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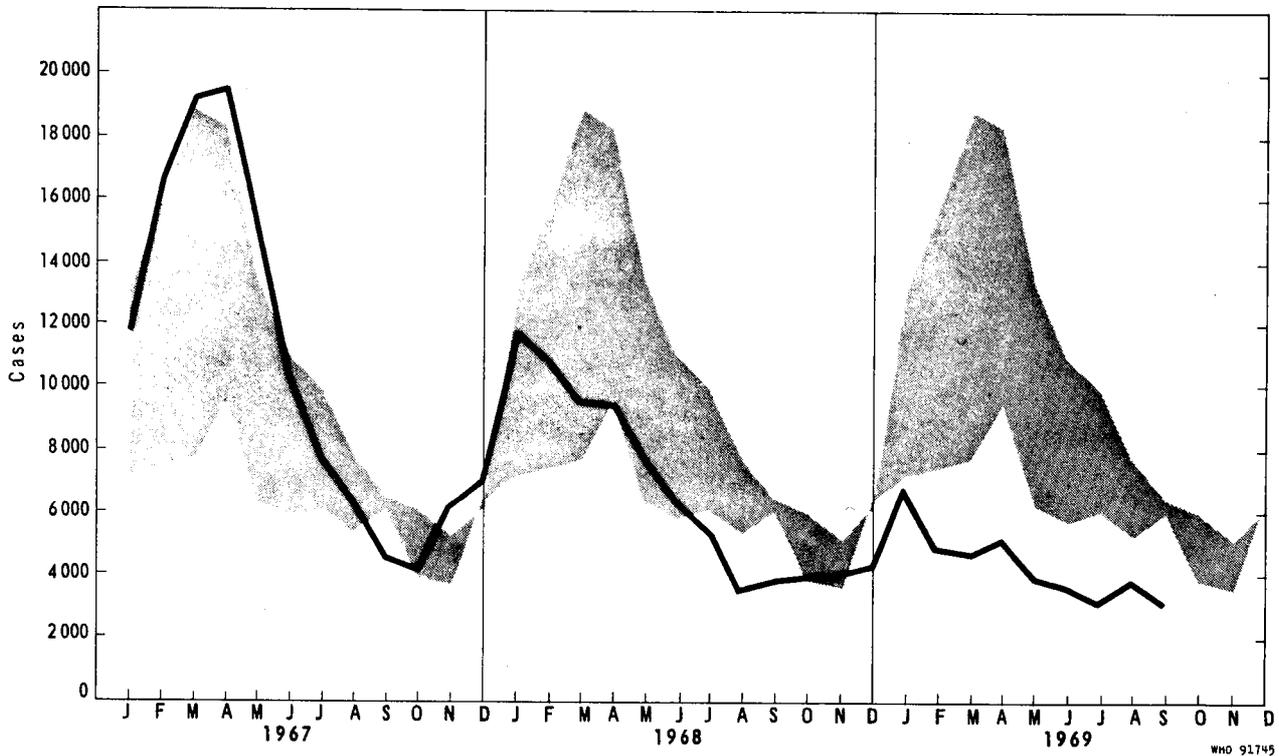
SMALLPOX ERADICATION PROGRAMME

Report of the Director-General

I. Introduction

The intensified programme of smallpox eradication, decided upon by the Nineteenth World Health Assembly,¹ commenced in January 1967 and has now completed its third year. Since 1967, the first year of the programme, smallpox incidence has declined almost 60 per cent. (Fig. 1) and the number of countries recording cases of smallpox has decreased from 43 to 29. In all but two endemic countries, intensive programmes of eradication are now in progress and programmes have been initiated by many countries which are at special risk of introduction of smallpox. These activities have been stimulated particularly by the provision of funds in the Organization's regular budget as well as by contributions to the Special Account for Smallpox Eradication and assistance from bilateral and multilateral agencies.

FIG. 1
 WORLDWIDE SMALLPOX INCIDENCE, 1967-1969



The grey area represents the range between the highest and lowest incidence reported during the five-year period 1962-1966

¹ Resolution WHA19.16, Handbook of Resolutions and Decisions, 10th ed., p. 42.

This report,¹ prepared in accordance with resolution WHA22.34, 4(2), presents the progress of the Smallpox Eradication Programme, its current status and plans for the programme in 1970 and 1971.

TABLE 1. REPORTED SMALLPOX CASES BY CONTINENT, 1962-1969*

Continent	1962	1963	1964	1965	1966	1967	1968	1969 (est.)	1969 to date**
<u>Africa</u>									
North	1	5	-	-	-	-	-	-	-
West-Central	17 034	6 689	3 565	6 257	7 571	10 812	5 407	500	482
South-East	7 542	10 149	9 017	10 683	6 894	4 460	5 544	3 000	2 588
<u>America</u>									
North - Central	1	-	-	-	-	-	-	-	-
South	9 868	7 351	3 705	3 519	3 578	4 376	4 328	8 000	6 254
<u>Asia</u>	63 692	108 405	58 906	91 582	74 284	108 634	64 739	45 000	31 744
<u>Europe</u>	136	129	-	1	62	5	2	-	-
Total	98 274	132 728	75 193	112 042	92 389	128 287	80 020	56 500	41 068

* Smallpox incidence data on this table and the following tables are based on the best information currently available as reported by government sources. Many countries have reviewed their records for previous years and submitted revisions which are reflected in this document and may differ from incidence data in previous reports on smallpox eradication submitted by the Director-General during the past three years.

** Reports received as of 25 November 1969.

II. Smallpox incidence and programme development

The annual incidence of smallpox since 1962, according to information available to the Organization on 25 November 1969, is presented by geographic regions in Table 1. For 1969, numbers of cases reported up to this date are shown, as well as estimates of the final totals for the year. The estimates have taken into account the trends to date as well as expected delays in reporting of cases by some countries.

In 1969 (through 25 November), 41 068 cases have been reported to the Organization. Based on present trends, the final total for 1969 is expected to be about 56 500 cases, the lowest total ever notified. The reduction in case notifications undoubtedly understates the actual magnitude of the decline as reporting has steadily improved since the inception of the programme.

The most marked reduction in incidence has occurred in the countries of west and central Africa which recorded only 10 per cent. as many cases in 1969 as in 1968. Smallpox incidence also declined appreciably in south and east Africa and in Asia. In the Americas, however, the number of recorded cases increased to levels higher than any recorded since 1962. The increase is attributed to the development of an intensive programme of surveillance in Brazil and the detection, through field investigation, of large numbers of cases which would not otherwise have come to notice through routine reporting channels.

