagnosis through the demonstration of complement fixing, haemagglutinating, and neutralizing antibody. In a few instances serological studies were useful in determining retrospectively whether outbreaks detected late had been caused by smallpox or chickenpox. However, because of its simplicity and greater sensitivity, electron microscopy rather than serology was the method principally used in diagnosis.

Fig. 2 Electron micrograph of variola virus isolated from a specimen from the last known case of smallpox in the world (magnification: X 100 000).

5. EPIDEMIOLOGY OF SMALLPOX

5.1 Infectivity

The patient was not infectious during the incubation period or the first day or two of the pre-eruptive phase of the illness. With the earliest appearance of the rash, which was often accompanied by oropharyngeal lesions, the patient became infectious and could transmit the virus throughout the course of the illness. However, many epidemiological observations indicated that transmission to contacts was most frequent during the first week. Virus occurred in material draining from ruptured pustules and in scabs for a longer period, but infection from this source appeared to be far less frequent.

Secretions from the oropharynx soon contaminated the face and the body, the clothes and the bedding. Spread usually resulted from direct face-to-face contact with patients via infected droplets or from physical contact with patients or contaminated articles. Cases were therefore most likely to occur in persons sharing the same bed, room, or hut; however, susceptible persons in the same room sometimes escaped infection and those in nearby huts were rarely infected unless they entered a patient's dwelling or otherwise had close contact with him. However, the handling or cleansing of the corpses of victims in preparation for burial carried a high risk.

Investigations of outbreaks caused by importations into developed countries in temperate areas showed that, in a closed environment, airborne virus could sometimes spread within buildings for considerable distances and infect persons in other rooms or on other floors; this was not of epidemiological importance in houses or hospitals in tropical countries, which are usually open.

5.2 Immunity

Second attacks of clinical smallpox, if they occurred, were extremely infrequent. Subclinical or inapparent smallpox infections were of no epidemiological importance. Studies on the duration of excretion of the virus indicated that a prolonged carrier state did not exist.

Smallpox sometimes occurred in persons who had been vaccinated many years earlier and whose immunity was waning. Vaccinated persons had milder diseases, shed less virus, and were in general less efficient transmitters than the unvaccinated.

5.3 Spread

If smallpox patients were isolated in a setting where they had contact only with adequately vaccinated or previously infected persons, the chain of transmission was broken. By identification and immediate isolation of contacts who became ill a barrier to further transmission was established. This made it possible to interrupt transmission in the home or, in the case of importation of smallpox, through appropriate isolation procedures.

Because of its long incubation period and relatively low communicability, smallpox sometimes smouldered for long periods even in a relatively small population. In a small village or nomadic group, particularly one with low immunity, it occasionally persisted for months, involving new persons at approximately two week intervals. On the other hand, when the vaccination coverage was high, some outbreaks died out without intervention.

In urban areas the spread of smallpox followed more complex patterns. As in rural communities contiguous house-to-house spread was common, but greater geographical dispersion occurred owing to wider contacts. Prolonged outbreaks in urban areas seeded the surrounding rural areas as patients or infected contacts returned to their villages. Conversely, rural transmission was responsible for reintroducing the disease into cities through the movements of people with or people incubating the disease. The relative importance of urban and rural transmission in maintaining the endemicity of the disease differed in different settings. In general, as the intensified programme progressed, endemic smallpox was controlled in the large urban centres but persisted in villages and among nomads.

There were differences between the patterns of spread of variola major and variola minor. The former was a severe disease that usually immobilized the patient early in the pre-eruptive phase and throughout the illness. Secondary cases occurred for the most part in the immediate vicinity of the primary case. Variola minor, on the other hand, was frequently so mild that patients remained ambulatory during the infectious phase of their illness and were able to spread the infection far more widely. Transmission chains were more difficult to trace, and the lack of concern many communities felt for this mild disease increased the difficulty of containment and of eradication.

5.4 Age incidence

Unless previously infected or vaccinated, persons of all ages were susceptible. However, smallpox was most commonly a disease of childhood because immunity, owed primarily to vaccination, increased with age.

5.5 Seasonal incidence

The reported incidence of smallpox in many parts of the world showed distinct and consistent seasonal patterns. A low seasonal incidence reflected fewer chains of transmission and intensive containment during this period accelerated the elimination of smallpox in some countries. Many explanations for seasonal fluctuation have been offered, including the effect of humidity and temperature on the survival of the virus, the effect of wet or dry periods on population activities and movements, and reduced case reporting during periods when communications were interrupted. These factors were of varying importance in the different epidemiological situations.

6. INTERNATIONAL INVOLVEMENT IN CONTROL AND ERADICATION : 1924 - 1966

6.1 1924 - 1947

The first monthly supplement of the WHO Weekly Epidemiological Record, in June 1947, presented data on the incidence of smallpox between 1924 and 1947 that had been reported to the epidemiological services of the International Office of Public Health of the League of Nations (Annex 1). Reporting was incomplete during that period and the actual number of cases was undoubtedly far greater than reported. Although the number of countries and reporting areas changed greatly following the Second World War, it remained relatively constant during the period 1924-1947 and it is possible to observe certain trends. Table 1 shows, at five-year intervals, the number of countries on each continent that were reporting smallpox cases.

Table 1. Number of countries and areas reporting cases, 1926 - 1947

Continent	1926	1931	1936	1941	1946	1947
Africa	27	37	37	30	41	38
N. and S. America	12	14	16	17	15	15
Asia	20	20	18	16	20	21
Europe	19	13	9	6	11	11
Oceania	1	--	--	--	--	--
TOTAL	79	84	80	69	87	85

At the beginning of this period smallpox was present in most countries in the world, including those of Europe and North America. Between 1926 and 1941 the number of countries reporting cases decreased from 79 to 69, mainly as a result of a decrease in the number of European countries reporting smallpox. In North America variola minor continued to occur in Canada and the United States, but the number of cases had fallen to a level far below that of 1926. Most of the larger countries in Africa, Asia and South America continued to report substantial numbers of cases.

The Second World War was responsible for a sharp deterioration in the situation and in 1946 the number of countries reporting smallpox cases increased to 87. Large epidemics occurred in the countries of Africa north of the Sahara, and cases were imported into most west European countries, often followed by periods of endemic transmission. In Asia the situation worsened. For example, 230 849 deaths were reported in India in 1944 and it is probable that more than one million cases occurred. This situation had changed little by 1948 when WHO was established.

6.2 1948 - 1957

At its first meeting in July 1948 the World Health Assembly decided that the Expert Committee on International Epidemiology and Quarantine should form a joint study group on smallpox. During the next 20 years action on smallpox was taken at all but five of the annual Health Assembly meetings (Annex 4). The Director-General was requested to explore ways of implementing a campaign against smallpox and to urge health authorities to conduct such campaigns as an integral part of public health programmes. In 1955 the Seventh World Health Assembly requested the Director-General to continue studies on the most effective methods of smallpox control, with particular reference to those countries in which the disease was endemic, and to provide, within budgetary limitations, the assistance requested by national administrations in the furtherance of their smallpox control programmes. At the end of this period, in 1958, the Eleventh World Health Assembly noted that smallpox remained widespread and that in many regions of the world endemic foci existed constituting a permanent threat of propagation. It further noted that the funds devoted to the control of and vaccination against smallpox exceeded the amount required for the eradication of the disease and that the eradication of smallpox might make such expenditures redundant.

6.3 1958 - 1967

The Eleventh World Health Assembly accordingly, following a motion by the USSR delegation, requested the Director-General to investigate the means of ensuring the worldwide eradication of smallpox and to encourage the preparation during 1958 - 1960 of sufficient vaccine and the training of vaccinators among the local population. He was also requested to formulate recommendations for the production of a sufficient amount of heat-stable vaccine suitable for prolonged storage and use in tropical and subtropical regions of the world. The Health Assembly further recommended that the populations in which the principal endemic foci existed should be vaccinated during 1959 and 1960, and that additional vaccinations should be carried out in 1961 and 1962 in foci where the disease persisted.

In June 1958 the Executive Board took note of gifts of smallpox vaccine by the Governments of Cuba and the USSR and established a special account that would be credited with the value of the gifts. It further decided that assets in the special account would remain available until utilized and requested the Director-General to ensure that any vaccine donated for the programme was of acceptable quality.

Between 1958 and 1966 the Health Assembly addressed itself every year to the question of the eradication of smallpox. Governments were encouraged to institute, and later to intensify, national smallpox eradication programmes. Efforts were made to increase the supply of suitable vaccine and to provide assistance to the national programmes. In 1959 a WHO Study Group on Requirements for Biological Substances made recommendations on the manufacture and standardization of freeze-dried vaccine. Economically advanced countries were urged to make voluntary contributions to the special fund, and donations of vaccine were received from many governments.

In January 1964 a WHO Expert Committee on Smallpox reviewed the existing state of knowledge of smallpox and the progress of the eradication programme. It noted that the global eradication of smallpox was well within the bounds of possibility. It stressed the need for the use of freeze-dried vaccines. It observed that the goal of vaccinating 80% of the population, as proposed by WHO, had been unsatisfactory in some national programmes; the coverage had been much lower in some segments of the population and smallpox transmission continued. The Committee defined three phases for the programme: (1) the preparatory phase, including a detailed plan submitted to WHO for consideration; (2) the attack phase, with concentration on areas of high population density, whether urban or rural, the goal being 100% coverage; and (3) the control phase, with continuation of the vaccination programme,

epidemiological investigation of outbreaks, and "ring" vaccination around outbreaks. Emphasis was placed on close international cooperation and independent concurrent evaluation of the results of vaccination coverage.

The Eighteenth World Health Assembly in 1965 passed a resolution declaring that the worldwide eradication of smallpox was one of the major objectives of the Organization. In the following year, on the recommendation of the Executive Board, the Nineteenth World Health Assembly decided that WHO should undertake an intensified global eradication programme and that WHO participation in the programme should be financed from its regular budget. It further urged countries to hasten plans to institute or strengthen programmes, requested Member States and bilateral and multilateral agencies to provide adequate material support, and decided that the regular budget or the Special Account for Smallpox Eradication might meet the costs for: (1) supplies and equipment necessary for the programme in individual countries, and (2) services that might be required in individual countries and could not be made available by the governments of such countries.

A WHO Scientific Group on Smallpox Eradication met in Geneva in October 1967, reviewed the successes and failures of the preceding 20 years and provided overall guidance on strategy. It noted that in the Americas, a regional eradication programme started in 1950 had succeeded in virtually eliminating the disease from all the countries of the Region except Brazil. Several countries in north Africa, Asia, and the Eastern Mediterranean area had been freed from the disease by intensified vaccination programmes. In fact, between 1960 and 1966, 24 countries had reported that they had achieved eradication. These included 11 countries in Africa, 7 in South America, and 6 in Asia. However, eradication had not been achieved in most of the larger endemic areas; in at least 50 countries smallpox was endemic or the countries were at high risk from importations from neighbouring countries (Annex 1). The reported world incidence of smallpox had not significantly decreased and reporting was recognized as incomplete.

The Scientific Group, in its analysis of the reasons for the failure of some programmes, pointed to several common features: (1) supervisory personnel had failed to check the vaccination coverage, and the lack of a proper assessment had led to the assumption that the coverage was good when in fact it was not; (2) concealment of cases and the absence of proper notification had resulted in epidemic spread when the health department could easily have contained the outbreak; (3) failure to use the more stable freeze-dried vaccine had frequently resulted in the failure of an otherwise well conducted programme; and (4) in several instances the initial good execution of a programme had not been maintained; a susceptible population had therefore gradually accumulated, composed of children born after the initial programme, of people missed previously, and of immigrants. When smallpox had been reintroduced from infected neighbouring countries localized outbreaks had occurred. In the absence of an adequate surveillance-containment programme smallpox had been re-established in some countries as an endemic disease.

7. THE ESTABLISHMENT OF THE INTENSIFIED SMALLPOX ERADICATION PROGRAMME

7.1 Headquarters

Following the Health Assembly's decision in 1966 to undertake an intensified global eradication programme, a smallpox eradication unit was established in the Division of Communicable Diseases at WHO headquarters, Geneva. It comprised four medical officers, two administrative officers, and three secretaries. Its budget was $ 400 000, covering primarily salary support for the headquarters staff, travel funds, and $ 40 000 for research. Other units at headquarters provided assistance for the programme in such areas as public information, the shipment of vaccine and specimens, the recording of data, and administrative support services.

As an initial step in providing overall direction and coordination to the programme, a 265-page handbook for smallpox eradication programmes in endemic areas was prepared and issued in July 1967. The handbook contained technical information, a description of programme strategy, and alternative possible operational approaches. Subsequent coordination and guidance were facilitated by the distribution of special surveillance reports in September and December 1967. From May 1968 on, they were published every two to four weeks in the Weekly Epidemiological Record. With one or more specially prepared technical or descriptive-operational papers, the surveillance reports were sent to all WHO and national

smallpox programme staff. These communications ensured that all concerned were kept up to date on progress and problems in the global programme, on the practical lessons and approaches derived from the different programmes, on technical advances, and on epidemiological observations of possible use. One or more inter-country seminars held each year facilitated communication between programmes still further.

Advice and assistance were willingly provided by experts and laboratories in many parts of the world. Overall guidance on strategy and methodology was provided by the WHO Scientific Group on Smallpox Eradication that met in October 1967 and the WHO Expert Committee on Smallpox Eradication that met in 1971.

Two WHO collaborating laboratories (Annex 5) were designated as reference diagnostic centres for testing specimens from suspect cases and for research (the Center for Disease Control, Atlanta, Georgia, USA, and the Research Institute of Virus Preparations, Moscow). To assist other laboratories engaged in the examination of specimens, a group of scientists collaborated in the preparation of a Guide to the laboratory diagnosis of smallpox for eradication programmes, published in 1969. Other WHO collaborating laboratories undertook a variety of studies on the biology of poxviruses and the epidemiology of smallpox. WHO collaborating laboratories also participated in the development of vaccine production (section 8.1.4).

To provide overall direction for research on poxviruses an informal working group was established, comprised of virologists and epidemiologists. This group met every one to two years and decided which studies were of priority and which laboratories would conduct the studies. Interim reports of work in progress were regularly circulated among the participants, who represented seven laboratories in six different countries.

Educational materials on the clinical diagnosis of smallpox were developed in collaboration with clinicians and epidemiologists and distributed widely. They included an 8-page colour pictorial guide, a WHO recognition card, and two sets of teaching slides depicting the clinical appearance of smallpox in African and Asian patients respectively. Two sets of training materials were also developed, one to instruct surveillance officers in techniques for the containment of an outbreak, and the other to instruct programme directors in the management of a large eradication programme.

7.2 Regional offices

In 1967 smallpox was endemic in four of WHO's six regions. Special funds appropriated for the programme by the Health Assembly were allocated to these four regions. Medical officers were designated as the regional advisers for smallpox in the Region of the Americas and the Eastern Mediterranean Region. In the South-East Asia Region an inter-country advisory team of two medical officers was formed, which was increased to four in 1973. In Africa the regional adviser for communicable diseases was assigned responsibility for smallpox eradication and two inter-country smallpox advisers were assigned, one to east, central, and southern Africa in Nairobi, the other to west Africa in Monrovia. These advisers constituted a regional link between WHO headquarters and national programmes. They were responsible, with national health staff, for developing plans and identifying programme needs. They served to coordinate programmes between countries and advised on programme implementation. Headquarters staff were in constant communication with the advisers by telephone, telex, and mail and frequently travelled with them to visit national programmes. Every year headquarters staff and advisers met to discuss strategies and needs and establish overall programme goals.

7.3 National programmes

Many national smallpox eradication programmes developed as a part of the health service structure and, as such, differed from antecedent malaria eradication programmes, which were usually independent of the existing health service network. Smallpox eradication programmes adapted themselves both in organization and in practice to the existing health service structure, as well as to the political, epidemiological, and social realities; thus no two programmes were identical. In all the programmes the existing health staff, health centres, clinics, hospitals, etc., played important roles. In general, the better organized the structure and management of the basic health services the more important was the role they played. The degree to which the programme was integrated into the routine health care system of each country varied from country to country and even from area to area within a given country.

All countries subscribed to a common strategy, consisting of some form of extensive vaccination programme and a surveillance-containment activity to detect cases and contain outbreaks. The development of a competent surveillance programme to detect cases was one of the principal objectives. Programme structure and activity in all countries continually changed and evolved in response to the progress made towards meeting the goal of a smallpox incidence of zero.

In most countries there was a full-time national programme director. Until 1973 WHO or other international counterpart staff numbered only one or two persons in each country, although in a few instances in which countries were large or the problems especially complex as many as four or five were assigned. During the concluding phases of the intensified programme large numbers of WHO staff participated in programmes in Bangladesh, Ethiopia, India and Somalia. However, they were few in number compared with national staff.

Systematic vaccination programmes were usually conducted by specially constituted teams. Often the numbers were not large; in Afghanistan there were 175 staff for 17 million people, in Kenya 75 staff for 10 million, in Rwanda 12 for three million. Cooperation and assistance in the vaccination work was provided by the basic health service staff. The teams also administered measles vaccine in west and central Africa and BCG vaccine in east and southern Africa.

In most countries stationary health units constituted the network for the detection and reporting of cases. Surveillance teams promoted regular reporting and frequently worked with local health staff in the containment of outbreaks. In several countries special programmes were developed to meet emergency situations and tended to function independently. An important factor in the success of the programme, however, was the designation by each country of a cadre of individuals who became fully versed in the characteristics of the disease and the strategy and objectives of the programme. They continually monitored progress by observations in the field and could hold to account those responsible for the execution of the various measures taken.

8. STRATEGIES IN THE INTENSIFIED ERADICATION PROGRAMME

8.1 Provision of a sufficient amount of potent and heat-stable vaccine

8.1.1 Freeze-dried vaccine

The experience accumulated in smallpox programmes before 1967 amply confirmed that freeze-dried vaccine was essential for successful immunization of the population in tropical regions, where the potency of liquid vaccine decreased rapidly owing to the high ambient temperatures. Such freeze-dried vaccine needed to have a titre of at least 10^8 pock-forming units (pfu) per ml after incubation at 37°C for four weeks, for use by the multiple puncture or multiple pressure method. Detailed requirements were laid down in 1965 by a WHO Expert Group on Requirements for Biological Substances.

8.1.2 Production

In 1967, 64 laboratories in 62 countries were producing freeze-dried vaccine. Nine were in Africa, 9 in the Americas, 19 in 17 different countries in Asia, and 27 in Europe. Many of these laboratories gradually diminished or discontinued production as increasing amounts of vaccine became available from larger better equipped laboratories.

The most commonly produced vaccine was of animal skin origin. Vaccine was produced on embryonated eggs by a few laboratories and a tissue culture vaccine was produced experimentally, but vaccine stability problems with the former and the production costs of the latter precluded their wide use.

In 1968 more than 15 different strains of vaccinia virus were being used by producers throughout the world. The Lister strain, the one most frequently employed, was used by one-third of the producers. By 1972 two-thirds of the producers had come to use this strain, which caused less severe reactions than most other strains. To facilitate the changing of strains, the WHO collaborating centres produced quantities of seed virus of the Lister strain and made it available on request to all producers.

8.1.3 Quality control

WHO questionnaires in 1967 requested information regarding the potency and stability of vaccine as tested in the producing laboratories. Only 16 out of 45 laboratories recorded satisfactory results for both the potency and the heat stability of their vaccines. During 1967, 16 laboratories submitted samples of vaccine to WHO for independent testing. Vaccine from only seven of these laboratories consistently met WHO requirements. It was apparent that, if the eradication programmes were to be successful, urgent measures were required to improve vaccine quality. To achieve this, a seminar on vaccine production was convened in March 1968 and steps were taken to provide laboratories with advisory services and fellowship training for personnel. Independent testing of batches of vaccine was also arranged without cost to the producer.

Staff from five laboratories (Annex 5) participated in the seminar and prepared a guide on the methodology of freeze-dried smallpox vaccine production, which was made available to producers on request. The guide made many recommendations, for example on improved standardization of potency titrations, procedures for the establishment of a seed virus system, options for freeze-driers, types of vaccine containers, and methods for sealing ampoules and vials. To reduce wastage in the field, a vaccine fill of 0.25 ml was suggested.

8.1.4 Provision of consultant services, fellowship training and vaccine testing by WHO

Plans were developed to establish the closest possible contact between producers and consultant laboratories. In the Americas the Connaught Medical Research Laboratories, Toronto, Canada, assumed the responsibility, under contract with WHO, for the provision of advisory services, fellowship training, and vaccine testing for 13 laboratories in South and Central America. For laboratories in other parts of the world the Rijks Instituut, Utrecht, Netherlands, undertook to provide a vaccine testing service, which included testing of the initial potency and heat stability (both at 100°C for one hour and at 37°C for four weeks), bacteriological testing, and tests for the phenol and moisture content and for the degree of vacuum in the final containers. Assistance was given to developing laboratories by experts from Canada, Czechoslovakia, France, India, the Netherlands, the Philippines, Sweden, Thailand, the United States and the USSR.

The Netherlands laboratory also supplied seed lot virus prepared from the Lister strain to producers who wished to replace their own vaccine strains and vials of a reference vaccine for vaccine testing. In 1969 the two collaborating laboratories were officially designated, respectively, as the WHO regional reference centre[1] for smallpox vaccine (Connaught Medical Research Laboratories) and the WHO international reference centre[1] for smallpox vaccine (Rijks Instituut).

Only 31% of the batches tested met WHO standards in 1967 (Table 3). It is estimated that no more than 15% of the total amount of vaccine in use in endemic countries at that time met the requirements.

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[1] From July 1974 they were redesignated as WHO collaborating centres for smallpox vaccine.

Table 3. Vaccine batches tested by WHO reference centres and percent with satisfactory results

Year	Number of batches tested	Percent satisfactory
1967	73	31
1968	169	58
1969	235	76
1970	412	82
1971	233	77
1972	324	82
1973	400	95
1974	227	92
1975	185	86
1976	245	96
1977	150	93
1978	54	89

By the early 1970s a number of laboratories in the developing countries were successfully producing vaccine of good quality, including those in Bangladesh, Brazil, Burma, Colombia, Guinea, India, Indonesia, Iran, Kenya and Thailand. The results of vaccine testing by the reference laboratories revealed that after 1971 more than 80% of the test batches were satisfactory.

8.1.5 Techniques of vaccination

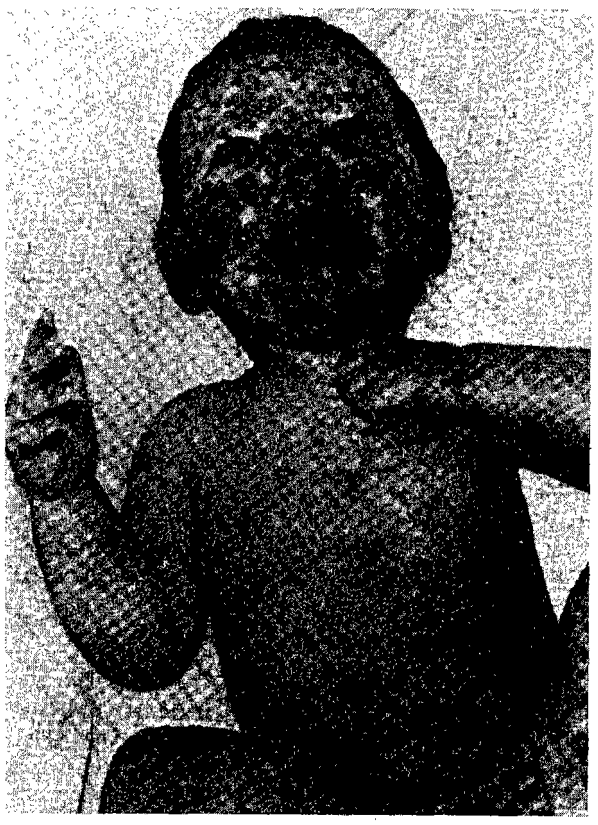
In 1967 a vaccinostyle, lancet, or simple needle was used for vaccination in most countries. The foot-operated jet injector was employed during the initial phases of smallpox eradication programmes in west and central Africa and in Brazil. However, the maintenance of the equipment was difficult. In most countries, beginning in 1969, the bifurcated needle, originally developed by Wyeth Laboratories, USA, became the recommended instrument. Bifurcated needles had several advantages: in the field the take rates were higher than with multiple-pressure or scarification methods (approaching 100% following primary vaccination); the method was so simple that only brief training was sufficient for a vaccinator; and only a small dose of vaccine was required - 0.0025 ml, a quarter of the dose previously required.

8.1.6 Complications of vaccination

The more severe complications of vaccination are generalized vaccinia (including fetal vaccinia), eczema vaccinatum, vaccinia necrosum, and postvaccinal encephalitis. The latter two are the most serious and may result in death. The best estimates of the frequency of complications are found in a study in the United States that involved 14 168 000 vaccinated persons, of whom 5 594 000 had primary vaccination and 8 574 000 revaccination. Encephalitis, which occurred only after primary vaccination, was observed in 16 persons, with 4 deaths. Vaccinia necrosum occurred in 11 persons, with 4 deaths. Eczema vaccinatum was more common, with 64 cases. Sixty additional cases of eczema vaccinatum (one fatal) occurred in contacts of vaccinated persons. It was estimated that approximately one death per million resulted from complications following primary vaccination and one death per four million following revaccination.

Complications of vaccination were observed during the eradication campaign, but their frequency could not be determined because the operating situation in which vaccination was done precluded a systematic follow-up. It was assumed that the complications would occur at a rate comparable to that described above, the risk being considered acceptable where smallpox was endemic. With smallpox eradicated, the risk, however small, is no longer acceptable either in the formerly endemic countries or in non-endemic countries, which have for decades been forced to continue vaccination programmes as a precautionary measure against the reintroduction of smallpox by importation.

FIG.3 A case of eczema vaccinatum, one of the severe complications of smallpox vaccination



(Photo: Royal College of General Practitioners, United Kingdom)

8.2 The mass vaccination strategy

8.2.1 Rationale

The concept of mass vaccination as the basic strategy in smallpox eradication was prevalent until the late 1960s. Mass vaccination was credited with the success of eradication efforts in the developed countries of Europe and North America and also in a number of developing countries. Indonesia, which had apparently eradicated smallpox in the 1930s through a systematic programme of primary and periodic revaccination, was cited as an example of success in a developing area with a high population density.

8.2.2 Vaccination coverage

Experience in a number of countries had shown that 100% vaccination coverage was not necessary for eradication. Coverage at levels of 80% or greater was generally considered to be adequate for eradication. Achieving such levels in all segments of the population was recognized to be difficult and transmission often continued in missed segments. The provision of sufficient supplies and transport, the training of personnel and the preparation of the population through educational campaigns were complex and time consuming tasks and particularly difficult in areas where health services were undeveloped and communications poor. Systematic vaccination programmes employed a variety of methods to reach the populations, of which the collecting point and house-to-house approaches were the most common. The collecting point systems were rapid and efficient and worked well when the population was relatively dense and government, religious, or tribal influence sufficient to ensure compliance. However, when the population was scattered and the villages small, house-to-house vaccination was more effective.

In many populations high levels of coverage were difficult to achieve, young persons being those most often missed. Problems were also encountered in reaching non-resident populations in cities, nomadic and migratory working groups, and residents of remote areas. Other causes that led to resistance to vaccination were religious beliefs or superstitions, the hostility of minority groups towards vaccinators from other groups, and civil disturbances. Great ingenuity and persistence were required to overcome these obstacles. With time most were overcome, but they played a role in impeding the success of a number of programmes.

8.2.3 Assessment

Continuing independent assessment of vaccination coverage was an important element. The total number of vaccinations performed by vaccinators was sometimes exaggerated and on occasion exceeded the number of persons in the target populations. In most systematic vaccination programmes responsible supervisory staff were assigned to verify the vaccination coverage by scar surveys of randomly selected population groups. On the basis of their findings corrective measures could be taken to improve the operations. Early in the programme little attention was given to recording whether vaccinations were primary vaccinations or revaccinations. Receptive and readily accessible individuals were revaccinated frequently. Surveillance data soon showed, however, that the efficacy of the vaccine was far more durable than had been previously believed and the emphasis shifted toward primary vaccination. In the earlier phases of the programme primary take rates were assessed to ensure that potent vaccine had been administered. Later, when it was possible to ensure that all the vaccine met WHO standards, take rates of more than 95% were so consistently obtained that this type of assessment was rarely considered necessary. The response to revaccination was not evaluated because the results were impossible to interpret.

8.2.4 Successes and failures

Eradication campaigns based entirely or primarily on mass vaccination succeeded in some countries but failed in most. Mass vaccination campaigns were most successful in countries with relatively well developed and well managed health services, adequate reporting systems, and reasonably good communications. Notable successes were recorded in China, several South American countries, a few African and Middle Eastern countries, some parts of South-East Asia such as Burma, and a number of the southern states of India.

However, in some countries, even when vaccination coverage reached 80% or even 90%, the remaining susceptibles, grouped in particular parts of the country or in lower socioeconomic areas of cities, provided a sufficiently large population for smallpox transmission to continue. Achieving substantially higher levels of vaccination coverage would have been extremely costly and logistically difficult or impossible. To deal with smallpox in those countries within the constraints of the resources available required a change in strategy.

8.3 Changing strategies

8.3.1 Lessons from the field

By 1967 it was evident that, despite some progress towards global eradication, the situation in many endemic countries was not encouraging. The smallpox incidence remained high in Africa south of the Sahara, Brazil, Indonesia, and the Indian subcontinent. In India, five years after a national eradication campaign began in 1962, the number of reported cases was larger than in any year since 1958.

From 1967 on the emphasis was placed on the need for the development of adequate reporting systems as part of a more comprehensive surveillance programme. The strategy was changed from one whose focus was solely on mass vaccination to one that also emphasized surveillance.

New information began to come in from the field, where experienced epidemiologists in direct contact with numerous outbreaks were carefully analysing and recording their experiences. In west Africa it was estimated that as few as 1% of cases were being reported through the regular reporting system. Efforts were therefore intensified to improve reporting and detection through active surveillance. In areas where outbreaks were

identified intensive vaccination was applied to contain them. This approach, combined with a mass vaccination campaign whose goal was to reach 80% of the population, effected eradication in all the endemic countries of west Africa within three and a half years. The need for a surveillance containment programme was further dramatized in Indonesia, where smallpox had been reintroduced following the Second World War. In heavily populated portions of Java, where the vaccination coverage had reached levels of over 90%, transmission continued until active surveillance detected outbreaks and they were contained. These, and similar experiences in other programmes between 1967 and 1970 indicated a need to assign even greater priority to active surveillance and containment.

When smallpox cases were reported from a district or country it was originally assumed that the cases would be widely dispersed throughout the whole area. In point of fact smallpox was usually localized to relatively few areas. In Pakistan in 1967, in a heavily infected district, 1040 cases were found in a population of 1 200 000. However, during that year only 170 out of 1700 of the villages were infected. During the same year, in a highly endemic area in India, only 101 out of 2331 towns (4.3%) were infected throughout the year and no more than 20 (1%) at any one time. Rather than being a disease that simultaneously and randomly affected many parts of the district or country, smallpox was usually found to be a slowly spreading disease that at any one time affected only a small proportion of population centres. Exceptions to this rule were observed in some parts of Bangladesh, Ethiopia, India and Somalia during certain periods, but the observation generally proved valid. Recognition of this fact further stimulated the development of intensified surveillance-containment measures.

Early in the programme it was widely believed that smallpox was often transmitted by aerosolized virus to persons at a considerable distance, and that blankets, clothes, other fomites and scabs of former patients often served as the source of outbreaks. Epidemiological observations, however, indicated that these modes of transmission were relatively unimportant. Virtually all cases were infected by close contact with patients and occurred in persons living in the same house or in persons who had visited the patient. That smallpox was not as communicable as was commonly believed was illustrated by the fact that unvaccinated persons living in the same house often escaped infection. Careful studies showed that an infected person usually infected between one and five other persons. Thus it was apparent that intensive vaccination of household members and contacts would quickly stop transmission.

The belief that smallpox often caused explosive outbreaks with dozens to hundreds of cases within a single incubation period proved to be unfounded. When 20 or 30 cases were reported in one week from an area, it usually signified that the disease had been spreading over a period of two months or more.

In the past, except in countries with highly developed health services, chains of smallpox transmission had rarely been adequately investigated. Often the case was vaguely attributed to contact with blankets or scabs or labelled as "sporadic". Careful investigation of cases almost invariably disclosed close contact with an infected person, and when that person was located the chain of infection could often be traced back for many generations and to outbreaks in other communities. Endemic smallpox soon came to be visualized as chains of transmission that required renewal, through infection of new persons, every two to three weeks. Thus, in a year, a single chain of transmission would require sequential infection of at least 15-25 persons. In a country with 500 cases per year, it could be assumed that there were probably no more than 20 transmission chains. When transmission was considered in this manner it was apparent that comparatively modest but vigorous and well directed containment measures should rapidly stop it. Indeed, many transmission chains died out without outside intervention in isolated areas and in well vaccinated groups. These observations led to an approach in which the smallpox incidence came to be viewed in terms not of numbers of cases but of numbers of outbreaks, and efforts were concentrated on breaking the transmission chains.

Previously during mass vaccination campaigns quotas had often been set for teams and individual vaccinators, the aim being to vaccinate the quota in the shortest possible time. This induced vaccinators to vaccinate large accessible groups such as schoolchildren or previously vaccinated adults receptive to repeated vaccination. There was little concern about differentiating between primary vaccination and revaccination, and in many countries only the total number of vaccinations was recorded. This practice resulted in a low

vaccination coverage of young children and other groups that were difficult to reach. Recognition that even a single primary vaccination conferred long-lasting immunity resulted in a redirection of vaccination efforts to emphasize the need for reaching those who had never before been vaccinated.

8.3.2 Characteristics of smallpox facilitating eradication

A number of characteristics facilitated the surveillance-containment strategy. Some of them had been recognized before the intensified programme began, but others were appreciated only after field operations had begun. They were as follows.

1. The recognition of smallpox cases is a comparatively simple matter. Subclinical infections, although recognized as occurring among partially immune persons, are not considered important since the individuals so infected have not been shown to transmit infection.

