

Smallpox, 1961-62.

Contributors

Great Britain. Ministry of Health.

Publication/Creation

London : H.M.S.O., 1963.

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No. 109

SMALLPOX 1961-62

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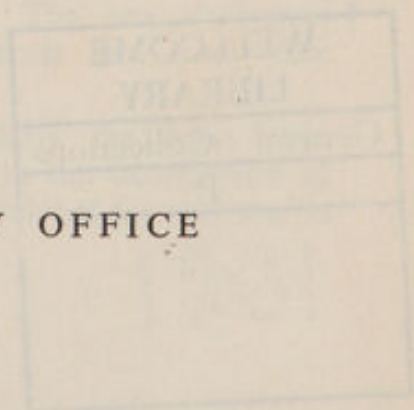
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PREFACE

This report is concerned with the outbreaks of smallpox which occurred in England and Wales between December, 1961 and April, 1962. There were five separate incidents each following arrival in this country by air of a traveller from Karachi who developed smallpox after arrival. Two of these immigrants died from that disease. There was an epidemic of smallpox in Karachi between November, 1961 and February, 1962 at a time when unusually large numbers of immigrants to this country were in transit through the city from other areas. All were required to be vaccinated and the five who subsequently developed smallpox had been properly certified as re-vaccinated. These certificates are given without inspection of the result and none of these patients had evidence that the re-vaccination had been successful. The special measures instituted by the Pakistani authorities in January not only halted the epidemic but also prevented any further case from reaching this country after 12th January. There followed in all 62 indigenous cases—16 in England and 46 in Wales—and of these, 24 died of smallpox.

A special feature of this outbreak was the extent to which it involved the Hospital Services. No less than 40 of the indigenous cases occurred in persons who were hospital patients, either at the time of onset or when infection was thought to have occurred, or were members of hospital staffs.

The traditional methods of field control were once more successfully applied and the disease was at no time loose in the population. It is true that there were four and possibly five examples of infection which seem most likely to have been transmitted to an individual in the community from a smallpox hospital. The occurrence of these individual cases unassociated with contemporary infection among their immediate contacts does not suggest a general diffusion of the infective agent from smallpox hospitals. It does, however, emphasize the importance and the difficulty of controlling the movements of persons and things in contact with smallpox patients.

Particular tribute must be paid to the Medical Officers of Health concerned and to the numerous staff at all levels in public health departments for the untiring efforts they made in applying these control measures; also to the volunteers who staffed the smallpox hospitals, where they cheerfully carried out their duties during a period of strict isolation from the outside world. The amount of work and the responsibility involved can only be understood fully by those who have taken part. The value of the panel of doctors with special experience of smallpox available to medical officers of health to assist in the diagnosis of this disease was again demonstrated and those in the affected areas were much used. The new virological methods gave greatly improved precision in diagnosis and every case diagnosed in life was confirmed by this means.

The Public Health Laboratory Service, particularly the main virus laboratories, provided great assistance in this and in the distribution of vaccine lymph. The Lister Institute must be congratulated for the way in

which the unpredictable demands for smallpox vaccine lymph were met. A generous gift of lymph from the Argentine provided help at a crucial period.

This experience of a smallpox invasion by air routes is in strong contrast to a subsequent importation of smallpox by sea later, in August, 1962. On this occasion, as usually happens in these circumstances, the disease had developed before the ship entered the Port of London. The patient was admitted to a smallpox hospital and the other members of the family, who had occupied the same cabin were allowed to remain there also. Two of these subsequently developed highly modified smallpox. Surveillance of all the passengers and crew from this vessel resulted in no other secondary cases coming to light.

Vaccination, of course, played an important part in control and in the circumstances of the Rhondda and Bradford the public demand is easily understood. But much vaccination was done as a matter of urgency, where no urgency existed. A price, albeit small, has been paid for this in unnecessary illness. The population as a whole has, of course, obtained some advantage from this in increased immunity and assurance of quicker enhancement of that immunity if required in future. Yet mass demands when smallpox occurred reflected a state of public anxiety attributable in part to the neglect of routine vaccination. Smallpox is not yet eradicated from the world; more than 60,000 cases were reported in 1962. Air transport has brought the endemic areas within a day's travel of this country. It is still important, therefore, that parents should secure primary vaccination for their children; and the best time for this, in the view of the Standing Medical Advisory Committee, is in the second year of life.