¹ The designations employed and the presentation of material in this report do not imply the expression of any opinion whatsoever on the part of the Director-General concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

FIG. 2
SMALLPOX CASES PER 100 000 POPULATION - 1967

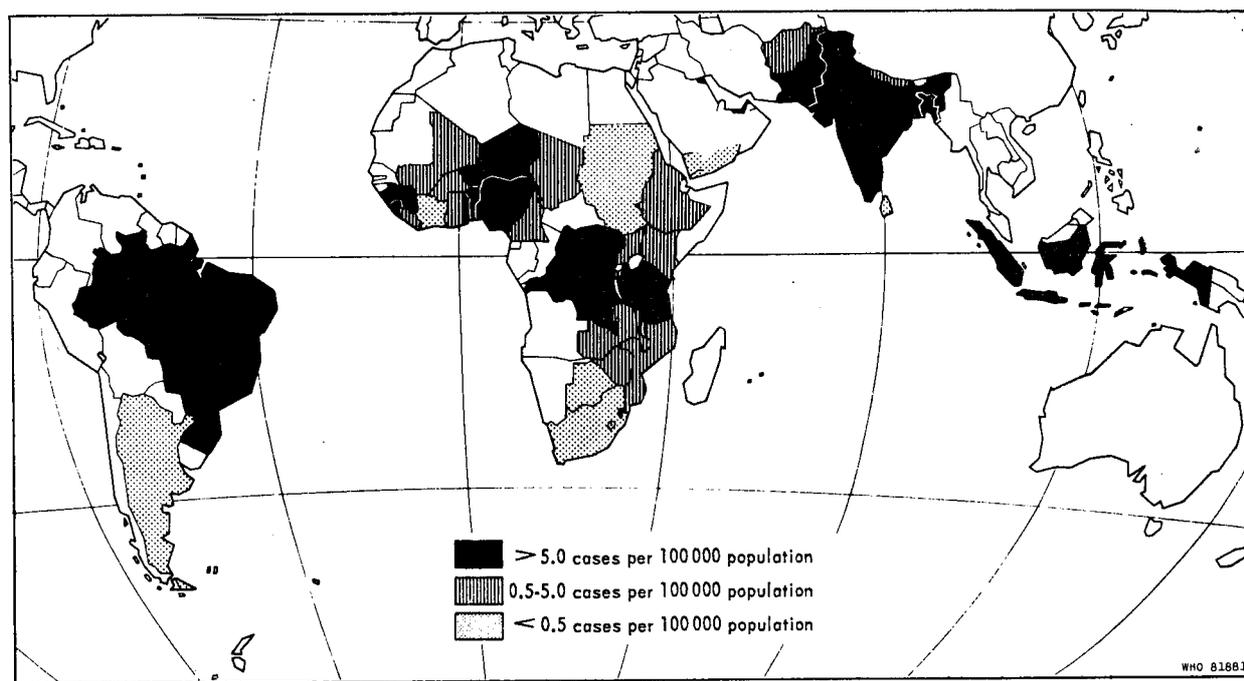
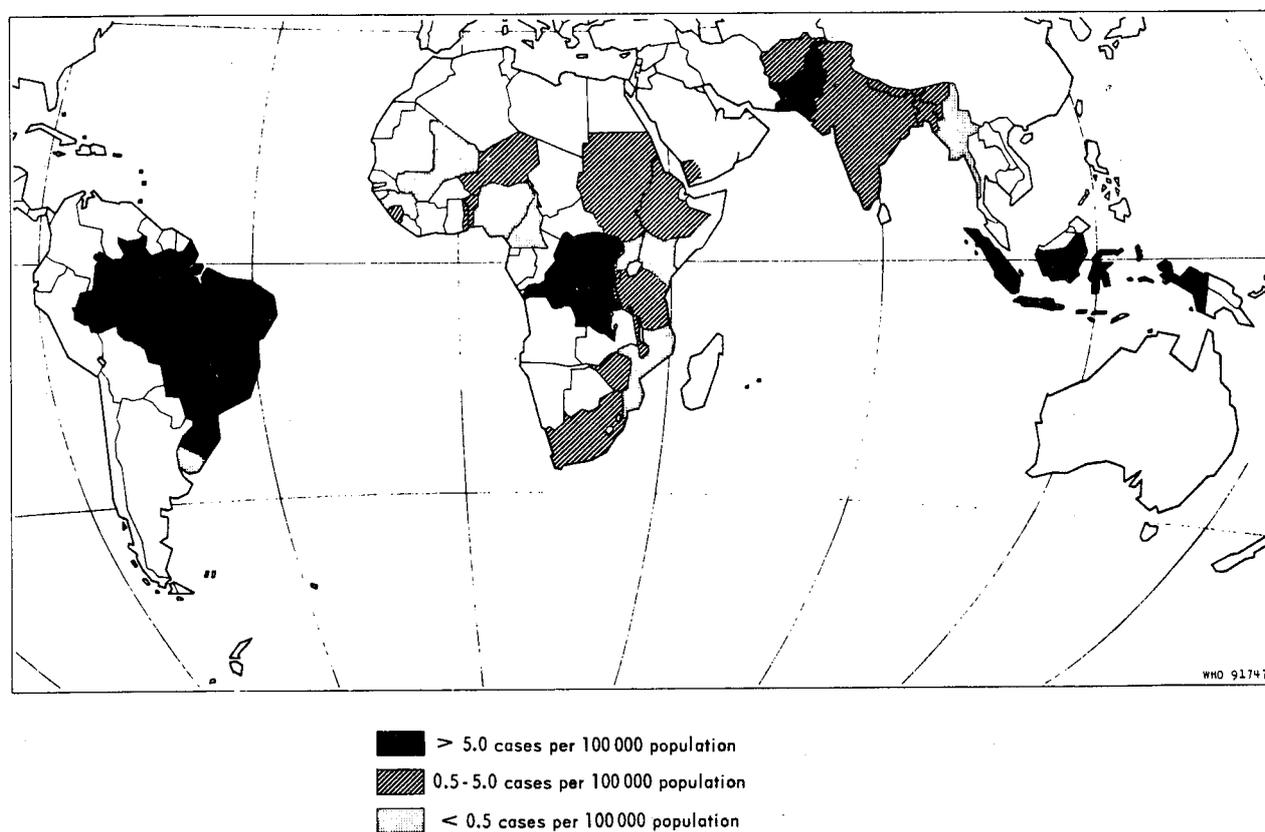


FIG. 3
SMALLPOX CASES PER 100 000 POPULATION - 1969 *



*Projected from data received as of 25 November

Of the 27 countries considered to be endemic at the beginning of 1969, 14 remain in this category. Eight are now considered to be described more accurately as "possibly non-endemic" (Sierra Leone, Guinea, Togo, Niger, Uganda, Kenya, Southern Rhodesia and Mozambique) and five others are now considered to be non-endemic (Zambia, Liberia, Mali, Swaziland and Upper Volta). On the other hand, three countries (Sudan, South Africa and Yemen) which last year were thought to be non-endemic have been categorized with the endemic group on the basis of additional information received this year which suggests that continuing endemic transmission of smallpox is occurring in these countries.