2. Smallpox is transmitted solely from person to person. There are no known animal reservoirs.

3. The transmissibility of infection is low and epidemics develop slowly. Between each generation of cases there is an interval of two to three weeks. In most circumstances when transmission occurs one individual infects between one and five others.

4. Possibly infected individuals can be readily identified because transmission requires close contact between infected and susceptible persons, most commonly in the home, hospital, or school.

5. The number of chains of transmission at any one time is usually relatively small.

6. With the development of a surveillance system that discovers and traces all outbreaks promptly, small but rapid and thorough containment actions can break the transmission chains and smallpox can be eradicated within a relatively short time.

8.4 The surveillance and containment strategy

8.4.1 Routine reporting systems

Routine reporting systems relied on the receipt of monthly or weekly reports or both from clinics, hospitals, or health centres; these were forwarded to intermediate levels (e.g. district, state, or provincial) and from there to the central health administration. Other government officials and health workers in other fields were usually directed to report epidemic diseases, among them smallpox, by the fastest means available. In theory the established system should have detected smallpox outbreaks promptly, but in practice it commonly failed. Its effectiveness diminished with the distance from central headquarters and became progressively weaker in the less developed areas and along borders. Communications were often difficult and frequently non-existent during seasonal rains. From many areas and reporting units reports were long delayed or not received at all.

In many African and in some Asian countries there were large areas where there were no health units. Even when health units were present the population was sometimes reluctant, for a number of reasons, to report cases. The intrusion of vaccination teams into a community was not always welcome. Regulations such as those requiring that the houses of victims should be burned down discouraged reporting. In urban areas families often tried to avoid having relatives sent to infectious diseases hospitals, which they regarded as places of death and which sometimes would not return the corpse of a patient to the family. Quite apart from these and other considerations, there was in many endemic countries a widespread acceptance of smallpox as inevitable. Where variola minor was prevalent it was usually considered a disease of minor importance that did not require medical attention, and it was often confused with chickenpox.

For many reasons the routine reporting systems reported only a small proportion of cases. Since prompt and complete reporting was essential for the rapid containment of outbreaks, major efforts were made to improve the system. Mobile surveillance teams began to visit regularly each of the reporting units to insist that weekly reports, including those reporting no cases, should be submitted promptly. In addition, many programmes developed a

reporting system of their own independent of the routine network. Wall posters of smallpox patients were distributed to stimulate interest in and encourage the reporting of suspected cases. Improved forms were developed to permit information to be obtained on each outbreak and each case - the name, the age, the sex, the village, the vaccination status, the outcome, and the source of infection. Systems of cross-notification were set up to pass information on to adjoining areas if an outbreak had been traced to that place and to warn other districts when a patient or a contact was moving to that community. In many countries surveillance reports were prepared and distributed weekly or monthly to peripheral reporting units and programme staff to stimulate greater interest in the programme.

Even with these measures, reporting based solely on the passive surveillance system was recognized to be incomplete. Many patients never sought medical assistance. Reports were often delayed, and the delays contributed significantly to problems in containment. A limited outbreak with a few cases in the second generation could be controlled with much less effort than one that had persisted for three or four generations, by when the number of cases was greater and the disease might have spread to other communities.

8.4.2 Active surveillance

To speed up the detection of outbreaks and to discover those which had not been reported, surveillance teams were given the responsibility of investigating reported cases, seeking other cases in the area and identifying and tracing the sources. In each instance they initiated rapid containment measures. The teams usually consisted of two to four people, included a leader trained in basic epidemiology, and were equipped with a vehicle. When outbreaks became infrequent or stopped, they continued to search in high risk areas and periodically visited all parts of the area assigned to them until independent assessment confirmed that transmission had been interrupted.

The teams contacted many sources in both urban and rural areas to obtain information. Showing the smallpox recognition cards, they contacted both urban and rural populations including schoolchildren, government officials and religious leaders, teashop owners, people in markets, nomads, and refugees. In many countries schoolchildren were found to be good sources of information because they were more open than their elders and surprisingly aware of local events. Markets were especially useful because people came to them from a wide surrounding area. The travel routes of nomads and of migratory workers were sought out and contact with such groups was arranged. The techniques surveillance teams developed were increasingly refined and later used in the comprehensive surveys carried out by other health workers during the later stages of the campaign and during the certification process.

8.4.2.1 Special searches

Routine reporting and active surveillance were supplemented in special situations by more intensive searches in every village in which all health workers took part for one week of each month. This was first done on a large scale in northern India in the autumn of 1973. There it was found that in some districts outbreaks were occurring in 5% or more of all villages. In Uttar Pradesh, during the week preceding the first search, only 354 cases had been reported in 21 out of the 55 districts. The first week-long search uncovered 5989 cases in 47 of the 55 districts, and cases were found in 1483 villages and 42 municipalities. Similar findings were obtained in the neighbouring states of Bihar and Madhya Pradesh. The results were astonishing and proved at once the value of the approach. Subsequent searches carried on at monthly intervals in endemic areas uncovered many new outbreaks but in decreasing numbers. This technique was particularly well adapted to countries like Bangladesh and India with a high population density, poor routine reporting, large numbers of cases, and many trained health workers.

Different techniques were developed in Ethiopia and Somalia during the intensified campaigns of 1976 and 1977. In both countries the number of health personnel was small. To strengthen surveillance, a large number of local people were employed and trained to work under supervisory staff. Since they knew the local languages and customs, they were highly effective in detecting hidden foci in remote rural areas. The system was reinforced in all areas by a reward offered to both the individual who reported a case and the health worker who received the report and investigated it.

8.4.3 Containment

Early in the programme it was found that isolation of the patients at home and rapid thorough vaccination of persons in the village or part of a town was sufficient to contain most outbreaks. The older notion that everyone within a radius of five kilometres or even more should be vaccinated was discarded because it was inefficient and wasteful of limited resources. Patients usually preferred to stay in their homes. Hospitalization, even if available, was avoided because isolation procedures in hospitals were frequently ineffective and spread of infection from hospitals was common. Vaccination of all persons in the affected house began at once and was followed by vaccination of those in surrounding houses, then of a relatively small ring of contacts of the index case. As the number of outbreaks diminished, it was possible to impose strict isolation by paying watchmen to keep 24-hour guard. All persons entering or leaving the house were vaccinated and their movements were recorded; if exposed persons left the area a notification was sent immediately to their stated destination. Isolation was maintained throughout the period of infectivity and the community was visited repeatedly by special teams until six weeks had lapsed after the onset of the last patient's illness. The six-week interval represented three incubation periods and was considered sufficient to confirm the interruption of transmission.

8.4.4 Special problems

8.4.4.1 Concealment of outbreaks

Concealment of cases and outbreaks by health personnel at various levels was a problem in many countries. In some countries vaccinators and supervisors who knew of smallpox in their area were unwilling to report it because the occurrence of smallpox was considered to reflect on their routine vaccination performance and they feared dismissal or other punishment. Health personnel at higher levels also sometimes failed to report cases, minimized the number of cases, or changed the diagnosis to chickenpox. Even at the national level there were governments that failed to report large outbreaks or adjusted figures to keep them within a respectable range. Eventually, through reports from other countries, travellers, and other sources, suppression of reports came to be known, but often after delays that had tragic consequences.

8.4.4.2 Variolation

Variolation scars or a history of variolation were found in many countries of Africa and Asia. In most countries the practice appeared to have stopped during the 1950s or earlier, but in others, notably Afghanistan, Benin and Ethiopia and, to a lesser extent, Malawi and Pakistan, it continued until eradication and was responsible for a large number of outbreaks.

In Ethiopia variolation was usually performed by the head of a household or extended family using material obtained from pustules or patients in his own or a nearby area. In Afghanistan and Pakistan, and in a few areas of Ethiopia, traditional variolators used a suspension of pulverized scabs obtained from a patient during the current or preceding smallpox season. The crusts were stored either as a powder or as a suspension and then mixed with a variety of substances. The suspension was introduced into cuts, usually on the hand or forearm. Recipients developed smallpox that was usually milder than the infection acquired by the respiratory route, but the disease was transmissible and the usual severe illness occurred in later cases. Many large outbreaks were started in this manner.

Variolators in Afghanistan and Pakistan presented an especially serious danger since they travelled widely, they were hard to find, and their activities were proscribed by government. Extensive efforts were made to locate them and to dissuade them from further practice or persuade them to substitute vaccination for variolation. Wherever possible, specimens of their variolation material were obtained and submitted for laboratory study to determine if infectious virus persisted. Through interviews it was learned that variolators generally believed that their material lost its potency in one or, at most, two years. In laboratory tests on 45 specimens viable virus was not recovered more than nine months after the specimen was said to have been originally collected from a smallpox patient (Annex 6).

8.5 Research

8.5.1 Epidemiology and public health

Previous concepts of smallpox transmission were re-examined both in laboratory and in field studies, and a much altered picture emerged. Studies in Madras in the early 1960s had shown that the virus was not widely disseminated in the environment but closely associated with the patient's person and bedding. Vaccinia immune globulin, if given soon after exposure, was shown to be useful in preventing illness in exposed persons, but its cost precluded its use in the programme. Later studies in Madras and Calcutta increased knowledge about transmission and explored the relationship between serum antibody levels and protection against illness. Other studies provided evidence of airborne transmission over considerable distances in a European hospital.

In the field, many careful studies of outbreaks by WHO epidemiologists and their national counterparts documented the findings cited previously, that played such an important role in guiding programme strategy. They also demonstrated that infection could persist for many months in relatively small populations in a person-to-person chain of transmission. Studies in Africa and Asia of the frequency of persistence of pockmarks in patients who had recovered from smallpox established a method of estimating the incidence of the disease in previous years. They also showed that pockmark surveys were a valuable aid in certification procedures. They demonstrated the less frequent occurrence of pockmarks following variola minor in Ethiopia, Somalia, and Sudan.

8.5.2 Virology

Variola strains from many sources were studied in an effort to characterize those which behaved like variola major, variola minor, or intermediate types. The isolation of monkeypox virus from patients with a smallpox-like illness in some countries of central and west Africa and reports of the recovery of whitepox virus strains from animals emphasized the need for further study of the orthopoxvirus group. Investigations using the most sophisticated techniques of modern virology were conducted in laboratories in France, Japan, the Netherlands, the United Kingdom, the United States, and the USSR. A study group on orthopoxvirus research was formed by WHO to advise and help coordinate these studies.

The duration of virus survival in crusts or in fomites was studied because of concern that these might, even at a late date, be infectious. Studies in Bangladesh and India demonstrated that, under the conditions of heat and high humidity that prevail in most formerly endemic countries, virus survival in crusts is measured in days or weeks rather than months. Studies in India showed that survival of viruses in fomites was even shorter than in crusts. Epidemiological studies confirmed the laboratory findings.

9. IMPLEMENTATION OF THE INTENSIFIED ERADICATION PROGRAMME

The progression of the eradication programme can be divided into three phases: (1) the period between 1967 and 1972 when eradication was achieved in most African countries, Indonesia, and South America; (2) the period from 1973 to 1975 when major efforts were focused on the countries of the Indian subcontinent; (3) the period from 1975 to 1977 when the goal of eradication was finally achieved in the Horn of Africa.

The progress of the eradication programme is illustrated in Annex 5 using annual incidence data from 43 selected countries in Africa, Asia, and South America. West Africa became smallpox-free in 1970; South America in 1971; Indonesia in 1972; central and southern Africa in 1973; the Indian subcontinent by 1975; and the Horn of Africa by 1977.

The methods used in this continually evolving programme are described in the following sections. During the first phase (1967 - 1972) the approaches were similar in most countries. In the second phase (1973 - 1975) the countries of the Indian subcontinent presented a number of formidable and special problems that stimulated the development of several new approaches. In the third phase (1975 - 1977), a quite different set of difficult problems was encountered in Ethiopia and Somalia and required further changes in strategy.

9.1 The period from 1967 to 1972

9.1.1 West and central Africa

In 1967 a coordinated area-wide programme began involving 20 west and central African countries. It was assisted by the United States Center for Disease Control and financed by the United States Agency for International Development and WHO. The countries were Benin, Chad, Central African Republic, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, United Republic of Cameroon, and Upper Volta. The two main goals were to vaccinate 80% or more of the total population within three years and concurrently to develop a reporting-surveillance system that would enable the remaining foci of smallpox to be rapidly eliminated. The programme was well provided with transport and other logistic support and, in each country, international advisers worked closely with national counterparts in implementing the programme. The programme, unburdened by old dogmas and beliefs about smallpox, contributed significantly to a better understanding of its transmission and control. It was in this programme that the selective containment and surveillance strategy was first found to be especially effective. Close communications were developed between countries and cross-notification assisted the control of outbreaks in border areas. Vaccination was carried out for the most part at collection points with jet injectors. Measles vaccine was administered simultaneously to children between nine months and four years of age.

In 1967, 14 of the 20 countries reported a total of 11 069 cases; in 1968, 12 countries reported 5487 cases; in 1969, 8 countries reported 459 cases. In 1970, 79 cases were reported from one country. Eradication was achieved in 1970, three and a half years after the programme began.

9.1.2 South America

9.1.2.1 Brazil

Between 1950 and 1967 mass vaccination programmes in most South American countries, coordinated by the Pan American Health Organization (PAHO), succeeded in eradicating endemic smallpox in all the countries except Brazil. In 1962 Brazil began a mass vaccination campaign in its north-eastern states, and in 1965 it signed an agreement with PAHO to undertake a nationwide eradication programme, which began the following year. A system of concurrent assessment to ensure effective vaccination coverage of the population was introduced in 1969. During the vaccination programme, which was completed in 1971, 81 953 000 vaccinations were carried out in a population of 94 436 000.

When the programme began essentially all the reports of smallpox cases came from hospitals located in state capitals. A national reporting system was steadily developed, and by 1971, there were 2927 reporting sites submitting weekly reports, a number that had increased to 6381 by 1973. In 1969 special surveillance teams were created and active surveillance units were established in each state. There were 4514 cases reported in 1967 and 4372 in 1968. With improved reporting the number of notified cases increased to 7407 in 1969. The number fell to 1771 in 1970 and, in November 1970, it was believed that eradication had been achieved. However, in March 1971, four months later, vaccination teams discovered one further outbreak. The last known case occurred on 19 April 1971.

The campaign in Brazil overcame many difficult problems. Among these were the very large size and population of the country and the relatively low level of vaccination coverage in the population when the programme began. The extensive Amazon basin, which some considered an impossible barrier, was searched extensively and the population vaccinated during an arduous campaign jointly conducted with malaria eradication personnel. The fact that only the mild form of smallpox, variola minor, was prevalent in Brazil was a further barrier in that it lessened public concern and impeded the detection of cases and outbreaks.

9.1.2.2 Other countries

Importations from Brazil were reported by Argentina, French Guyana, and Peru. The last outbreak, with 24 cases, occurred in Argentina in 1970. It was controlled by massive surveillance and containment action.

9.1.3 Other central African countries

The three central African countries that reported cases in 1967 or thereafter were Burundi, Rwanda, and Zaire. Burundi and Rwanda were small and densely populated, but Zaire was a vast country with a population estimated at 18 000 000 in 1967.

Burundi and Rwanda had three-year mass vaccination programmes. In Rwanda the rapid progress of the vaccination campaign was assisted by a well organized system of vaccination at collection points; one vaccinator was able to perform about 1000 vaccinations daily. In both countries the reporting system was slow and inadequate. Rwanda reported no cases of smallpox in 1967 and 1968, although subsequent investigations pointed to outbreaks during that period. Outbreaks were often unreported or, when reported, were notified as chickenpox. In both countries the surveillance component of the programme was intensified in 1969 and 1970, and both reported their last cases in 1970.

The programme in Zaire was in many ways unique, the speed with which eradication was accomplished standing as one of the most remarkable achievements of the worldwide programme. When the programme began in 1967 smallpox was widespread, the vaccination coverage was low, the health services were comparatively undeveloped, the number of trained health personnel was small, and the communications were extremely poor. Transport in this large tropical country, with its many rivers, was always difficult.

The plan of operations called for a three-year mass vaccination campaign by mobile teams using Ped-o-Jet injectors for vaccination. Through careful and resourceful planning the vehicles were kept moving and the jet injectors working. The concept of active surveillance was introduced early in the campaign. Most of the outbreaks were reported by the vaccination teams or mobile surveillance teams that were set up in each of the main administrative regions. Prompt and thorough containment action followed. Cases fell steadily from a peak of 3800 in 1968 until 1971, when the last cases were reported.

9.1.4 South-eastern Africa

In Malawi, Mozambique, the United Republic of Tanzania and Zambia smallpox epidemics had occurred throughout the decade before the intensified smallpox eradication programme began. The smallpox was comparable in severity to that seen in west Africa, with case fatality rates of about 10%. Pockmarks were common in surviving patients, and later pockmark surveys indicated that the disease was greatly underreported.

All the countries took steps to accelerate and strengthen the control programmes that were then in operation. Surveys in Malawi, Tanzania, and Zambia, countries that participated in the WHO programme, showed that the vaccination coverage was relatively poor, particularly in more remote areas and in children, in whom most of the cases had occurred. Plans called for an attack phase during which systematic vaccination campaigns using mobile teams reached as large a proportion of the population as possible. This was to be followed by a maintenance phase during which vaccination to maintain high immunity levels and surveillance-containment programmes to eliminate the remaining foci of smallpox would be carried out.

The campaigns were preceded by widespread publicity and measures to increase public awareness of smallpox and of the need for reporting cases. In Zambia, which had had 2214 cases in 1964 and numerous importations from Zaire, the number of cases fell from 47 in 1967 to 0 in 1969; two imported cases from Zaire occurred in 1970. Tanzania reported 1629 cases in 1967, mainly in its southern and western areas. The number of cases fell rapidly and none were reported after 1970. In Malawi the last cases were reported in 1971. In both Malawi and Tanzania there was evidence of recent variolation, but it appeared that the practice had stopped before 1967.

In the Mozambique programme the approach was similar, a three-year mass vaccination programme using locally produced freeze-dried vaccine being followed by a maintenance phase. The last case was reported in 1969.

Botswana had conducted vaccination programmes for many years utilizing liquid vaccine. The number of vaccinations between 1967 and 1970 was relatively small in relation to the population. Endemic smallpox, which had not been reported since 1965, reappeared in

1971 following importation from South Africa. There had been no active surveillance structure, and before the extent of the epidemic became apparent the disease had spread throughout the more heavily populated eastern part of the country and was extending into the central area. A total of 1059 cases were reported in 1972, with only two deaths. The disease was so mild that it caused little public concern and this hampered reporting.

The epidemic was brought under control by a massive containment vaccination programme during which over half the population was vaccinated. The last known case was believed to have occurred in November 1972. However, another outbreak was discovered, then a second and finally a third, which continued up to November 1973 (section 9.5). These outbreaks occurred mainly among members of a religious sect that had refused vaccination and deliberately concealed cases when they occurred.

9.1.5 Sudan and Uganda

9.1.5.1 Uganda

Uganda conducted a large mass vaccination campaign in 1965 and 1966, but smallpox continued to occur. An intensified six-month-long WHO-assisted mass vaccination programme was launched in 1969 with six large mobile teams using freeze-dried vaccines and bifurcated needles. Very high coverage was obtained. Surveillance was carried out by the network of health units and by a small mobile maintenance and surveillance team in each region. The last indigenous cases occurred in 1970.

Importations continued to occur until 1972 in the northern part of the country from Equatoria Province in Sudan, where a large outbreak of variola minor was occurring. After Sudan achieved eradication late in 1972 the importations ceased and Uganda remained smallpox-free.

9.1.5.2 Sudan

Sudan launched a WHO-assisted mass vaccination programme in 1962 with freeze-dried vaccine from the USSR and achieved high coverage in the northern and central parts of the country, but it was unable to carry out the programme in the south because of civil disturbances. In the areas covered by this campaign the incidence of reported smallpox dropped almost to zero in 1965.

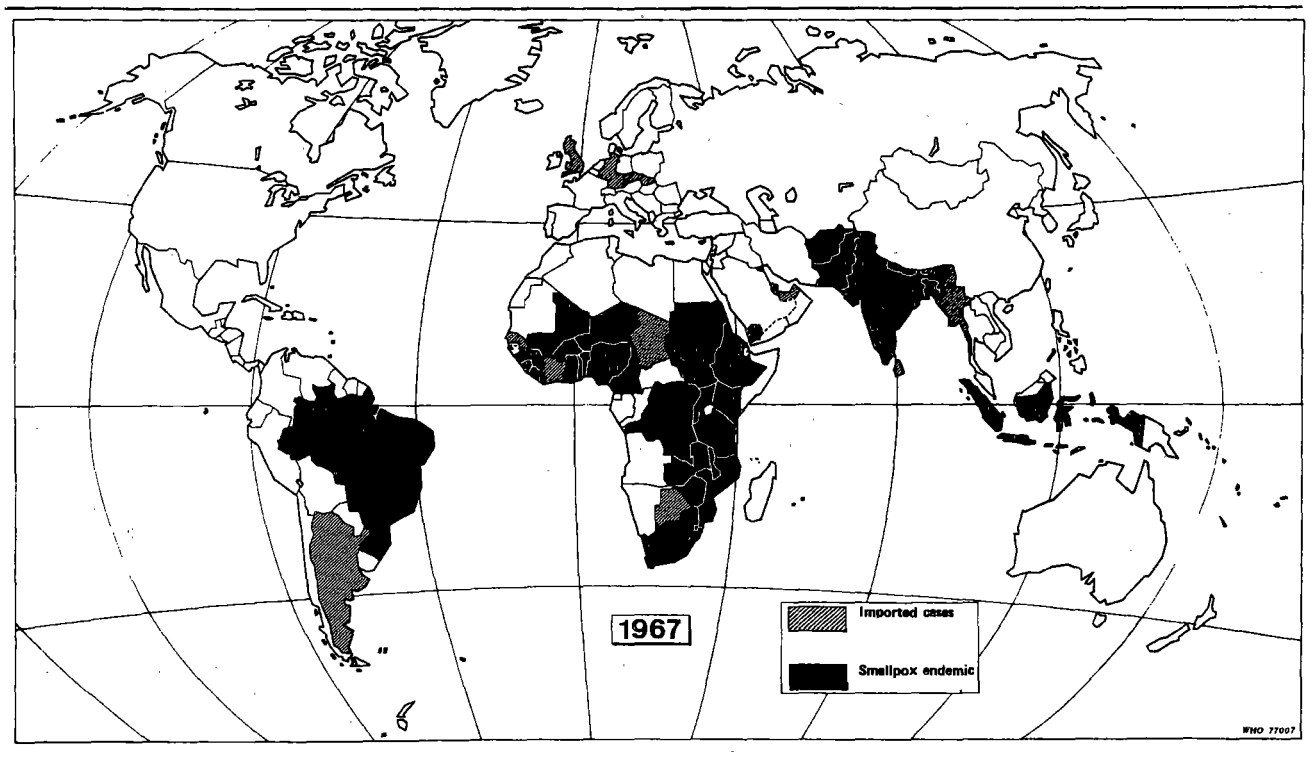
In 1968 the incidence of smallpox began to rise again following importations from the southern provinces and Ethiopia. An intensified WHO-assisted programme began in 1969, again based on mass vaccination. The strategy was gradually changed during 1971 and 1972 to one emphasizing surveillance and containment. When the civil disturbances ceased in the south in 1972 virtually all the personnel from the northern and central regions were moved to the south. There now began repeated tours by surveillance teams, which obtained information mainly from civil sources and the public, sought out the outbreaks and brought the incidence to zero in November 1972. A single importation from Ethiopia in December 1972 was the last case recorded.

9.1.6 Indonesia

Smallpox is believed to have been eradicated in Indonesia in the late 1930s by a systematic vaccination programme that used room-dried vaccine and emphasized primary vaccination for infants. After the Second World War smallpox was reintroduced and large outbreaks followed; 490 348 cases were reported in 1949.

The WHO-assisted programme began in May 1968, a year when 17 350 cases were reported. Mass vaccination was initially carried out in the areas of highest incidence and efforts were made to improve the reporting system. Surveillance reports were published regularly and distributed to reporting units throughout the country to stimulate interest and provide them with information about the progress of the programme. From 1969 onwards increasing emphasis was placed on surveillance and containment. All the field units, including the surveillance, the vaccination, and the containment teams, searched actively for cases and sought to identify the source of outbreaks. Contact was established with a variety of population groups, schoolchildren proving to be an especially valuable source of

FIG. 4 Countries reporting smallpox cases in selected years, 1967-1976



COUNTRIES REPORTING SMALLPOX CASES IN 1970

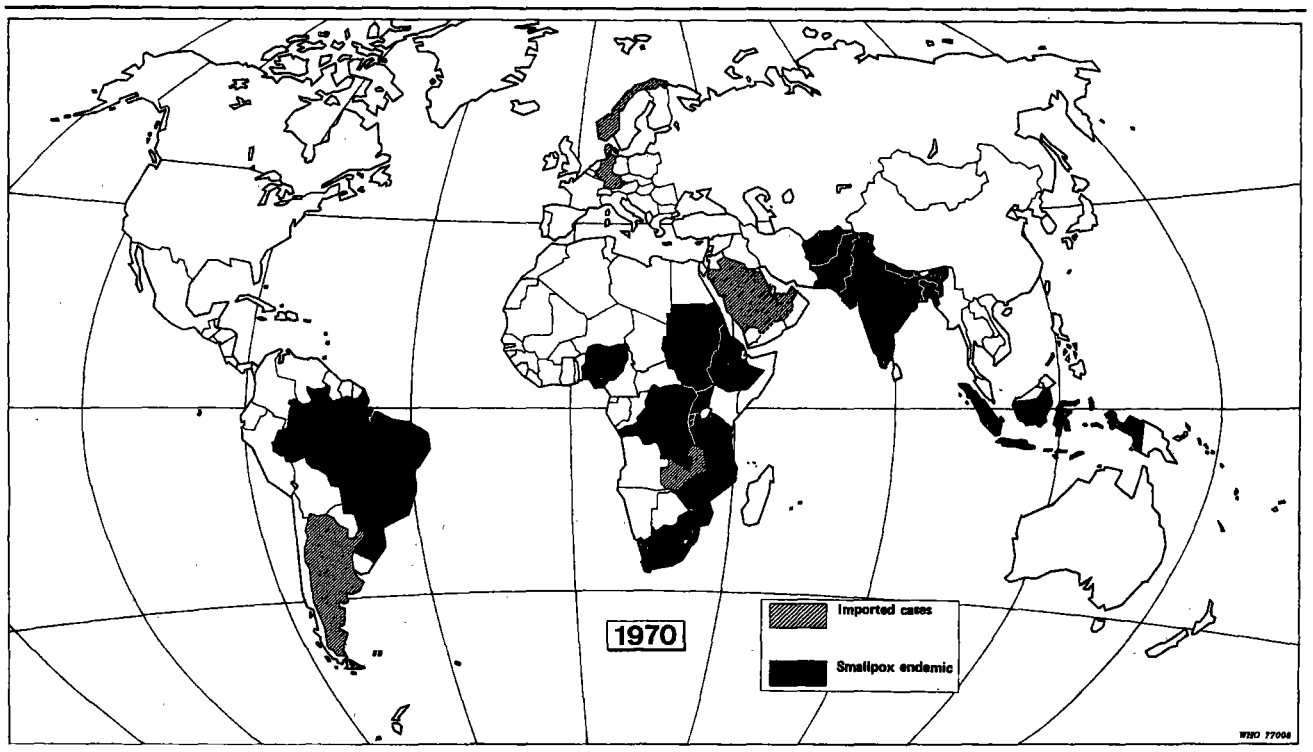
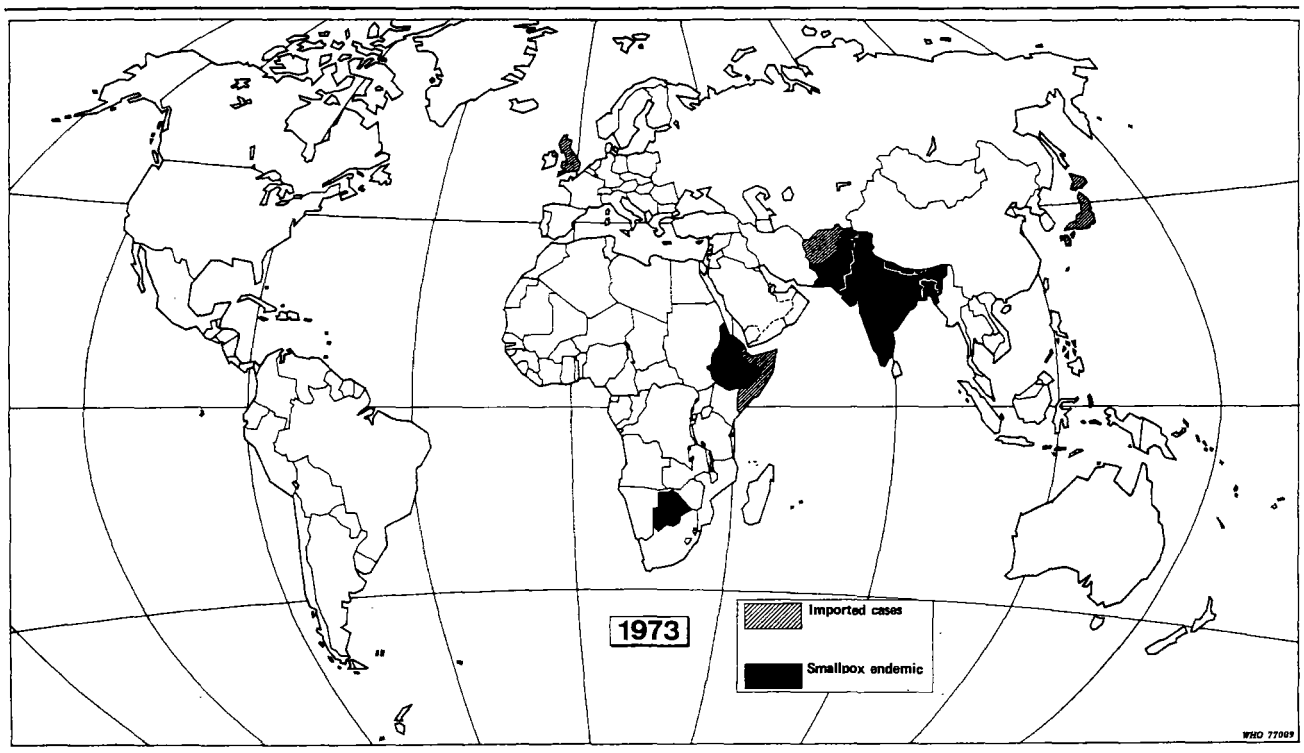
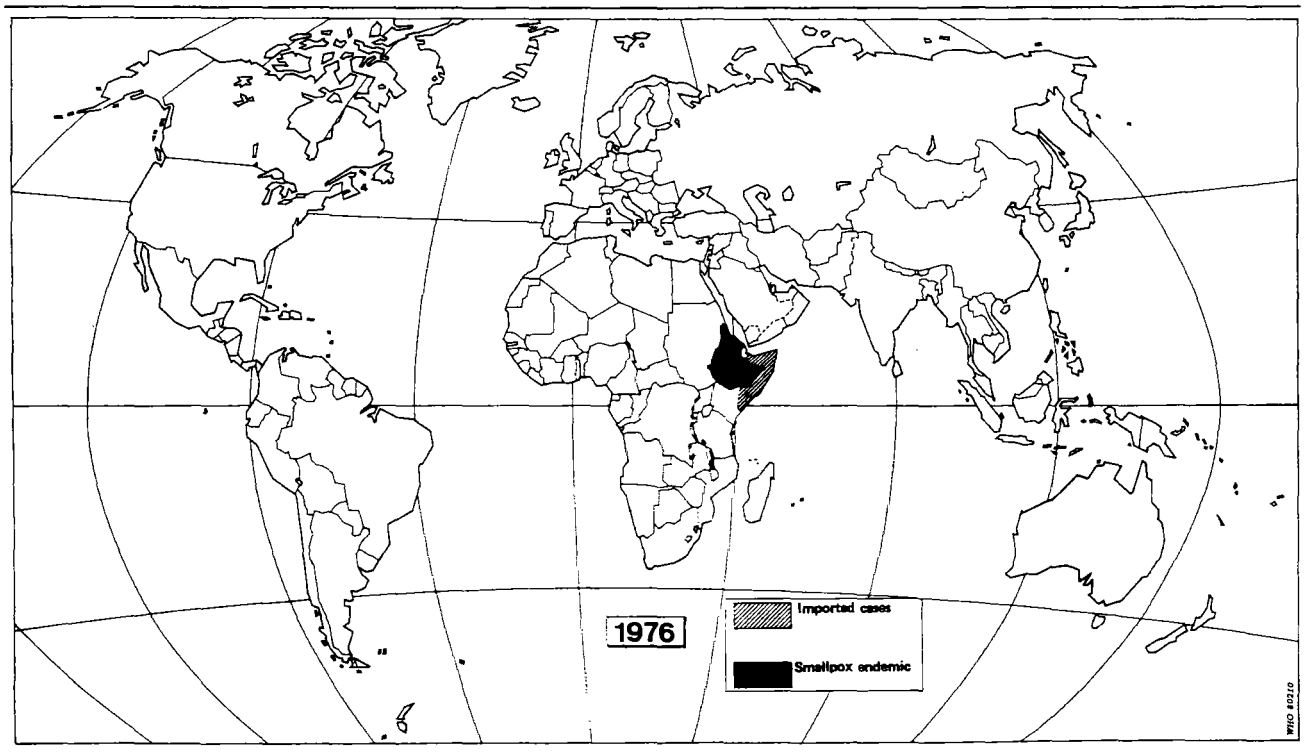


FIG. 4 (Cont'd.)

COUNTRIES REPORTING SMALLPOX CASES IN 1973



COUNTRIES REPORTING SMALLPOX CASES IN 1976



information. It was during this period that Indonesian workers conceived the idea of showing pictures of a child with smallpox while talking with groups of people. This was the origin of the WHO recognition cards, which were subsequently used in all the campaigns.

In spite of all the measures taken, smallpox proved to be extraordinarily difficult to eradicate. In Java, despite levels of vaccination exceeding 90%, transmission continued in densely populated areas, particularly among children under five years of age, until effective case detection and surveillance systems were fully developed.