Information has been contributed to this report by many outside the Ministry and the Welsh Board of Health and the help afforded by Medical Officers of Health, members of the Smallpox Panel, virologists and Senior Administrative Medical Officers is gratefully acknowledged. The main work of preparation has been undertaken within the Department by Dr. Burbridge, with the assistance of Drs. Bradley, Culley and Roden and statistical advice from Dr. Heasman.

G. E. GODBER,
Chief Medical Officer.

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SMALLPOX 1961-62

Summary

Importations

1. During the period 16th December 1961, to 12th January 1962, five travellers from Pakistan arrived in this country by air and subsequently developed variola major within the accepted incubation period of that disease. Two of them died.

2. Each held a valid International Certificate of (re) Vaccination against Smallpox which had been issued and authenticated less than two months before their leaving Pakistan.

3. They had passed through Karachi at a time when smallpox was epidemic in the local population.

4. There is no evidence that they infected any of their fellow travellers; nor that any other infected person arrived here amongst the thousands of immigrants who were crowding in at that time.

5. The five imported cases presented chronologically as follows:

No.	District	Arrival at London Airport	Onset of illness	Smallpox suspected	
1	St. Pancras Met. B. ...	25th Dec.	25th Dec.	28th Dec.	Died 7th Jan.
2	West Bromwich C.B.	19th Dec.	20th Dec.	28th Dec.	
3	Bradford C.B. ...	16th Dec.	?26th Dec.	Never in life	Died 30th Dec.
4	Birmingham C.B. ...	4th Jan.	?8th Jan.	15th Jan.	
5	Cardiff C.B. ...	12th Jan.	13th Jan.	15th Jan.	

Indigenous Cases

6. From 11th January, 1962, indigenous cases began to be recognized. In all there were 62 of these, of whom 25 died. These figures include 2 persons who died of illnesses diagnosed retrospectively as smallpox without laboratory confirmation, and one person, confirmed as a case of smallpox, who died of another cause.

7. No secondary cases arose from the fourth importation; nor can any be directly connected with the first and fifth importations. Following the second importation only a single secondary case occurred—a medical officer of health who had examined him.

8. The third importation, diagnosed retrospectively after death in Bradford Children's Hospital, clearly gave rise to 13 indigenous cases, of whom 5 died of smallpox.

9. The fifth importation, taken ill in Cardiff on 13th January, did not give rise to any secondary cases amongst persons known to have been in contact with him. Nevertheless a substantial outbreak occurred in South Wales in two main waves between 9th February and 15th April which involved 46 indigenous cases, of whom 19 died. It must be assumed that infection was conveyed to the area by the fifth importation.

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22. In fact, the assistance offered him by other sanitary authorities, Local Health Authorities and Regional Hospital Boards, varied in degree and pattern; and this was clearly illustrated recently by reference to the organisations developed in the West Midlands, West Yorkshire, and South Wales. These are discussed in some detail in Section VI.

Hospital Arrangements

23. The fact that a number of first line smallpox hospitals were opened simultaneously drew particular attention to the problems surrounding this provision.

24. Disinfection facilities were a problem in some of the hospitals and where not adequately provided on site the patients on discharge and their effects had to be moved to some distance for final disinfection.

Section I

INTERNATIONAL BACKGROUND AND IMPORTATIONS

During December, 1961, and January, 1962, smallpox reached epidemic proportions in Karachi, which is the only international airport of West Pakistan. It so happened that about this time the number of immigrants from Pakistan to the United Kingdom was continuously large ; and special charter flight arrangements were in vogue to move these people quickly, cheaply and in maximum numbers by air. Consequently some of those wishing to travel are believed to have been delayed in Karachi while being documented and waiting a suitable flight.