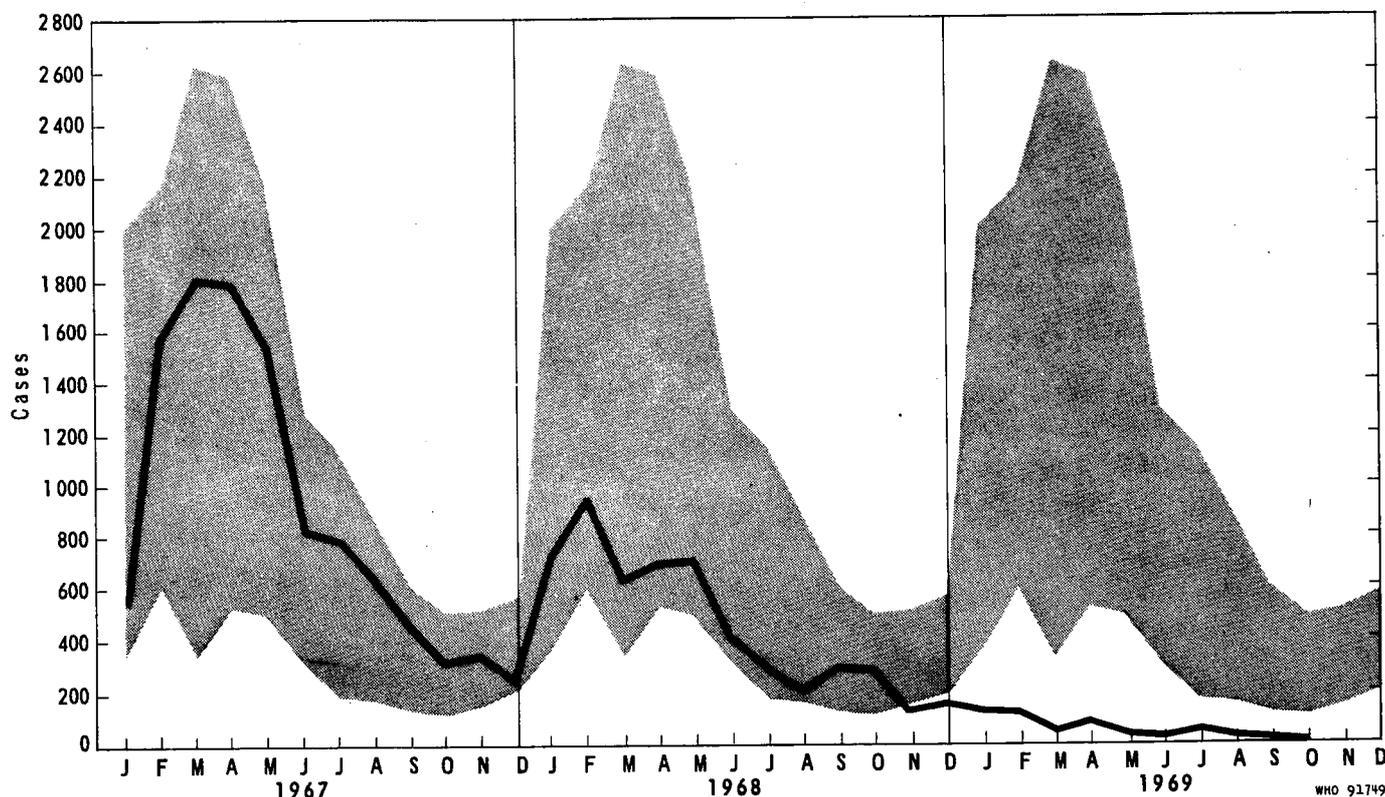
Africa - West and Central (Fig. 5, Table 2)

Smallpox incidence in the 21 countries of west and central Africa declined steadily during 1968 and reached a record low during 1969. The decrease in incidence continued throughout the period when a seasonal peak of cases is normally observed and at a time when all reported cases were being promptly and carefully investigated in an effort to detect all possible cases and foci of infection.

Only two countries, Nigeria and Dahomey, have recorded cases of smallpox since June, despite intensive surveillance throughout all countries in this area. Since the sources of infection for recent cases can be traced to previously known outbreaks, it is now felt that the remaining infected foci, if any, must be few in number and limited in extent.

With special assistance from the United States of America as well as from the Organization, the programme of systematic vaccination is continuing. By early December 1969, over 100 million of the 120 million inhabitants in this area had been vaccinated.

FIG. 5
SMALLPOX INCIDENCE: AFRICA, WEST AND CENTRAL, 1967-1969

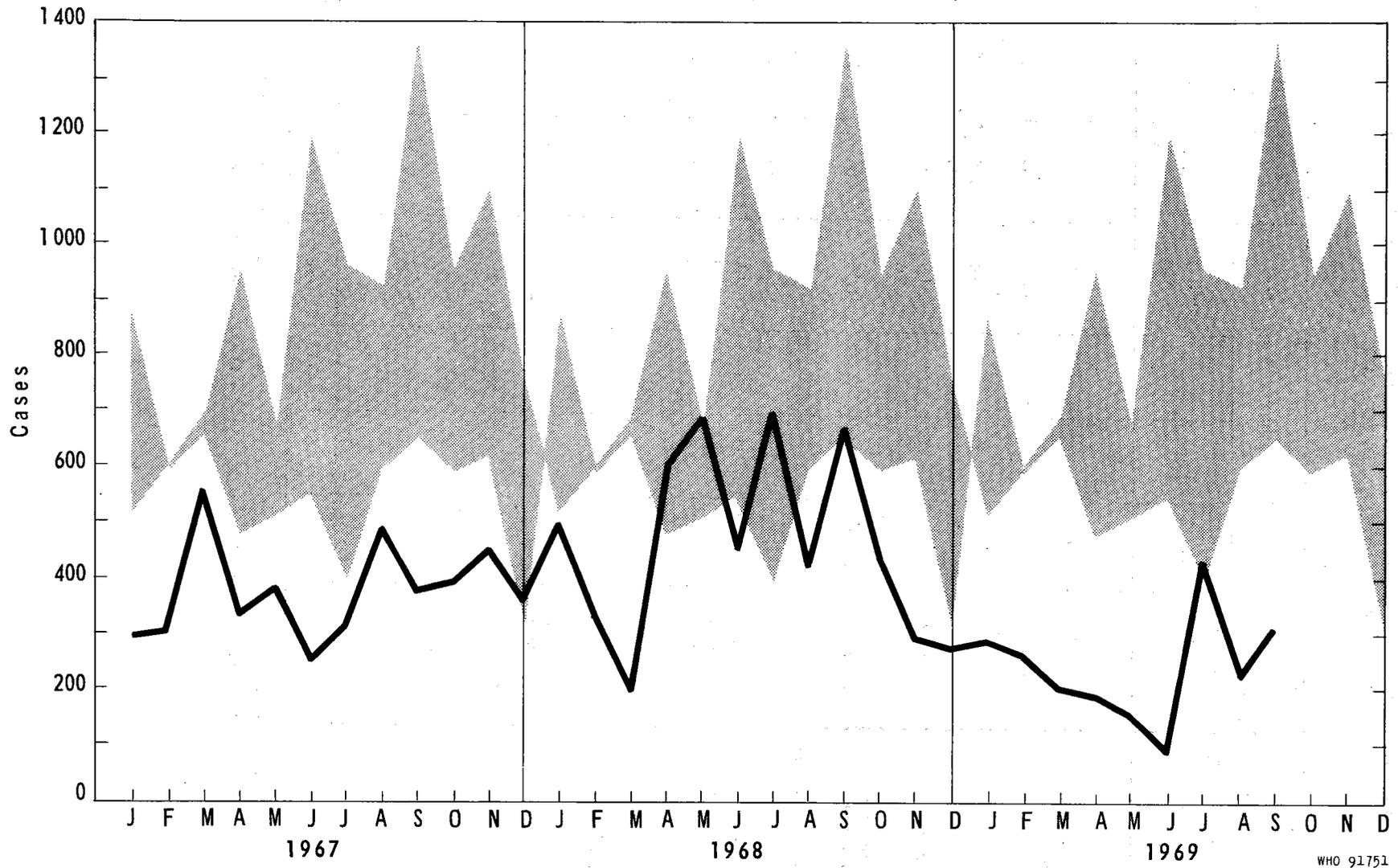


The grey area represents the range between the highest and lowest incidence reported during the five-year period 1962-1966