Increasingly effective efforts gradually brought transmission to an end. In 1968 there were 17 350 reported cases; in 1969, 17 972 cases; in 1970, 10 081 cases; and in 1971, 2100 cases. Late in 1971 Indonesia appeared for an eight-month period to have become smallpox-free, but an outbreak was then discovered that had been smouldering for a year in three villages. The cases were known to lower level health workers, but information about them had been suppressed. Rapid containment measures were taken. Only 34 cases were recorded in 1972, the last on 23 January.

9.2 Southern Asia

9.2.1 Burma

Burma implemented a smallpox eradication programme in 1963. The strategy was one of mass vaccination, the goal to reach 95% of the population. The system was based on three-year rounds, mass vaccination being carried out every three years in one-third of each health centre area while primary vaccination of infants and children continued in the other two-thirds. A focus of smallpox persisted until 1966 in Karen State, but endemic transmission was believed to have ceased at that time. In 1968 importations from the then East Pakistan led to the occurrence of 181 cases in 1968 and 68 cases in 1969. No cases were reported thereafter.

9.2.2 Afghanistan

When the smallpox eradication programme in Afghanistan began in 1969 smallpox was endemic in all parts of the country. The prospects for early success appeared particularly poor because of the difficult terrain and climate, the large nomadic population, the scarcity of health personnel, the low vaccination coverage, and the wide prevalence of variolation. Traditional variolators obtained scabs from patients wherever they could be found and travelled widely throughout the country to variolate groups of villagers. Numerous outbreaks followed in their wake.

The strategy called for a thorough vaccination programme, a surveillance-containment programme to detect outbreaks and interrupt transmission, and efforts to discover variolators and to dissuade them from their practice.

Systematic mass vaccination was carried out by mobile teams with rigorous assessment of the results, and very high levels of coverage were achieved. Simultaneously a highly effective surveillance programme was developed with seven mobile teams operating in all parts of the country under central direction. Gradually variolation diminished, but between 1970 and 1973 20% of 237 outbreaks were traced to variolation. Endemic transmission was terminated before the end of 1972. The last three outbreaks, in 1973, followed importations from Pakistan and were promptly contained.

9.2.3 Pakistan

The intensified smallpox eradication programme in Pakistan was implemented in 1970 with somewhat different plans developed for each of the four provinces of Baluchistan, the North-West Frontier, the Punjab, and Sind and for Azad Kashmir. They reflected the great diversity of the country in population density, climate and terrain, language and customs, and stage of development of the health services. Liaison was maintained by frequent meetings between provincial programme directors and WHO epidemiologists.

The original plan called for a mass vaccination campaign designed to attain a high level of coverage in the shortest possible time. Before it had been completed the strategy was shifted to emphasize surveillance and containment. Large urban areas that spread

infection to adjoining rural areas and to other parts of the country were cleared only after great effort. Remote and mountainous areas, nomadic populations, and resistance to vaccination combined with a serious shortage of health personnel in some areas to create difficulties. Variolation continued in the western areas and was responsible for many outbreaks. Time was required to improve the speed and efficiency of containment action.

Surveillance was steadily improved and reporting by the public was encouraged. An extensive publicity and educational campaign was developed. The number of reported cases rose from 3192 in 1970, when the programme began, to 9258 in 1973. During 1974 there were 1642 outbreaks with 7859 cases, but by October of that year the last case had been reported.

9.2.4 Nepal

Nepal was bordered on the south by two of the most heavily infected Indian states, Bihar and Uttar Pradesh, and its principal problems were attributable to numerous importations from those states. A pilot control project was begun in Nepal in 1962 and converted in 1967 to an eradication programme based mainly on mass vaccination. In 1971 a further change was made to a surveillance and containment strategy. Smallpox transmission continued, the 1549 cases reported in 1974 representing the largest number since reliable reporting had begun in 1963. In 1974, 115 out of 180 outbreaks were attributed to importations, 59 to local spread, and 8 to unknown sources. As the programme was strengthened and the disease brought under control in the Indian states of Bihar and Uttar Pradesh, transmission in Nepal was interrupted. The last case occurred on 6 April 1975.

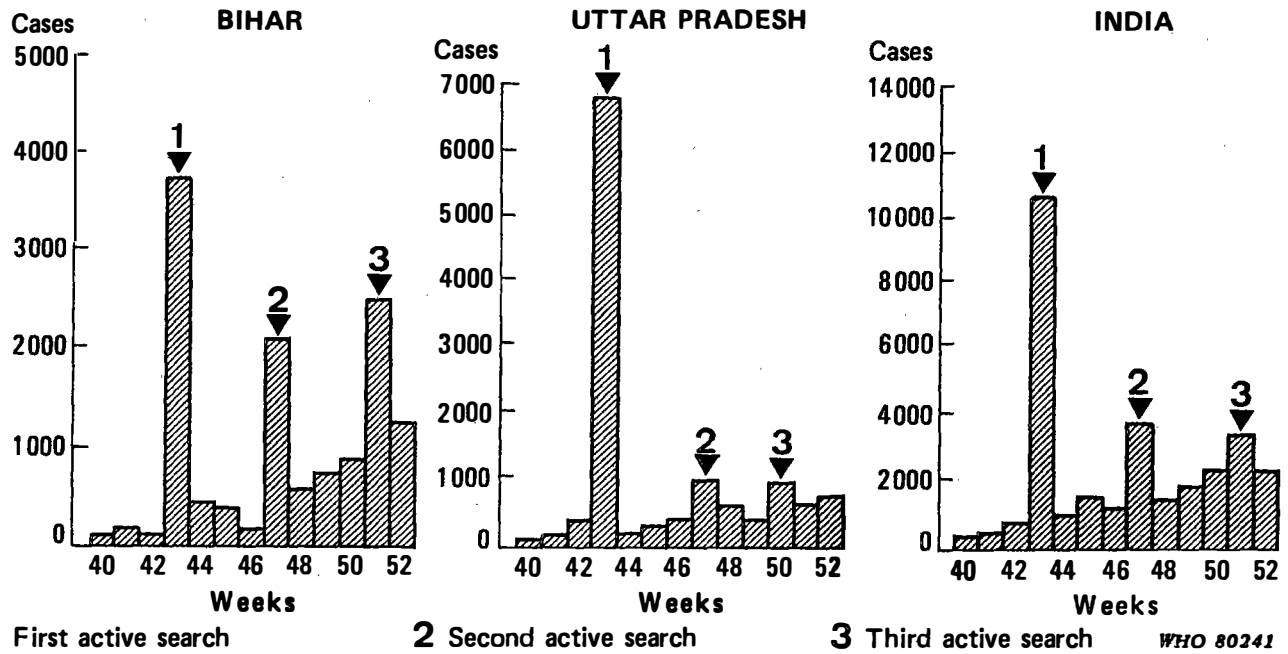
9.2.5 India

India, with its population of nearly 600 million and long history of severe and extensive smallpox, presented a formidable challenge. The Government of India had launched a nationwide eradication programme in 1962 and 1963, for which the USSR had provided 450 million doses of freeze-dried vaccine. Assessment in 1963 showed that actual coverage of the population was far lower than would have been expected from the reported number of vaccinations. Although 60 million primary vaccinations and 440 million revaccinations were performed between 1962 and 1966, the number of cases reported in 1967 remained as high as when the programme began. The Government decided to stress administrative supervision, to give priority to primary vaccination of infants and children, and to improve reporting and containment. In 1969 the bifurcated needle was introduced to replace the rotary lancet for vaccination.

In 1970 a plan of operation for the national smallpox eradication programme was signed by India and WHO. By this time liquid vaccine had been replaced by freeze-dried vaccine and primary take rates were virtually 100%. The strategy was gradually changed to one based on active surveillance with epidemiological investigation of outbreaks and rapid containment. The reporting system was strengthened. The states, mostly in the south, that had approached or achieved eradication were classified as non-endemic and all outbreaks were investigated as a matter of priority and specimens from suspect cases tested in the laboratory. The remaining states, mainly in the north, were classified as endemic and intensive efforts were made in them to strengthen the reporting and outbreak containment systems.

Progress was slow and eradiction still seemed far away in 1973. In that year a decision was made to launch a special intensified campaign to detect outbreaks in the urban areas in July and August and throughout the country from September to December, with special emphasis on the four major endemic states of Bihar, Madhya Pradesh, Uttar Pradesh, and West Bengal. Detailed plans were prepared and epidemiologists from the central Government, from other states, and from other countries were assigned to assist in special areas. The special searches were carried out in these states by all the health workers, numbering over 60 000, who visited every village during a period of one week.

Fig. 5 IMPACT OF ACTIVE SEARCHES ON REPORTING OF SMALLPOX CASES, INDIA, 1973



An unexpected and unprecedented number of outbreaks were discovered during the first search (Fig. 5). In Uttar Pradesh 1525 outbreaks with 5989 cases were discovered, bringing the total number of cases reported in one week to almost 7000. In Bihar 614 new outbreaks and 3826 cases were detected, and in Madhya Pradesh 170 new outbreaks and 1216 cases. Thereafter special house-to-house searches were carried out every month in the endemic states and at longer intervals in the non-endemic states.

In 1974 the programme was further intensified and additional funds were provided by the Indian Government, the Swedish International Development Authority, WHO, and Tata Industries Ltd. At any one time approximately 100 national and international epidemiologists were in the field, primarily in the heavily infected areas. The number of reported outbreaks reached a peak of 8403 in May, with 11 000 cases being reported in a single week.

Gradually the number of outbreaks began to decrease and containment measures could be intensified. Four watchmen working around the clock were posted at every infected home and cross notification of sources of infection between districts and states became routine. Central or international assessment officers visited each outbreak that continued to produce new cases after 21 days. Containment actions were taken around any suspect case or chickenpox outbreak where a death had occurred. The number of outbreaks fell rapidly and the last indigenous case in India occurred in Bihar on 17 May 1975, only a year after the peak incidence was reported.

The Indian campaign profited from the lessons learned in other countries and, in turn, refined and developed many procedures of its own. It demonstrated the limitations of a strategy based on mass vaccination alone in a country as large and densely populated as India. Primary vaccination was performed on a very large scale, but there always remained a large pool of unvaccinated persons and it was constantly added to by the large number of newborn children. Even when vaccination coverage reached 85% to 90%, a goal difficult to achieve, there consequently remained in the endemic states a population numbered in tens of millions among whom smallpox transmission was readily perpetuated. On the other hand, when active surveillance and effective containment programmes were fully developed, India, with its great number of trained health personnel, was able to complete eradication within a relatively short period.

The concealment of cases leading to continuing spread was a major problem. To overcome it, an active surveillance programme was developed that sought information from all sectors of the public in markets, schools, and other places where people gathered. The searcher with the smallpox recognition card asking about smallpox, or chickenpox, or fever

with a rash became a familiar figure in every Indian village. The action of the Government in making reporting commendable rather than an act that might result in reprimand or discipline, and the grant of a reward for reporting, encouraged both health workers and members of the public to report outbreaks promptly.

There was ample evidence of the exportation of cases from endemic areas to other parts of India, neighbouring countries, and overseas. Ten outbreaks in Europe arising from cases imported from India were recorded between 1962 and 1974. Nepal reported 115 importations in 1974 alone. Bangladesh, which was essentially smallpox-free in 1971, experienced a major outbreak in the following years when smallpox was reintroduced from India. Within India the problem was even greater. One community in Bihar was the source for nearly 300 outbreaks involving almost every other Indian state.

The most innovative concept in the campaign was the "search week". Despite heavy emphasis on searching for outbreaks by regular health personnel aided by scores of trained epidemiologists, it was obvious that many outbreaks were not being found or were found so late that they had already given rise to others. The decision was made to use India's huge pool of trained health workers, an unparalleled resource, in visits during a one-week period to every village in the endemic areas. The results of the first and of subsequent searches, startling though they were, defined the true extent of the problem and from then on it was only a matter of time and colossal effort before the target of a smallpox incidence of zero was reached. The last case, an importation from Bangladesh, was recorded on 24 May 1975.

9.2.6 Bhutan

In 1961 a smallpox programme was incorporated into the general expansion of health services that began in that year. In 1966 mass vaccination campaigns were started in each of the six medical zones and freeze-dried smallpox vaccine was introduced. The last known cases in the country were six in 1973 and three in 1974.

9.2.7 Bangladesh

A smallpox eradication programme was launched in 1960, based on mass vaccination of the population over a two-year period. Transmission continued, however, and in 1967 Bangladesh embarked on an intensified eradication programme that again stressed mass vaccination but included a concurrent assessment of the coverage. Freeze-dried vaccine administered with the bifurcated needle increased the effectiveness of the programme. In 1969 the strategy of surveillance and containment was introduced and by August 1970 transmission appeared to have been interrupted. No further cases were detected in 1971.

When the country became independent early in 1972, large numbers of cases of smallpox were reintroduced by refugees returning from India and outbreaks occurred in many parts of the country. The emphasis in control shifted to early detection through active surveillance and immediate local containment. This strategy was successful and, by October 1974, there were only 90 known active cases. Unfortunately devastating rains and floods led to mass migrations and rapid spread of infection to many parts of the country, particularly slum areas in cities.

In February 1975 a national emergency was declared and the programme was intensified with the help of additional national and WHO epidemiologists. All field health workers were mobilized for house-to-house searches, intensified surveillance and containment, and a reward for case reporting was introduced. The epidemic peaked in April 1975 and then rapidly declined, the last case being reported on 16 October 1975.

Fig. 6 A smallpox surveillance worker in south Asia displays a smallpox recognition card while questioning villagers

(WHO Photo: P. Roberts)

9.3 The countries of the Arabian peninsula

Yemen reported its last case of endemic smallpox in 1969, but the seven other countries in the Arabian peninsula reported no endemic smallpox after 1962. There had been a long history of epidemics caused by importations from the Indian subcontinent followed by large-scale containment operations to bring them under control. This risk continued until as late as 1972, as shown in Table 4. During the annual pilgrimages to holy places in Saudi Arabia special smallpox surveillance activities were undertaken; these activities were intensified in 1977 and 1978.

Table 4. End of endemic transmission and years of importation of smallpox in the Arabian peninsula

Country	Year endemic transmission ceased	Year(s) when importations occurred
Bahrain	1957	-
Democratic Yemen	1960	1961
Kuwait	1957	1959, 1962, 1967
Oman	1962	-
Qatar	1961	-
Saudi Arabia	1962	1970, 1972
United Arab Emirates	before 1957	1962, 1967, 1968, 1970, 1971
Yemen	1969	-

9.4 Countries in the Horn of Africa

9.4.1 Djibouti

Four epidemics of smallpox were recorded in Djibouti after 1959, all the result of importations from Ethiopia. The most recent occurred between October 1973 and April 1974 when a series of nine importations resulted in 23 cases. A vaccination programme was organized to cover one-third of the population every year. In October 1977 an active search programme began as part of accelerated surveillance action to detect smallpox cases in the

Horn of Africa. Five nationwide searches concentrated on the large nomad population, refugee camps, caravan gathering centres, military border posts, medical units, schools and other places where people assembled. A total of 161 specimens were collected from December 1977 to December 1979; all were negative for smallpox.

9.4.2 Ethiopia

The intensified smallpox eradication programme in Ethiopia began in 1971. All the obstacles that were known to make eradication difficult were present. The country was large and mainly mountainous, and about 90% of the population of 28 million were dispersed in rural areas. Communications in most areas were poor and large areas could be reached only by vehicles with four-wheel drive, by mule, or on foot. During the rainy season many areas were inaccessible. The health system was rudimentary and limited to the larger towns. Reporting of communicable diseases came only from the few hospitals and the larger health units and did not reflect the situation in most of the country. Health personnel were so few in number that the Government was able to make only a very limited commitment to the programme. Variolation was widespread. Variola minor was present and caused a relatively mild disease with few deaths.

From the start emphasis was placed on strengthening surveillance, improving the reporting system, and containing outbreaks. Two-man surveillance teams consisting of a sanitarian and a United States peace corps volunteer were placed in regional capitals in order to detect outbreaks, define the extent of the problem, and start containment measures. At the beginning there were only 19 surveillance teams and by the end of 1971 there were only 24. Nevertheless, the number of reported cases rose from 722 in 1970 to 26 329 in 1971. Of these cases 85.6% were reported by surveillance teams and 5.4% by health facilities. It was reported that 3075 cases had resulted from variolation.

During the succeeding years the number of surveillance teams was increased by the training of national personnel and the arrival of additional volunteer workers from Austria and Japan. By the end of 1972 there were 65 surveillance teams. Communications were improved by a radio network that connected the mobile units to headquarters. More vehicles were funded by WHO and helicopters were funded by the United States Public Health Service, two at first and later four. Coordination was established with the smallpox eradication programmes in the neighbouring countries of Kenya, Somalia, and Sudan.

By 1973 some regions had become smallpox-free, notably along the Sudan border, and personnel were concentrated in the remaining endemic foci. In 1974 the number of reported cases dropped to 4439. In 1975, the rest of the world then being smallpox-free, WHO support was greatly augmented and the staff expanded to 4 epidemiologists, 12 international consultants, 85 surveillance officers, and 1200 temporary workers. With the larger staff intensive containment of outbreaks became feasible.

Among the changes that followed the revolution in 1974, farmers associations were organized and students dispersed throughout the country, many of whom became available as temporary workers in containment operations. By the end of 1976, 1400 Ethiopian staff were engaged in the programme, an Ethiopian national had been made director, and surveillance teams were headed whenever possible by national personnel. By this time the major endemic foci had been reduced to three and surveillance and containment were intensified within them. House-to-house searches were carried out and cases effectively isolated through a system of watchmen. The last remaining focus was in the Ogaden region, where operations, always difficult, had been made even more so by exceptional floods. The last reported case occurred there on 9 August 1976.

9.4.3 Kenya

The last endemic smallpox cases in Kenya were reported in 1969, but importations occurred in Mandera district, which borders on Ethiopia and Somalia, in 1971, 1973, 1974, and 1977. The intensified eradication programme began in 1968 and was based on mass vaccination using freeze-dried smallpox vaccine. Surveillance and containment were emphasized during the campaign. The attack phase was completed in May 1972 and at that time it was estimated that 80% of the population had been vaccinated. During the maintenance phase vaccinations continued, emphasis was placed on the investigation of rumours, and importations were vigorously contained. In December 1976 an importation from Somalia resulted in five cases,

which were reported in 1977. Systematic active searching for smallpox in high priority areas bordering on Ethiopia and Somalia began in 1977 and was extended to the entire country in early 1979. A total of 1751 specimens were collected throughout the country between January 1977 and December 1979; none were positive for variola virus except those from the imported cases.

9.4.4 Somalia

The intensified WHO-assisted programme in Somalia began in January 1969. The aim was to achieve 100% vaccination coverage of the 3.5 million population within three years, follow up with routine vaccination of infants, immigrants, and the floating population, then revaccinate after three or four years. Some success was obtained in Mogadishu and the larger towns, but it was soon apparent that 100% coverage was not feasible in a country where many people were resistant or indifferent to vaccination and a large proportion of the population was nomadic.

From 1971 to 1976 a reporting system was gradually developed, particularly in the border districts. Information was obtained from health staff, people in political and administrative positions, and village and nomad leaders. Importations from Ethiopia were nevertheless reported every year from various points along the border, especially in 1975, when an extremely severe drought caused large-scale population movements across the frontier. Border disputes were also occurring. In September 1976 smallpox was reported in Mogadishu and, despite repeated searches and containment actions, cases continued to occur until January 1977.

Fig. 7 A nomad woman in Africa is questioned by a smallpox surveillance worker who is showing her a smallpox recognition card

In March 1977 numerous outbreaks were found in a wide belt extending across the southern and south-central part of the country. In May 1977 the Government of Somalia declared the smallpox epidemic a national emergency and appealed for aid through WHO to the Office of the United Nations Disaster Relief Coordinator (UNDRO). In response, 16 vehicles and other equipment were airlifted into the country. WHO personnel were increased to 25 and the programme was fully operational by June. Over 3000 workers were hired throughout the country.

A weekly reporting system from villages and nomad encampments was set up. Wide publicity was given to the reward for reporting cases and continuous house-to-house locality-by-locality searches were made. Information was sought from all segments of the population wherever they could be contacted. The number of reported outbreaks rose from 63 in late April to 425 in early July, reflecting the impact of the programme. Containment activities were strengthened by vaccinating all residents in the vicinity of a case within 48 hours, establishing a secure isolation unit, and providing isolated patients with shelter, food and water as an incentive to them to remain in isolation.

In September the final steps were taken to interrupt transmission in the areas formerly most heavily infected. The last known case occurred on 26 October 1977, less than seven months after the emergency strategy came into force. Surveillance was further intensified but no cases were found.

9.5 Missed outbreaks

The requirement for certification of smallpox eradication was that at least two years should elapse after the occurrence of the last case and that the surveillance system should be adequate to detect cases. In all countries the surveillance systems were strengthened during the programme and, in the great majority, no outbreaks occurred after transmission was thought to have been interrupted.

In four countries outbreaks were discovered at periods varying from 10 to 34 weeks after the last known case. In Nigeria in early 1970, 22 weeks elapsed before detection of an outbreak that consisted ultimately of 84 cases. In Brazil, during an active search and vaccination campaign in an urban area, 19 cases of smallpox were found 15 weeks after the last case had been recorded. In West Java in 1971, 34 weeks passed after the last case before an outbreak was detected; 163 cases occurred. In Botswana three outbreaks with a total of 30 cases occurred between 1972 and 1973. The delays were of 13, 27 and 10 weeks after the previous outbreak and were attributed to the lack of cooperation of a small religious sect.

There were many reasons for the delay in detection of these outbreaks. Among them were uneven geographical coverage by the surveillance system, the suppression of reports by certain local staff or particular communities, the ignorance of some local staff of the importance of smallpox surveillance and, at times, confused communication between the various levels involved in reporting. However, in spite of these factors causing delay, the existing active surveillance systems were ultimately able to detect the outbreaks.

In Malawi an investigation of a pockmarked person suggested that smallpox cases may have occurred in 1972, 19 months after the last reported case. However, the situation was different from those just described in that an active surveillance programme had not then been developed in the area and the evidence was based only on retrospective investigation of facial pockmarks.

The outbreaks described occurred between 1970 and 1973 and no missed outbreaks were observed thereafter. After these incidents all the countries where eradication programmes were under way strengthened their surveillance systems. To make doubly sure that no outbreaks had been missed, the effectiveness of the surveillance system was always evaluated by WHO before it fixed the date for certification by an international commission. Many countries with relatively weak systems were not certified until several years had passed over and above the specified two years after the last reported case.

10. OUTBREAKS OF SMALLPOX IN NON-ENDEMIC AREAS

10.1 Importations of smallpox

10.1.1 International quarantine

Fear of the importation of smallpox from endemic areas was a major factor in upholding international quarantine measures. The requirement that travellers should possess an international certificate of smallpox vaccination undoubtedly prevented many, and perhaps most, importations but on many occasions it failed to do so. Non-potent vaccine was sometimes used, and false certificates were occasionally obtained.

When travel was largely by ship, the voyage to the principal non-endemic areas was usually long enough for crew or passengers exposed to smallpox to become ill and be detected before arrival at their destination. A total of 27 instances of smallpox occurring on ships were reported to WHO in 1948, the first year of its existence. In most instances travellers were detained on shipboard or were refused entry. The rapid expansion of air travel created new problems because passengers incubating the disease could reach and pass through their port of entry days before illness developed.

10.1.2 Importations into Europe (1950 - 1977)

Many importations occurred into non-endemic countries in various parts of the world, but the documentation on them was often incomplete. The data are most complete for importations into Europe since 1950. Between 1950 and 1973, 50 importations resulted in 1113 cases in 10 different countries. Data from the last 27 outbreaks that occurred between 1961 and 1973 have been carefully reviewed and are presented in Annex 8.

Of the last 27 importations 21 originated from the Indian subcontinent, 5 from Africa, and 1 from the Middle East. Of the index cases 24 travelled by air, 2 by sea, and 1 by land. Of the outbreaks 9 involved between 14 and 175 cases, the remainder 5 or fewer. In 14 instances there were no secondary cases.

In a different review of importations into Europe between 1950 and 1971, 49 outbreaks were analysed. Fewer than half of the index cases were sick at the time of arrival. Most patients sought medical assistance during their illness and approximately half were isolated within 48 hours of the onset of illness. In all, 926 cases were reported during the subsequent outbreaks. Variola major was responsible for 591 cases in 34 outbreaks and considered the probable cause of 11 other outbreaks with 88 cases. The remaining 256 cases were considered to be cases of variola minor. Hospital transmission was responsible for almost a quarter of the cases, which occurred in hospital personnel and their contacts, hospital patients, and visitors. There were 107 deaths among variola major patients, an overall case fatality rate of 17%.

Transmission by close face-to-face contact was the form most frequently observed in Europe, as in the endemic countries. However, two outbreaks demonstrated that airborne transmission could occur at considerable distances in a closed hospital setting. In both instances the index patient had a severe cough, which presumably increased the quantity of aerosolized virus particles. In one outbreak 10 patients were infected by virus transmitted down a corridor to an adjoining ward. In the second outbreak 13 patients in rooms either on the same floor or on the two floors above the patient were infected.

The last large outbreak in Europe occurred in 1972 in Yugoslavia, which had not experienced a case of smallpox since 1946. There were 175 cases and 35 deaths. A pilgrim returning from Iraq developed mild smallpox and 11 cases developed among his many contacts, one of them a haemorrhagic case. In the process of reaching a diagnosis this patient passed through four hospitals and 48 cases resulted, of which 42 were hospital personnel or hospital contacts. Other contacts of the index case spread the disease to 17 villages. The epidemic was brought under control by mass vaccination and a surveillance-containment programme within four weeks of the detection of the first case.

Importations were more frequent when many countries were heavily endemic. There became fewer as the eradication programme progressed, and the last importation into Europe occurred in 1973.

10.2 Laboratory-associated outbreaks

Many laboratories around the world have been engaged for decades in laboratory diagnosis of smallpox and studies of variola virus. The safety procedures that were followed conformed to those used for other infectious agents, work with variola virus not generally being regarded as particularly hazardous. Many laboratory workers have been exposed but the fact that they were well vaccinated presumably prevented clinical illness.

There are three documented instances of laboratory-associated infections, which occurred in 1949, 1973, and 1978 in the United Kingdom. These are a cause for concern, since cases originating in laboratories represent a source for the reintroduction of smallpox into a smallpox-free world.

The first case occurred in 1949 owing to self-inoculation with variola virus by a newly appointed laboratory worker who had handled infected instruments on the same day as he was vaccinated. There were no secondary cases. In the second episode, in 1973, a laboratory technician visiting a smallpox laboratory is believed to have been infected while watching the routine harvesting of virus-infected eggs. She developed extremely mild smallpox, which was not immediately diagnosed, and was placed in a general hospital ward where she infected two visitors of a patient in the adjacent bed, both of whom died. The third outbreak, in 1978, differed in that the individual infected worked on the floor above a smallpox laboratory and was presumably infected by virus originating from the laboratory through an unknown route. This patient died after a prolonged and unusual course and infected one person, whose illness was very mild. In each of these three episodes variola major virus was responsible for the disease. An outbreak of variola minor in 1966 may have originated in the same laboratory as the 1978 outbreak, but no proper investigation was carried out.

These incidents show that laboratory work with variola virus may carry a small risk, though it is probably far less than that of many other infectious agents. Adequate vaccination reduces the risk to a very low level. A WHO group has considered the question of laboratory investigations with variola virus after eradication, and has recommended administrative and containment procedures to prevent the virus from escaping from laboratories (Annex 9).

11. THE CERTIFICATION OF ERADICATION

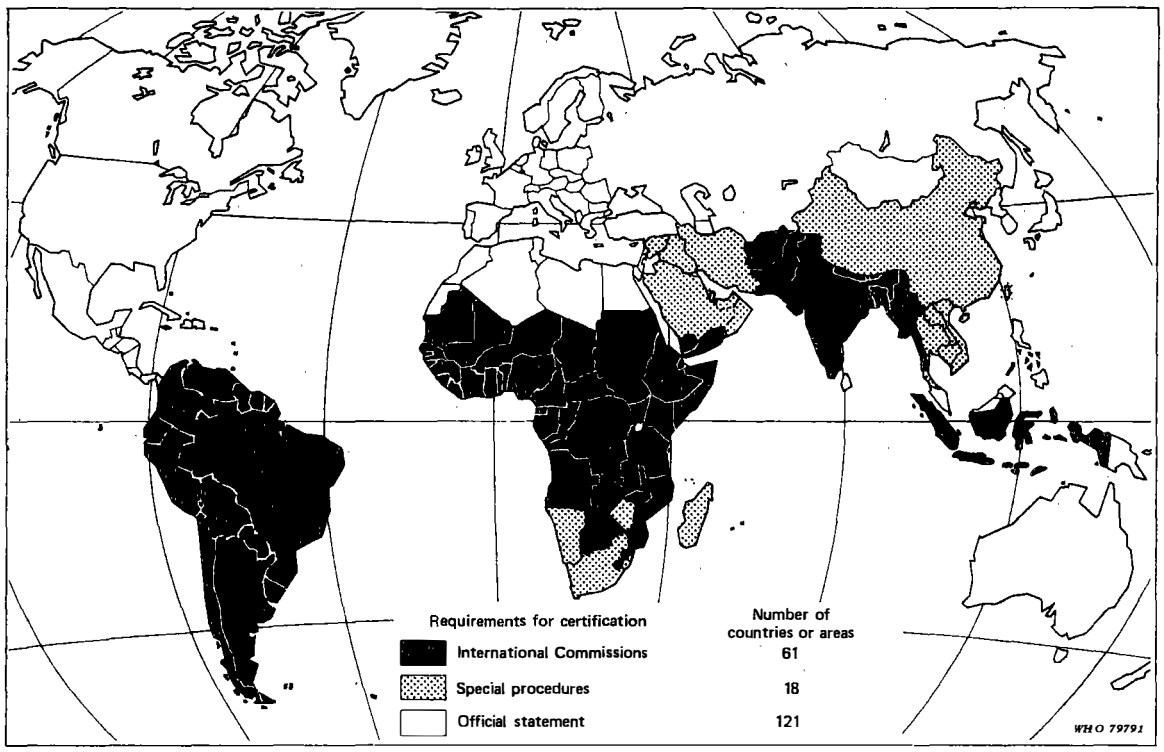
11.1 International Commissions

A decision by a national health authority to cease requiring international certificates of vaccination against smallpox or to cease routine vaccination is one of considerable importance involving a certain risk. The announcement by a country or group of countries that smallpox transmission has been interrupted is therefore not by itself sufficient unless other countries at risk of importing cases are confident that interruption has been achieved. It was decided, therefore, that when at least two years had elapsed after the last known case a WHO international commission would be convened to examine the documentary evidence and evaluate it in the light of personal observations in the field. For each commission individuals were selected who would be very critical in their assessments and whose views as experts in infectious disease control would be respected both nationally and internationally. Experts were particularly sought from the countries most at risk of importation of cases from the country or countries to be certified. As time passed a deliberate effort was also made to incorporate into the commissions authorities from as many different countries as possible, so that the nature and extent of the efforts made to document the interruption of transmission would be widely appreciated (Annex 10).

It was recognized that no commission could reasonably expect to examine all, or even a substantial proportion of, the individuals in a country to confirm that none had smallpox. Moreover, if experts were to participate, it was appreciated that they would be unable to devote more than three or four weeks to the work. Thus, in preparing for the visit of a commission, each country drew up a national report that described its activities in detail. The commissions normally spent two to three days reviewing the reports and then decided which parts of the country they would visit to compare the reports with direct field observations. To reach the maximum possible number of areas, the commissions usually divided into teams of one or two persons each. The areas selected were those which the commission identified as having the least satisfactory or the most questionable documentation or which appeared to be

at unusual risk as sites where smallpox transmission might still persist. The teams then travelled extensively in the field for one to three weeks before reconvening to consider the results of their observations and to reach a decision on certification.

Fig. 8 Procedures for global certification of smallpox eradication 1973 - 1979



11.2 Preparations for certification

11.2.1 In recently endemic and adjacent countries

The WHO Expert Committee on Smallpox Eradication in 1971 established for the interruption of smallpox transmission the criterion that an effective surveillance system should be maintained so that clinical infections could be detected. Each country continued active surveillance for a minimum of two years after reporting its last case. Some were visited by commissions two years after reporting their last cases. Others continued active surveillance for many years before certification because they were adjacent to a country or region where smallpox transmission continued or considered to be at a high risk from importations.

The methods used to gather evidence that smallpox had been eradicated varied from country to country, depending on the size and distribution of the population, the degree of development of the health services, and the kind of outbreaks, whether caused by severe or by mild smallpox. Each country documented its activities and most carried out intensive programmes for one to several years before the anticipated visit by an international commission, in an effort to find and document any case or suspect case of smallpox. Reports on these programmes were then submitted to WHO and to commission members. Evidence was sought from the following sources: (1) evaluation of the effectiveness of the regular reporting system; (2) special active searches, particularly in the areas of the most recent outbreaks and in high risk areas; (3) assessment activities; (4) reports of chickenpox cases, special attention being paid to deaths attributed to chickenpox; (5) facial pockmark surveys; (6) records of special surveillance and containment operations; (7) the laboratory findings for specimens from chickenpox patients and other suspect cases; (8) surveys of public awareness of smallpox; (9) vaccination coverage; and (10) where applicable, surveys of knowledge about the reward offered to persons reporting a previously undisclosed outbreak.

11.2.1.1 Effectiveness of the routine reporting system

Each country provided data on the number and distribution of health units and the regularity and completeness of reporting. The data included the number and types of hospitals, health centres or stations, and peripheral health units, and maps showing their distribution throughout the country were usually provided. The requested number of monthly or other periodical reports was compared with the number actually received. Data were also supplied on the reporting of chickenpox, especially when associated with death, and on the receipt of weekly reports indicating that no smallpox had occurred. Finally, the records of what action was taken if a suspect smallpox case was reported were examined. Action was taken to increase awareness among health personnel of the need to report immediately any cases in which there was a suspicion of smallpox.