Apart from this special situation, the United Kingdom is receiving increasing numbers of passengers by air. In the early nineteen fifties airports were concerned with only hundreds of thousands of passengers each year ; whereas in 1961 more than 100 million passengers used the international routes, and at London Airport there were 6 million passenger movements. International Sanitary Regulations lay down the maximum measures which a country may take in health control at airports, only a few of which are mandatory. Article 83, relating to smallpox, states that the health administration may require anybody from an infected area to produce a certificate of vaccination. If that person has been in an infected area within the previous 14 days and has not been protected, the health administration can require vaccination or surveillance or, under certain conditions, isolation. The International Certificate of Vaccination, to be valid, must comply with the rules ; but, in the case of re-vaccination, this only implies that, at the time under consideration, the operation had been recorded and authenticated without any subsequent examination of the result.

There is a Council of Europe Agreement of 1950 which is designed to cut health formalities to a minimum in order to free movement. There are no health controls for passengers arriving in aircraft which began a flight in any of the Council of Europe Agreement countries. In 1960 just over 2 million passengers arrived at London Airport who were thus free of health control.

In the United Kingdom, with its well developed Public Health Service, we depend for safety largely on surveillance of those who may be at risk. A yellow warning card was designed in 1947 and this is given to each person arriving from areas with endemic smallpox. The onus is placed upon the individual to report to his doctor should he feel unwell and to show him the card. The card is not printed in any of the Asiatic languages.

Of the thousands of Pakistanis who passed through Karachi and travelled by air to the United Kingdom, either direct or after changing flight in Council of Europe Agreement countries, only 5 subsequently developed smallpox. In parenthesis, one might remark upon the good fortune that these did not apparently infect anyone during flight ; for the aircraft, carrying maximum pay-loads, were full and a first generation might well have been infected before arrival, if recent vaccination had been unsuccessful,

and have subsequently dispersed widely over the country before their own, possibly vaccino-modified, smallpox came to light ; or failing to come to light, caused widespread second generation cases.

Table I shows the 5 imported cases in the order in which they were recognized to have been suffering from smallpox, together with dates of arrival, onset of illness and removal from the community.

Table I

<i>District</i>	<i>Date of arrival at London</i>	<i>Onset of illness</i>	<i>Removal from community</i>
1. St. Pancras Met.B....	25th December, 1961	25th December, 1961	28th December, 1961 (died 7th January, 1962)
2. West Bromwich C.B.	19th December, 1961	20th December, 1961	28th December, 1961
3. Bradford C.B. ...	16th December, 1961	?26th December, 1961 or earlier	30th December, 1961 (died unrecognized)
4. Birmingham C.B. ...	4th January, 1962	28th January, 1962	15th January, 1962
5. Cardiff C.B. ...	12th January, 1962	13th January, 1962	16th January, 1962

(Importation No. 3 first came to light with the recognition of secondary cases on 11th January, 1962)

The following paragraphs give brief details of the immediate history and subsequent disposal of each of the five importations.

Importation No. 1

This patient was a young man of 24 years who moved from his village in East Pakistan to Karachi in the latter part of 1961. It is not known how long he spent in Karachi, but, accordingly to his International Certificate of Vaccination, he was re-vaccinated against smallpox on 17th November, 1961. Early on 25th December he emplaned for Europe. During the journey he may well have already entered the prodromal phase of smallpox ; he complained of headache and borrowed aspirins from friends aboard the plane. At Paris he changed aircraft and at this time vomited on the tarmac⁽¹⁾.

He reached London Airport in the early evening of Christmas Day. He travelled to the air terminal by bus and thence to his cousin's apartment in St. Pancras by taxi. By this time he was feverish and had little appetite. He spent the night in a tenement house half a mile away from his cousin's lodgings, together with a number of other Pakistanis—including his uncle. On Boxing Day morning he returned to his cousin's room and spent the day there with his cousin's wife. He was complaining of headache, backache and fever, but, late that evening, he returned once more to the tenement house to sleep.