TABLE 2. AFRICA - WEST AND CENTRAL - SMALLPOX INCIDENCE IN ENDEMIC AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or territory	Population (000) 1969	Smallpox cases reported				Number of vaccinations reported (000)		
		1966	1967	1968	1969 at 25 Nov.	1967	1968	1969 (Jan-Oct.)
<u>Endemic</u>								
Dahomey	2 653	530	813	359	55	702	990	768
Nigeria	64 813	4 924	4 753	1 832	204	9 560	23 494	17 354
<u>Possibly non-endemic</u>								
Guinea	3 890	65	1 530	330	16	1 068	2 063	1 764
Niger	3 740	1 147	1 181	678	28	1 610	1 166	685
Sierra Leone	2 513	293	1 698	1 143	80	-	965	1 026
Togo	1 807	201	332	784	83	605	608	1 036
<u>Other countries reporting cases 1966-1969</u>								
Cameroon	5 713	3	63	87	15			
Chad	3 513	-	86	5	-			
Congo, Republic of	884	2	-	-	-			
Equatorial Guinea	287	1	-	-	-			
Gambia	357	3	-	-	-			
Ghana	8 572	13	114	26	-			
Ivory Coast	4 196	-	2	-	-			
Liberia	1 152	32	6	5	-			
Mali	4 927	281	144	58	1			
Upper Volta	5 258	76	90	100	-			
Total		7 571	10 812	5 407	482			

FIG. 6
SMALLPOX INCIDENCE: AFRICA, EAST AND SOUTH, 1967-1969



WHO 91751

The grey area represents the range between the highest and lowest incidence reported during the five-year period 1962-1966

TABLE 3. AFRICA - EAST AND SOUTH - SMALLPOX INCIDENCE IN ENDEMIC AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or territory	Population (000) 1969	Smallpox cases reported				Number of vaccinations reported (000)		
		1966	1967	1968	1969 at 25 Nov.	1967	1968	1969 (Jan-Sept.)
<u>Endemic</u>								
Burundi	3 475	363	74	270	74			(171) ⁷
Congo (Dem. Rep. of)	18 508	1 914	1 479	3 800	1 692	302	2 849	6 802 ⁶
Ethiopia	24 309	228	466	426	170		1 439	(1 240) ⁶
Malawi	4 339	88	38	61	58	675 ⁶	767	707 ³
Rwanda	3 514	-	-	-	87	(187) ⁶		(214) ³
South Africa	19 643	256	43	81	210	66		
Sudan	15 170	-	9	106	126	825	(2 058) ¹¹	(2 260) ⁶
United Republic of Tanzania	12 889	3 027	1 629	455	104	2 451	2 123	1 630
<u>Possibly non-endemic</u>								
Kenya	10 553	159	153	85	14	1 179	(718) ⁶	648
Mozambique	7 296	19	104	145	11			
Southern Rhodesia	4 815	33	26	12	26			
Uganda	8 335	614	365	55	16	959	660	(124) ³
<u>Other countries reporting cases 1966-1969</u>								
Angola	5 442	3	-	-	-			
Botswana	629	-	1	-	-			
French Territory of the Afars and the Issas	93	52	-	-	-			
Lesotho	937	-	1	-	-			
Somalia	2 844	2	-	-	-			
Swaziland	408	73	25	15	-			
Zambia	4 196	63	47	33	-			
Total		6 894	4 460	5 544	2 588			

Note: Parentheses indicate that information is incomplete for the year - superscript represents the number of months for which information is available.

Africa - East and South (Fig. 6, Table 3)

During 1969, recorded cases of smallpox in east and south Africa declined by half from the number reported in 1968 to reach a record low incidence. Zambia and Swaziland recorded no cases of smallpox in 1969. Kenya, Mozambique, Southern Rhodesia and Uganda, although recording large numbers of cases in past years, reported so few cases at such irregular intervals in 1969 that it appeared that continuing endemic transmission of smallpox may have been interrupted. However, more thorough epidemiological investigations are needed to be certain. In Tanzania and Malawi, endemic smallpox appeared to be confined to a limited geographical area.

Although over half of all the cases in east and south Africa were reported by the Democratic Republic of the Congo, the national eradication programme there is by far the most active of any in the endemic countries of this area. Between the commencement of the programme in March 1968 and October 1969, 7.0 million of the 18.5 million persons were vaccinated by special vaccination teams and 3.6 million additional persons were vaccinated by co-operating health services. At the present time about 900 000 persons are being vaccinated monthly and it is expected that this pace of vaccination will soon be further accelerated. Special efforts have been made to improve the completeness of routine case notifications and plans are being developed to undertake intensified investigation and containment activities.

For the second year in succession, significant outbreaks of smallpox occurred in Sudan coincident with large-scale seasonal movements of agricultural workers from southern Sudan into the central part of the country. Epidemiological data now suggest that there may be continuing endemic transmission of smallpox in the south of Sudan. An eradication programme has begun.

Of the endemic countries in Africa, South Africa and Ethiopia are the only ones who have not yet initiated eradication programmes. The number of cases recorded this year by South Africa more than doubled and cases were recorded throughout the year in Natal, Orange Free State and Transvaal Provinces in the north-eastern part of South Africa. However, little additional information is available. The number of cases reported from Ethiopia is comparatively small but, based on experiences in other countries where health services are limited, it is reasonable to suppose that the actual number of cases occurring annually may be as much as 50 to 100 times higher than the number of cases reported. The continuing reservoir of smallpox in South Africa and Ethiopia is of increasing concern to neighbouring countries, most of whom have become, or are rapidly becoming, smallpox free.