In almost all countries routine reporting was incomplete, and some regional health units did not submit reports with regularity. On the other hand the health units provided information on a very substantial number of chickenpox outbreaks and collected a large number of specimens for laboratory diagnosis. It is noteworthy that cases of monkeypox that occurred after the elimination of smallpox in several west and central African countries were reported through the routine system.

11.2.1.2 Active searches

Special mobile teams conducted field surveys in order to obtain current information. The teams were organized and directed by the national eradication programme if it was still intact, by persons who had been involved in the programme during the attack phase, or by persons responsible for communicable disease programmes.

The investigations were carried out in those localities where the risk of hidden smallpox was thought to be greatest. They included the localities that had notified the most recent outbreaks, those which had reported suspect smallpox cases or chickenpox deaths after the last known outbreak, and those with poor health coverage and communications. Areas bordering on countries that had recently been endemic and areas where there were extensive population movements were also included. Special attention was given to interviewing families of old or suspected cases, looking for pockmarks and vaccination scars, and obtaining complete data on any deaths from a disease with a vesicular rash.

A general survey was planned for the cities, towns, and larger villages. Experience in the programme had shown that, if smallpox had persisted in smaller villages or nomadic groups, it would ultimately reach the larger population centres. The selection of localities to be visited was made so as to include, where possible, communities with health units and primary schools, which attracted persons from a large geographical area who might report suspect cases. The usual objective was to reach communities containing at least 20% to 25% of the population. In countries with large numbers of health personnel higher levels of coverage or even visits to every populated place were planned.

The training of the teams included the following:

(1) Complete background information on the status of smallpox eradication in the country including details of the last outbreaks, suspect cases, and deaths from chickenpox. Particular localities for special investigations and field surveys were designated.

(2) The identification features of facial pockmarks caused by smallpox infection and of scars caused by other conditions. Only persons with facial pockmarks caused by, or suspected to be caused by, smallpox infection were to be investigated and documented.

(3) Epidemiological investigation of suspect cases, including the collection of specimens. Isolation and containment procedures were reviewed with the team.

(4) The itinerary for field visits and the recording, reporting, and presentation of data and of regular reports.

The teams sought information about smallpox and chickenpox cases, actual or rumoured, in the primary schools, health units, markets, and other places where people congregate and from nomadic and other migratory groups. Special attention was paid to the assessment of surveillance activities. Evaluation teams directed by the national programme

were organized to visit every month up to 10% of the places that the mobile teams had visited. The evaluation teams visited health units and primary schools, where some younger children were re-examined, to verify the observations of the survey teams. They examined as many as possible of the chickenpox patients from whom specimens had been collected.

11.2.1.3 Pockmark surveys

Permanent facial pockmarks were found in about 70% of persons who survived variola major. The rates were slightly lower following infection with the somewhat less virulent form of smallpox that occurred in most parts of Africa. Heavy diffuse facial scarring, readily observed at a distance of five meters, was seen on the faces of many victims, but others had lesser degrees of scarring that could be detected only by close inspection. Residual pockmarks were found less frequently among those infected during the first few years of life. The presence of five or more depressed facial scars greater than 1 mm in diameter at the base has been accepted as being virtually diagnostic of a previous attack of smallpox. Chickenpox leaves some residual scars, but it is rare to find five or more scars on the face. Other causes of facial scarring or pitting could usually be distinguished by experienced observers, such as those caused by burns and acne and other skin diseases.

The mildest form of smallpox, variola minor, which is prevalent in Brazil and parts of eastern and southern Africa, caused far less scarring. A careful follow-up study in Somalia found five or more pockmarks in only 7% of patients seen a year after recovery. Thus the usefulness of pockmark surveys in countries where only variola minor had occurred was limited.

When a pockmarked person was found the dating of his illness became a matter of importance, for if it was learned that the illness had occurred after the last known case the adequacy of the surveillance system was placed in question. Pockmarks in children provided more useful information than in adults, because in the former the age and dating of illness could usually be estimated fairly closely whereas in the latter there was often difficulty. Failure to find any children with pockmarks acquired after the last known case among the very large number examined provided evidence that smallpox had not been present.

In pockmark surveys carried out by national teams in 34 African and 5 Asian countries a widely varying incidence of pockmarks was observed in adults, the highest being about 5%. A relatively high incidence was also found in schoolchildren in some countries, particularly those known to have had comparatively recent large outbreaks of variola major. However, the date of illness of each was carefully investigated and no children were found whose illness had occurred after the last reported case. Especially impressive was the failure to find pockmarks in over two million pre-school children in the African countries, most of whom had been born after the last case was reported.

The members of the international commissions also carried out a number of pockmark surveys during their field visits. The prevalence of facial pockmarks they observed was often higher than that recorded during the national surveys because the commissions tended to focus on high risk areas whereas the national surveys were conducted on a more random basis.

11.2.1.4 Chickenpox surveillance

Chickenpox can sometimes be confused with smallpox. Problems in the differential diagnosis were more likely to occur with variola minor, which was mild and rarely fatal, than with variola major. In the countries where variola minor was prevalent, such as Botswana, Ethiopia and Somalia, pockmark surveys, as noted earlier, were relatively non-productive. The emphasis was therefore placed on the surveillance of chickenpox cases, because a surveillance system sensitive enough to detect chickenpox would in all likelihood detect smallpox. Efforts were made to determine the incidence and distribution of chickenpox and to verify the diagnosis by laboratory study.

Both the established health units and the mobile units sought and reported chickenpox cases. Those countries which had not previously required notification of chickenpox cases instituted notification during the post-eradication period. It was considered important to obtain one specimen (5 to 6 scabs) from at least one case in each outbreak. Special emphasis was placed on obtaining specimens from certain types of cases or

their contacts -- from outbreaks, for example, in which a death attributed to chickenpox had occurred, chickenpox in an unvaccinated child, patients with an extensive rash involving palms and soles, and patients in whom the diagnosis was uncertain.

11.2.1.5 Rumour register

At the regional level health officials were required to maintain a register of all patients reported as suspect cases. The information recorded included the full name, family, age, sex, village or locality, presence or absence of a vaccination scar, date, and data relevant to the illness. All such cases were investigated by qualified personnel. Most were seen at the local level by trained persons who reached a decision on whether the case could be smallpox. If there was any doubt regarding the diagnosis, a consultation was sought through the national surveillance organization and specimens were collected. The rumour register was kept at the regional office. National registers were kept of all information received from the regions. Both were of considerable value to the international commissions.

11.2.1.6 Specimens for laboratory diagnosis

Relatively few specimens were collected when smallpox was widespread because the diagnosis was usually clear; when there was doubt cases were treated as being smallpox. As the incidence fell to low levels, increasing numbers of specimens were taken from outbreaks. When transmission was nearing the end specimens were collected from each case.

In preparation for certification large numbers of specimens were collected from patients with chickenpox, persons with fever and a rash, and other suspects. They were sought over a wide geographical range and from high-risk groups such as nomads, persons living along borders, refugees, and persons living in the area where the last cases had been reported. Specimens were forwarded to WHO and from there sent on to one of the two WHO collaborating centres in Atlanta and Moscow. Shipment and testing of the specimens were done with the least possible delay and those with priority dealt with immediately. The results were cabled to the field.

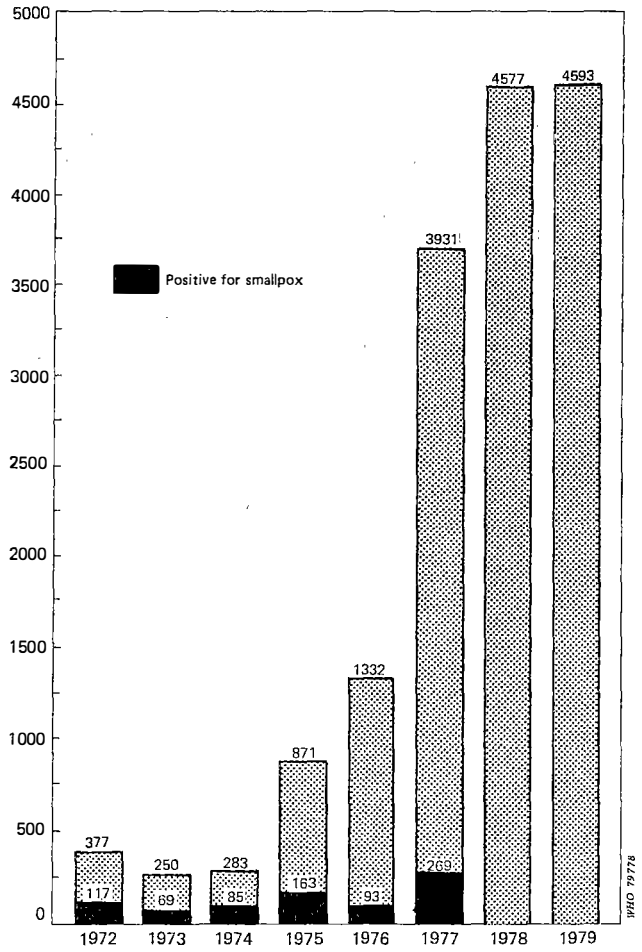
Annex 3 shows the national origin of specimens tested from 1969 to the end of 1979. The number tested rose from 283 in 1974 to over 4500 in 1979 (Fig. 9). The percentage of specimens positive for variola virus was relatively large during the earlier years, but none were positive after October 1977. Large numbers of specimens were collected by certain countries during a single year in preparation for certification. Thus about three-quarters of the specimens collected in 1978 and 1979 came from Ethiopia, Kenya and Somalia, which had reported their last cases in 1976 and 1977 and were preparing for certification in 1979. Electron microscopy showed that many of the specimens contained herpesvirus.

11.2.1.7 Publicity, knowledge about smallpox, and rewards

Publicity campaigns about smallpox continued until formal certification. In large urban centres radio, newspapers, and television were used. In smaller villages and remote areas leaflets and posters showing pictures of smallpox patients were utilized more frequently. Personnel in health units were encouraged to enquire about smallpox or fevers with a rash and personnel in mobile units repeatedly visited schools, markets, and other places where they informed the public about the disease in individual conversations or by loudspeaker. In several countries the walls were so covered with posters and wall writings that the smallpox teams were asked to desist because they were defacing the buildings.

As the eradication programme progressed many countries offered rewards for the reporting of previously undetected smallpox cases. The rewards were initially small but were gradually increased in amount until they ultimately reached the level of $ 1000 offered by WHO. Active search teams in their contacts with schoolchildren or other segments of the population showed the smallpox recognition card, asked people what the disease was, where cases had last been seen, and whether there were any reports or rumours of smallpox or chickenpox in the area. They inquired whether people knew where to report if they knew of such a case and also whether people knew about the reward and its amount. Since the amount was changed at intervals, the replies provided information on how recently the persons had been informed about the campaign.

Fig. 9 Specimens collected worldwide and tested by WHO collaborating laboratories, 1972 - 1979



Many countries conducted large-scale surveys to assess what proportion of the population knew about smallpox, knew where to report a case, and knew about the reward. The techniques they used varied widely and for this reason the results are difficult to tabulate. It was evident that in a number of the more populous and more recently endemic countries these campaigns reached a very high proportion of the people. It appeared highly unlikely that smallpox transmission could have continued without detection when a large proportion of the population knew about the disease and the reward.

11.2.2 In countries free from smallpox for several years

Certain countries that had not had WHO-assisted eradication programmes received special attention during certification. They included countries that had experienced importations between 1967 and 1977 (resulting on several occasions in the re-establishment of endemic foci) and countries considered to be at high risk because endemic smallpox was present in an adjoining or nearby country. The countries falling into one or other of these categories were: in Africa, Madagascar, Namibia, Southern Rhodesia, and South Africa; in the Middle East, Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates; in Asia, China, Democratic Kampuchea, Lao People's Democratic Republic, Thailand, and Viet Nam.

Since special smallpox eradication programmes had not existed in most of these countries and they did not have trained smallpox surveillance teams, almost all were visited by WHO consultants who outlined the steps necessary for certification and assisted in the preparation of appropriate programmes and in the training of personnel. The programmes varied in nature according to the epidemiological factors. For some only a detailed report was requested; for others action extending over six to 12 months. Forms were provided in order to obtain the same type of information as that requested from recently endemic countries (section 11.2.1) and to ensure the uniform recording of findings.

The data provided, supplemented in most countries by information obtained through visits by WHO consultants, including members of the Global Commission, provided the basis on which the Global Commission reached its judgement that the country should be certified as smallpox-free.

11.3 Certification by international commissions

The first international commission visited Brazil in August 1973, two years after the last reported case, and certified that Brazil and the other 12 countries of South America were free of smallpox. Indonesia was certified in 1974, two years after the last reported case. The countries of west and central Africa had completed eradication in 1971, but certification was delayed because of the presence of smallpox in nearby countries. In 1976, more than five years had passed since smallpox had been reported in adjoining countries in Africa and a commission visited and certified eradication in 15 countries in west and central Africa.

Commissions visited Afghanistan and Pakistan late in 1976, and certified eradication three and two years respectively after these countries had reported their last cases. In April 1977 a large commission certified Bhutan, India, and Nepal after a special preparatory visit in which some commission members took part. The last cases had been reported in India and Nepal two years and in Bhutan three years before. Certification of the other previously endemic countries of the Asian subcontinent was completed in December 1977 by a commission that visited Burma seven years and Bangladesh two years after the last reported cases.

Certification of the remaining countries of Africa was delayed because of continuing smallpox in Ethiopia and exportations to Kenya and Somalia. However, Sudan and Uganda had maintained good surveillance, especially along the borders, and remained as a smallpox-free barrier. In June 1977 a commission certified nine central African countries six years after the last reported case in Zaire. Four countries in south-east Africa -- Malawi, Mozambique, the United Republic of Tanzania, and Zambia -- were visited and certified in March 1978, seven years after the last reported case in Malawi. Separate commissions certified Uganda and Sudan in October and November 1978, six years after their last reported cases and one year after the last known case in the Horn of Africa.

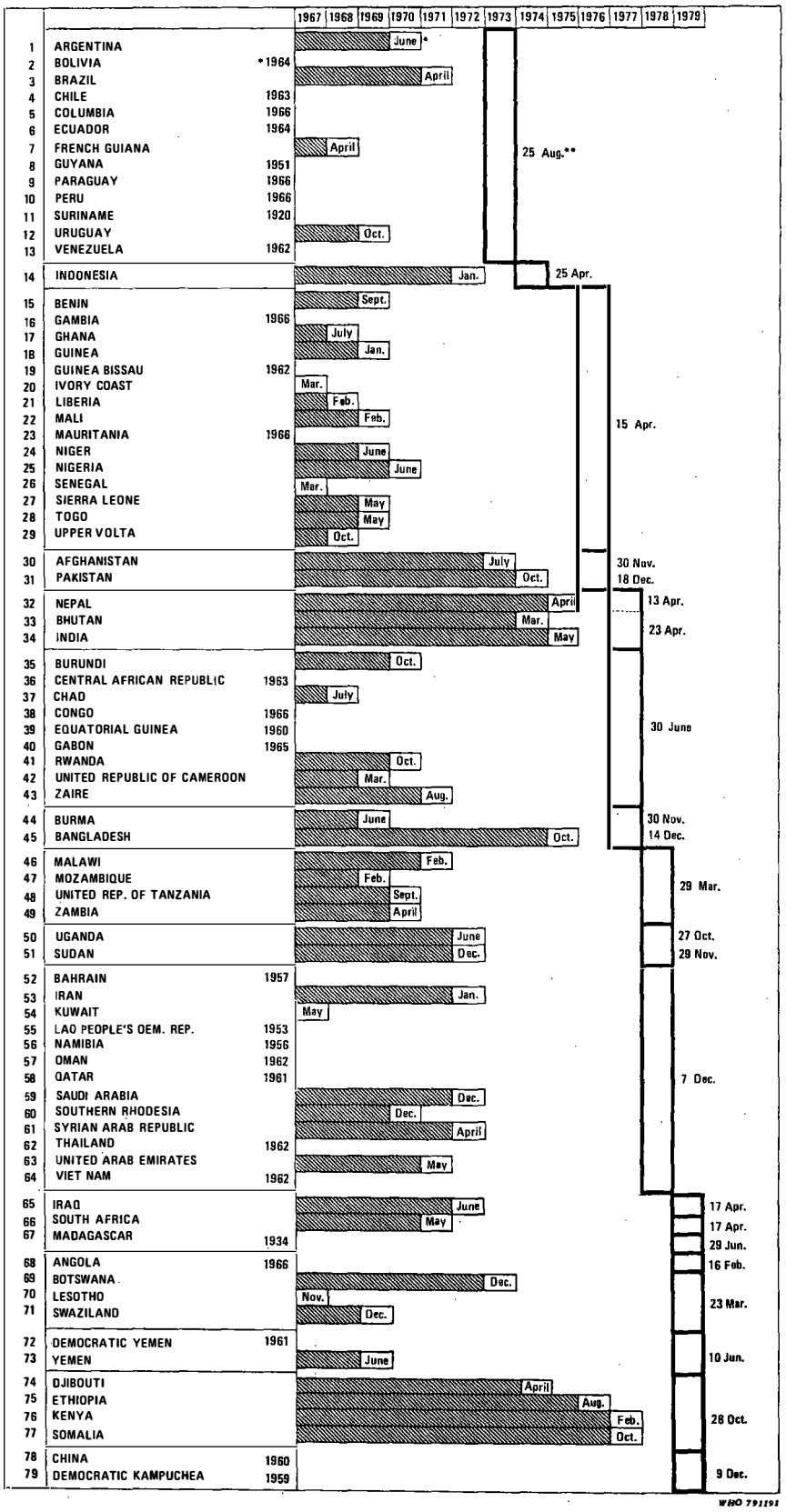
In February 1979 a commission certified Angola, 13 years after its last reported case. Another commission in March 1979 certified Botswana, Lesotho and Swaziland, 6, 10 and 13 years respectively after their last reported cases. In June 1979 a commission certified Democratic Yemen, 11 years after its last reported case, and another commission certified the Yemen Arab Republic, 10 years after its last reported case.

Only the four countries in the Horn of Africa remained. These were visited in October 1979. Special programmes were developed in Ethiopia and Somalia which were visited in advance by Global Commission members to advise on suitable programmes. Eradication was certified in Djibouti five years after the last reported case, in Ethiopia three years after its last case, and in Kenya and Somalia two years after the last case had been reported in southern Somalia. Because the four countries of the Horn of Africa were considered to constitute a single epidemiological unit, representatives of each of the four international commissions met in Nairobi after each country had been certified. They reviewed the situation in each country, considering particularly transmission across the borders, and then certified that the entire Horn of Africa was free of smallpox.

The activities of the commissions increased in intensity and thoroughness as worldwide eradication approached. The various members visited the remotest areas, interviewed large numbers of persons and conducted extensive pockmark surveys in order to corroborate the evidence provided by the national programmes. The findings are documented in the reports of a number of the commissions.

Fig. 10

79 COUNTRIES WHICH REQUIRED SPECIAL PROCEDURES FOR THE CERTIFICATION OF SMALLPOX ERADICATION SHOWING MONTH OF LAST REPORTED SMALLPOX CASE AND DATE OF CERTIFICATION



* Month and/or year of last reported smallpox case.
** Date of certification.

11.4 Certification by the Global Commission

11.4.1 Rationale

There were two major questions facing WHO as eradication appeared imminent: (1) how to be certain that there was no continuing smallpox transmission anywhere in the world; (2) whether there was any possibility that smallpox could be reintroduced into the human population from a non-human source such as an animal reservoir or from virus stored in a laboratory.

Assurance that smallpox transmission had been interrupted in those countries that had participated in the WHO smallpox eradication programme had been, or was to be, provided by national health authorities and by the international commissions. There remained, however, a number of countries that had not participated in the programme and it was thought at least remotely possible that smallpox transmission might have continued in them.

It was essential that the world community should be furnished with evidence that there was no smallpox transmission anywhere on the globe. Policy questions regarding the continuation of vaccination and the establishment of a vaccine reserve for an unforeseen emergency needed to be answered. There were unanswered questions about the source and significance of monkeypox virus and other orthopoxviruses of animals. Decisions needed to be made about the disposal of stored virus stocks, the extent and type of research, and the conditions under which laboratory research should be carried out. These considerations formed the basis for the decision to establish a Global Commission for the Certification of Smallpox Eradication.

11.4.2 Action by the Global Commission

11.4.2.1 Countries already certified by international commissions

The Global Commission reviewed and endorsed the conclusions of the 21 international commissions that had certified eradication in 38 countries in Africa, 2 countries of the Arabian peninsula, 7 countries of the Indian subcontinent, Indonesia, and 13 countries of South America.

11.4.2.2 Countries designated for special reports and/or visits

Eighteen countries had previously been singled out for special consideration, either because it was felt that adequate information about smallpox and surveillance in them was not available or because their geographical location had made them particularly vulnerable to importations (Table 5; see also section 11.2.2). Fifteen of them were visited by Global Commission members and/or WHO staff or consultants, and all the data obtained were assessed by the Global Commission before eradication was certified. It is noteworthy that there had been no reports of smallpox from any of the countries concerned for more than five years prior to certification.

11.4.2.3 Formal statements by countries and areas

The Global Commission requested all other countries in the world to submit formal statements that they were smallpox-free, indicating the year in which smallpox had last occurred (Annex 11). All 121 countries and areas from which statements were requested supplied them for review by the Global Commission before certification of global eradication.

11.5 International smallpox rumour register

In January 1978 WHO established an international rumour register. Up to the end of December 1979, 104 such rumours had been reported directly to WHO from 40 countries considered to be free of smallpox (Annex 12). This total does not include the many rumours coming to the attention of local or national authorities. The investigation of these rumours by national health authorities or by joint WHO/national teams showed that more than half were cases of chickenpox or measles; they were followed in order by other skin diseases and old smallpox cases. The two confirmed smallpox cases originated in the Birmingham laboratory-associated outbreak. One case of monkeypox from Nigeria and detected in Benin was reported and confirmed.

Table 5. Countries designated for detailed reports or visits

Country	Last reported case	Country report submitted	Visited by Global Commission member/WHO staff	Date certified	Interval (years) last case to certification
Madagascar	1934	+	+	1979	45
Namibia	1956	+	+*	1978	22
South Africa	1971	+	+*	1979	8
Southern Rhodesia	1970	+	+	1978	8
Bahrain	1957	+	+	1978	21
Kuwait	1967	+	+	1978	11
Oman	1962	+	+	1978	16
Qatar	1961	+	+	1978	17
Saudi Arabia	1972	+	+	1978	6
United Arab Emirates	1971	+	+	1978	7
Iran	1972	+	+	1978	6
Iraq	1972	+	+*	1978	6
Syrian Arab Rep.	1972	+	+*	1978	6
China	1960	+	+*	1979	19
Dem. Kampuchea	1959	+**	-	1979	20
Lao People's Dem. Rep.	1953	+	-	1979	26
Thailand	1962	+	+*	1978	16
Viet Nam	1962	+	-	1978	16

* Visited by member of Global Commission
** Prepared by WHO Regional Office for the Western Pacific

12. HUMAN MONKEYPOX

12.1 Discovery and properties of monkeypox virus

Following the successful field trials of poliomyelitis vaccine in 1954, large numbers of monkeys were shipped from Africa and Asia to laboratories in Europe and North America, where cultured monkey kidney cells were used for poliomyelitis vaccine production. In 1958, an epidemic of a pox disease broke out in a monkey colony in Copenhagen. Several similar outbreaks were recognized during the next 10 years, but none has been reported since 1968.

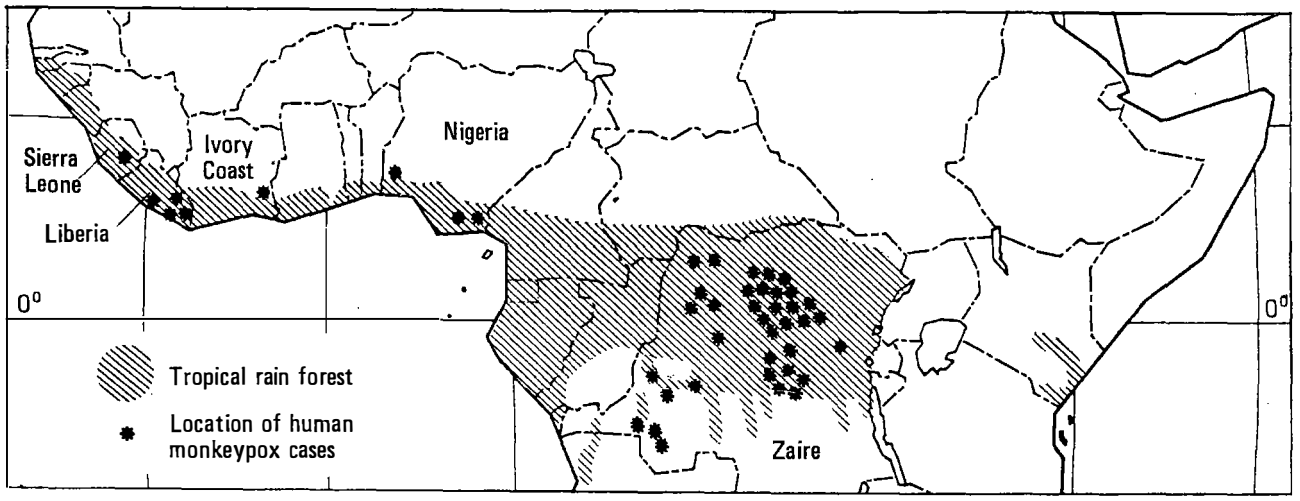
The causative virus, which was recovered from the Copenhagen and four other outbreaks and once from healthy monkey kidney tissue, proved to be a new species of orthopoxvirus with distinctive biological properties and a distinctive genome map (Annex 13). It was designated "monkeypox virus", but the disease has never been recognized in monkeys in the wild, nor have organs from large numbers of wild monkeys or other animals yielded the virus. Sera from over 2000 monkeys from various African and Asian sources were negative for orthopoxvirus antibodies. Subsequently, however, orthopoxvirus-positive sera were obtained from primates captured in west and central Africa; several such sera contained monkeypox-specific antibodies. Several other animal species also had orthopoxvirus antibodies.

12.2 Human infections with monkeypox virus

In August 1970 a child in the Equateur region of Zaire developed a smallpox-like clinical syndrome, six months after the last smallpox case had been detected in the area. A vigorous investigation ensued, as no case of smallpox had been detected during the intensified programme in areas where transmission had been interrupted and adequate surveillance was maintained. The virus isolated from skin lesions of the patient was identified as monkeypox virus in a WHO collaborating centre in Moscow.

Between 1970 and November 1979, 45 cases of this newly recognized disease, human monkeypox, were found in west and central Africa (Fig. 11 and Annex 14): 36 cases in Zaire; 4 in Liberia; 3 in Nigeria, and 1 each in the Ivory Coast and Sierra Leone. It is of course likely that infections occur more frequently than reported. All but two cases came from small villages of 200-600 persons located in the tropical rain forest. Clustering of patients has been observed in countries, in localities within countries, and within families. The Equateur region, one of the nine regions in Zaire, reported 21 cases; and within the Bumba zone of this region 13 cases were detected in a population of about 300 000.

Fig. 11 Map of Africa showing distribution of tropical rain forest and 45 monkeypox cases, 1970 - Oct. 1979



The major clinical features of monkeypox are similar to those of the form of smallpox that was seen in west and central Africa. Both very mild and very severe cases have occurred; eight (18%) of the patients, none of whom had been vaccinated, died. Only four of the patients had a vaccination scar and they had received their vaccination several years previously.

Children have been affected more often than adults; 36 patients were below 10 years of age. Males and females were equally affected, but 5 of 7 patients over 15 years of age were women.

Person-to-person transmission may have occurred in four instances. In these episodes second members of the same family came down with the disease between 9 and 17 days after the first case. Two of the secondary cases were milder than the index case. Tertiary transmission has not been observed. Of 40 non-vaccinated very close family contacts 3 contracted the disease. This attack rate of 7.5%, and the secondary attack rate among susceptibles of 3.3% (4 cases/123 susceptibles), is substantially less than that seen with smallpox. Surveys in areas where monkeypox cases have occurred have usually shown between 35% and 50% vaccination coverage in the 0-4 year age group in which most cases of human monkeypox have occurred, although some areas have much higher vaccination rates. Thus a substantial number of children are at risk, but relatively few have contracted the disease. It is nevertheless likely that more cases would occur if the immunity level were lower.

The source of the infection is still unknown. Monkeys are an important source of food for people in the forest, but the population has contact with many other wild animals. Special ecological and epidemiological investigations have recently been carried out in Zaire to define more precisely the frequency, transmissibility, and natural cycle of human monkeypox. Laboratory studies on specimens collected during this study are in progress.

13. POSSIBLE SOURCES FOR A RETURN OF SMALLPOX

Four sources can be postulated from which variola virus might be reintroduced into the human population: laboratory stocks, crusts or variolation material, activation of a latent human infection, or an animal reservoir.

13.1 Laboratory stocks of variola virus

Following advice from an independent committee of scientists who were not themselves engaged in laboratory research with variola virus, the Global Commission believes that it is still necessary to hold variola virus stocks for research purposes in a limited number of laboratories with adequate containment facilities. The situation should be periodically reviewed. All future work with variola virus should be carried out only in such laboratories, under the conditions outlined in Annex 9.

As a result of efforts by WHO, the number of laboratories holding variola virus has been successively reduced from 76 in 1976 to 14 in 1978 and 7 at present (Annex 15), with the possibility of further reductions in 1980. The risk of accidental escape from the laboratories now known to be holding variola virus is extremely small, provided that the precautions outlined above are maintained.

13.2 Deliberate release

In 1972 many nations in the world signed the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, which outlaws the use of biological weapons in warfare. Nevertheless, abhorrent as such an act would be, the possibility of variola virus being deliberately released by an individual group as an act of sabotage or terrorism cannot be excluded. The potential harm of such an act would increase as the immunity of the population waned; in addition to illness and death there would be psychological and possibly socioeconomic damage. However, the risk should not be exaggerated. Unless the public health services had completely broken down, the outbreak that followed could be readily contained and the virus then eliminated. The existence of such a possibility nevertheless emphasizes the need for the security of laboratories holding variola virus stocks, for provisions for the maintenance of vaccine reserves, and for epidemiological and laboratory expertise for diagnosis and control. The remote risk of such an act does not constitute a ground for the continuation of smallpox vaccination of the general public.

13.3 Natural reservoirs of variola virus

13.3.1 Virus in crusts

Virus particles are present in large numbers in the crusts shed by patients during convalescence. In a controlled laboratory setting the virus may remain viable for some years, even at room temperature. However, it is rapidly destroyed at the higher temperatures and humidities usually present in formerly endemic countries and by direct sunlight. The virus in crusts is also enmeshed in a dense fibrin network, from which it is not readily dispersed into the air. Variolation materials are not a likely source of smallpox infection now that natural transmission has been interrupted for some time (see section 8.4.4.2).

13.4 An animal reservoir

The risk that global eradication could not be achieved if there were an animal reservoir of variola virus was recognized from the beginning of the intensified smallpox eradication campaign. The early study of monkeypox virus was a direct result of this concern, the value of which was demonstrated by the recognition of cases of human monkeypox soon after the elimination of smallpox in west and central Africa. In subsequent laboratory studies it has been reported that a virus, which has been called "whitepox", that is indistinguishable from variola virus by laboratory tests has been recovered from the tissues of wild animals and also from cultures of monkeypox virus.

13.4.1 Whitepox virus

Twice, in a period of two weeks in September-October 1964, whitepox virus was recovered from the kidney tissues of healthy cynomolgus monkeys shipped from Malaysia that were being used for diagnostic purposes in a laboratory in Utrecht. Between 1971 and 1975 whitepox virus was obtained from the kidney tissues of four different species of wild animals captured in Zaire in areas where human monkeypox cases had occurred. The tissues were processed and the viruses isolated in the WHO collaborating centre in Moscow, which was engaged in diagnostic work supporting the smallpox eradication programme. Orthopoxvirus antibodies were present in the sera of three of the four animals and the virus was also isolated from the tissues of two animals.

Many years have now elapsed since the elimination of smallpox in Malaysia and Zaire, whence the animals originated, and there has been no evidence of human infection with whitepox virus. In the absence of epidemiological evidence, the isolation of whitepox virus from these animal tissues is not sufficient to demonstrate the existence of an animal reservoir of variola virus from which human smallpox could re-emerge. However, the finding reinforces the need for continued surveillance in Zaire and other parts of west and central Africa.

13.4.2 White pock variants of monkeypox virus

Like other orthopoxviruses that produce haemorrhagic pocks on the chorioallantoic membrane (cowpox, rabbitpox), monkeypox virus also yields white pock mutants that can be recovered and purified. Two conflicting kinds of observation have been made about the white pock variants of monkeypox virus (Annex 13); investigations to resolve the differences between the results obtained in different laboratories have not yet been completed. One series of observations suggested that the white pock variants of monkeypox virus were in all respects comparable with those of other orthopoxviruses like rabbitpox. Thus white pock variants differed from each other and from other orthopoxviruses, including variola virus, in biological characters, but the genome maps resembled the parental monkeypox virus in structure. However, with certain stocks of monkeypox virus studied in one of the WHO collaborating centres, all the white pock variants isolated, whether obtained by cloning on the chorioallantoic membrane or by the inoculation of hamsters, consistently resembled variola virus in biological properties and genome maps.

At this stage it is impossible to make a definitive pronouncement on this issue, but it is hoped that efforts to repeat the experiments will clarify the situation. However, analysis of the genome maps of several species of orthopoxvirus suggests that the transformation of one species into another (including monkeypox into variola) cannot occur by one, or even a few, mutational steps. Nowhere in the world has there been any epidemiological evidence suggesting an animal reservoir origin for cases of human smallpox, although human monkeypox is now regularly observed as a smallpox-like zoonotic disease in west and central Africa. The present evidence justifies the view that the occurrence of an animal reservoir of human smallpox is highly unlikely, but impossible to disprove.

14. INTERNATIONAL RESOURCES FOR THE INTENSIFIED ERADICATION PROGRAMME

Resources were deployed by WHO in supporting national and international personnel, supplying vaccine and providing vehicles, spare parts and local costs. The latter included payment to locally employed staff, fuel and maintenance for vehicles, and other operational costs. In most countries the WHO contribution was relatively small and the major part of the costs was borne by the national programme.