The next morning, Wednesday, 27th December, he was exhausted and lay on his cousin's bed throughout the day attended by his cousin's wife and clearly a very sick man. He developed a cough and at the same time a rash appeared on his face and limbs. Late that night he was so obviously ill that his cousin and his wife took him by taxi to the casualty department at University College Hospital. The casualty officer suspected smallpox and this suspicion was confirmed by the Medical Officer of Health for St. Pancras, who called in a member of the Panel of Smallpox Consultants.

The clinical diagnosis was agreed and the patient was removed to the Smallpox Hospital at Long Reach, Dartford. This diagnosis was subsequently proven virologically. The illness developed into malignant confluent smallpox, and he died in the early evening of 7th January. There were no marks or scars indicative of successful vaccination in this patient. He was buried in the public cemetery at Dartford on 9th January.

Importation No. 2

This patient was a man, aged 27, who travelled to Karachi during early November, 1961, to await a passage. His passport was issued in Karachi and he was given an International Certificate of (re) Vaccination dated the 28th November, 1961.

He emplaned at Karachi on 18th December and arrived at London Airport direct on 19th December. Here he was met by two fellow countrymen who took him by van to their home in London for the night. On the morning of 20th December he travelled in the same van to Paddington and caught the 12.10 p.m. train to Snow Hill, Birmingham. There he met a fellow Pakistani by chance, and, soon after, took a taxi to a West Bromwich address. He stayed in this house, feeling ill, from 20th December until Christmas Eve, when his rash appeared. That evening another of his countrymen came from Dudley and took the patient back with him to a Dudley address, where he remained over Christmas. On Boxing Day he went to a special cinema show in Darlaston by private car and returned. On the afternoon of 27th December he returned to the original address in West Bromwich.

On 28th December he travelled by bus to a doctor's surgery in Tipton. The doctor called upon the Medical Officer of Health to see the patient and he consulted a member of the Panel of Smallpox Consultants. The diagnosis at this time remained in considerable doubt, and the patient was removed to an infectious disease hospital, although handled there as a case of suspected smallpox from the outset. Specimens were sent to the virus laboratory and on 31st December the preliminary tests were positive. On 1st January, egg culture established a diagnosis of smallpox. The patient was transferred to Witton Smallpox Hospital on 3rd January.

In this case there was clear evidence of previous vaccination though not of its date. (4 scars the size of one shilling on his left arm.) The patient was at no time seriously ill and he recovered uneventfully. The clinical picture may have been greatly modified by his earlier, successful vaccination. He was discharged on 20th January.

Importation No. 3

This patient was a girl, aged 9. Her father had returned to Pakistan from Bradford, where he was already a householder, to bring his wife and the child to England. They stayed in Karachi for approximately two weeks, awaiting a flight to London, and living a normal life—shopping and sight-seeing. On 5th December, 1961, all attended for smallpox vaccination and each was issued (as this was re-vaccination) with a valid International Certificate. On 16th December they travelled from Karachi to Beirut and thence, via Frankfurt, to London, where they arrived at midnight. On 17th December they travelled to Bradford by train.

On 23rd December the child was admitted to Bradford Children's Hospital with symptoms suggestive of malaria. A heavy infestation with *Plasmodium vivax*, mostly at the ring stage, was confirmed by blood film examination. There was a severe microcytic, hypochromic anaemia, with a relative monocytosis and leucopenia. The child appeared to respond to anti-malarial treatment and on 24th, 25th and 26th December had no recorded rise of temperature. On the morning of the 27th a low grade fever developed but this disappeared in the afternoon. On 28th December there was again a minimal rise of temperature. During this time she was apathetic and listless.

On 29th December her temperature rose to 103°F and on 30th December she developed a few petechiae on one side of her face and neck and died.

At post-mortem on 1st January death was attributed to staphylococcal septicaemia and malaria; and staphylococcus albus was grown in blood culture from the heart after death. The child's body was embalmed and placed in a coffin on 3rd January, 1962, by three Pakistanis, and was shipped back to Pakistan by plane.