South America (Fig. 7, Table 4)

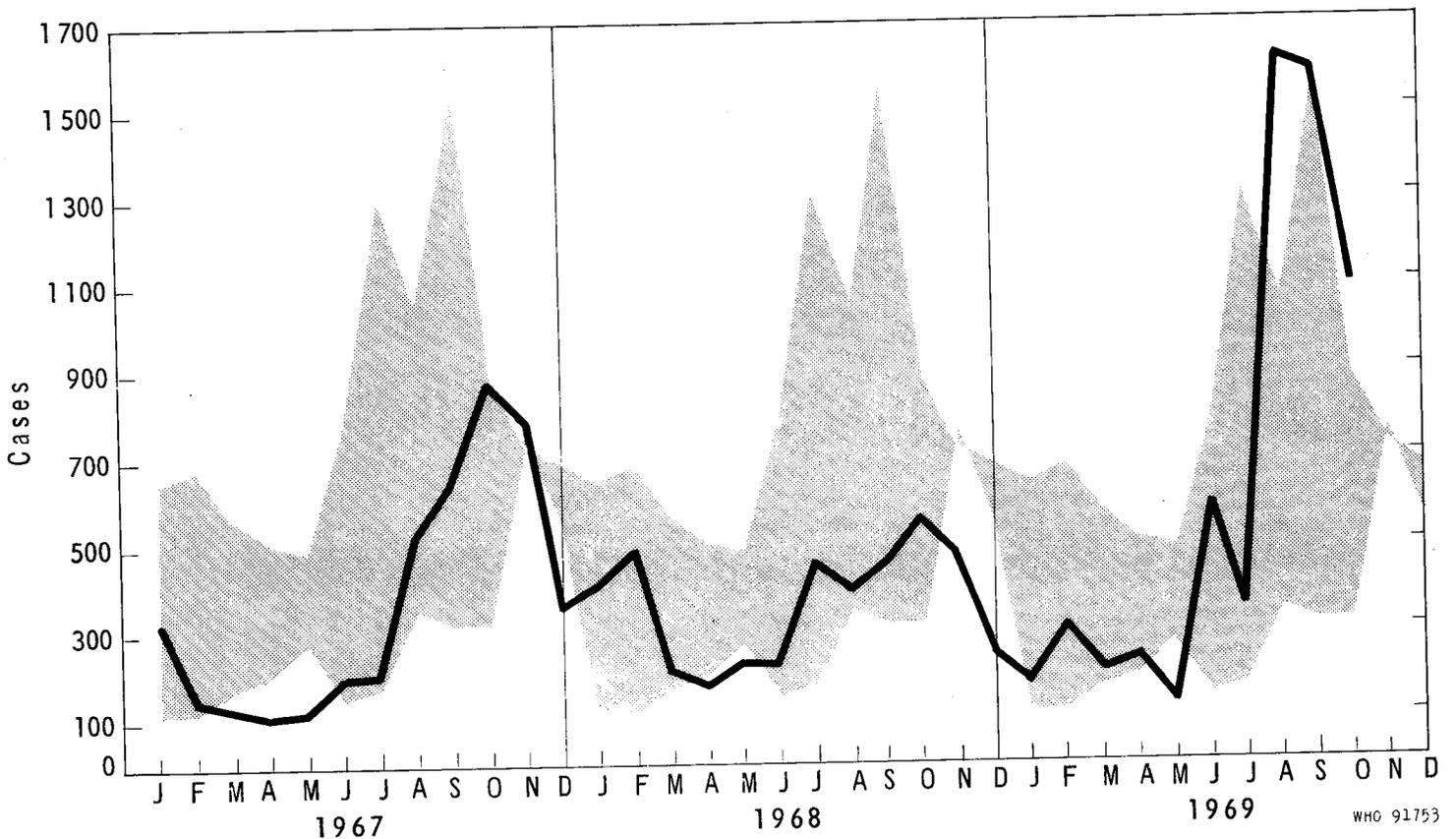
The only smallpox-endemic country in the Americas is Brazil and, except for two imported cases in Uruguay, all cases this year have been reported from Brazil. The eradication programme in Brazil began in 1967 and smallpox incidence declined until June 1969, when there was a sharp increase in reported cases. Through 8 November, 6252 cases had been reported from Brazil which is 73 per cent. higher than the number of cases reported during this same period in 1968. The final total of cases for 1969 will be one of the highest ever recorded in Brazil.

The substantial increase in reported cases is attributed to the initiation of a special programme of surveillance in which full-time surveillance officers have been assigned for duty in each of the major states. In addition to the investigation and containment of outbreaks, the surveillance officers are endeavouring to expand the network of reporting centres. In one of the major states, it has been found that an average of 40 cases of smallpox are found

during investigation for each case officially reported. From these data, it would appear that reporting is less complete in Brazil than in many other endemic countries. It is to be noted, however, that only variola minor is found in Brazil, a form of smallpox which is much less severe than that found in Africa or Asia and which thus may be less likely to be reported to health authorities.

The systematic programme of vaccination continues to progress actively; in 1969 there was an increase of 50 per cent. in the number vaccinated. By the end of the year, over 45 million persons will have been vaccinated in special vaccination programmes and all of the more populous states of Brazil will have either completed or will be actively engaged in such programmes.

FIG. 7
SMALLPOX INCIDENCE: SOUTH AMERICA, 1967-1969



The grey area represents the range between the highest and lowest incidence reported during the five-year period 1962-1966

TABLE 4. SOUTH AMERICA - SMALLPOX INCIDENCE IN ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or territory	Population (000) 1969	Smallpox cases reported				Number of vaccinations reported (000)		
		1966	1967	1968	1969 at 25 Nov.	1967	1968	1969 (Jan-Oct.)
<u>Endemic</u>								
Brazil	90 871	3 531	4 353	4 325	6 252	6 596	12 224	16 771
<u>Other countries recording cases 1966-1969</u>								
Argentina	23 727	21	23	-	-			
Colombia	20 439	8	-	-	-			
French Guiana	40	-	-	1	-			
Paraguay	2 297	5	-	-	-			
Peru	13 165	13	-	-	-			
Uruguay	2 850	-	-	2	2			
Total		3 578	4 376	4 328	6 254			

Asia (Fig. 8, Table 5)

In Asia, smallpox incidence declined by 40 per cent. in 1968 and will probably show a decline of about 30 per cent. in 1969. All countries are engaged in eradication activities but progress differs significantly from one to the next as do the trends in incidence and factors influencing these trends.

The most intensive programme in Asia is being conducted by Indonesia. The programme commenced in July 1968 and has progressively been extended throughout the country. The reported incidence of smallpox in 1969 is little different from that in 1968, presumably as a result of surveillance activities having been greatly intensified. Special teams began work in January 1969 and have steadily broadened the scope and intensity of their activity. The impact of the vaccination programme in reducing reported incidence has thus been balanced by the improvement in notification and case detection. There was no apparent endemic transmission in 1969 in East Java, Jogjakarta and Bali (population 31 300 000). Central Java (population 22 270 000) had virtually ended endemic transmission by the end of the year, and an intensive programme in West Java (population 21 000 000) is expected to be similarly successful within the next six months. Remaining foci in the less densely populated islands of Sumatra, Kalimantan and Sulawesi will be dealt with more intensively as the special programmes in Java and Bali are completed.