14.1 Financial

14.1.1 1958 - 1966

In 1958 the Special Account for Smallpox Eradication of the Voluntary Fund for Health Promotion (VFHP) was established. From 1958 to 1966 the extrabudgetary donations amounted to US$ 876 280, of which $ 27 658 were in cash and $ 848 622 in kind (primarily vaccine). An additional estimated $ 11 million worth of vaccine was donated by the USSR on a bilateral basis to countries in Asia.

14.1.2 1967 - 1980

In 1967 money was allocated from WHO's regular budget for smallpox eradication (Annex 16). From 1967 until the completion of the programme in 1980 WHO's smallpox eradication programme budget was US$ 81 million, $ 38 million of which came from the regular budget and $ 43 million from extrabudgetary sources. These extrabudgetary contributions were made up of $ 34 million in cash and $ 9 million in kind (equipment, vaccine, and personnel). In addition to these funds channelled through WHO, it is estimated that $ 32 million worth of assistance was contributed to the global effort on a bilateral basis, most of which is accounted for by $ 10.5 million worth of vaccine given by the USSR to countries in Asia and $ 18.5 million contributed by the United States to support eradication programmes in 20 countries in west and central Africa.

An estimate, accurate only in terms of orders of magnitude, is that individual governments since 1967 spent double this amount for their national programmes, or $ 200 million.

It is estimated that globally, $ 313 million were spent in eradicating smallpox from the world. This includes the national input and international assistance during the 13 years 1967 to 1980 and gives an average of $ 24 million per year. It is conservatively estimated that routine vaccination programmes, quarantine services (including the maintenance of personnel and facilities), the control of international travellers, and the medical care of complications caused by vaccination cost all the nations of the world about $ 1000 million per year. Thus there was a major cost-benefit aspect to the eradication programme.

Until 1974 contributions to the VFHP were almost entirely in the form of smallpox vaccine and it was only then that considerable additional cash was received. From 1974 onwards the Swedish International Development Authority contributed $ 15 700 000 and many countries increased their contributions (Annex 16). An extremely flexible approach had to be adopted for budgeting and the disbursement of funds because of rapid upward revisions in the estimated requirements. Occasionally the sums spent threatened to outstrip the resources available from month to month. The final appeal for resources was to support the emergency logistical operation begun in May 1977 in Somalia following the discovery of widespread outbreaks in that country. A public health disaster was declared and an appeal through the Office of the United Nations Disaster Relief Coordinator resulted in an airlift within 27 days of 16 vehicles and tons of supplies worth $ 460 000.

14.2 National and locally recruited personnel

The great majority of those working in the smallpox programme were national staff of all levels. Many were drawn from existing health services, others recruited directly into the programme. When the eradication efforts reached their peak, staff from other health units were temporarily involved in the programme.

In national programmes in countries in which endemic smallpox persisted progress was often impeded by slow and inflexible disbursement of funds or lack of ready funds at all levels. In these instances WHO funds covering the per diem expenses of national staff and other expenses such as for petrol and vehicle repairs greatly enhanced the effectiveness of the programme.

In countries where no programme had been functioning and national health facilities were extremely limited, WHO covered extensively the cost of staff salaries as well as the capital and running costs of vehicles. In these situations countrywide surveillance and containment networks were established where none had previously existed and a functioning structure was left in place after the certification of eradication.

14.3 International personnel

The international personnel working in the programme numbered 687 persons and came from 73 countries, many being engaged as consultants for three-month to six-month assignments. The number of personnel involved in different country programmes varied from one to several hundred according to the extent of the problem and the resources available. Many of the staff were under 35 years of age; youth was an advantage in the more remote areas where travel by vehicle was at best rough and walking often the only possibility.

Four groups of volunteer workers, all young, all nonmedical, worked for the programme, from the United States Peace Corps the Austrian volunteer service, Japanese overseas cooperation and OXFAM. Several of the volunteers later became WHO short-term consultants or long-term staff members with the programme.

14.4 Vaccine

In 1967 it was clear that the cost of meeting the global requirement for vaccine far exceeded WHO's entire annual budget for smallpox; vaccine donations to the VFHP were therefore actively solicited. Donations worth $ 18 million were accepted from 26 countries (Annex 17). Since 1967, 370 572 000 doses have been distributed to 71 countries, the maximum amount distributed in any year being 47 597 000 doses in 1975.

Most of the vaccine from donors was forwarded for storage in Geneva, whence it could be most efficiently and rapidly dispatched to the field. In meeting the urgent requirements of countries where smallpox outbreaks were treated as a national public health emergency, air shipment of the vaccine within 24 hours of a telegraphic request was usual.

14.5 Transport

Reliable rapid communications systems were essential for the effective implementation of the surveillance-containment strategy. The methods of communication utilized varied from country to country and ranged from established telephone and telegraph systems to WHO-supplied radio transceiver networks, from walking to bicycles, from motorcycles to vehicles with four-wheel drive, and from boats to helicopters.

Where necessary WHO provided fuel and maintenance for the transport for the smallpox eradication programme. It was recognized that surveillance, containment, and supervisory work, especially assessment, had to be carried out in the field, and that when there were excessive delays in obtaining operational vehicles time and money were wasted and opportunities lost.

ANNEXES

ANNEX 1

WORLD: NUMBER OF SMALLPOX CASES REPORTED BY YEAR, 1920-1979[a]

[a] In envelope at back of book.

ANNEX 2

CLINICAL SMALLPOX

The following descriptions of the principal types of variola based on Rao's classification[1] according to the nature and evolution of the lesions, are taken from a WHO technical report.[2]

"The classification includes 4 recognizable clinical types: (1) ordinary - the most frequent; (2) modified - mild and occurring in previously vaccinated persons; (3) flat; and (4) haemorrhagic. Variola sine eruptione is a febrile illness occurring after the usual incubation period has elapsed. It is seen in well vaccinated individuals and can be confirmed only by antibody studies or, rarely, by virus isolation.

(1) Ordinary

The majority of cases, in both the vaccinated and unvaccinated, are of this type, which corresponds to the classical description of smallpox. The febrile, pre-eruptive illness is of varying severity and lasts 2 - 4 days. As the eruption develops, the patient's temperature usually drops and he feels better. Fever may return with the development of the pustular stage, depending on the severity of the rash. The lesions appear as papules on the third or fourth day of illness; fluid begins to collect in them, usually within 24 - 28 hours. The vesicles may be umbilicated and their contents may become pustular in a day or two. The lesions are sharply raised, and tend to be tense and firm to the touch. Drying up of the pustules and scabbing begin from the eighth to the tenth day after the eruption. The eruption shows a centrifugal distribution, and lesions in any one area are at the same stage of development. In general, the severity of the clinical picture parallels the extent of the rash.

(2) Modified

In this clinical type, which occurs in vaccinated persons, the modification relates to the character of the eruption and the rapidity of its development. The pre-eruptive illness is usually less severe than in the ordinary type, and secondary fever may not occur during the evolution of the eruption. The skin lesions are often few, though they may sometimes be numerous. They tend to evolve more quickly, are more superficial, and may not show the uniformity characteristic of the typical smallpox eruption. Cases of the modified type are never fatal.

(3) Flat

With this type, which is frequently fatal, there is a severe pre-eruptive illness with fever persisting throughout the eruptive phase. The lesions are slow to mature and the vesicles tend to be flat, so that they project little from the surrounding skin. They are soft and velvety to the touch. In the patients who survive, the lesions resolve without pustulation. Cases with haemorrhages into the base of the lesions may not be readily distinguishable from late haemorrhagic cases.

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[1] Rao, A. R. Smallpox. Bombay, Kothari, 1972.

[2] WHO Technical Report Series, No. 493, 1972 (second report of the WHO Expert Committee on Smallpox Eradication), pp. 20-22.

(4) Haemorrhagic

Haemorrhagic smallpox is almost invariably fatal. The pre-eruptive illness, which may be prolonged, is marked by fever, intense headache and backache, restlessness, a dusky flush or sometimes pallor of the face, extreme prostration, and toxicity. There is little or no remission of fever throughout the illness. In the fulminating form, haemorrhagic manifestations appear on the second or third day as subconjunctival bleeding, bleeding from the mouth or gums, petechiae in the skin, epistaxis, haematuria, and, in women, bleeding from the vagina. Death often occurs suddenly between the fifth and seventh days of illness, when only a few insignificant maculopapular cutaneous lesions are present. In patients who survive for 8 - 10 days, the haemorrhages appear in the early eruptive period, and the rash is flat and does not progress beyond the vesicular stage."

ANNEX 3

SPECIMENS TESTED BY WHO COLLABORATING CENTRES

Country	Number of specimens received (Number positive for smallpox)										
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
AFRICA											
Angola	-	-	-	-	-	-	-	-	1	99	23
Benin	-	-	-	-	-	-	-	1	-	1*	6
Botswana	-	-	19(15)	108(55)	14 (5)	9	8	2	43	210	54
Burundi	-	3 (2)	-	5	4	3	1	-	-	-	-
Central African Republic	-	-	-	-	-	-	-	-	-	-	3
Congo	-	-	-	3	-	-	-	-	2	1	-
Ethiopia	-	-	-	24(23)	27 (5)	39 (9)	112(32)	431(60)	565	1004	1182
Gambia	-	-	-	-	-	-	-	1	-	-	-
Ghana	-	-	-	-	-	-	1	-	-	-	-
Ivory Coast	-	-	-	-	-	-	9	1	-	-	-
Kenya	-	-	12(12)	6	2	9 (3)	2	1	147 (4)	113	1491
Lesotho	-	-	-	-	-	-	-	-	-	32	27
Liberia	-	-	-	-	-	-	9	-	-	-	-
Malawi	-	-	-	-	2	2	-	3	296	24	1
Mauritania	1	-	-	-	-	-	1	2	1	2	-
Mozambique	-	-	-	-	-	-	4	-	62	13	1
Namibia	-	-	-	-	-	-	-	-	-	9	9
Niger	-	-	-	-	-	-	-	1	-	-	-
Nigeria	2 (2)	-	-	-	-	-	4	3	-	1	-
Rhodesia	-	-	-	-	-	-	-	-	-	23	-
Rwanda	5 (5)	10 (9)	-	-	2	-	-	-	3	-	-
Senegal	-	-	-	-	-	-	-	1	-	-	-
Sierra Leone	-	-	-	-	-	-	5	3	1	-	1
South Africa	-	-	-	-	-	-	-	-	-	39	113
Swaziland	-	-	-	-	-	-	-	-	1	38	2
Uganda	-	-	-	-	-	-	1	1	-	119	-
United Republic of Tanzania	2 (1)	12 (5)	-	5 (3)	1	-	2	-	3	77	-
Zaire	-	23*(8)	67 (3)	140*(1)	79*	63*	207*	125*	181*	120*	213*
Zambia	-	-	-	-	-	-	2	-	50	50	-
EASTERN MEDITERRANEAN											
Afghanistan	-	1 (1)	-	2	4 (1)	-	1	5	4	-	-
Bahrain	-	-	-	-	-	-	-	-	-	51	1
Democratic Yemen	-	-	-	1	-	-	-	1	-	30	7
Djibouti	-	-	-	-	13 (9)	7 (1)	-	-	17	69	75
Dubai	-	-	9 (7)	1	-	-	-	-	-	1	-
Iran	-	-	-	-	-	-	-	-	-	346	-
Iraq	-	-	-	-	-	-	-	-	-	13	1
Kuwait	-	-	-	-	-	-	-	-	-	78	-
Lebanon	-	-	-	-	1	-	-	-	-	-	-
Oman	-	-	-	-	-	-	-	-	-	57	5
Pakistan	-	6 (5)	1	7 (6)	11 (6)	21(11)	52	116	7	2	2
Qatar	-	-	-	-	-	-	-	-	-	24	-
Saudi Arabia	-	-	8	-	1 (1)	-	-	-	22	116	-
Somalia	-	-	-	-	-	-	-	56(33)	864(265)	1691	1341
Sudan	-	-	2 (1)	2 (1)	9	22	9	16	14	34	5
Syrian Arab Republic	-	-	-	3 (3)	-	1	-	-	-	9	4
United Arab Emirates	-	-	-	-	-	-	-	-	-	52	1
Yemen	-	-	1	2	7	6	3	2	2	28	24
SOUTHEAST ASIA											
Bangladesh	-	-	-	-	-	1 (1)	18 (3)	183	664	-	-
Burma	-	-	6	19	-	-	-	12	-	-	-
India	-	-	7 (5)	23(15)	32(14)	39(20)	404(120)	358	977	1	-
Indonesia	-	11	8 (6)	22 (9)	3	12	-	1	-	-	-
Nepal	-	-	-	4 (1)	37(27)	48(40)	16 (8)	5	3	-	-
Sri Lanka	-	-	-	-	1 (1)	-	-	-	-	-	-
OTHERS											
Belgium	-	-	-	-	-	-	-	-	-	-	1
Italy	-	-	-	-	-	-	-	-	1	-	-
Malaysia	-	-	1	-	-	-	-	-	-	-	-
Viet Nam	-	1	-	-	-	1	-	-	-	-	-
Switzerland	-	-	-	-	-	-	-	1	-	-	-
TOTAL	10 (8)	67(30)	141(49)	377(117)	250(69)	283(85)	871(163)	1332(93)	3931(269)	4577	4593

*Monkeypox diagnosed: 1970 (1), 1972 (4), 1973 (4), 1974 (1), 1975 (2), 1976 (3), 1977 (6), 1978 (8 - Zaire 7, Benin 1), 1979 (5)

ANNEX 4

RESOLUTIONS OF THE EXECUTIVE BOARD AND WORLD HEALTH ASSEMBLY RELATING TO SMALLPOX

[WHA1.16] The First World Health Assembly decided that the Expert Committee on International Epidemiology and Quarantine should have available a joint study-group on smallpox.

July 1948 **13**,303

[WHA1.17] The First World Health Assembly decided to refer the minutes of a discussion [3] on the report on the first session of the OIHP/WHO Joint Study-Group on Smallpox [4] to the Joint Study-Group on Smallpox and to the Expert Committee on International Epidemiology and Quarantine.

July 1948 **13**,304

WHA3.18 The Third World Health Assembly

1. REQUESTS the Expert Committee on Biological Standardization to consider the question of the establishment of a centre for the testing and standardization of smallpox vaccines, with particular reference to dried vaccine, and

2. RECOMMENDS that greater weight should be given to smallpox in the regular programme for 1952.

May 1950 **28**,21

EB11.R58 The Executive Board,

Having noted the report of the Director-General dealing with further action on general world health problems; and

Taking note of resolution WHA4.80 of the Fourth World Health Assembly, referring to the need for a general co-ordinated programme calling for action by all governments to improve health conditions, to eliminate sources and vectors of diseases and to raise the level of protection against certain communicable diseases by vaccination and other methods;

Noting also the interest expressed by two regional committees in campaigns against smallpox,

1. RECOMMENDS that the Sixth World Health Assembly consider the adoption of the Director-General's suggestion that WHO should stimulate certain world-wide programmes;

2. CONSIDERS that a campaign against smallpox would be suitable for such a programme; and

3. REQUESTS the Director-General to submit to the Sixth World Health Assembly a study on the ways of carrying out such a world-wide campaign, including:

(1) a general programme of work to be implemented by WHO;

(2) the estimated costs to the Organization.

Feb. 1953 **46**,31

WHA6.18 The Sixth World Health Assembly,

Having considered resolution EB11.R58 of the eleventh session of the Executive Board concerning a campaign against smallpox;

In view of the many economic, social and other technical factors that must be considered,

REQUESTS the Executive Board:

(1) to proceed with a detailed study of the means of implementing such a campaign, this study to include, *inter alia*, consultation with Member States and with WHO regional committees, and

(2) to report to the Seventh World Health Assembly.

May 1953 **48**,23

[3] *Off. Rec. Wld Hlth Org.* **13**, 161.
[4] *Off. Rec. Wld Hlth Org.* 11, 18.

EB12.R13 The Executive Board,

In pursuance of resolution WHA6.18 of the Sixth World Health Assembly, requesting the Executive Board to proceed with a detailed study of the means of implementing a campaign against smallpox,

REQUESTS the Director-General to consult with Member States, WHO regional committees and members of the relevant WHO expert advisory panels, to obtain suggestions and information on which to base this study, and to report to the thirteenth session of the Board on the results of these consultations.

May 1953 49,4

EB13.R3 The Executive Board,

Having noted the results of the Director-General's consultation with regional committees and members of expert advisory panels in order to obtain suggestions and information on which to base a study on the means of implementing a campaign on smallpox,

REQUESTS the Director-General

(1) to urge health administrations to conduct wherever possible campaigns against smallpox as an integral part of public-health programmes;

(2) to include, where possible, additional studies on smallpox, both in its field and laboratory aspects, in his future programme plans.

Jan. 1954 **52**,2

WHA7.5 The Seventh World Health Assembly,

Considering that Article 2 (*g*) of the Constitution provides that a function of the Organization shall be " to stimulate and advance work to eradicate epidemic, endemic and other diseases ";

Considering the study made by the Executive Board in accordance with resolution WHA6.18,

REQUESTS the Director-General:

(1) to continue studies on the most effective methods of smallpox control, particularly with reference to those countries where the disease is endemic;

(2) to urge health administrations to conduct, wherever possible and necessary, campaigns against smallpox as an integral part of the public-health programmes;

(3) to provide within budgetary limitations the assistance requested by national administrations to further their smallpox control programmes; and

(4) to report to the Eighth World Health Assembly on the progress made and the results obtained.

May 1954 **55**,18

WHA8.38 The Eighth World Health Assembly,

Having noted resolution WHA7.5 of the Seventh World Health Assembly on the subject of campaigns against smallpox, and the report submitted by the Director-General,

URGES again that health administrations conduct, wherever necessary, campaigns against smallpox as an integral part of their public-health programmes.

May 1955 **63**,38

WHA11.54 The Eleventh World Health Assembly,

Noting that smallpox still remains a very widespread and dangerous infectious disease and that in many regions of the world there exist endemic foci of this disease constituting a permanent threat of its propagation and consequently menacing the life and health of the population;

Having regard to the economic aspect of the question, which shows that the funds devoted to the control of and vaccination against smallpox throughout the world exceed those necessary for the eradication of smallpox in its endemic foci and consequently the destruction of the sources from which the infection arises and spreads, and clearly indicates that the eradication of smallpox might in future make vaccination and all expenditures involved in its application redundant; [1]

Taking into account the level of development reached by medical science and the health services in the control of infectious diseases, and in particular of smallpox, and the manifest tendency of the morbidity of smallpox to diminish in recent years;

Having regard to the decisions and pertinent practical measures adopted by WHO for smallpox control and the intensification of antismallpox programmes, in particular resolutions WHA3.18, EB11.R58, WHA6.18, EB12.R13, EB13.R3, WHA7.5, WHA8.38 and WHA9.49; and

Considering it opportune to raise the problem of the world-wide eradication of smallpox in the near future,

1. REQUESTS the Director-General to study and report to the Executive Board at its twenty-third session on the financial, administrative and technical implications of a programme having as its objective the eradication of smallpox, the study to include the various problems involved in carrying out the following activities:

(*a*) investigation of the means of ensuring the world-wide eradication of smallpox, taking into account the fact that smallpox persists in certain areas despite repeated vaccination campaigns;

(*b*) encouragement of the preparation during 1958-1960 of the necessary amount of smallpox vaccine in national laboratories and institutes;

(*c*) training of vaccinators among the local population in countries in which mass immunization campaigns will be conducted;

(*d*) the pooling of experience and the formulation of recommendations for the production of a sufficient amount of thermostable smallpox vaccine suitable for prolonged storage and use in tropical and subtropical regions of the world, and

(*e*) study of the measures to be taken in order to avoid complications which might result from smallpox vaccination;

2. RECOMMENDS to all governments:

(*a*) that during 1959-1960 the population be vaccinated in countries in which principal endemic foci of smallpox exist; and

(*b*) that during 1961-1962 additional vaccination of the population should be carried out in foci where the disease persists, and that subsequently revaccinations be given to the extent it becomes necessary in accordance with the experience acquired in each country;

3. RECOMMENDS that all countries in which smallpox vaccination is compulsory continue to give smallpox vaccinations during the eradication of this disease throughout the world;

4. CALLS upon medical scientists and scientific institutions active in the field of microbiology and epidemiology to stimulate their efforts towards improving the quality and the technology of the production of satisfactory smallpox vaccine resistant to the influence of temperature; and

5. REQUESTS the Director-General to report to the Twelfth World Health Assembly on the progress made and the results obtained.

June 1958 **87**,41

EB22.R12 The Executive Board,

Having considered the report of the Director-General on gifts of smallpox vaccine offered by the Governments of Cuba and the Union of Soviet Socialist Republics; [1]

Considering the policy established by the Eleventh World Health Assembly in resolution WHA11.54 concerning the antismallpox programme; and

Having noted that these gifts can be used by the Organization in providing vaccine on request in relation to the antismallpox programme,

1. ACCEPTS these gifts in accordance with Article 57 of the Constitution, and expresses appreciation to the Governments of Cuba and the Union of Soviet Socialist Republics;

2. NOTES that the Director-General, pursuant to the provisions of Financial Regulations 6.6 and 6.7, will establish a special account which will be credited with the value, as reported by the governments concerned, of these gifts of vaccine and of any gifts for the same purpose which may be accepted by the Board or the Health Assembly in the future; [2]

3. DECIDES that the assets in the special account shall remain available until they are utilized; and

4. REQUESTS the Director-General to ensure, in accordance with the normal practice of the Organization, that any vaccine accepted for the antismallpox programme is of acceptable quality.

June 1958 **88**,7

EB23.R71 The Executive Board,

Having considered the report of the Director-General on the financial, administrative and technical implications of a world-wide programme of smallpox eradication;

Noting:

(1) that definite progress has been made in large areas of the world where eradication has been achieved after intensive vaccination campaigns;

(2) that the disease still remains a serious problem in other areas especially concentrated in some important endemic foci from which smallpox may be reimported into other countries, threatening the life and health of their populations;

(3) that sufficient information on the production and use of suitable smallpox vaccine is available;

(4) that it has been demonstrated that eradication of smallpox from an endemic area can be accomplished by successfully vaccinating or revaccinating 80 per cent. of the population within a period of four to five years;

(5) that in regard to the organization of a national campaign guide-lines are suggested; and

(6) that in regard to financial requirements of country programmes, sufficient information is not available to set out a detailed estimate of costs,

1. RECOMMENDS to those countries where the disease is still present

(*a*) to take the necessary steps to ensure the provision of a potent and stable vaccine;

(*b*) to organize, if they have not yet done so, as soon as possible, eradication programmes along the guide-lines provided by the report of the Director-General; and

2. REQUESTS the Director-General

(*a*) to collect from Member States, especially of those areas where smallpox is endemic, information on the financial requirements for an eradication programme;

(*b*) to provide, on request, assistance to national administrations for the different aspects of the organization and development of eradication programmes; and

(*c*) to report to the Twelfth World Health Assembly on further developments.

Jan. 1959 **91**,35

[1] See *Off. Rec. Wld Hlth Org.* **87**, Annex 19.

[1] The Government of Cuba had offered two million doses of smallpox vaccine annually, and the Government of the Soviet Union twenty-five million doses of dried vaccine, for use in the smallpox eradication campaign.

[2] See resolution WHA13.23, p. 423.

WHA12.54 The Twelfth World Health Assembly,

Having considered the report of the Director-General on smallpox eradication,[1]

Noting:

(1) that although great progress has been made in the eradication of the disease in some areas of the world, important endemic foci of smallpox still remain in other areas, especially in South-East Asia and Africa, from which the disease can be exported to countries already free of it;

(2) that eradication of smallpox from an endemic area can be accomplished by successfully vaccinating or revaccinating 80% of the population within a period of four to five years, as has been demonstrated in several countries;

(3) that sufficient scientific and technical information is available on the production of a suitable smallpox vaccine; and

(4) that although an eradication programme may require for four or five years, an increase in the national efforts and financial obligations for the intensified campaign against smallpox, the heavy annual burden of continuing expenditure incurred for this purpose may be considerably lightened by increasing the interval between vaccinations once eradication may be considered to have been accomplished,

1. EMPHASIZES the urgency of achieving world-wide eradication;

2. RECOMMENDS to the health administrations of those countries where the disease is still present that they organize and conduct, as soon as possible, eradication programmes, making provision for the availability of a potent stable vaccine;

3. REQUESTS the Director-General:

(1) to urge health administrations of those countries where the disease is still present to develop eradication programmes and to offer them any necessary technical guidance and advice;

(2) to provide for the necessary activities to further smallpox eradication programmes and for the assistance requested by national health administrations for this purpose, in his programme and budget for future years; and

(3) to collect from the countries concerned information on the organization and progress of their respective eradication programmes and to report further to the Thirteenth World Health Assembly.

May 1959 **95**,47

WHA13.53 The Thirteenth World Health Assembly,

Having considered the report of the Director-General on the progress of smallpox eradication programmes in the countries where the disease is still present,

Noting

(1) that progress is being made towards smallpox eradication in certain countries where effective steps have been taken;

(2) that eradication campaigns have, however, not yet started in other countries with endemic foci of the disease, owing to local administrative and financial difficulties; and

(3) that technical assistance for the planning and organization of eradication campaigns is being offered by the Organization to all countries concerned,

1. EMPHASIZES the urgency of achieving world-wide eradication;

2. URGES the health administrations of those countries which have not yet started eradication campaigns to make all efforts necessary to surmount the administrative and financial difficulties that may exist and to give the smallpox eradication programme the high priority it deserves;

3. REQUESTS the Director-General:

(1) to continue to provide under the programme and budget of future years for the assistance requested by national health administrations in organizing and developing smallpox eradication programmes and for all necessary activities to further this end;

(2) to report to the Fourteenth World Health Assembly on the progress of eradication programmes in all countries concerned.

May 1960 **102**,23

WHA14.40 The Fourteenth World Health Assembly,

Having examined the Director-General's report on the smallpox eradication programme;

Considering that progress has been made in the programme, particularly as concerns the production of potent and stable vaccines; and

Noting, however, that this disease still represents an important problem in international travel, according to the reports of the WHO Committee on International Quarantine, that for this reason it is urgent to speed up the activities of the programme, and that in order to do so it is necessary to provide adequate material resources and advisory services,

1. RECOMMENDS that those countries which have not yet done so should start their eradication programme as soon as possible;

2. URGES those countries more economically advanced to make voluntary contributions in cash or in kind so as to increase the funds of the WHO Special Account; and

3. REQUESTS the Director-General to report further to the Fifteenth World Health Assembly.

Feb. 1961 **110**,16

WHA15.53 The Fifteenth World Health Assembly,

Having considered the report of the Director-General on smallpox eradication;

Noting that the progress made since the Eleventh World Health Assembly in 1958 took the decision to initiate a world-wide eradication programme has been slow;

Recognizing that countries in the endemic areas are meeting difficulties in organizing country-wide campaigns owing to insufficient funds and health personnel, inadequacy of transport, vaccine and equipment;

Reiterating that the persistence of the disease causes a high morbidity and mortality in the endemic areas and exposes the rest of the world to risk from importation of infection,

1. EMPHASIZES the urgency of achieving eradication;

2. COMMENDS the efforts already made in those countries which are implementing eradication campaigns;

3. URGES the health administrations of those endemic countries which have not already done so to plan and implement country-wide eradication campaigns with stable potent vaccine, in concert with their neighbours;

4. INVITES countries able to do so to make voluntary contributions in cash or in kind of such essential requirements as freeze-dried vaccines, suitable transport and necessary laboratory and cold-storage equipment for distribution by the Organization to countries in the endemic areas with sound eradication programmes requesting such assistance; and

5. REQUESTS the Director-General:

(*a*) to continue to offer advice and technical guidance to the countries concerned;

(*b*) to provide for the necessary activities and material assistance in his programme and budget estimates for future years;

(*c*) to prepare, with the aid of national governments, their requirements and firm estimates of costs for their smallpox eradication programmes; and

(*d*) to report further to the Sixteenth World Health Assembly on the progress of the eradication programme.

May 1962 **118**,26

[1] *Off. Rec. Wld Hlth Org.* **95**, Annex 18.

Annex 4

EB31.R33 The Executive Board

RECOMMENDS to the Sixteenth World Health Assembly that it adopt the following resolution: [1]

. . . . . .

Jan. 1963 **124**,20

WHA16.37 The Sixteenth World Health Assembly,

Having considered the report of the Director-General on the progress so far achieved in the world-wide programme of smallpox eradication,[2]

1. NOTES

(i) that smallpox continues to be a serious health problem in the endemic areas, and exposes the rest of the world to risk of infection;

(ii) that the implementation of many national eradication programmes is making slow progress due to inadequacy of national resources, particularly in transport, equipment, and potent and stable vaccine so necessary for tropical and sub-tropical areas;

2. INVITES Member States to make voluntary contributions in cash or in kind to enable the Organization to provide assistance to requesting countries to meet their deficiencies of transport, equipment and vaccine;

3. RECOMMENDS to those countries where the disease is still present

(i) that they intensify their control programmes aiming at eradication and take the necessary steps to ensure the provision of a potent and stable vaccine;

(ii) that neighbouring countries, and particularly contiguous ones, co-ordinate their smallpox control activities and/or eradication campaigns in order to diminish the risk of spread of the disease between their respective territories during their programmes; and

4. REQUESTS the Director-General to submit a further report on the progress of the smallpox eradication programme to the Seventeenth World Health Assembly.

May 1963 **127**,19

WHA17.43 The Seventeenth World Health Assembly,

Having considered the report of the Director-General [3] on the present situation of smallpox in the world and on the progress so far achieved towards the eradication of the disease from endemic areas;

Noting that the Expert Committee on Smallpox which met in January 1964:

(*a*) recommended that in each smallpox eradication campaign a comprehensive plan of action must be prepared and that its aim should be to cover 100 per cent. of the population, and that special attention should be paid to the age-groups in which the disease most frequently occurs, as shown by the analyses of age-specific attack rates, and to new-born children and pregnant women in whom the mortality is very high; and

(*b*) considered that the use of freeze-dried vaccine is absolutely essential in hot climates and under conditions of difficult communications, especially for adequate revaccination;

Recognizing that, in order to ensure the success of the programme, sufficient quantities of potent freeze-dried vaccine and freeze-drying equipment should be made available as necessary to countries in endemic areas developing eradication programmes;

Noting that, while some countries have taken commendable steps to eradicate smallpox, many others are hampered in their efforts by lack of material support, particularly freeze-dried vaccine and other imported supplies and transport;

Noting with appreciation the donations of freeze-dried vaccine to the Organization by the Governments of the Netherlands, Switzerland, the Union of Soviet Socialist Republics, and the United Kingdom of Great Britain and Northern Ireland; and

Recognizing that the need for freeze-dried vaccine for eradication programmes during the next two years is of the order of two hundred million doses,

1. URGES those countries where the disease is still present, and which have not initiated eradication programmes, to plan and implement as soon as possible programmes of eradication following the recommendations of the Expert Committee on Smallpox;

2. INVITES countries able to do so to contribute to the programmes by making substantial voluntary contributions in cash or kind to enable the Organization to provide freeze-dried vaccine and other necessary materials and equipment to countries with sound eradication programmes requesting such assistance; and

3. REQUESTS the Director-General:

(1) to prepare a further comprehensive plan for the world-wide eradication of smallpox;

(2) to provide, under the future regular programme and budget of the Organization—if necessary at the expense of lower-priority activities—for making good the shortfall of the vaccine required, and of other essential supplies and equipment, to countries developing eradication programmes; and

(3) to report on the programme at future sessions of the Executive Board and of the Health Assembly.

March 1964 **135**,19

WHA18.38 The Eighteenth World Health Assembly,

Having examined the report of the Director-General on the present status of smallpox in the world, and the results achieved; [1]

Noting with concern that, though some recently endemic countries have eradicated the disease as a result of well-organized campaigns, progress in general is slow and major endemic foci remain in Asia, Africa and the Americas;

Noting that the Director-General has estimated that smallpox might be eradicated within ten years for an estimated international expenditure of from US $23 500 000 to US $31 000 000 in addition to the provision which the countries having endemic smallpox themselves can make;

Believing that strong reaffirmation of the intent to eradicate smallpox would present a challenge and a stimulus to the world to mobilize resources to achieve the objective, and that the support required is available within the international and national programmes devoted to world social and economic development; and

Recognizing the need to review the technical and administrative requirements of programmes, to ensure the extensive use of freeze-dried vaccine and the development of its production in endemic areas and to provide annually for the mass phase of the campaign up to 50 million doses of freeze-dried vaccine in addition to supplies locally produced or already being provided in bilateral agreements, or through voluntary contributions,

1. DECLARES the world-wide eradication of smallpox to be one of the major objectives of the Organization;

2. REQUESTS the countries having smallpox but no eradication programmes to initiate them and the countries with programmes to intensify them;

3. REQUESTS Member States to give the programme greater support than in the past and to provide the substantial contributions essential for its execution;

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[1] For text recommended by the Board and adopted by the Health Assembly, see resolution WHA16.37 below.

[2] *Off. Rec. Wld Hlth Org.* 127, Annex 16.

[3] *Off. Rec. Wld Hlth Org.* 135, Annex 11.

[1] *Off. Rec. Wld Hlth Org.* 143, Annex 19.

4. REQUESTS governments which carry on bilateral programmes of aid to include smallpox eradication in their programmes of assistance;

5. REQUESTS governments to take early steps to establish basic health services for the maintenance phase which would also serve for the eradication of other communicable diseases;

6. REQUESTS the Director-General to seek anew the necessary financial and other resources required to achieve world-wide smallpox eradication with special reference to resources that might be made available through voluntary contributions and bilateral programmes, as well as through programmes such as those of UNICEF and the United Nations Expanded Programme of Technical Assistance; and

7. REQUESTS the Director-General to make available the increased amount of technical guidance and advisory services necessary to accelerate the programme as well as to assist countries in obtaining the necessary vaccine, transport and other equipment, and to report on the progress achieved to future sessions of the World Health Assembly.