There is no record that she bore physical evidence of effective vaccination against smallpox. The child's father, who was considered a reliable witness, stated that she had been vaccinated primarily between the ages of 6 and 12 months at a specified hospital in Pakistan. He also said that a few days after re-vaccination on 5th December the child's arm was red but that no crust or scar developed. Both parents bore small scars consistent with successful re-vaccination. It may be that re-vaccination was successfully performed on this child but that this failed to protect her from death following vaccino-modified smallpox, debilitated as she was by the superimposed malarial infection and the severe anaemia secondary to it.

Importation No. 4

This patient was an adult male, aged 30, who travelled from his home in Rawalpindi to Karachi some time before Christmas, 1961. There he was issued with a valid International Certificate of (re) Vaccination against smallpox dated 16th December, 1961.

He left Karachi on 3rd January, 1962, and flew to Frankfurt where he changed planes, arriving in London at approximately 9 o'clock on the morning of 4th January. That day he travelled from London to Birmingham by train and thence to an address at Small Heath by taxi. On the next day he visited the local Labour Exchange but, apart from this excursion, did not leave the house until his subsequent admission to hospital.

On 8th January he ran a temperature and appeared to have a cold. On 12th January his general practitioner diagnosed influenza; but on 14th January he developed a rash, and when the doctor saw him on 15th January this had become maculo-papular, involving his face, trunk and both arms. The practitioner called in the Deputy Medical Officer of Health who in turn asked for the opinion of a member of the Smallpox Panel. He was admitted to Witton Smallpox Hospital as a suspected case of smallpox that day and virological confirmation was received on 19th January.

The patient's rash was heavy on face, back, shoulders and upper arms, but his condition did not give cause for anxiety, and he subsequently recovered and was discharged on 6th February.

There were scars suggestive of successful primary vaccination in this case.

Importation No. 5

This patient was an adult male who travelled from Dacca to Karachi and remained there for two months, awaiting passage to this country. On 27th December, 1961, he was issued with an International Certificate of (re) Vaccination against Smallpox. He left Karachi on 11th January, 1962, by plane for Beirut and there changed planes for London, where he arrived during the night of 11th-12th January. He proceeded by taxi to Birmingham and stayed with a fellow Pakistani. On Saturday, 13th January, he took a bus to the station and thence a train for Cardiff, arriving that evening. He had felt ill during the train journey. He travelled by taxi to a Pakistani restaurant and he did not leave these premises until he was removed to hospital. He occupied an upstairs room and remained in bed during the 14th January. On 15th January he was seen by a general practitioner who called in the Medical Officer of Health for Cardiff. The patient had a high temperature and an influenza-like illness with no rash. He was removed for observation to Lansdowne Isolation Hospital, where he was seen by a member of the Smallpox Panel. This consultant saw him again on 16th January when a maculo-papular rash had appeared. A clinical diagnosis of smallpox was made and he was admitted to Penrhys Smallpox Hospital, Rhondda. This case was virologically confirmed on 21st January. The subsequent development was that of benign confluent variola; he gave cause for considerable concern but eventually recovered. He was discharged from hospital on 6th March.

This patient bore no marks typical of successful primary vaccination but there were two circular scratch marks on the left forearm which were compatible with an attempted vaccination on the date of the certificate.