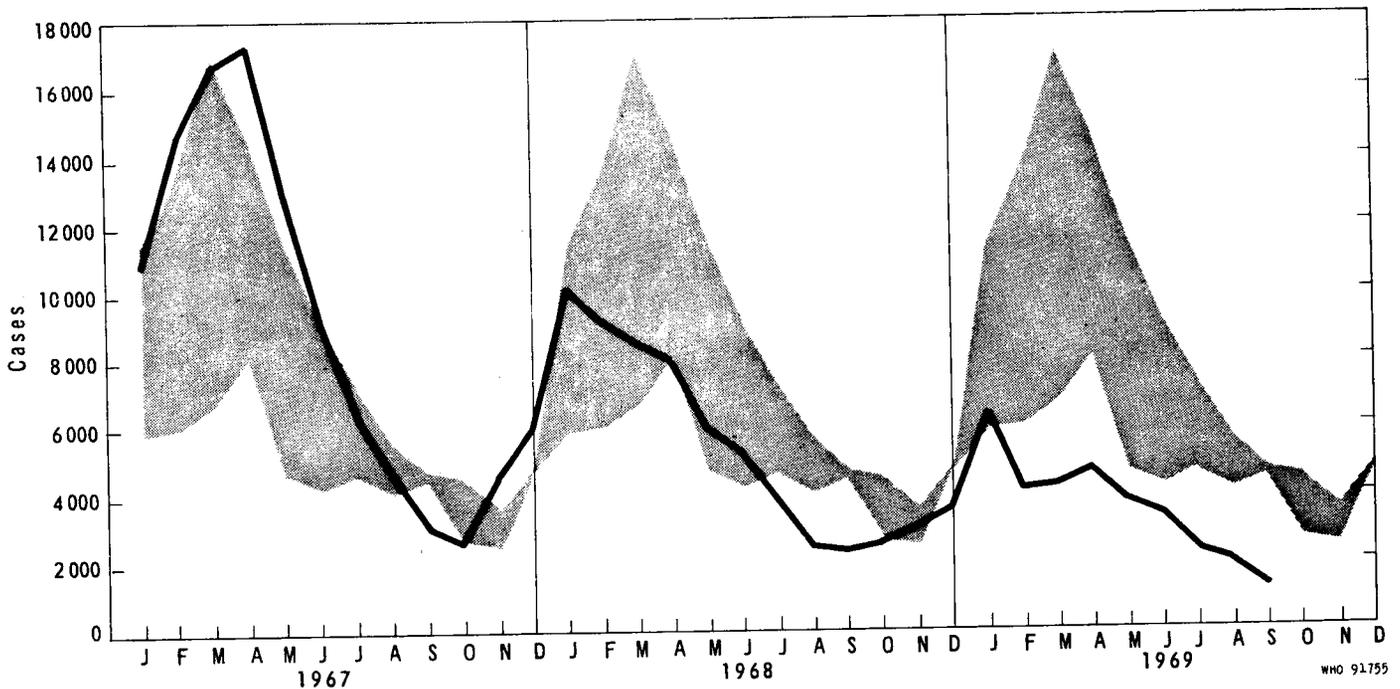
Programmes in Nepal and Afghanistan are now also placing an increased emphasis on surveillance in the context of their developing programmes. Although neither country has yet reached the desired pace of activity in their vaccination programmes, smallpox incidence declined sharply from that recorded in 1968.

Smallpox incidence increased almost twofold in 1969 in West Pakistan, one of the few major areas in which such a substantial increase was observed. Outbreaks occurred concomitantly with epidemics in adjacent states of India. The increase in incidence cannot be

attributed to improved reporting as the programme in West Pakistan is still in its early phases and special surveillance activities were not initiated until mid-year. The eradication programme, however, now appears to be making satisfactory progress. In East Pakistan, smallpox incidence declined sharply following major epidemics in 1968. The decrease in incidence is similar to that observed in previous post-epidemic years. As the eradication programme in East Pakistan has been delayed in its development, it is doubtful that the programme has yet had a significant influence on smallpox morbidity.

In India, smallpox incidence appears to have declined significantly for the second year in succession; however, the magnitude of the decline is similar to that observed during other post-epidemic years. Additionally, reporting is considerably delayed from many states and districts so that it is difficult to be certain of trends for at least six months or longer. Several positive steps in the smallpox programme have been taken, including suspension of the use of liquid vaccine, substitution of the bifurcated needle for the rotary lancet and an emphasis on vaccination of those never previously vaccinated, particularly pre-school children. Notably, in Tamil Nadu (formerly Madras) State (population 39 000 000) only nine cases were recorded during the 12-month period, July 1968 to June 1969; all cases resulted from introductions from other states. Except in Tamil Nadu State, however, reporting is still relatively incomplete and surveillance activities are limited. Based on a national assessment in 1967 by a joint Government of India-WHO team, a plan of operations has been drafted and is now under discussion.

FIG. 8
SMALLPOX INCIDENCE: ASIA, 1967-1969



The grey area represents the range between the highest and lowest incidence reported during the five-year period 1962-1966

TABLE 5. ASIA - SMALLPOX INCIDENCE IN ENDEMIC
AND NEIGHBOURING COUNTRIES AND TERRITORIES

Country or territory	Population (000) 1969	Smallpox cases reported				Number of vaccinations reported (000)		
		1966	1967	1968	1969 at 25 Nov.	1967	1968	1969 (Jan-Aug.)
<u>Endemic</u>								
Afghanistan	16 387	66	334	739	95	880	1 627	726
India	537 115	32 616	82 206	35 165	14 262	87 884	79 682	48 074 ⁶
Indonesia	118 054	35 283	13 478	17 311	13 678	14 702	15 631	(9 177) ⁶
Nepal	10 902	164	96	249	108	280	1 450	2 744
East Pakistan	60 655	3 207	6 377	9 255	976	27 735	34 079	20 717 ⁶
West Pakistan	50 104	2 936	6 084	1 836	2 527	22 681	15 428	(10 437) ⁶
Yemen	4 151	1	3	-	29	119	13	(21) ⁶
<u>Other countries reporting cases 1966-1969</u>								
Burma	26 980	6	-	181	69			
Ceylon	12 359	-	1	-	-			
Kuwait	601	-	41	-	-			
Malaysia	9 738	5	-	-	-			
Trucial Oman	150	-	10	2	-			
Southern Yemen	1 222	-	4	1	-			
Total		74 284	108 634	64 739	31 744			

Note: Parentheses indicate that information is incomplete for the year - superscript represents the number of months for which information is available.

III. General Programme Activities

1. Programme Operation

The technical and operational strategy of the eradication programme was discussed by a scientific group on smallpox eradication which met in October 1967. The report of this group (Technical Report Series No. 393) and a "Handbook for Smallpox Eradication", published in 1967, have been widely distributed. A special supplementary manual which discusses the theory and practice of surveillance-containment operations was prepared and distributed in 1969 and a further manual dealing with programme assessment is planned for 1970. These documents have served as the basis for special seminars dealing with programme execution which were conducted in Bangkok (December 1967) for countries in Asia, in Kinshasa (November 1968) for countries in east and south Africa, in Lagos (May 1969) for countries in west Africa and in Dacca (November 1969) for countries of the Eastern Mediterranean Region.