May 1965 **143**,24

EB37.R16 The Executive Board,

Recalling resolution WHA18.38 of the Eighteenth World Health Assembly, which " declares the world-wide eradication of smallpox to be one of the major objectives of the Organization ";

Having considered the report of the Director-General on smallpox eradication;[1] and

Emphasizing that all countries will make long-term savings after the global eradication of the disease has been achieved,

1. CONSIDERS that the participation of the Organization in the smallpox eradication programme should be financed from the regular budget of the Organization; and

2. RECOMMENDS to the Nineteenth World Health Assembly that it adopt the following resolution:[2]

. . . . . .

Jan. 1966 **148**,14

WHA19.16 The Nineteenth World Health Assembly,

Having considered the report of the Director-General on smallpox eradication [3] and the recommendation of the Executive Board (resolution EB37.R16) thereon; and

Noting that particular emphasis has been placed on the need for co-ordination of individual countries' smallpox eradication programmes,

1. DECIDES that the participation of the Organization in the smallpox eradication programme should be financed from the regular budget of the Organization;

2. URGES countries which plan to strengthen or initiate smallpox eradication programmes to take the necessary steps to begin the work as soon as possible;

3. REQUESTS Member States and multilateral and bilateral agencies to provide adequate material support for the realization of the programme;

4. DECIDES that, in the part of the programme financed by the Organization either from the regular budget or from the Special Account for Smallpox Eradication, the following costs may be met:

(*a*) such supplies and equipment as are necessary for the effective implementation of the programme in individual countries;

(*b*) such services as may be required in individual countries and as cannot be made available by the governments of such countries; and

5. REQUESTS the Director-General, in co-operation with all Members, to initiate action to carry out a world-wide smallpox eradication programme and to submit a report to the Executive Board at its thirty-ninth session and to the Twentieth World Health Assembly.

May 1966 **151**,8

[1] For discussion by the Standing Committee on Administration and Finance and the Board, see *Off. Rec. Wld Hlth Org.* **149**, 32, 75-79, 81, 88, 89, 137, 139.
[2] For text recommended by the Board and adopted by the Health Assembly, see resolution WHA19.16 below.
[3] *Off. Rec. Wld Hlth Org.* **151**, Annex 15.

EB39.R20 The Executive Board,

Having considered the report of the Director-General on the smallpox eradication programme,

1. THANKS the Director-General for this report and invites him in conformity with resolution WHA19.16, to bring it up to date for presentation to the Twentieth World Health Assembly; and

2. RECOMMENDS to the Twentieth World Health Assembly the adoption of the following resolution:[1]

. . . . . .

Jan. 1967 **157**,13

WHA20.15 The Twentieth World Health Assembly,

Having considered the report of the Director-General on the smallpox eradication programme; and

Noting that smallpox continues to represent a serious world health problem notwithstanding the progress being made in the global eradication programme,

1. INVITES countries where the disease is still present to initiate or intensify their programmes leading to the eradication of smallpox as soon as possible;

2. RESOLVES:

(*a*) to urge the governments of the countries whose eradication programmes are progressing slowly to adopt prompt measures within their available resources to eliminate any administrative difficulties that may be hampering their campaigns, and to give the highest possible priority to the provision of funds, personnel, and supplies needed to complete those campaigns as soon as possible;

(*b*) to recommend to the governments which are producing smallpox vaccines that special care be taken in the preparation of smallpox vaccine to ensure that it meets the purity and potency requirements established by WHO, and that in the endemic countries freeze-dried vaccine should be used;

(*c*) to urge the countries where migrant sections of their populations constitute a constant threat of inter-state transmission of the disease to initiate or intensify a strict surveillance programme of this group of the population;

(*d*) to recommend that until such time as smallpox is no longer a world-wide problem the countries where the disease has been eliminated, or where an eradication programme is proceeding, establish maintenance programmes and epidemiological surveillance services;

3. REQUESTS Member States and multilateral and bilateral agencies to provide technical, financial and other support for programmes in endemic countries, particularly in the form of freeze-dried vaccine, transport, and equipment; and

4. REQUESTS the Director-General:

(*a*) to continue to elaborate and implement the detailed plan, including the co-ordination of all international, bilateral and national efforts, with the objective of achieving global smallpox eradication in a predetermined time;

(*b*) to intensify the research programme; and

(*c*) to report further to the Executive Board and the World Health Assembly.

May 1967 **160**,8

EB41.R18 The Executive Board,

Having considered the report of the Director-General on the smallpox eradication programme submitted in accordance with paragraph 4 of resolution WHA20.15,

1. THANKS the Director-General for his report and invites him, in conformity with resolution WHA20.15, to bring it up to date for presentation to the Twenty-first World Health Assembly; and

2. RECOMMENDS to the Twenty-first World Health Assembly the adoption of the following resolution:[2]

. . . . . .

Jan. 1968 **165**,12

[1] The text that followed was adopted by the Health Assembly, with a number of modifications, as resolution WHA20.15 (see below).

[2] For text recommended by the Board and adopted by the Health Assembly, see resolution WHA21.21 below.

Annex 4

WHA21.21 The Twenty-first World Health Assembly,

Having considered the report of the Director-General on the smallpox eradication programme, submitted in accordance with paragraph 4 of resolution WHA20.15;

Noting that, while progress in the eradication effort is now being made, smallpox continues to represent a serious health problem to both endemic and non-endemic countries; and

Recognizing the need for full and active participation by all endemic countries if eradication is to be achieved, and for the maximum of co-ordination in their efforts,

1. REITERATES that the worldwide eradication of smallpox is one of the major objectives of the Organization;

2. URGES again that:

(*a*) countries having smallpox, and no eradication programmes, give the highest possible priority to the provision of funds and personnel to achieve eradication; and

(*b*) those countries where eradication programmes are progressing slowly intensify their eradication efforts;

3. REQUESTS that those countries where smallpox has been eradicated should continue their vaccination programmes so as to maintain a sufficient level of immunity in their populations;

4. REQUESTS all Member States to give the programme greater support in the form of contributions, such as vaccine and transport, so that the programme may be executed as rapidly as possible;

5. REQUESTS countries providing bilateral aid in the health field to include in their activities assistance in the context of the global smallpox eradication programme;

6. REQUESTS all governments to place particular emphasis on:

(*a*) complete reporting of smallpox cases; and

(*b*) the institution of active containment measures for each outbreak;

7. REQUESTS all governments producing freeze-dried smallpox vaccine to take special care in its preparation so as to ensure that vaccine meets the WHO potency and purity requirements; and

8. REQUESTS the Director-General:

(*a*) to continue to take all necessary steps to assure the maximum co-ordination of national efforts and provision of contributions from international and bilateral agencies with the objective of achieving smallpox eradication as quickly as possible;

(*b*) to report further to the Executive Board and the World Health Assembly.

May 1968 **168,10**

EB43.R21 The Executive Board,

Having considered the report of the Director-General on the smallpox eradication programme;

Noting that, while significant progress is being made in the eradication effort, not all endemic countries have yet initiated programmes, and that in some countries programmes are not yet proceeding at the pace necessary to assure success in the effort; and

Noting the importance of more complete and prompt reporting of cases and improved surveillance techniques,

1. REITERATES the need for all countries to give the highest possible priority to the provision of funds and personnel to achieve eradication;

2. REQUESTS Member States to provide continued support to the programme, including vaccine and assistance in the context of bilateral aid;

3. REQUESTS all countries with endemic smallpox to strengthen their programmes through more intensive surveillance, assessment, and case investigation activities;

4. REQUESTS endemic countries in particular to take special care to ensure that only freeze-dried vaccine is employed which meets the potency requirements established by WHO;

5. REQUESTS the Director-General to continue to take all necessary steps to assure the maximum co-ordination of national efforts as well as support provided through international and bilateral agencies with the objective of achieving smallpox eradication as quickly as possible; and

6. REQUESTS the Director-General to report further on the progress of the smallpox eradication programme to the World Health Assembly and to the Executive Board.

Feb. 1969 **173,16**

WHA22.34 The Twenty-second World Health Assembly,

Having considered the report of the Director-General on the smallpox eradication programme;

Noting that, while very significant progress is being made in the eradication effort, not all endemic countries are proceeding at the pace necessary to assure the success of the eradication programme; and

Recognizing the need for full and active participation by all endemic countries, for the maximum of co-ordination, and for more complete and prompt reporting and improved surveillance techniques,

1. REITERATES the need for all countries to give the highest possible priority to the provision of funds and personnel to achieve eradication;

2. EXPRESSES appreciation to Member States for continuing support to the programme, including the supply of vaccine and bilateral aid to the endemic countries;

3. REQUESTS

(1) all countries with endemic smallpox, particularly those having nomadic and mobile populations, to strengthen their programmes, surveillance, case investigations, active containment measures in each outbreak, and assessment activities; and

(2) all countries, especially those neighbouring endemic countries, to continue their vaccination programmes and surveillance, especially along their common borders; and

4. REQUESTS the Director-General:

(1) to continue to take all necessary steps to assure the maximum co-ordination of national efforts, as well as of support provided through international and bilateral agencies, with the objective of achieving smallpox eradication as quickly as possible; and

(2) to report further on the progress of the smallpox eradication programme to the forty-fifth session of the Executive Board and to the Twenty-third World Health Assembly.

July 1969 **176,16**

EB45.R20 The Executive Board,

Having considered the report of the Director-General on the smallpox eradication programme;

Having noted that significant progress is being made in the eradication effort in most parts of the world and, particularly, in countries of western and central Africa which have virtually succeeded in interrupting smallpox transmission after only three years;

Believing that the progress in the programme to date calls for renewed efforts on the part of all countries and that the programme should continue to be one of the principal objectives of the Organization;

Viewing with concern that a few endemic countries have still not initiated programmes and that not all are yet using freeze-dried vaccine conforming to recommended standards; and

Noting the importance of surveillance in present programmes and the desirability, at this time, of placing a much greater emphasis on the detection, investigation and containment of all cases and outbreaks in all countries,

Annex 4

1. REQUESTS

(1) all countries to take appropriate steps to improve further case-reporting and to adopt as an objective the immediate investigation and containment of all reported cases and outbreaks of smallpox from 1970 onwards; and

(2) all countries to provide continued support to the programme, including vaccine and other assistance; and

2. REITERATES the importance of using in the eradication programme only freeze-dried vaccine which meets the requirements established by WHO;

3. REQUESTS the Director-General:

(1) to contact those endemic countries that are not yet conducting eradication programmes to determine what assistance might be required to permit them to undertake such efforts;

(2) to continue to take all necessary steps to assure the maximum co-ordination of national and international efforts; and

(3) to report further on the progress of the smallpox eradication programme to the World Health Assembly and to the Executive Board.

Jan. 1970 **181**,13

WHA23.46 The Twenty-third World Health Assembly,

Having examined the Director-General's report on the smallpox eradication programme submitted to the Executive Board at its forty-fifth session,

ENDORSES the recommendations of the Executive Board contained in its resolution EB45.R20.

May 1970 **184**,24

WHA24.45 The Twenty-fourth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Having noted that significant progress is being made in the eradication effort throughout the world to the extent that endemic smallpox is now present in fewer than ten countries;

Believing that a renewed and intensified effort is now required in order to reach the objective of global eradication in the shortest possible period of time; and

Noting that improved reporting as well as surveillance and containment measures have been of vital importance in the interruption of smallpox transmission,

1. REQUESTS all countries to give priority attention to the further improvement of case reporting and the immediate investigation and effective containment of all outbreaks of smallpox;

2. URGES governments of Member States to provide the requisite additional assistance to those countries where the disease is still endemic to permit them to intensify current programmes; and

3. REQUESTS the Director-General to report to the Twenty-fifth World Health Assembly on the development of the smallpox eradication programme.

May 1971 **193**,23

WHA25.45 The Twenty-fifth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Appreciating the significant progress made to date in programmes throughout the world, and congratulating those countries which have succeeded in eradicating the disease;

Noting with concern, however, that endemic smallpox still exists in parts of Africa and Asia and that smallpox has recently reappeared in several countries which were free from the disease,

1. REQUESTS all Member States to continue to give priority attention to the eradication of smallpox, to intensify their efforts to interrupt transmission of the disease in the remaining endemic areas as soon as possible, and to prevent smallpox from re-establishing itself in countries from which it has been eliminated;

2. URGES all governments concerned:

(*a*) to report immediately to the Organization, as already required, all cases of smallpox, and in particular to use the most rapid means in respect of any case which occurs in a non-endemic area;

(*b*) to establish or strengthen national surveillance systems with a view to the identification of sources of infection, the rapid containment of outbreaks, and the elimination of endemic foci;

3. REQUESTS the Director-General to arrange to transmit promptly to all Member States whom it may concern information provided under paragraph 2 (*a*);

4. RECOMMENDS further that countries normally free of smallpox, where cases occur or are suspected, inform WHO fully of their epidemiological investigations and give such opportunity of WHO participation as would best facilitate international co-ordination of the measures taken;

5. REQUESTS the Director-General:

(*a*) to provide assessment teams on request to countries which have recently interrupted smallpox transmission;

(*b*) to continue to extend every possible assistance to countries to facilitate progress in the programme, including the development, to the extent possible, of audiovisual materials such as illustrated books and films;

6. THANKS those countries that are generously contributing vaccine to the programme, either under bilateral agreements or through the WHO Voluntary Fund for Health Promotion;

7. RECOMMENDS the intensification of research on all aspects of the problem, including the laboratory diagnosis of smallpox, the treatment of smallpox cases, immunizing mechanisms in pox virus infections and the effects of simultaneous application of several different antigens; and

8. REQUESTS the Director-General to report to the Twenty-sixth World Health Assembly on the progress of the eradication programme.

May 1972 **201**,22

REPORTS OF EXPERT COMMITTEES AND STUDY GROUPS

	Published in *Techn. Rep. Ser.* No.	Relevant resolution
Expert Committee:		
Smallpox Eradication[a]		
First report	283	EB34.R8 (1964)
Second report	493	EB50.R3 (1972)
Study Group:		
Smallpox (OIHP/WHO)		
First session [b]	—	*WHA1.17*13, 304 (1948)
Second session [c]	—	WHA2.17 (1949)

[a] Formerly Expert Committee on Smallpox.
[b] Published in *Off. Rec. Wld Hlth Org.* 11, 18.
[c] Published in *Off. Rec. Wld Hlth Org.* 19, 22.

Annex 4

EB51.R26 The Executive Board,

Noting with gratification the progress of the smallpox eradication programme,

1. EXPRESSES

(1) its deep gratitude to those countries which have been able to complete the eradication of endemic smallpox, to those still engaged in the effort to do so, and to the WHO staff concerned; and

(2) the expectation that every country will maintain that combination of strict surveillance and vaccination appropriate to its circumstances;

2. RECOMMENDS that the maximum effort should be developed by the Organization and those countries where the disease is still endemic in order to complete eradication at the earliest possible time.

Jan. 1973 **206,** 21

WHA26.29 The Twenty-sixth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Appreciating the decisive contribution made to the global eradication effort by the many countries which have succeeded in eliminating endemic smallpox, and recognizing with gratitude the efforts being made by those where the disease still exists;

Noting with concern, however, that in some areas of the countries where endemic smallpox persists the situation presently appears more serious than in previous years;

Reaffirming, therefore, the necessity to make every possible effort to ensure the speedy progress of eradication and to maintain it where it is achieved,

1. REQUESTS all countries to give the highest priority to the smallpox eradication programme, with particular emphasis on active surveillance, so as to interrupt transmission of the disease at the earliest possible time in the areas where it is still endemic and to prevent reoccurrence of the disease in countries from which it has been eliminated;

2. REQUESTS the Director-General to continue to give all necessary assistance to the countries concerned in order to support and accelerate national eradication efforts, to determine through independent evaluation whether eradication has actually been achieved, and to identify the additional resources, both national and international, which may be required for the successful completion of the programme; and

3. THANKS the countries that have generously contributed to the programme, either bilaterally or through the WHO Voluntary Fund for Health Promotion, in the confident hope that continued support will be provided to the programme, especially during the critical years ahead.

May 1973 **209,** 14

WHA28.52 The Twenty-eighth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Noting with satisfaction the considerable successes achieved in carrying out the programme, as witnessed by the sharp reduction in the number of cases of smallpox in countries where it is endemic;

Considering that the progress made and the unflagging efforts and care of WHO and its Member States in carrying out this programme inspire confidence that smallpox eradication will soon be achieved throughout the world;

Bearing in mind that the successful completion of this programme will be the first example of the eradication of a disease by man as a result of broad international cooperation and the collective efforts of WHO, its Member States and various international governmental and nongovernmental organizations;

Recognizing that the success of the programme has been dependent on its profoundly scientific basis, on unceasing research and practical investigations throughout the course of its implementation, on making correct allowances for the special features of the causal agent of smallpox and the nature of immunity to it, on the considerable improvements achieved in the last few years in the quality and effectiveness of the smallpox vaccine, on the development and wide practical introduction of new methods of mass vaccination and on constant improvements in systems for case-finding and for the recording of vaccinations;

Noting also that the entry of the smallpox eradication programme into its final stage has been the result of lengthy and heroic efforts by numerous countries, international organizations, establishments, physicians and field workers, both in the period up till the 1950s, when national campaigns were developing and when the prerequisite conditions were being created for smallpox control on an international scale, and after the proclamation and development of an international smallpox eradication campaign in accordance with resolution WHA11.54 in 1958 and the intensification of the programme from 1967 onwards in accordance with resolution WHA19.16; and

Expressing confidence that with continued effort the countries so near the end will achieve eradication,

1. CONGRATULATES the countries which, since the inception of the global programme, have made the outstanding achievement of eradicating smallpox from within their borders;

2. THANKS all governments, organizations and individuals who have contributed to the implementation of the programme and asks them to continue to increase their efforts for smallpox eradication in this concluding stage of the programme;

3. EMPHASIZES the need to increase the vigilance and sense of responsibility in all regions of the world, with a view to preventing possible outbreaks of smallpox so as not to let slip the favourable situation for the successful conclusion of the programme that now exists, by continuing active epidemiological surveillance and the corresponding vaccination programmes, particularly for newborn children;

4. DEEMS it necessary to summarize and describe in a major publication the experience of smallpox eradication throughout the world, for which purpose the help should be enlisted of scientific experts and practical workers who have taken part in carrying out the programme, having first analysed with great care and thus preserved for mankind the unique historical experience of the eradication of one of the most dangerous communicable diseases as a result of effective international cooperation, experience which will doubtless be used in programmes for the control of other communicable diseases;

5. REQUESTS the Director-General:

(1) to draw up recommendations regarding those further activities of the Organization and its Member States that will be needed to maintain smallpox eradication throughout the world, including possible changes in the International Health Regulations;

(2) to ensure the wider development of research on methods of differentiating viruses of the poxvirus group and determining the special features of their epidemiology, paying particular attention to variola-like viruses (white strains) isolated from monkeys and to other monkey viruses; and

(3) to submit a report on further developments in this sphere to the Executive Board at one of its sessions or to a World Health Assembly.

May 1975 **226,** 26

WHA29.54 The Twenty-ninth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Noting with satisfaction that smallpox is now restricted to only a few remote villages of a single country and that interruption of smallpox transmission is believed to be imminent;

Bearing in mind the importance of completing the eradication of smallpox in the shortest possible period of time and of ensuring confidence in the achievement by using international groups of experts to confirm the eradication two years or more after the last known case;

Recognizing the need for all laboratories which retain stocks of variola virus to take maximum precautions to prevent accidental infection;

Appreciating the importance of continued surveillance and research to provide further assurance that there is no animal or other natural reservoir of the virus;

Noting that the risk of smallpox importations by persons travelling by sea or air has so diminished that no such importations have occurred during the past 17 months;

Noting also that, as supplies of vaccine now being produced are more than sufficient in quantity to meet all current needs, an accumulation by WHO of vaccine stocks for use in the event of an unforeseen emergency could be established;

1. CONGRATULATES the many countries which have made and are making such a successful and determined effort to eradicate smallpox;

2. EXTENDS special congratulations to the 15 countries of western Africa where smallpox eradication was certified on 15 April 1976 and to Bangladesh, India and Nepal, which interrupted smallpox transmission during the past year;

3. THANKS all governments, organizations and individuals who have contributed to the implementation of the programme and requests that they continue to contribute generously to the programme until global eradication can be certified;

4. ENDORSES the procedures developed by the Director-General in the use of groups of international experts in the certification of eradication and asks for the full cooperation of all countries concerned in carrying out these procedures, so that countries throughout the world may have confidence that eradication has been achieved;

5. URGES that all governments continue to conduct surveillance for smallpox-like illnesses and to inform the Organization promptly should any such cases be discovered;

6. REQUESTS all governments and laboratories to cooperate fully in preparing an international registry of laboratories retaining stocks of variola virus but, at the same time, urges all laboratories which do not require such stocks of variola virus to destroy them;

7. URGES all governments to restrict their requests for International Certificates of Smallpox Vaccination to travellers who, within the preceding 14 days, have visited a smallpox-infected country as reflected in the WHO *Weekly Epidemiological Record*;

8. REQUESTS Member countries to continue to donate vaccine to the Voluntary Fund for Health Promotion so that a reserve supply of 4 million vials of vaccine (sufficient to vaccinate 200 to 300 million persons) may be accumulated which could be made available to Member countries in the event of unforeseen emergencies;

9. REQUESTS the Director-General to obtain expert advice, through the Committee on International Surveillance of Communicable Diseases or by other means, on questions such as the need for retention of variola virus in laboratories and, if necessary, to make recommendations on the number and distribution of such laboratories and on the precise precautions which should be taken to prevent accidental infection;

10. REQUESTS further the Director-General to undertake a study of the organization of a world conference on the problems of eradicated smallpox and to report on the subject to the Executive Board and to the Thirtieth World Health Assembly.

May 1976 **233,** 34

EB59.R28 The Executive Board,

Having examined the report of the Director-General on the smallpox eradication programme;

Noting resolution WHA29.54;

1. EXPRESSES APPRECIATION of the intensive efforts being made by the Organization and the countries concerned to interrupt smallpox transmission at the earliest possible date and to verify and document this achievement;

2. ENDORSES the recommendation of the Committee on International Surveillance of Communicable Diseases that stocks of variola virus be retained only by WHO Collaborating Centres under conditions ensuring maximum safety;

3. URGES Member States to continue to provide maximum possible support to the programme so that it may be completed as soon as possible.

Jan. 1977 **238,** 20

WHA30.52 The Thirtieth World Health Assembly,

Having considered the Director-General's report on the smallpox eradication programme;

Recognizing that, while smallpox is now reported from only a single country in north-eastern Africa, continuing smallpox transmission in that area represents a considerable danger for adjacent countries owing to nomadic population movements;

Stressing the importance of establishing data in respect of previously endemic areas, for review by an independent group of experts, in order to document the absence of smallpox transmission for a period of two years or more;

Noting that 18 laboratories are currently registered as retaining stocks of variola virus or specimens from smallpox cases;

Noting also that the Organization's vaccine reserves for use in an unforeseen emergency are not yet at a level sufficient to permit the vaccination of 200 to 300 million persons as envisaged in resolution WHA29.54;

1. CONGRATULATES Afghanistan, Bhutan, India, Nepal, and Pakistan, where smallpox eradication has been certified during the last six months;

2. REQUESTS governments and laboratories to continue to cooperate in preparing the international register of laboratories retaining stocks of variola virus or specimens from smallpox cases, and to ensure that, in accordance with the recommendation of the Committee on International Surveillance of Communicable Diseases endorsed by the Executive Board in resolution EB59.R28, these stocks and specimens are retained only by WHO collaborating centres under conditions ensuring maximum safety;

Annex 4

3. REQUESTS all Member States to continue to give financial support to the smallpox eradication programme, either through the Special Account for Smallpox Eradication of the Voluntary Fund for Health Promotion or on a bilateral basis, in order that the last known smallpox foci can be eliminated as rapidly as possible;

4. REQUESTS all Member States to consider their vaccination programmes and requirements and whether any unnecessary vaccination requirements can be reduced;

5. URGES all governments to make full use of the expertise of international and national personnel with experience in smallpox surveillance and in containment measures as may be required effectively to interrupt transmission of the disease and to prepare for independent assessment in those countries where the eradication of smallpox has not yet been certified;

6. INVITES Member States to continue to donate smallpox vaccine to the Voluntary Fund for Health Promotion until reserves sufficient to vaccinate 200 to 300 million persons have been built up;

7. REQUESTS the Director-General to report to the Thirty-first World Health Assembly on the progress made in this programme during the next 12 months.

May 1977 **240,** 32

EB61.R10 The Executive Board,

Having examined the report of the Director-General on the smallpox eradication programme;

Noting resolution WHA30.52;

1. EXPRESSES appreciation for the intensive efforts being made by the World Health Organization and the countries concerned to interrupt smallpox transmission and verify this achievement;

2. ENDORSES the recommendations of the Consultation on Worldwide Certification of Smallpox Eradication, as annexed to the report of the Director-General;

3. REQUESTS the Director-General to establish as soon as possible an International Commission for the Global Certification of Smallpox Eradication (Global Commission);

4. URGES all governments to continue full support and cooperation to this final phase of the programme, so that global eradication of smallpox can be certified by the end of 1979.

Jan. 1978 **244,** 7

WHA31.54 The Thirty-first World Health Assembly,

Having considered the Director-General's report on smallpox eradication;

Endorsing the Executive Board's resolution EB61.R10 on smallpox eradication;

Recognizing that for six months reported smallpox incidence throughout the world has been nil, that achievement of smallpox eradication is now imminent, and that it will constitute an unprecedented event in the history of medicine;

1. CONGRATULATES Somalia on the effective eradication campaign and adjacent countries on their intensive surveillance and maintenance of their smallpox-free status;

2. COMMENDS Bangladesh, Burma, the nine countries of central Africa (Burundi, Central African Empire, Chad, Congo, Equatorial Guinea, Gabon, Rwanda, United Republic of Cameroon, and Zaire), and the four countries of south-east Africa (Malawi, Mozambique, United Republic of Tanzania, and Zambia) where international commissions have visited and certified eradication of smallpox in 1977 and in 1978 to date;

3. REQUESTS the 31 countries where certification activities will take place in 1978 and 1979 to proceed with their planned activities, in collaboration with WHO and the Global Commission for the Certification of Smallpox Eradication so that these activities can be completed by the end of 1979;

4. REQUESTS all laboratories except WHO collaborating centres to destroy or transfer remaining stocks of variola virus to a collaborating centre;

5. REQUESTS the Director-General to establish a reward of US$ 1000 for the first person who, in the period preceding final certification of global eradication, reports an active case of smallpox resulting from person-to-person transmission and confirmed by laboratory tests, in the belief that such a reward will strengthen worldwide vigilance for smallpox as well as national surveillance in priority countries;

6. REITERATES the final paragraph of the Executive Board's resolution EB61.R10, which urged all governments to continue full support and cooperation for this final phase of the programme.

May 1978 **247,** 39

EB63.R5 Smallpox eradication programme

The Executive Board,

Having examined the report of the Director-General on the smallpox eradication programme;

Recognizing that, while global certification is proceeding satisfactorily, certain measures must be taken by the Organization to ensure that smallpox has been permanently eradicated;

1. CONGRATULATES those countries and areas where smallpox eradication has been certified by the Global Commission;

2. COMMENDS the Director-General on establishing a Global Commission which has produced such a comprehensive review on the status of global certification;

3. ENDORSES the recommendations made by the Global Commission at its first meeting as presented by the Director-General and set out in the annex to this resolution, including the need for continuing surveillance activities as recommended by the Global Commission;

4. URGES all institutions still retaining stocks of variola virus to destroy or transfer them to WHO collaborating centres with adequate safety facilities.

(Twelfth meeting, 17 January 1979)

Annex

Recommendations of the Global Commission for the Certification of Smallpox Eradication

The recommendations made by the Global Commission for the Certification of Smallpox Eradication at its first meeting, held in Geneva from 4 to 7 December 1978, were as follows:

1. Global certification of smallpox eradication

1.1 Countries preparing for certification by international commissions should be encouraged to proceed with the timely preparation of the necessary documentation.

1.2 WHO should proceed with the collection and review of the additional information sought from China, Democratic Kampuchea, Iraq, Madagascar and South Africa. The requirements for certification are described in the comments about each of these countries. Global Commission members should be kept informed of further developments.

1.3 All countries which have not yet submitted formal declarations of freedom from smallpox should be requested to do so as promptly as possible.

2. The Birmingham smallpox outbreak

2.1 An *ad hoc* committee should be established to review the report of the governmental inquiry into this outbreak and report to the Global Commission at its next meeting.

3. Orthopoxviruses

3.1 WHO should support studies applying the new techniques of DNA analysis to variola virus and related orthopoxviruses.

3.2 A study group on orthopoxviruses should be appointed by WHO, and this group should meet periodically.

3.3 White pock clones (reported as derived from monkeypox virus) should be further characterized by polypeptide and DNA analysis and attempts should be made to confirm these findings in other centres as soon as possible, under WHO's coordination.

3.4 The proposed epidemiological study in Zaire, a project in which WHO is cooperating, and which is designed to investigate the natural history of monkeypox and whitepox viruses, was endorsed.

3.5 Selected Member States and research institutions should be encouraged to lend their full support to the recommendations concerning orthopoxviruses.

4. Retention of stocks of variola virus and safety in laboratories holding them

4.1 WHO should continue its efforts to reduce the number of laboratories retaining stocks of variola virus with the objective that by 1980 not more than four laboratories should retain stocks. These laboratories should be WHO collaborating centres with maximum containment facilities. The full collaboration of the national health administrations concerned is needed for this action.

Annex 4

4.2 An expert group to report to the Global Commission should be convened by WHO during 1979, to investigate whether retention of stocks of variola virus is justified after global smallpox eradication has been completed and, if it is justified, to identify the need for and nature of any research to be conducted.

4.3 Although national governments have the responsibility of ensuring safety in laboratories retaining variola virus, each such laboratory should be visited at intervals of not more than two years by WHO staff and consultants in order to evaluate its safety on the basis of WHO guidelines.

4.4 WHO should periodically publish the names of all laboratories with stocks of variola virus, indicating which laboratories are retaining virus for purely archival purposes and which are conducting research, and whether they meet WHO safety standards.

5. Vaccination policy

5.1 As more than one year has elapsed since the last known naturally occurring cases of smallpox and smallpox eradication has already been certified in most countries, the Global Commission considers that routine vaccination is unnecessary, except in countries of, and adjacent to, the Horn of Africa, and in those countries awaiting certification by an international commission. The Global Commission recognizes that between the present time and final certification each government will need to assess its routine vaccination policy, depending on its own assessment of the risks and benefits.

5.2 Since there is no smallpox-infected country anywhere in the world, smallpox vaccination certificates should not be required for international travel.

5.3 In those countries where human cases of monkeypox have been detected the incidence and transmissibility of this disease are so low, even amongst unvaccinated persons, that there is no justification for wide-scale vaccination. The complications and deaths associated with countrywide vaccination would be expected to exceed those due to the monkeypox infections.

5.4 All persons entering laboratories holding variola virus stocks should be revaccinated every year. Routine vaccination of persons who do not enter such laboratories is unnecessary.

6. Vaccine reserves

6.1 Provision should be made by WHO for storage in Geneva, New Delhi and Toronto of a total of approximately 300 million doses of smallpox vaccine and materials needed for emergency use.

6.2 WHO should seek information about the location, size and potential availability of national stocks of smallpox vaccine.

7. Surveillance after global certification

7.1 To assist countries in investigating reports of suspected cases of smallpox WHO should maintain selected WHO collaborating centres for examination of laboratory specimens.

7.2 To further assist in investigating such reports WHO should maintain a current list of epidemiologists with knowledge of smallpox who could be available at short notice to assist where necessary with the prompt investigation of rumours.

7.3 WHO should continue to fund and support a human monkeypox surveillance programme, particularly in Zaire, for at least five additional years (1981-1985).

7.4 Other African countries, especially those where human monkeypox has occurred in the past, should be encouraged to continue active surveillance of patients with fever and rash to promote the recognition of cases of monkeypox. Specimens should be obtained from suspected cases for laboratory investigation.

7.5 WHO should retain or recruit staff, located at WHO headquarters, to ensure the investigation of all suspected cases of smallpox. Additional staff responsibilities would include the maintenance of vaccine reserves, the monitoring of safety in laboratories

retaining variola virus, the coordination of research on orthopoxviruses, and the supervision of all surveillance activities. An additional responsibility would be participation in the documentation of the smallpox eradication programme.

8. Documentation of the smallpox eradication programme

8.1 Complete documentation of the smallpox eradication programme should be prepared, to provide necessary information for the meeting of the Global Commission in December 1979, for Member States, and for other purposes. It is recognized that completion of full documentation will extend beyond 1979 and continued WHO support should be provided.

THIRTY-SECOND WORLD HEALTH ASSEMBLY

WHA32.32

25 May 1979

SMALLPOX ERADICATION

The Thirty-second World Health Assembly,

Having examined the report of the Director-General on the smallpox eradication programme;

Stressing that the achievement of global smallpox eradication is the result of the commitment of all nations involved in this programme;

1. ENDORSES resolution EB63.R5, including the recommendations of the Global Commission for the Certification of Smallpox Eradication annexed thereto;[1]

2. REQUESTS the Director-General:

(1) to consider how best to give full recognition, during the Thirty-third World Health Assembly, to the achievement of global eradication of smallpox, including a review of the lessons learned from the programme;

(2) to present a plan to that Health Assembly for the implementation of measures to ensure the permanence of smallpox eradication in the post-eradication era.

Fourteenth plenary meeting, 25 May 1979
A32/VR/14

[1] Document EB63/48, p. 7.

ANNEX 5

WHO COLLABORATING CENTRES ASSOCIATED WITH SMALLPOX ERADICATION, 1969 - 1979*

Country	Centre
Canada**	WHO Collaborating Centre for Smallpox Vaccine Connaught Medical Research Laboratories University of Toronto, WILLOWDALE
France	WHO Collaborating Centre for Smallpox Laboratoire national de la Santé PARIS
Japan	WHO Collaborating Centre for Poxvirus Research Division of Poxviruses, National Institute of Health, TOKYO
Netherlands**	WHO Collaborating Centre for Smallpox Vaccine Rijks Instituut voor de Volksgezondheid BILTHOVEN
United Kingdom 1)	WHO Collaborating Centre for Poxvirus Research Department of Microbiology University of Reading, READING
2)	WHO Collaborating Centre for Characterization of Variola and Related Poxviruses Department of Virology The Wright-Fleming Institute of Microbiology St Mary's Hospital Medical School, LONDON
USA	WHO Collaborating Centre for Smallpox and other Poxvirus Infections Viral Exanthems Branch Center for Disease Control, ATLANTA
USSR**	WHO Collaborating Centre for Smallpox and other Poxvirus Infections Laboratory of Smallpox Prophylaxis Research Institute of Virus Preparations MOSCOW

* Laboratories in USSR and USA had been assisting the smallpox eradication programme in previous years.