Increasing recognition of the critical importance of smallpox surveillance in the programme (see section IV) and the comparatively slow development of this phase of the programme in many countries has pointed out the need for special seminars, both international and national, which emphasize this aspect of the programme. A special seminar dealing particularly with surveillance and assessment procedures is planned for the endemic countries of Asia in 1970. Such seminars have already been held in Brazil and plans are being

developed to conduct similar courses in the larger endemic countries such as Pakistan and India. Illustrated problems to assist in the teaching of such courses are now being prepared.

In addition, national programme assessments were conducted during 1969 in Afghanistan, Indonesia, Nepal, Thailand, and Zambia by joint national government-WHO teams. An increased number of assessments is planned for these and other programmes in the years to come.

In 1971, during the fifth year of the programme, it is proposed to convene an Expert Committee on Smallpox Eradication to review the progress and strategy of the programme and to advise on future steps to be taken.

2. Vaccine Supply

Major efforts continue to be made to ensure that freeze-dried vaccine which fully meets WHO standards is used in all programmes in endemic countries and those at particular risk of importation of the disease. With only three known exceptions, freeze-dried vaccine of satisfactory potency, stability and purity is now used in all endemic countries. However, in South Africa, liquid vaccine continues to be employed and in both Brazil and Pakistan, vaccine stability has frequently proved to be unsatisfactory. Through the assistance of consultants, special efforts are being made to improve the vaccine quality both in Brazil and Pakistan.

The service for independent testing of vaccines at the WHO International Reference Centre for Smallpox Vaccine (Rijks Instituut, Netherlands) and at the WHO Regional Reference Centre for Smallpox Vaccine (Connaught Medical Research Laboratories, Toronto) is increasingly widely employed as shown in the table below:

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u> (est.)
Number of samples tested	12	43	83	167	205

During 1970, a regular programme of vaccine testing is planned which will permit the testing every three months of at least two lots of vaccine from each of the production laboratories in endemic countries and those countries at particular risk of smallpox introduction. Such testing will provide additional assurance of the quality of vaccine in routine use. It is recalled that such testing is performed at no expense to the laboratories or the countries concerned.

As previously noted, the vaccine production capacity in the countries conducting eradication programmes does not fully meet programme requirements. There is, and will be, a continuing need for donations of vaccine, especially since many countries do not require sufficient vaccine (12 million doses or more annually) to warrant development of a special vaccine production laboratory of their own. Bilateral donations of vaccine by the USSR of approximately 100 million doses per year, by the United States of America of approximately 40 million doses per year and by Brazil and Argentina of several million doses of vaccine each year, take care of much of the additional requirement. In addition, during 1969, nine countries made donations of vaccine to the Special Account for Smallpox Eradication. The amount of vaccine distributed by WHO through the Special Account is steadily increasing as shown below:

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u> (est.)	<u>1971</u> (est.)
Number of doses distributed (000)	2 290	3 767	13 747	20 861	21 641	33 300	33 500

Based on estimates of need for 1970 and 1971 additional donations of freeze-dried vaccine, in ampoules containing 0.25 ml, will be required.

3. Vaccination Technique

The bifurcated needle (multiple puncture vaccination) and the jet injector have largely replaced older vaccination devices in eradication programmes. A variety of studies have clearly demonstrated that multiple puncture vaccination is superior in efficacy to vaccination by the conventional scratch technique (including that performed by the rotary lancet) and much easier to teach than multiple pressure vaccination. Additionally, when the needles have been introduced, a saving of from two- to threefold in vaccine has been realized in several countries. The speed with which vaccination can be performed with the bifurcated needles was not originally appreciated. In several African countries, vaccinators were able to vaccinate routinely an average of 500 persons per day. In one particularly intensive containment operation in Rwanda, vaccinators averaged over 1000 vaccinations per day during a three-week period. Considering the problems which have been experienced in maintenance and repair of the jet injectors, and the difficulties in most programmes of assembling large numbers of people for vaccination, the bifurcated needles are increasingly being employed as the instrument of choice.

4. Diagnosis of Smallpox

4.1 Clinical Diagnosis

Reliable reporting rests in large measure upon the accurate clinical diagnosis of smallpox. Experience has shown that as smallpox incidence diminishes, the problem of correct clinical diagnosis becomes greater. Many cases of chickenpox (varicella) particularly, are erroneously diagnosed as smallpox. To assist health personnel and others responsible for the reporting of smallpox, the Organization has produced a brochure and a slide series showing pictures of African patients with smallpox and chickenpox at different stages in the evolution of the disease. These have been widely distributed throughout Africa and many additional requests have been received from countries in other parts of the world. During 1970, pictures will also be obtained of smallpox patients in Asia and it is hoped that teaching materials based on these pictures can be made available later in the year.

4.2 Laboratory Diagnosis

When the number of cases in a country is large, laboratory diagnosis of individual cases contributes little, since clinical identification of cases is sufficiently reliable. However, as the cases become few in number each case assumes a greater importance and laboratory confirmation is often necessary. A number of the endemic countries are now recording so few cases that all or most should be confirmed by virus isolation.

A network of diagnostic laboratories to provide geographically convenient diagnostic services to every country is being developed by WHO. It is planned for each participating laboratory to be able to conduct at least three basic examinations for the identification of variola virus: a microscopic smear examination, a precipitation-in-gel test and definitive identification through virus isolation on the chorioallantoic membrane of chick embryos. A manual has been prepared entitled "Guide to the Laboratory Diagnosis of Smallpox" which describes in detail, and pictorially, each of the tests noted. Arrangements have been made with collaborating laboratories to produce requisite antisera; and antigens and additional materials for each of the tests have been procured.

Training courses have already been conducted in the Americas (Rio de Janeiro, 1967, 1968) and a network of 12 diagnostic centres established. Additional courses are planned for the countries of the South-East Asia and Western Pacific Regions in 1970. Following the training courses and the designation of laboratories as diagnostic centres, arrangements will be made to distribute test specimens twice each year to ensure that each of the laboratories has retained its competence or, if not, to assist in retraining the technicians concerned.

5. Research

Principal research efforts are being devoted to the elucidation of patterns of smallpox transmission in the endemic countries (see section IV), to the elaboration of improved diagnostic techniques for smallpox, to the characterization of strains of smallpox and vaccinia, to the development of improved methods for the production of smallpox vaccine both in animal skin and in tissue culture and to the nature of monkeypox and experimental smallpox in simians.

Several studies are in progress which relate to diagnostic techniques for smallpox. These include studies of practical kits for the collection and shipment of specimens, the stability of smallpox virus when collected and preserved by different methods, the use of the precipitation-in-gel technique to differentiate serological responses after smallpox and after vaccination, and the feasibility of a precipitation-in-gel technique to identify varicella antigen in lesions and varicella antibodies in blood.

Strains of smallpox from different geographic areas are being characterized by different methods. Strains of an intermediate type, originally found in one country of East Africa, have now been found in other African countries and in Indonesia. Vaccinia strains are being further characterized in an effort to relate laboratory characteristics to pathogenicity and immunogenicity.

Limited quantities of a rabbit-kidney tissue culture vaccine have now been produced. This vaccine is heat stable and appears to induce a satisfactory response in humans. Further studies of efficacy, safety and economy of production by this method are required. Work with a chick embryo fibroblast tissue culture vaccine is also in progress. A number of studies have been, and are being, conducted with regard to alternative approaches to smallpox vaccine production in animal skin.

Studies of monkeypox virus which is closely related to smallpox virus are being conducted in several laboratories. Additionally, studies are in progress to characterize experimental variola infection in monkeys. All studies of this type have to date indicated that there is no simian or other animal reservoir for smallpox. Foci of naturally-occurring monkeypox are being sought for further study. Studies to date indicate that monkeys can be infected with variola virus but that, on serial transmission, the virus eventually fails to transmit further. No human infections with monkeypox virus have yet been documented.

IV. Methodology of Eradication

On the basis of the experience of the past three years and considering the progress in the eradication programme to date, it would appear desirable in 1970 to take the next logical step in the strategy of the global programme - to establish as an objective that every suspect case of smallpox be investigated immediately on notification by trained investigators, that the source of infection be traced and that containment measures be taken immediately.

In the 1968 Report to the Assembly, it was noted that the experience of the first two years had indicated the urgent need to develop special surveillance-containment activities concomitantly with the systematic vaccination programme. Originally, such an approach had not been considered feasible until the smallpox rate in a given country fell below 5.0 cases per 100 000 population. During the past year, a number of countries have incorporated this strategy into their programmes with highly gratifying results, as briefly described below. Based on present progress, it is quite possible that in 1970 no country will record rates exceeding 5.0 cases per 100 000. In view of the diminished level of smallpox incidence and the experiences of the past year, it is believed that the eradication programme could be considerably accelerated if every country were now to establish as an objective the immediate investigation of every reported case of smallpox by trained investigators, the tracing of the source of infection and the prompt application of effective containment measures.

The experiences of several countries and areas which have fully implemented this approach may be mentioned briefly. In west Africa, two countries, Sierra Leone and Guinea, began smallpox programmes in January 1968. In 1967, both had experienced the highest rates of smallpox, by far, of all countries in the world. Surveillance-containment teams began active operations almost simultaneously with the teams undertaking systematic vaccination. The number of recorded cases of smallpox increased during the first few months as field investigations revealed additional cases which had not been reported through routine reporting channels but soon thereafter incidence declined sharply. In May 1969, only 17 months after the programme commenced, the last cases of smallpox were detected. The systematic vaccination programme which at this time had covered less than 70 per cent. of the population was continued but no further cases were detected by these teams in the course of their village by village visits.

In Indonesia, a similar experience was noted. An assessment of population immunity levels in June 1969 revealed comparable levels of immunity in West Java and East Java, both of which provinces have populations of about 25 million persons. Between January and June, 6752 cases of smallpox had been reported in West Java but only 17 cases in East Java, the latter cases having occurred in two outbreaks following introductions of smallpox. In East Java, every case of smallpox had regularly been regarded as a public health emergency and surveillance teams had promptly investigated and contained all suspect cases and outbreaks; in West Java, such teams had not begun to function. Central Java, which lies between the two, was found during assessment to have, by far, the best level of immunity. However, during the first six months of 1969, 1184 cases were recorded in 14 of 29 regencies. Aggressive case investigation and outbreak containment measures were able to interrupt indigenous transmission of smallpox in a few months' time.

By careful investigation of every case and every outbreak, a far clearer appreciation is obtained of the smallpox situation in a country. The experience in Togo is illustrative. Between January and September 1969, all suspect cases were carefully investigated with results as shown below:

Smallpox cases by month - Togo - 1969

	<u>J</u>	<u>F</u>	<u>M</u>	<u>A</u>	<u>M</u>	<u>J</u>	<u>J</u>	<u>A</u>	<u>S</u>	<u>Total</u>
Number of notified cases	6	6	3	6	1	0	1	1	1	25
Number of cases after investigation	13	6	3	51	9	0	0	0	0	82

On the basis of routine notifications, one would have assumed that smallpox transmission in Togo was continuing at a constant but very low rate and, although not depicted here, in several different parts of the country. Field investigations, however, revealed that some of the cases notified were not smallpox at all but actually were cases of chickenpox, measles and impetigo. On the other hand, certain of the reported cases led to the detection of a number of other cases and outbreaks confined to one part of the country. As the true picture emerged, it became clear that there had been a moderate incidence of endemic smallpox during the first five months of the year but after May, so far as could be determined, the country had become smallpox free. The implications of the two different sets of data are, of course, quite different.

As described previously, the cost of establishing surveillance units in the context of a programme is minimal. Experience has shown that a single unit of two to four persons can investigate an average-sized outbreak within a two- to five-day period and can deal with eight to 10 outbreaks per month. Depending on geography and disease incidence, a single team can cover a population area of two million to as many as 30 million persons. To be effective, however, the teams must be adequately trained and must constitute more than simply a group of vaccinators who indiscriminately vaccinate large numbers of people in infected foci.

Containment action can be most effective when cases are at a seasonal low level in incidence and transmission is poorest. A few cases prevented at this time may prevent a great many cases at a later time when the seasonal increase occurs. Where there are initially too many outbreaks to permit action to be taken immediately with respect to all, experience has shown that as outbreaks are contained, the number of cases and the extent of subsequent outbreaks rapidly diminishes so that soon all can be promptly and effectively dealt with.

Of interest is the experience of a group of nine west African countries in conducting surveillance activities during a three-month period when only a few outbreaks were investigated, and during the subsequent four months when efforts were made to investigate all reported cases:

CASES AND OUTBREAKS DETECTED BEFORE AND AFTER DEVELOPMENT OF
INTENSIVE SURVEILLANCE PROGRAMME - NINE WEST AFRICAN COUNTRIES

	Total cases	No. found by investigation	% found by investigation	No. of outbreaks	Average No. of cases per outbreak
<u>Before intensive programme</u>					
July-September	828	216	26.1	85	9.7
<u>During intensive programme</u>					
October 1968	265	177	66.8	21	12.6
November 1968	215	146	67.9	21	10.2
December 1968	140	80	57.1	17	8.2
January 1969	130	76	58.5	23	5.7

The proportion of all cases which were found during investigations increased abruptly from 26 per cent, in the July-September period to 67 per cent, in October. Despite more complete detection of cases the total number of cases declined steadily from 265 in October to 130 in January and the average size of the outbreaks diminished from 12.6 cases in October to 5.7 in January. Notably, December and January are months when the most marked seasonal increase in cases normally occurs, but during this period, the exact opposite effect was noted. By December 1969, all of these countries were believed to be smallpox free.

The recommendation that effective surveillance units be developed in every endemic country and area does not, of course, imply that systematic programmes of vaccination be terminated. Both components are necessary. However, the objective of the programme is a nil incidence of smallpox and a direct attack on the problem through the surveillance-containment programme is most vital if this objective is to be realized.

It is recommended, therefore, as the next logical step in the strategy of the eradication effort, that beginning in 1970, every suspect case of smallpox, wherever it occurs, be promptly investigated, its source traced, and containment action taken.