** Staff of these laboratories participated in a seminar in 1968 on vaccine production along with staff from Wyeth Laboratories Inc., USA, and the Research Institute of Immunology, Prague, Czechoslovakia.

ANNEX 6

RESULTS OF LABORATORY TESTS OF SPECIMENS OBTAINED FROM VARIOLATORS

Country	Age of specimen	Type of material	Date collected	Electron microscopy	Precipitation in gel	Virus isolation
Afghanistan	4 months	Scabs	September 1969	n.d.	n.d.	+
"	9 months	Scabs	May 1969	n.d.	n.d.	+
"	6 years	Powder	May 1976	+	+	-
"	6 years	Scabs	May 1976	+	+	-
"	10 years	Scabs	May 1976	+	+	-
"	...	Fluids	March 1969	n.d.	n.d.	+
"	...	Scabs	April 1970	n.d.	n.d.	+
"	...	Scabs	January 1972	-	-	-
"	...	Scabs	April 1976	+	+	-
Pakistan / N	3½ years	Scabs	July 1976	+	+	-
"	4 years	Scabs	May 1976	+	+	-
"	3 - 6 years	Scabs	March 1976	+	+	-
"	4 - 5 years	Scabs	April 1976	+	+	-
"	3 - 8 years	Scabs	April 1976	+	+	-
"	...	Scabs	August 1976	+	+	-
"	...	Scabs	August 1976	+	+	-
Pakistan / P	1 year	Scabs	March 1975	n.d.	n.d.	-
"	2 years	Scabs	May 1975	+	+	-
"	4 years	Scabs	April 1975	+	+	-
"	...	Scabs	May 1975	h.v.	-	-
Ethiopia	3 months	Fluids	June 1976	-	-	-
"	5 years	Fluids	April 1976	-	-	-
"	6 years	Fluids	May 1979	-	-	-
"	7 years	Fluids	May 1979	-	-	-
"	...	Threads	February 1974	n.d.	n.d.	-
"	...	Fluids	April 1976	-	-	-
"	...	Fluids	April 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	May 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	+	+	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-
"	...	Fluids	June 1976	-	-	-

n.d. = not done
h.v. = herpes varicella (chickenpox)
Pakistan / N = North-West Frontier Province
Pakistan / P = Punjab Province
... = not known

ANNEX 7

THE SEQUENCE OF ERADICATION IN 43 COUNTRIES OF AFRICA, SOUTH AMERICA AND ASIA

		NUMBER OF CASES REPORTED											
AREA	COUNTRY	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
WEST AFRICA	Senegal	1	-	-	-	-	-	-	-	-	-	-	-
	Ivory Coast	2	-	-	-	-	-	-	-	-	-	-	-
	Liberia	6	5	-	-	-	-	-	-	-	-	-	-
	Ghana	114	24	-	-	-	-	-	-	-	-	-	-
	Upper Volta	195	100	-	-	-	-	-	-	-	-	-	-
	Mali	292	131	1	-	-	-	-	-	-	-	-	-
	Guinea	1 530	334	12	-	-	-	-	-	-	-	-	-
	Niger	1 187	679	28	-	-	-	-	-	-	-	-	-
	Benin	815	367	58	-	-	-	-	-	-	-	-	-
	Sierra Leone	1 697	1 143	80	-	-	-	-	-	-	-	-	-
	Togo	332	784	83	-	-	-	-	-	-	-	-	-
	Nigeria	4 753	1 832	182	79	-	-	-	-	-	-	-	-
SOUTH AMERICA	French Guiana	-	1	-	-	-	-	-	-	-	-	-	-
	Uruguay	-	2	3	-	-	-	-	-	-	-	-	-
	Argentina	30	-	-	24	-	-	-	-	-	-	-	-
	Brazil	4 514	4 372	7 407	1 771	19	-	-	-	-	-	-	-
CENTRAL AFRICA	Chad	86	1	-	-	-	-	-	-	-	-	-	-
	Unit. Rep. Cameroon	59	87	15	-	-	-	-	-	-	-	-	-
	Burundi	74	301	108	197	-	-	-	-	-	-	-	-
	Rwanda	-	-	107	253	-	-	-	-	-	-	-	-
	Zaire	1 479	3 800	2 072	716	63	-	-	-	-	-	-	-
	Indonesia	13 478	17 350	17 972	10 081	2 100	34	-	-	-	-	-	-
SOUTH AND EAST AFRICA	Lesotho	1	-	-	-	-	-	-	-	-	-	-	-
	Zambia	47	33	-	2	-	-	-	-	-	-	-	-
	Swaziland	25	20	24	-	-	-	-	-	-	-	-	-
	Mozambique	104	145	11	-	-	-	-	-	-	-	-	-
	S. Rhodesia	26	12	25	6	-	-	-	-	-	-	-	-
	Unit. Rep. Tanzania	1 629	455	117	32	-	-	-	-	-	-	-	-
	Malawi	38	61	65	39	9	-	-	-	-	-	-	-
	S. Africa	43	81	246	121	10	-	-	-	-	-	-	-
	Sudan	9	106	130	1 051	1 141	827	-	-	-	-	-	-
	Uganda	365	55	9	2	19	16	-	-	-	-	-	-
	Botswana	1	-	-	-	36	1 059	27	-	-	-	-	-
INDIAN SUB-CONTINENT	Burma	2	181	68	-	-	-	-	-	-	-	-	-
	Afghanistan	334	739	250	1 044	736	236	25	-	-	-	-	-
	Bhutan	6	3	-	-	-	-	6	3	-	-	-	-
	Pakistan	6 084	1 836	3 520	3 192	5 808	7 053	9 258	7 859	-	-	-	-
	Nepal	110	249	163	76	215	399	277	1 549	95	-	-	-
	India	84 902	35 179	19 281	12 773	16 190	27 407	88 114	188 003	1 436	-	-	-
	Bangladesh	6 648	9 039	1 925	1 473	-	10 754	32 711	16 485	13 798	-	-	-
HORN OF AFRICA	Djibouti	-	-	-	-	26	93	14	13	-	-	-	-
	Ethiopia	466	426	197	722	26 329	16 999	5 414	4 439	3 935	915	-	-
	Kenya	153	87	14	-	46	-	-	4	-	-	5	-
	Somalia	-	-	-	-	-	5	7	11	14	39	3 229	-

IMPORTATIONS OF SMALLPOX INTO EUROPE, JANUARY 1961-DECEMBER 1973

Import No.	Year	Month	Country	Total of cases	Number of cases among patients, visitors in hospitals or medical personnel	Origin of imported infection	Method of transport of index case into Europe
1	1961	Jan.	Spain	17	13	India	Air
2	1961	March	Federal Republic of Germany	4	1	India	Air
3	1961	April	USSR	1	-	India	Air
4	1961	Oct.	Belgium	1	-	Zaire	Air
5	1961	Dec.	Federal Republic of Germany	5	2	Liberia	Air
6	1961	Dec.	Federal Republic of Germany	33	19	Pakistan	Air
7	1961	Dec.	United Kingdom	3	-	Pakistan	Air
8	1961	Dec.	United Kingdom	2	1	Pakistan	Air
9	1961	Dec.	United Kingdom	14	13	Pakistan	Air
10	1962	Jan.	United Kingdom	1	-	Pakistan	Air
11	1962	Jan.	United Kingdom	47	26	Pakistan	Air
12	1962	March	Poland	29	4	India	Sea
13	1962	July	United Kingdom	3	-	India	Sea
14	1963	March	Sweden	27	15	Asia (country unknown)	Air
15	1963	May	Poland	99	46	India	Air
16	1963	Aug.	Switzerland	1	-	Gabon	Air
17	1965	Oct.	Federal Republic of Germany	1	-	United Rep. of Tanzania	Air
18	1967	Feb.	Federal Republic of Germany	1	-	India	Air
19	1967	March	Czechoslovakia	1	-	India	Air
20	1967	March	Federal Republic of Germany	1	-	India	Air
21	1967	Oct.	United Kingdom	2	-	Pakistan	Air
22	1968	Feb.	United Kingdom	1	-	Pakistan	Air
23	1968	Aug.	Belgium	1	-	Zaire	Air
24	1970	Jan.	Federal Republic of Germany	20	19	Pakistan	Air
25	1970	Aug.	Denmark	1	-	Afghanistan	Air
			Norway	1	-	Denmark	
26	1972	Feb.	Yugoslavia	175	84	Iraq	Land
			Federal Rep. of Germany	1	-	Yugoslavia	
27	1973	Jan.	United Kingdom	1	-	India	Air
Total cases				568	245		

ANNEX 9

WHO RECOMMENDED SAFETY STANDARDS IN LABORATORIES RETAINING VARIOLA VIRUS [1]

1. Introduction

With the interruption of smallpox transmission expected to be certified in the near future, the only known source of variola virus and potential for smallpox epidemics will be in laboratories maintaining the virus. Following the recommendation of the 30th World Health Assembly (1977) that variola virus be retained only by World Health Organization (WHO) collaborating centres under conditions ensuring maximum safety, WHO convened a group of experts to consider the safety standards for the maintenance and use of variola virus in laboratories. The group recognized the need to retain a minimum number of such laboratories for archival, diagnostic and research purposes and this view has been endorsed by the Global Commission for the Certification of Smallpox Eradication at its first meeting.

1.1 Objectives

The objectives of the meeting were to define physical containment standards for maintaining the virus, establish requirements to ensure the safety of personnel and propose administrative control measures. The group formulated recommendations addressed to these objectives and, with WHO, strongly urges that national safety measures for containing variola virus in laboratories embody these recommendations.

2. Agents subject to safety recommendations

2.1 Variola and whitepox viruses

Among the orthopoxviruses only variola virus is recognized as a highly dangerous pathogen but because there is no consistent laboratory difference between whitepox viruses and variola virus, whitepox viruses must also be subject to these safety measures, although, at present, whitepox viruses are not known to infect humans.

2.2 Monkeypox and vaccinia viruses

Monkeypox and vaccinia viruses pose no major public health danger. Although suitable precautions, including vaccination, should be taken by personnel working with these and other orthopoxviruses, they need not be subject to the same stringent safety measures as variola viruses.

3. Numbers and functions of laboratories

Risk is directly related to the number of laboratories maintaining variola virus stocks. It was recommended that variola virus should only be held in WHO collaborating centres which have full containment as described in 4, and that the number of these should be subject to periodic review. WHO collaborating centres which do not retain variola virus will be encouraged to continue research on orthopoxviruses other than variola virus. Further recommendations were:

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[1] The safety standards described herein are based on the report of a Workshop Meeting on Safety Measures in Laboratories Retaining Variola Virus, Geneva 1-4 August 1977 (WHO document SME/77.2), as revised in March 1979.

3.1 Archival

The responsibility for maintaining a representative collection of variola viruses for archival purposes should rest on the WHO collaborating centres.

3.2 Diagnostic

The laboratories at the Viral Exanthems Branch, CDC, Atlanta, and the Laboratory of Smallpox Prophylaxis, Research Institute of Virus Preparations, Moscow, should continue as the principal WHO centres for diagnosis of suspect human smallpox cases.

3.3 Research

3.3.1 Variola virus should not be used for research purposes in laboratories which are not WHO collaborating centres, and these latter should, by 1980, not exceed four in number.

However, should national authorities deem variola virus necessary in their institutions, the WHO should be notified and be assured that the physical containment system of the laboratory and the personnel safety measures meet the standard safety requirements. However, it is urged that national authorities and their institutions follow the procedures presented in section 3.3.2.

3.3.2 It is strongly recommended that all other institutions maintaining variola virus destroy these stocks or transfer them to one of the above-mentioned WHO centres; they should be informed that the WHO centres would accept visiting investigators who wish to work with variola if the research protocol fell within the general policy of WHO and there was no substitute for variola for the research in question.

4. Recommended safety procedures pertaining to physical construction and administration of laboratories with variola virus

4.1 Physical containment

Because, even for archival purposes, it is necessary from time to time to handle the stock viruses, all holding of variola virus whether or not research is undertaken, should be in laboratories meeting all the following requirements.

A place authorized to hold, or work with variola viruses, including infecting animals (hereinafter called the laboratory) must be constructed and operated in such manner to prevent dissemination of variola virus. Experiments involving smallpox virus shall be confined to work areas in a laboratory of the type designed to contain microorganisms that are extremely hazardous to man or may cause serious epidemic disease. The laboratory is either a separate building or it is a controlled area, within a building, which is isolated from all other areas of the building. Access to the laboratory is under strict control, excluding entry of unauthorized persons. Requirements for laboratories holding and working with variola are:

4.1.1 Imperviously sealed walls, floors and ceilings in which all penetrations (such as for air ducts, electrical conduits, and utility pipes) are sealed to assure the physical isolation of the work area and to facilitate housekeeping and space decontamination.

4.1.2 If air locks are provided through which supplies and material can be brought into the laboratory, a system for gaseous fumigation must also be available to prevent breach of containment.

4.1.3 Contiguous clothing change and shower rooms through which personnel enter into and exit from the laboratory.

4.1.4 Double-door autoclaves, sealed to the laboratory barrier wall, to decontaminate and safely remove wastes and other materials from the laboratory.

4.1.5 If laboratory drains are installed, a biowaste treatment system to decontaminate liquid effluents, including autoclave chamber condensates, prior to discharge.

4.1.6 A separate ventilation system which maintains negative air pressures and directional air flow into the laboratory, whenever diagnostic or experimental work is in progress.

4.1.7 Passage of supply air through a prefilter and high efficiency particulate air (HEPA) filter before entering the laboratory. Exhaust air should be decontaminated by passage through two HEPA filters connected in series before discharge to the atmosphere. The HEPA filters should be pretested to retain 99.97% of 0.3 micron particles. A post-installation test should be done to exclude accidental damage to the filters and to ensure adequate sealing of filters has been achieved.

4.1.8 All primary doors leading into the laboratory are always locked except for entry and exit to prevent entry of unauthorized persons. Any windows should also be secured against intruders. The laboratory director controls access to the laboratory.

4.1.9 A biohazard warning sign on all primary doors of the laboratory and a list of authorized personnel posted on the entries.

4.1.10 Appropriate primary safety devices (such as biological safety cabinets and sealed centrifuge buckets) to prevent or minimize release of virus into the air of the laboratory.

4.1.11 Provisions for maintaining visual or voice contact (view windows intercom system) with colleagues outside of the laboratory.

4.1.12 Appropriate design and operational measures employed to prevent introduction of Insects, rodents and other pests.

4.1.13 A laboratory operations manual should be prepared which describes function and operation of the laboratory.

4.1.14 A contingency plan which provides for special guarding in the event of pending or potential threat to the facility.

4.2 Administrative control

4.2.1 Responsibility, authority and compliance

An effective safety system defines clear lines of responsibility and authority. The day-to-day safety in the laboratory is the responsibility of the laboratory director, who is responsible to national health authorities. It is appreciated that different countries have different methods for ensuring safety. WHO should be informed of the safety measures adopted in each country and will be available to consult on such matters. WHO will keep the appropriate national authorities informed of all exchanges relating to safety measures which they have with collaborating centres. Laboratories will be requested to submit a safety report, through national authorities, at least yearly.

4.2.2 The authorization to possess, receive, maintain and use variola virus shall be issued by national authorities and only to WHO centres. This authorization should be obtained in writing and WHO should be kept informed of all such authorizations issued.

4.2.3 Personnel

Only personnel authorized by the director shall enter the laboratory and these persons shall be indicated on a list posted on entries to the laboratory. This list shall be updated as necessary. All such persons must have been satisfactorily trained, briefed and immunized as judged by the director. Persons can be added to the list only on authorization of the director.

4.2.3.1 Prerequisites for authorization to enter the laboratory:

i) Vaccination at yearly intervals with potent WHO approved vaccine and proper technique and measurement of detectable antibodies at least every three years. This information must be recorded.

ii) All such persons must have been given a written copy of the safety instructions and must have signed a statement that they have been read and understood.

4.2.3.2 All untoward incidents and accidents, even minor ones, involving personnel, containment devices, and laboratory support systems must be reported to the director and immediately recorded.

4.2.3.3 All entries of personnel and visitors into the laboratory should be documented in a permanent record.

4.2.3.4 Any absence must be reported to the director who should verify cause of absence.

4.2.3.5 The personal physician of each worker should receive notification for his files that that individual works with variola virus. The physician should be provided with the telephone number of the director.

4.2.4 Special situations

Action in case of major accidents and other emergencies will be detailed in the laboratory operations manual.

5. Packaging and shipping

Diagnostic specimens and cultures should be packaged and shipped in accordance with national regulations and those of the International Air Transportation Association (IATA) and Universal Postal Union (UPU). Shipments should be sent by the most expeditious available method of transport to prevent loss. The shipment and arrival details should be cabled to the receiving laboratory prior to shipment of the specimens.

ANNEX 10

REPORTS AND MEMBERSHIP OF INTERNATIONAL COMMISSIONS FOR CERTIFICATION OF SMALLPOX ERADICATION

1. SOUTH AMERICA : 12 - 25 August 1973 (PAHO document CD22/19 of 11 September 1973)

Commission Members:

Dr A.N. Bica	Secretary of Public Health, Ministry of Health, Rio de Janeiro, Brazil (CHAIRMAN)
Dr F. Cambournac	Director, Institute of Hygiene and Tropical Medicine, Lisbon, Portugal
Dr E. Echezuria	Chief, Department of Demography and Epidemiology, Ministry of Health, Caracas, Venezuela (RAPPORTEUR)
Dr J.D. Millar	Director, State and Community Services Division, Center for Disease Control, Atlanta, USA
Dr R. Wilson	Chairman, Connaught Laboratories Ltd., University of Toronto, Willowdale, Canada

2. INDONESIA : 15 - 25 April 1974 (Document WHO/SE/74.68)

Commission Members:

Dr N. McK. Bennett	Specialist Physician, Fairfield Hospital, Melbourne, Australia
Dr J.J. Dizon	Chief of Disease Intelligence, Disease Intelligence Centre, Department of Health, Manila, Philippines
Dr J.S. Gill	Assistant Director, Health and Epidemiology, Ministry of Health, Kuala Lumpur, Malaysia (RAPPORTEUR)
Dr S. Kumarapathy	Senior Registrar, Quarantine and Epidemiology, Environmental Public Health Division, Ministry of Environment, Singapore
Dr J. Sulianti Saroso	Director-General of Communicable Disease Control (CDC), Ministry of Health, Jakarta, Indonesia
Dr I. Tagaya	Director, Department of Enteroviruses, National Institute of Health, Tokyo, Japan
Dr P. Wehrle	Director of Paediatrics, Los Angeles County - University of Southern California Medical Center, Los Angeles, USA (CHAIRMAN)

3. WEST AFRICA : 23 March - 15 April 1976 (Document AFR/SMALLPOX/80)

Countries included are Benin, Gambia, Ghana, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

Commission Members:

Dr S. Bédaya-Ngaro	Inspecteur Général des Services de Santé, Bangui, Central African Republic
Dr W. Koinange Karuga	Director, Division of Communicable Disease Control, Ministry of Health, Nairobi, Kenya (CHAIRMAN/PRESIDENT - ABIDJAN)
Dr I. Ladnyi	Chief, Central Board of Quarantinable Diseases, Ministry of Health, Moscow, USSR

Dr B. Lekie	Directeur général du Département de la Santé publique, Kinshasa, Zaire (CHAIRMAN/PRESIDENT - BRAZZAVILLE)
Dr R. Netter	Directeur au Laboratoire national de la Santé, Paris, France
Dr M.I.D. Sharma	Former Director, National Institute of Communicable Diseases, New Delhi, India
Dr P. Wehrle	Hastings Professor of Paediatrics, University of Southern California, Los Angeles, USA (RAPPORTEUR)

4. AFGHANISTAN: 22 - 29 November 1976 (Document WHO/SE/77.89)
and
5. PAKISTAN : 6 - 18 December 1976 (Document WHO/SE/77.90)

Commission Members:

Dr H. Bedson	Professor of Medical Microbiology, University of Birmingham, Medical School, Birmingham, United Kingdom
Dr N. McK. Bennett	Specialist Physician and Deputy Superintendent, Fairfield Hospital, Melbourne, Australia
Dr A.A. Idris	Director-General, Epidemiology, Ministry of Health, Khartoum, Sudan (CHAIRMAN - PAKISTAN)
Dr G. Meiklejohn	Professor of Medicine, University of Colorado Medical Center, Denver, USA (RAPPORTEUR - AFGHANISTAN & PAKISTAN)
Dr N. Kumara Rai	Director, Planning Department, Directorate General for Communicable Disease Control, Ministry of Health, Jakarta, Indonesia
Dr P.N. Shrestha	Chief, Smallpox Eradication Project, Department of Health Services, Kathmandu, Nepal (CHAIRMAN - AFGHANISTAN)

6. CENTRAL AFRICA: 6 - 30 June 1977 (Document AFR/SMALLPOX/86)

Countries included are Burundi, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Rwanda, United Republic of Cameroon, and Zaire.

Commission Members:

Dr P. Agbodjan	Chef du Service des grandes Endémies, Direction général de la Santé, Lomé, Togo
Dr J.G. Breman	Epidemic Intelligence Service Officer (Michigan Department of Public Health), Bureau of Epidemiology, Center for Disease Control, Atlanta, USA
Dr E. Coffi	Directeur de l'Institut d'Hygiène, Ministère de la Santé publique, Abidjan, Ivory Coast
Dr F. Dekking	Laboratorium voor de gezondheidsleer, University of Amsterdam, Amsterdam, Netherlands
Dr A. M'Baye	Médecin-Chef du Service des grandes Endémies et Directeur adjoint de la Santé publique, Dakar, Senegal (CHAIRMAN)
Dr R. Netter	Directeur au Laboratoire national de la Santé, Paris, France (RAPPORTEUR)
Dr M. Yekpé	Responsable des Services des Maladies transmissibles, Ministère de la Santé publique, Cotonou, Benin

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7. INDIA : 4 - 23 April 1977 (Document SEA/Smallpox/78)

NEPAL : 4 - 13 April 1977 (Document SEA/Smallpox/80)

BHUTAN : 28 March - 1 April 1977, and 22 April 1977 (Document SEA/Smallpox/80)

Commission Members:

India and Bhutan

Dr J. Cervenka	Chief (Epidemiology), Institute of Epidemiology and Microbiology, Bratislava, Czechoslovakia
Dr W.A.B. de Silva	Deputy Director (Planning), Ministry of Health, Colombo, Sri Lanka
Dr F. Fenner	The Australian National University, Centre for Resource and Environmental Studies, Canberra, Australia (RAPPORTEUR)
Dr H. Flamm	Institute of Hygiene, University of Vienna, Vienna, Austria
Lt. Gen. R.S. Hoon	Director-General, Armed Forces Medical Services, New Delhi, India
Dr T. Kitamura	Chief, Division of Poxviruses, National Institute of Health, Tokyo, Japan
Dr W. Koinange Karuga	Director, Division of Communicable Disease Control, Ministry of Health, Nairobi, Kenya
Dr J. Kostrzewski	Secretary, Medical Division, Polish Academy of Sciences, Warsaw, Poland (CHAIRMAN)
Dr H. Lundbeck	The National Bacteriological Laboratory, Stockholm, Sweden
Dr A.M. Mustaqul Huq	Director of Health Services (Preventive), Ministry of Health, Dacca, Bangladesh
Dr D.M. Mackay	Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, London, United Kingdom
Dr M.F. Polak	Scientific Officer, Faculty of Medicine, Catholic University, Nijmegen, Netherlands
Dr R. Roashan	President, Foreign Relations Department, Ministry of Public Health, Kabul, Afghanistan
Dr D. Sencer	Director, Center for Disease Control, Atlanta, USA
Dr U Thein Nyunt	Director (Disease Control), Ministry of Health, Rangoon, Burma
Dr V.M. Zhdanov	Director, Institute of Virology, Academy of Medical Sciences, Moscow, USSR

Nepal

Dr T. Kitamura	Chief, Division of Poxviruses, National Institute of Health, Tokyo, Japan
Dr J. Kostrzewski	Secretary, Medical Division, Polish Academy of Sciences, Warsaw, Poland (CHAIRMAN)
Dr D.M. Mackay	Ross Institute, London School of Hygiene and Tropical Medicine, London, United Kingdom (RAPPORTEUR)

8. BURMA : 21 - 30 November 1977 (Document SEA/Smallpox/83)

Commission Members:

Dr S. Jatanasen	Director, Division of Epidemiology, Ministry of Public Health, Bangkok, Thailand
Dr A. Langmuir	Visiting Professor (retired), Harvard University Medical School, Department of Preventive and Social Medicine, Boston, USA (SECRETARY)
Dr C. Lerche	Director, National Institute of Public Health, Oslo, Norway
Dr H. von Magnus	Head, Department of Epidemiology, State Serum Institute, Copenhagen, Denmark (RAPPORTEUR)
Dr A.M. Mustaqul Huq	Director of Health Services (Preventive), Government of Bangladesh, Dacca, Bangladesh
Dr I.F. Setiady	Director, Epidemiology and Quarantine, Ministry of Health, Jakarta, Indonesia (CHAIRMAN)
Dr M.I.D. Sharma	Emeritus Medical Scientist, A-2/1 Model Town, New Delhi, India
Dr P.N. Shrestha	Chief, Smallpox Eradication Project, Department of Health Services, Kathmandu, Nepal
Dr U Thein Nyunt	Director, Disease Control, Department of Health, Rangoon, Burma

9. BANGLADESH : 1 - 14 December 1977 (Document SEA/Smallpox/84)

Commission Members:

Dr S. Jatanasen	Director, Division of Epidemiology, Ministry of Public Health, Bangkok, Thailand
Dr A.D. Langmuir	Visiting Professor (retired), Harvard University Medical School, Department of Preventive and Social Medicine, Boston, USA (CHAIRMAN)
Dr C. Lerche	Director, National Institute of Public Health, Oslo, Norway
Dr H. von Magnus	Head, Department of Epidemiology, State Serum Institute, Copenhagen, Denmark (RAPPORTEUR)
Dr A.M. Mustaqul Huq	Director of Health Services (Preventive), Ministry of Health, Dacca, Bangladesh
Dr I.F. Setiady	Director, Epidemiology and Quarantine, Ministry of Health, Jakarta, Indonesia
Dr M.I.D. Sharma	Emeritus Medical Scientist, A-2/1, Model Town, New Delhi, India
Dr P.N. Shrestha	Chief, Smallpox Eradication Project, Department of Health Services, Kathmandu, Nepal
Dr U Thein Nyunt	Director, Disease Control, Department of Health, Rangoon, Burma

10. MALAWI, MOZAMBIQUE, TANZANIA AND ZAMBIA : 6 - 29 March 1978 (Document AFR/SMALLPOX/87)

Commission Members:

Dr M. Davies	Chief Medical Officer, Ministry of Health, Freetown, Sierra Leone
Dr Z.M. Dlamini	Senior Medical Officer of Health, Ministry of Health, Mbabane, Swaziland
Dr J. Espmark	Department of Virology, State Laboratory of Biology, Stockholm, Sweden
Dr F. Fenner	The Australian National University, Canberra, Australia (RAPPORTEUR)

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Dr J. Moeti	Director of Medical Services, Ministry of Health, Gaborone, Botswana	(CHAIRMAN)

11. UGANDA : 11 - 27 October 1978 (Document AFR/SMALLPOX/88)

Commission Members:

Dr Abdullahi Deria	Director, Department of Public Health, Ministry of Health, Mogadishu, Somalia	(CHAIRMAN)
Dr Kalisa Ruti	Médecin Directeur du Programme élargi de Vaccination, Département de la Santé publique, Kinshasa, Zaire	(RAPPORTEUR)
Dr Y.P. Rikushin	Chief, Department of Epidemiology, Pasteur Institute, Leningrad, USSR	

12. SUDAN : 15 - 29 November 1978 (Document WHO/SE/79.134)

Commission Members:

Dr A.M. Fergany	Adviser, Ministry of Health, Oman	(CHAIRMAN)
Dr W. Koinange Karuga	Chief Deputy Director of Medical Services, Ministry of Health, Nairobi, Kenya	
Dr C. Lerche	Director, National Institute of Public Health, Oslo, Norway	(VICE-CHAIRMAN)
Dr S.S. Marennikova	Chief, Laboratory of Smallpox Prophylaxis, Research Institute of Virus Preparations, Moscow, USSR	
Dr G. Meiklejohn	Professor of Medicine, University of Colorado Medical Center, Denver, USA	(RAPPORTEUR)
Dr D. Robinson	Community Physician, Communicable Disease Surveillance Centre, London, U.K.	
Ato Yemane Tekeste	Project Manager, Smallpox Eradication Programme, Addis Ababa, Ethiopia	

13. ANGOLA : 5 - 16 February 1979 (AFRO Document AFR/SMALLPOX/89)

Commission Members:

Dr Bichat A. Rodrigues	Coordonnateur régional de la Région du Sud-Est, Ministère de la Santé, Brasilia, Brazil	(PRESIDENT)
Dr Cabral A.J. Rodrigues	Directeur national pour la Médecine préventive, Secrétariat de la Coopération internationale, Maputo, Mozambique	(CO-RAPPORTEUR)
Dr Kalisa Ruti	Médecin Directeur du Programme élargi de vaccination, Département de la Santé publique, Kinshasa, Zaire	(CO-RAPPORTEUR)

14. BOTSWANA, LESOTHO AND SWAZILAND : 5 - 23 March 1979 (AFRO Document AFR/SMALLPOX/90)

Commission Members:

Dr D. Chilemba	Chief Medical Officer, Ministry of Health, Lilongwe, Malawi
Dr Abdullahi Deria	Director, Department of Public Health, Ministry of Health, Mogadishu, Somalia
Dr P.E.M. Fine	Lecturer (University of London), Ross Institute, School of Hygiene and Tropical Medicine, London, United Kingdom

Dr W. Koinange Karuga	Chief Deputy Director of Medical Services, Ministry of Health, Nairobi, Kenya (CHAIRMAN)
Dr G. Meiklejohn	Professor of Medicine, University of Colorado Medical School, Denver, USA (RAPPORTEUR)
Dr E.A. Smith	Director of Medical Services, Federal Ministry of Health, Lagos, Nigeria
Dr I. Tagaya	Director, Department of Enteroviruses, National Institute of Health, Tokyo, Japan

15. DEMOCRATIC REPUBLIC OF YEMEN : 3 - 11 June 1979 (Document WHO/SE/79.140)

Commission Members:

Dr F. Jurji	Director of Epidemiology and Quarantine, Directorate General of Preventive Medicine, Ministry of Health, Baghdad, Iraq
Dr T. Kitamura	Chief, Division of Poxviruses, National Institute of Health, Tokyo, Japan (CHAIRMAN)
Dr V. Sery	Chief, Department of Tropical Diseases, Postgraduate School of Medicine, Prague, Czechoslovakia

16. YEMEN ARAB REPUBLIC : 2 - 10 June 1979 (Document WHO/SE/79.139)

Commission Members:

Dr J.M. Aashi	Assistant Director General of Preventive Medicine, Ministry of Health, Riyad, Saudi Arabia (CO-CHAIRMAN)
Dr T.J. Geffen	Senior Principal Medical Officer, Department of Health and Social Security, London, United Kingdom (RAPPORTEUR)
Dr R. Netter	Directeur au Laboratoire national de la Santé, Paris, France (CO-CHAIRMAN)

17. DJIBOUTI : 1 - 19 October 1979 (Document WHO/SE/79.147)

Commission Members:

Dr N. Grasset	Epidemiologist, Veigy Foncenex, Douvaine, France (RAPPORTEUR)
Dr T. Nacef	Directeur du Département de Médecine préventive et sociale, Ministère de la Santé publique, Tunis, Tunisia
Dr R. Netter	Directeur général du Laboratoire national de la Santé, Paris, France (CHAIRMAN)

18. ETHIOPIA : 1 - 19 October 1979 (Document WHO/SE/79.148)

Commission Members:

Dr K. Dumbell	Head, Department of Virology, Wright-Fleming Institute of Microbiology, St. Mary's Hospital Medical School, London, United Kingdom (RAPPORTEUR)
Dr D. Henderson	Dean and Professor of Health Services Administration, The Johns Hopkins University, School of Hygiene and Public Health, Baltimore, USA (RAPPORTEUR)

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Dr J. Kostrzewski	Secretary, Medical Division, Polish Academy of Sciences, Warsaw, Poland
Dr I. Noormahommed	Deputy National Director of Preventive Medicine, Ministry of Health, Maputo, Mozambique
Dr D.A. Robinson	Epidemiologist, Communicable Disease Surveillance Centre, London, U.K.
Dr A. Stroganov	Assistant Professor, Central Institute for Advanced Medical Training, Communicable Disease Department, Moscow, USSR

19. KENYA : 1 - 19 October 1979 (Document WHO/SE/79.149)

Commission Members:

Dr R.N. Basu	Assistant Director General of Health Services, Directorate General of Health Services, New Delhi, India (CHAIRMAN)
Dr S.S. Marennikova	Chief, Laboratory of Smallpox Prophylaxis, Research Institute of Virus Preparations, Moscow, USSR
Dr J.S. Moeti	Senior Medical Officer of Health, Ministry of Health, Gaborone, Botswana
Dr Kalisa Ruti	Médecin Directeur du Programme élargi de vaccination, Département de la Santé publique, Kinshasa, Zaire
Dr G. Meiklejohn	Department of Medicine, University of Colorado Medical Centre, Denver, USA (RAPPORTEUR)

20. SOMALIA : 1 - 19 October 1979 (Document WHO/SE/79.146)

Commission Members:

Dr J. Aashi	Assistant Director-General of Preventive Medicine, Ministry of Health, Riyad, Saudi Arabia
Dr Z.M. Dlamini	Director of Medical Services, Ministry of Health, Mbabane, Swaziland
Dr T. Geffen	Senior Principal Medical Officer, Department of Health and Social Security, London, United Kingdom (RAPPORTEUR)
Dr H. Lundbeck	Director, The National Bacteriological Laboratory, Stockholm, Sweden (CHAIRMAN)
Dr J.D. Millar	Assistant Director for Public Health Practice, Center for Disease Control, Atlanta, USA
Dr P.N. Shrestha	Chief, Planning Division, Tribhuvan University Institute of Medicine, Kathmandu, Nepal

ANNEX 11

121 COUNTRIES AND AREAS WHICH PROVIDED STATEMENTS ATTESTING TO THEIR FREEDOM FROM SMALLPOX

AMERICAS	Year[a]
Antigua	
Bahamas	1926
Barbados	
Belize	1933
Bermuda	1924
British Virgin Islands	>80yrs
Canada	1962
Cayenne	
Cayman Islands	never
Costa Rica	1930
Cuba	
Dominica	
Dominican Republic	
El Salvador	
Falkland Islands (Islas Malvinas)	
Grenada	
Guatemala	>20yrs
Haiti	
Honduras	1932
Jamaica	1926
Mexico	1951
Montserrat	
Netherlands Antilles	
Nicaragua	1924
Panama	>35yrs
Puerto Rico [b]	
St. Kitts-Nevis-Anguilla	
St. Lucia	>20yrs
St. Vincent	>50yrs
Trinidad & Tobago	20yrs
Turks and Caicos Islands	
United States of America	1949
Virgin Islands	

AFRICA	
Cape Verde	1951
Comoros	1925
Mauritius	1913
Sao Tome and Principe	>22yrs
Réunion	
Seychelles	1885
St. Helena	>40yrs

EUROPE	
Albania	
Algeria	1962
Andorra	>50yrs
Austria	1923
Belgium	1968
Bulgaria	1928
Channel Islands and Guernsey	1897 1925
Czechoslovakia	1967
Denmark	1970
Faroe Islands	>80yrs
Finland	1937
France	1955
German Democratic Republic	1959
Germany, Federal Republic of	1972

[a] The year of the last smallpox case, either endemic or imported, or the period since the last case, is shown only when recorded on the statement. It does not in all cases agree with that shown in Annex 1.

[b] Covered by statement of USA.

Annex 11

Gibraltar	1953
Greece	1950
Greenland	1852
Holy See	
Hungary	1926
Iceland	1872
Ireland	1907
Isle of Man	1936
Italy	1957
Liechenstein	
Luxembourg	
Malta	1946
Monaco	
Morocco	1952
Netherlands	1954
Norway	1945
Poland	1963
Portugal	1952
Romania	1946
San Marino	1911
Spain	1962
Sweden	1963
Switzerland	1963
Turkey	1957
Union of Soviet Socialist Republics	1960
United Kingdom	1978
Western Sahara	
Yugoslavia	1972
EASTERN MEDITERRANEAN	
Cyprus	never
Egypt	1952
Israel	1950
Jordan	1957
Lebanon	1956
Libyan Arab Jamahiriya	1948
Tunisia	1952
SOUTH-EAST ASIA	
Democratic People's Republic of Korea	1951
Maldives	1879
Mongolia	1939
Sri Lanka	1972
WESTERN PACIFIC	
American Samoa	
Australia	1957
Brunei	>15yrs
Cook Islands	
Fiji	never
French Polynesia [c]	
Guam	1958
Hong Kong	1952
Japan	1974
Kiribati	
Republic of Korea	1960
Macao	
Malaysia	1960
Republic of Nauru	
New Caledonia	
New Hebrides	
New Zealand	1920
Niue	
Papua New Guinea	never
Philippines	1949
Samoa	
Singapore	1959
Solomon Islands	never
Tokelau Islands	
Tonga	
Trust Territory of the Pacific Islands	never
Tuvalu	never
Wallis and Futuna	

[c] Covered by statement of France.

SUMMARY OF INTERNATIONAL RUMOUR REGISTER
1 JANUARY 1978-31 DECEMBER 1979

Region		Diagnosis/Disposition						
		Smallpox	Monkeypox	Chiekenpox or measles	Other skin diseases	False report/ previous spx.	Pending	Total
AFRICA	1978	-	1	2	-	7	-	10
	1979	-	-	5	2	4	-	11
AMERICAS	1978	-	-	2	-	-	-	2
	1979	-	-	4	-	4	-	8
EASTERN MEDITERRANEAN	1978	-	-	1	2	2	-	5
	1979	-	-	2	1	3	-	6
EUROPE	1978	2	-	1	-	1	-	4
	1979	-	-	4	1	-	-	5
SOUTH-EAST ASIA	1978	-	-	19	2	3	-	24
	1979	-	-	10	7	6	-	23
WESTERN PACIFIC	1978	-	-	-	-	2	-	2
	1979	-	-	2	-	2	-	4
TOTAL	1978	2	1	25	4	15	-	47
	1979	-	-	27	11	19	-	57

BIOLOGICAL AND CHEMICAL CHARACTERS OF SEVERAL ORTHOPOXVIRUSES

		Variola	"Whitepox"	Monkeypox	Monkeypox white pock variants*	Vaccinia
Isolated from		Man	Ape, monkey, rodent	Man, monkey, anteater	Experimental procedure	For vaccine production, origin unknown
Pocks on chorioallantois of chick embryo		Small, white	Small, white	Small, pink	Small, white	Large, white to grey
Ceiling temperature on chorioallantois of chick embryo (^{o}C)		37.5-38.5	38.5	39.5	38.5 - 39.5	41
Growth in rabbit skin		-	-	++	- to ++	+ to ++
Pathogenicity for baby mice		Low	Low	High	?	High
Antigens specific to:	vaccinia	-	-	-	-	+
	variola	+	+	-	-	-
	monkeypox	-	-	+	+	-
Polypeptide pattern:	vaccinia	-	-	-	-	+
	variola	+	+	-	-	-
	monkeypox	-	-	+	+	-
DNA pattern:	vaccinia	-	-	-	-	+
	variola	+	+	-	-	-
	monkeypox	-	-	+	+	-

* Monkeypox virus white pock variants isolated in four laboratories have the characters indicated, but one group of scientists has reported that all the white pock variants that they have isolated have the same characters as "whitepox" virus.

TABLE 1. HUMAN MONKEYPOX CASES IN WEST AND CENTRAL AFRICA, 1970-1979 (NOVEMBER)

Case No.	Village Name	Region/ County, etc.	Country	Age (years)	Sex	Vacc. scar	Date on-set rash	Severity*	Death	Comments
1	Bokenda	Equateur	Zaire	9/12	M	-	24.8.70	2	-	Died of measles after 2 months
2	Boudua	Grand Geddah	Liberia	4	M	-	12.9.70	2	-	
3	"	" "	"	4	F	-	13.9.70	1	-	Aunt of and co-primary with case 2
4	"	" "	"	6	F	-	13.9.70	1	-	Co-primary with case 2; in adjacent house to 2,3
5	Tarr Town	" "	"	9	M	-	2.10.70	2	-	
6	Limba Corner	Aguebu	Sierra Leone	24	M	+	1.12.70	2	-	
7	Ihie Umduru	Aba	Nigeria	4	F	-	9.4.71	3	-	
8	" "	"	"	24	F	-	18.4.71	1	-	Secondary transmission presumed. Mother of case 7
9	Bosmatché	Abengourou	Ivory Coast	5	M	-	18.10.71	2	-	
10	Ilonga	Kasai Oriental	Zaire	1	M	-	2.3.72	2	-	
11	Libela (B)	Equateur	"	3	M	-	27.7.72	3	+	Co-primary with case 11
12	Yamileka (B)	"	"	30	F	+	27.7.72	1	-	Mother of case 11
13	Bokokolo	"	"	7/12	F	-	16.9.72	2	+	
14	Niangi	Bandundu	"	2	M	Doubtful	30.10.72	2	+	
15	Bogon	Equateur	"	3	F	-	10.1.73	2	-	
16	"	"	"	5	F	Doubtful	22.1.73	2	-	Secondary transmission presumed-Sister of case 15
17	Bombana (B)	"	"	7/12	M	-	6.5.73	3	+	
18	Bumba Town (B)	"	"	4	F	Doubtful	6.8.74	2	-	
19	Iba	Bandundu	"	40	F	-	4.1.75	3	-	
20	Djungula (K)	Kasai Oriental	"	23	F	-	9.3.75	1	-	
21	Ebata (B)	Equateur	"	2	F	-	4.3.76	2	-	
22	Yangomba (B)	"	"	7	M	-	7.6.76	3	-	
23	Masina	Bandundu	"	8	F	+	27.8.76	3	-	
24	Yamagbe-Bohumbe(B)	Equateur	"	7	F	-	12.2.77	3	-	
25	Iwadji (K)	Kasai Oriental	"	4	M	-	12.2.77	2	-	
26	Yamagbe-Bohumbe(B)	Equateur	"	8/12	F	-	4.3.77	2	-	No contact with case 24; died of ? after 7 months
27	" " (B)	"	"	35	F	+	7.3.77	1	-	Mother of and co-primary with case 26
28	Bwalayulu	Bandundu	"	1	M	-	14.3.77	2	-	
29	Katanti	Kivu	"	4	F	-	22.3.77	3	-	
30	Manzita	Bandundu	"	14	M	-	4.1.78	3	-	
31	Ikela	Equateur	"	7	M	-	5.2.78	3	+	
32	Mongo Senge (K)	Kasai Oriental	"	4	F	-	16.2.78	3	-	
33	" " (K)	" "	"	6	M	Doubtful	18.2.78	2	-	Brother of and co-primary with case 32; died of malnutrition after 4 months
34	Imbimbi	Bandundu	"	5	F	-	6.5.78	3	+	
35	Okela (K)	Kasai Oriental	"	2	M	-	11.9.78	3	+	
36	Ekodji (K)	" "	"	6	F	-	28.9.78	3	-	Secondary transmission presumed. Cousin of case 35
37	Mindembo (B)	Equateur	"	3	F	-	9.11.78	2	-	
38	" (B)	"	"	1	M	-	16.11.78	3	-	Brother of and co-primary with case 37
39	Omifounfoun	Oyo	Nigeria	35	M	-	22.11.78	3	-	Reported from Parakou, Benin
40	Yaliengo (B)	Equateur	Zaire	7	F	-	23.11.78	3	-	
41	Apoko (K)	Kasai Oriental	"	3	M	-	11.12.78	3	-	
42	Yamahonde (B)	Equateur	"	3	M	-	6.1.79	3	-	
43	Bosokuma	"	"	3	M	-	5.2.79	3	+	Necropsy specimen electron microscopy +
44	"	"	"	9/12	M	-	20.2.79	2	-	Secondary transmission presumed. Brother of case 43
45	Bokonzo	"	"	5	M	-	10.9.79	3	-	

* See footnote, Table 2.

TABLE 2. PAIRS OF CASES OF HUMAN MONKEYPOX REPRESENTING POSSIBLE SECONDARY SPREAD

Case No.	Age	Sex	Relation	Date onset rash	Vacc. scar	Severity*	Laboratory results								
							Virological			Days after rash onset	Serological				
							EM	Virus isolation	Precipitation in gel		Vaccinia				Monkeypox specific antibody
											HI	CF	Neut	RIA	
7	4	F	-	9.4.71	-	3	+	+	+	1518	..	..	70	..	FA+
8	24	F	Mother of case 7	18.4.71	-	1	-	-	..	1509	..	..	178	..	FA+
15	3	F	-	10.1.73	-	2	+	+	+	1491	80	20	1200	230	RIA+
16	5	F	Sister of case 15	22.1.73	Doubt	2	+	-	-	1482	80	20	640	400	RIA+
35	2	M	-	11.9.78	-	3	+	+	+		..	..	..	..	..
36	6	M	Cousin of case 35	28.9.78	-	3	..	..	..	58	20	10	..	5900	RIA+
43	3	M	-	5.2.79	-	3	+	necropsy		[a]	..	..	..	..	..
44	9/12	M	Brother of case 43	20.2.79	-	2	..	..	..	70	32	..	..	..	..

.. Not done

EM = Electron microscopy; HI = Haemagglutination inhibition; CF = Complement fixation; Neut = Neutralization test; FA = Fluorescent antibody; RIA = Radioimmunoassay antibody

*Severity: 1= mild (less than 25 lesions with no incapacity, not usually requring medical care)
2= moderate (more than 25 lesions, necessitating stopping most physical activity, usually requiring medical care but not always hospitalization)
3= severe (more than 100 lesions, severely incapacitated, requiring medical care)

[a] ELISA titre 256

LABORATORIES RETAINING VARIOLA VIRUS AS OF DECEMBER 1979

	Laboratories	City, country
*1.	Center for Disease Control	Atlanta, Georgia, USA
2.	Institute for the Control of Drugs and Biological Products	Beijing, China
3.	National Institute of Virology	Sandringham, South Africa
*4.	Research Institute of Virus Preparations	Moscow, USSR
*5.	Rijks Instituut voor de Volksgezondheid	Bilthoven, Netherlands
**6.	Centre for Applied Microbiology and Research	Porton Down, United Kingdom
***7.	United States Army Medical Research Institute for Infectious Diseases	Frederick, Maryland, USA

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* WHO Collaborating Centre

** Variola virus stocks were transferred to this laboratory from the St. Mary's Hospital Medical School, a designated WHO Collaborating Centre, in November 1979.

*** Variola virus strains were transferred to the Center for Disease Control in April 1980.

ANNEX 16

SUMMARY OF EXPENDITURE AND CONTRIBUTIONS, INTENSIFIED SMALLPOX ERADICATION PROGRAMME, 1967-1979

COST OF SMALLPOX ERADICATION PROGRAMME SINCE 1967

WHO regular budget	$ 37 930 000
WHO Voluntary Fund for Health Promotion	$ 43 168 946*
	$ 81 098 946
Bilateral aid	$ 32 246 898
Estimated national expenditure	$ 200 000 000
TOTAL (approx.)	$ 313 000 000

* Includes in this and next two tables all USSR vaccine pledged to 1981.

INTERNATIONAL ASSISTANCE TO SMALLPOX ERADICATION YEARLY CONTRIBUTIONS 1967-1979 (US$ MILLIONS)

	WHO budget**	USA*	USSR*	Sweden	Other countries*	Total
1967	2.73	2.56	1.83	-	0.06	7.18
1968	3.04	2.85	1.91	-	0.11	7.91
1969	3.11	2.62	1.91	-	0.07	7.71
1970	3.17	2.78	2.16	-	0.06	8.17
1971	3.25	2.81	2.22	0.10	0.41	8.79
1972	3.51	2.93	1.03	-	0.78	8.25
1973	3.26	0.79	1.03	-	0.87	5.95
1974	3.51	1.04	0.46	3.24	1.04	9.29
1975	4.34	1.09	0.37	6.28	4.49	16.57
1976	3.68	3.42	0.45	2.91	3.00	13.46
1977	2.77	1.85	-	1.57	2.34	8.53
1978	1.22	1.50	-	1.59	2.97	7.28
1979	.34	-	0.65	-	0.42	1.41
	37.93	26.24	14.02	15.69	16.62	110.50
1980	-	-	0.65	-	-	0.65
1981	-	-	0.65	-	-	0.65
	37.93	26.24	15.32	15.69	16.62	111.80***

* Includes bilateral assistance.

** Includes headquarters, estimated at $400 000 per year 1967 - 1977.

***Rounding error accounts for difference between this figure and $112 million total in next table.

Annex 16

TOTAL CONTRIBUTIONS RECEIVED OR PLEDGED
1967-1979 (US$)

	Amount		Amount
Australia	33 625	Monaco	2 419
*Austria	75 500	*Netherlands	2 807 263
Argentina	13 275	New Zealand	10 500
Belgium	378 800	Nigeria	16 036
Brazil	128 925	Norway	998 530
*Canada	2 519 311	*OXFAM (United Kingdom)	103 104
China	4 000	Peru	3 000
Colombia	3 002	Philippines	5 000
Czechoslovakia	41 118	Poland	3 500
Denmark	1 083 062	Saudi Arabia	200 000
German Democratic Republic	26 417	Sweden	15 689 584
*Germany, Federal Republic of	503 767	*Switzerland	386 569
Finland	110 623	*Tata Industries (India)	536 399
Ghana	3 273	Thailand	3 565
Greece	23 000	Uganda	12 077
Guinea	18 529	*United Kingdom	1 026 924
Hungary	33 500	*USA	26 241 403
*India	688 560	*USSR	15 316 681
Iran	874 000	Yugoslavia	26 000
*Iraq	16 000	Zaire	2 500
*Japan	664 998	UNEO	750 000
Japan Shipbuilding Industry Foundation	1 969 344	UNICEF	Diverse, unknown
Jordan	140	UNDRO	459 750
Kenya	168 000	United Republic of Cameroon	707
Kuwait	12 992	WHO budget	37 929 539
Luxembourg	6 541	Other private sources	70 492
		TOTAL	112 001 844

*Includes bilateral assistance.

ANNEX 17

SMALLPOX VACCINE DONATIONS AND DISTRIBUTION

DONATIONS OF SMALLPOX VACCINE TO WHO VOLUNTARY FUND FOR HEALTH PROMOTION, SPECIAL ACCOUNT FOR SMALLPOX ERADICATION SINCE 1967 (US$)

Argentina	13 275	India	175 291
Belgium	278 800	Iran	374 000
Brazil	128 925	Jordan	140
Canada	431 076	Kenya	168 000
China	4 000	Netherlands	177 870
Colombia	3 002	New Zealand	10 500
Czechoslovakia	18 800	Peru	3 000
Finland	90 960	Philippines	5 000
France (Institut Pourquier)	1 632	Sweden	281 080
		Switzerland	219 910
German Democratic Republic	26 417	Thailand	3 565
		USA	57 758
Guinea	18 529	*USSR	15 316 681
Hungary	33 500	Yugoslavia	26 000
	26 countries	TOTAL	17 867 711

* USSR includes pledge to be fulfilled by end 1981.

Annex 17

SMALLPOX VACCINE DISTRIBUTION FROM THE SPECIAL ACCOUNT

(000's of doses)

REGION AND COUNTRY	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	TOTAL
AFRICA														
Benin	-	-	-	-	-	-	-	-	-	-	-	672	-	672
Botswana	-	-	-	-	245	445	100	190	194	256	292	220	267	2 209
Burundi	800	200	-	710	758	315	-	250	-	177	-	64	-	3 274
Chad	-	-	-	-	-	-	300	-	-	-	-	360	-	660
Central African Rep.	-	-	-	-	-	-	120	-	-	-	-	224	-	344
Cameroon	-	-	-	-	-	-	300	-	-	-	830	-	-	1 130
Cape Verde	-	-	-	-	-	-	-	-	155	80	64	6	32	337
Comoros	-	-	-	-	-	-	-	-	-	120	100	-	-	220
Congo	-	2 050	-	-	-	-	190	10	-	-	-	424	-	2 674
Equatorial Guinea	-	-	17	-	-	-	-	-	-	-	64	-	-	81
Ethiopia	-	-	-	428	4 323	2 400	1 998	2 523	2 384	5 720	2 568	560	25	22 929
Gabon	-	-	-	-	-	100	65	-	-	-	-	-	-	165
Gambia	-	-	-	-	-	-	-	-	-	-	46	32	-	78
Ghana	-	-	-	-	-	-	-	-	22	10	18	-	-	50
Guinea	1 148	-	-	-	-	-	-	-	-	-	-	-	-	1 148
Guinea-Bissau	-	-	-	-	-	-	-	-	100	-	-	-	-	100
Ivory Coast	-	-	-	-	-	-	5	-	-	-	-	-	-	5
Lesotho	-	-	-	210	70	105	20	-	40	90	152	48	96	831
Liberia	117	-	-	-	-	-	20	-	-	-	-	128	-	265
Malawi	-	807	250	1 050	525	1 000	500	490	1 471	500	610	600	315	8 118
Mali	-	-	-	-	-	-	810	295	-	-	-	320	-	1 425
Mauritania	-	-	-	-	-	90	260	107	80	-	64	224	-	825
Mauritius	-	100	157	35	107	70	105	35	32	32	35	32	55	795
Mozambique	-	-	-	-	-	-	-	-	-	848	1 824	2 344	135	5 151
Niger	-	-	-	-	-	-	-	-	-	675	-	-	-	675
Nigeria	-	-	-	-	-	-	2 010	-	-	-	-	-	-	2 010
Rwanda	-	-	1 049	500	-	112	205	280	204	210	198	624	-	3 382
Sao Tome & Principe	-	-	-	-	-	-	-	-	-	20	-	6	20	46
Sierra Leone	500	250	-	-	-	-	-	-	-	-	-	60	-	810
Swaziland	-	-	-	-	-	-	80	48	-	100	69	64	64	425
Un. Rep. Tanzania	557	-	2 500	2 000	1 490	1 468	820	1 476	1 525	550	2 074	512	-	14 972
Togo	-	-	-	-	-	-	215	-	-	-	-	-	-	215
Uganda	-	1 100	1 751	5 000	1 000	495	500	510	501	263	240	256	-	11 616
Upper Volta	-	-	-	-	-	-	-	-	-	-	1 607	520	10	2 137
Zaire	2 000	2 190	1 505	5 000	11 354	2 000	2 985	2 015	1 000	2 024	1 726	2 024	1 055	36 878
Zambia	360	1 547	2 249	1 900	1 561	1 820	1 700	1 647	1 273	2 000	1 285	1 408	300	19 050
AMERICAS														
Brazil	-	-	-	1 250	-	-	-	-	-	-	-	-	-	1 250
EASTERN MEDITERREAN														
Abu Dhabi	-	-	-	-	35	105	-	-	-	-	-	-	-	140
Afghanistan	698	-	-	-	-	515	-	-	-	192	704	-	-	2 109
Bahrain	-	-	-	-	70	15	-	-	-	-	-	-	-	85
Cyprus	-	-	-	-	-	-	-	-	32	-	-	-	-	32
Dubai	-	-	-	3	35	55	-	-	-	-	-	-	-	93
Djibouti	-	-	-	-	-	-	-	-	-	-	-	100	-	100
Iran	-	-	-	-	2 025	11 144	-	-	-	-	-	-	-	13 169
Iraq	-	-	-	-	-	5 085	-	-	-	-	-	-	493	5 578
Lebanon	1 000	1 000	-	213	1 921	1 388	250	503	-	10	-	60	-	6 345
Oman	-	-	-	-	454	-	65	-	-	-	-	-	95	614
Pakistan	-	620	3 099	10 000	10 000	3 495	9 085	14 246	7 562	5 000	2 016	1 500	1 000	67 623
Dem. Yemen	-	-	-	327	350	-	130	602	-	300	132	96	62	1 999
Saudi Arabia	-	-	-	287	414	-	-	-	-	-	-	-	-	701
Somalia	66	30	35	370	105	622	624	650	608	1 151	3 904	1 524	-	9 689
Sudan	2 000	3 157	2 490	3 500	244	2 088	1 500	490	512	256	640	416	562	17 855
Syrian Arab Rep.	-	-	-	-	-	1 010	-	-	-	-	-	-	-	1 010
Tunisia	-	-	-	200	1 085	560	1 110	600	257	-	-	-	-	3 812
Yemen	250	150	350	245	735	210	245	145	450	-	120	100	64	3 064
UNRWA	-	-	87	280	85	172	-	171	73	116	196	100	107	1 387
EUROPE														
Yugoslavia	-	-	-	-	-	500	-	-	-	-	-	-	-	500
SOUTH-EAST ASIA														
Bangladesh	-	200	-	25	-	648	4 738	11 330	28 401	-	-	-	-	45 342
Burma	3 000	1 575	-	-	-	-	-	-	-	-	-	-	-	4 575
India	1 000	-	-	-	-	-	-	1 606	-	-	-	-	-	2 606
Indonesia	502	2 000	700	300	-	-	-	-	-	-	-	-	-	3 502
Maldives	-	-	-	70	-	-	-	-	-	-	-	-	-	70
Mongolia	-	-	-	-	210	-	125	125	96	128	-	256	200	1 140
Nepal	450	2 900	2 705	700	1 995	5 875	3 330	2 800	-	1 024	2 048	1 024	-	24 851
Sri Lanka	-	-	-	-	-	955	65	468	625	-	-	-	-	2 113
WESTERN PACIFIC														
Democratic Kampuchea	-	1 000	-	-	-	-	-	-	-	-	-	-	-	1 000
New Hebrides	-	-	-	-	-	-	-	-	-	3	-	-	-	3
Lao People's Dem. Rep.	-	-	-	500	1 020	-	-	10	-	-	-	-	-	1 530
Viet-Nam	-	900	17	-	-	-	-	-	-	-	-	-	-	917
TOTAL	14 448	21 776	18 961	35 103	42 216	44 862	34 575	43 622	47 597	21 855	23 626	16 908	4 957	370 506

ANNEX 18

SELECTED BIBLIOGRAPHY OF WHO DOCUMENTS ON SMALLPOX ERADICATION

A. Country reports and reports of the International Commissions for the Certification of Smallpox Eradication

Includes the 79 countries fulfilling special requirements, arranged by year of certification.

Year	Country	Document reference numbers	
		Country report	International Commission report
1973	Argentina	SE/WP/71.25	PAHO/CD.22/19 1973
	Bolivia	SE/WP/71.27	"
	Brazil	SE/WP/71.48	"
	Chile		"
	Colombia	SE/WP/71.27	"
	Ecuador	SE/WP/71.27	"
	French Guyana	SE/WP/71.57	"
	Guyana	SE/WP/71.58	"
	Paraguay	WHO/SE/72.38	"
	Peru	SE/WP/71.27	"
	Suriname	SE/WP/71.56	"
	Uruguay	SE/WP/71.26	"
	Venezuela	SE/WP/71.51	"
1974	Indonesia	**	WHO/SE/74.68
1976	Afghanistan	**	WHO/SE/77.89
	Benin	SE/WP/75.10	AFR/Smallpox/80
	Gambia	SE/WP/75.11	"
	Ghana	SE/WP/75.12	"
	Guinea	SE/WP/75.1	"
	Guinea-Bissau	SE/WP/75.15	"
	Ivory Coast	SE/WP/75.2	"
	Liberia	SE/WP/75.9	"
	Mali	SE/WP/75.3	"
	Mauritania	SE/WP/75.13	"
	Niger	SE/WP/75.14	"
	Nigeria	SE/WP/75.4	"
	Pakistan	**	WHO/SE/77.90
	Senegal	SE/WP/75.5	AFR/Smallpox/80
	Sierra Leone	SE/WP/75.6	"
	Togo	SE/WP/75.7	"
	Upper Volta	SE/WP/75.8	"

**Submitted a series of working papers to International Commissions rather than one single report.

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Year	Country	Document Reference Numbers	
		Country Report	International Commission Report
1977	Bangladesh	SEA/Smallpox/82	SEA/Smallpox/84
	Bhutan	Government document	SEA/Smallpox/80
	Burma	SEA/Smallpox/81	SEA/Smallpox/83
	Burundi	SE/CAC/77.1	AFR/Smallpox/86
	Central African Republic	SE/CAC/77.4	"
	Chad	SE/CAC/77.8	"
	Congo	SE/CAC/77.3	"
	Equatorial Guinea	SE/CAC/77.6	"
	Gabon	SE/CAC/77.5	"
	India	SEA/Smallpox/77	SEA/Smallpox/78
	Malawi	SE/SEAC/78.1A,1B	AFR/Smallpox/87
	Nepal	SME/77.1	SEA/Smallpox/79
	Rwanda	SE/CAC/77.7	AFR/Smallpox/86
	United Republic of Cameroon	SE/CAC/77.2	"
	Zaire	SE/CAC/77.9	"
1978	Bahrain	WHO/SE/78.115	a
	Iran	WHO/SE/78.120	a
	Kuwait	WHO/SE/78.119	a
	Lao P.D.R.	No number	a
	Mozambique	SE/SEAC/78.2A,2B	AFR/Smallpox/87
	Namibia	GC/WP/78.6	a
	Oman	WHO/SE/78.117	a
	Qatar	WHO/SE/78.116	a
	Saudi Arabia	WHO/SE/78.122	a
	Southern Rhodesia	WHO/SE/78.108,110	a
	Sudan	SME/78.13	WHO/SE/79.134
	Syrian Arab Republic	WHO/SE/78.111	WHO/SE/78.126
	Tanzania	SE/SEAC/78.3A,3B	AFR/Smallpox/87
	Thailand	WHO/SE/78.113	a
	Uganda	SE/UGA/78.1A,1B	AFR/Smallpox/88
	United Arab Emirates	WHO/SE/78.118	a
	Viet Nam	WHO/SE/78.133	a
1979	Angola	SE/ANG/79.1A,1B	AFR/Smallpox/89
	Botswana	SE/BLS/79.1A,1B	AFR/Smallpox/90
	China	WHO/SE/79.142	b
	Democratic Kampuchea	No number	b
	Democratic Yemen	WHO/SE/79.136	WHO/SE/79.140
	Djibouti	WHO/SE/79.143	WHO/SE/79.147,150
	Ethiopia	WHO/SE/79.144	WHO/SE/79.148,150
	Iraq	WHO/SE/79.114	WHO/SE/78.127
	Kenya	WHO/SE/79.141	WHO/SE/79.149,150
	Lesotho	SE/BLS/79.1A,1B	AFR/Smallpox/90
	Madagascar	WHO/SE/78.124	b
	Somalia	WHO/SE/79.145	WHO/SE/79.146,150
	South Africa	GC/WP/78.5	b
	Swaziland	SE/BLS/79.1A,1B	AFR/Smallpox/90
	Yemen	WHO/SE/79.138	WHO/SE/79.139

a No International Commission: Global Commission document WHO/SE/78.132 refers.

b No International Commission: Global Commission document WHO/SE/78.132 and/or WHO/SE/79.152 refer.

Annex 18

B. Documents related to the proceedings of the Global Commission

Report of the Consultation on Worldwide Certification of Smallpox Eradication WHO/SE/77.98

Report of the Informal Consultation on Monkeypox, Whitepox and related Poxviruses SME/78.20

Report of the Global Commission for the Certification of Smallpox Eradication First Meeting, 4-7 December 1978 WHO/SE/78.132

Report of the Consultation on the Justification for the Retention and Use of Variola Virus in the Post-Eradication Era WHO/SE/79.135

Report of the Meeting of Officials from Laboratories Retaining Variola Virus and National Control Authorities Concerned WHO/SE/79.137

Report of the Meeting of the Study Group on Orthopoxvirus Research, Atlanta, 26-28 June 1979 SME/79.9

C. WHO Technical Report Series

No. 180, 1959, Requirements for Biological Substances, 5, Requirements for Smallpox Vaccine

No. 283, 1964, WHO Expert Committee on Smallpox, First Report

No. 323, 1966, Requirements for Biological Substances - Smallpox Vaccine

No. 393, 1968, Smallpox Eradication - Report of a WHO Scientific Group

No. 493, 1972, WHO Expert Committee on Smallpox Eradication, Second Report

D. SE/SME Series*

SE/68.2 Rev.1	Instructions for smallpox vaccination with bifurcated needle	
SE/68.3 Rev.2	Methodology of freeze-dried smallpox vaccine production	
SE/68.7	Studies of smallpox vaccination by bifurcated needles in Kenya	LADNYI
SE/68.9	Table for handling of animals during scarification and harvest (specifications)	
SE/69.1	Surveillance-containment operations, principles and operational procedures	
SE/70.1	Present status of vaccination programmes (by country)	
SE/70.3	Present status of vaccination programmes (by country)	
SE/71.2	La vaccination des malades hospitalisés et des nouveau-nés: Contre-indication de la vaccination	RAMACHANDRA RAO
SE/71.3	Production, stockage et emploi du vaccin	HENDERSON
SE/71.4	Matériel et techniques de la vaccination contre la variole	SHAFA
SE/72.1	Clinical smallpox classification and frequency of type of variola major	RAO
SE/72.2	Pattern of transmission. Relative significance of cases of varying severity	RAO
SE/72.3	Incubation period of smallpox	DOWNIE
SE/72.4	A comparison of multiple pressure and scratch techniques in vaccination against smallpox	BENENSON

* These include mainly unpublished papers or findings or those which required quick circulation among the programme staff before publication. They do not constitute official publications.

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SE/72.5	Studies of the bifurcated needle and recommendations for its use	HENDERSON, ARITA & SHAFA
SE/72.6	Epidemiological investigation of a smallpox outbreak in a city reported to be 100% vaccinated	MORRIS, MARTINEZ & DA SILVA
SE/72.7	Teaching exercise - smallpox surveillance	
SE/72.8	Smallpox surveillance in the strategy of global eradication	HENDERSON
SE/72.9	Training seminar on smallpox eradication, Karachi, November 1972 Inauguration of the seminar	HENDERSON
SE/72.10	The global smallpox eradication programme - the final phase	HENDERSON
SE/73.1	Smallpox - present and future	HENDERSON
SE/73.2	Manual of clinical microbiology - smallpox, vaccinia and human monkeypox viruses	NAKANO & BINGHAM
SE/74.1	The 1972 smallpox outbreak in Khulna Municipality, Bangladesh	SOMMER
SME/77.1	The Nepal Smallpox Eradication Programme	SHRESTHA, ROBINSON & FRIEDMAN
SME/77.2	Report of a Workshop Meeting on Safety Measures in Laboratories retaining Variola Virus	
SME/78.1 Rev.1	Operational Guidelines for Smallpox Eradication in Somalia	
SME/78.2	Smallpox facial pockmarks (photos)	
SME/78.3	Plan of action for the SEP in Somalia 1978/1979	
SME/78.6	Methodology for preparation of appropriate data for the 31 countries remaining to be certified free of smallpox	
SME/78.7	Recommendations of the Third Coordination Meeting for Smallpox Eradication, Nairobi, 17-19 April 1978	
SME/78.11	Report on a visit to Ethiopia by Members of the Global Commission for Smallpox Eradication	
SME/78.13	The eradication of smallpox in Sudan	
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ANNEX 19

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* 1. First meeting of the Global Commission for the Certification of Smallpox Eradication, 4-7 Dececember 1978.
2. Second meeting of the Global Commission for the Certification of Smallpox Eradication, 6-9 December 1979.

Annex 19

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