Enhanced Airport Precautions

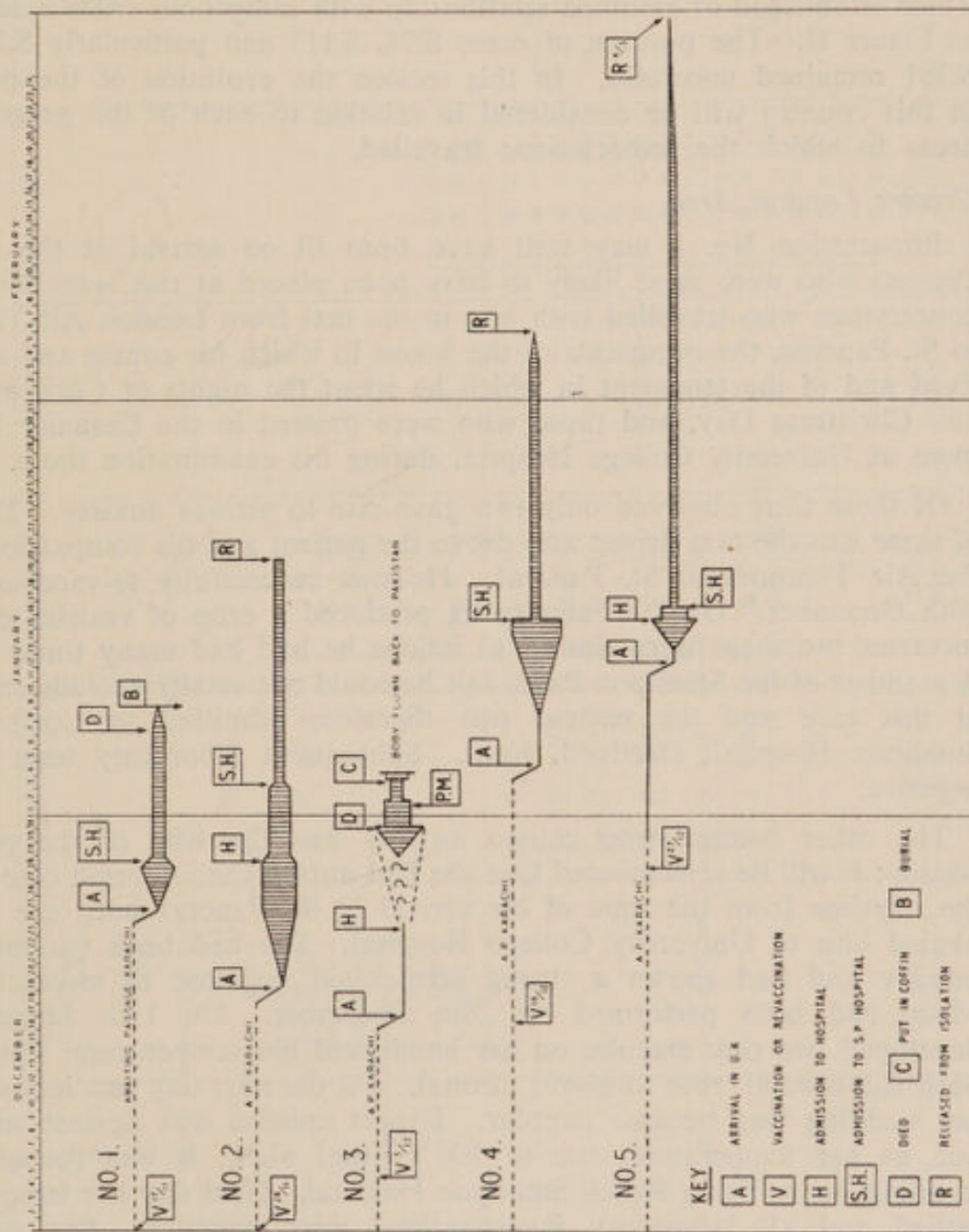
Medical staff at London Airport had been paying special attention to flights from Karachi from the time that they had been told by the Ministry of Health of the first importation, and checking certificates of vaccination before that.

By 12th January it was appreciated that on three separate occasions smallpox had been imported into this country since 16th December. On that day arrangements were made for the immigration authorities to direct all Pakistanis arriving at London Airport, and anyone else who had spent a night in Pakistan during the past 14 days, to the Port Health Authority for surveillance whether they had arrived direct or via a Council of Europe Agreement country. From 16th January, medical officers at airports examined all travellers from Pakistan whether they had valid international certificates or not and vaccinated them unless there was clear evidence of recent successful vaccination. If thus vaccinated these travellers were then isolated until the vaccination proved successful. If vaccination was refused, they were isolated for 14 clear days. The Eastern Hospital and the Isolation Hospital at Denton were used for this purpose.

No further imported cases came to light. At Figure I, the impact of these imported cases upon this country is illustrated.

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FIGURE 1 - IMPORTATIONS



SECTION II

EVOLUTION OF THE OUTBREAK

The five Pakistanis who subsequently developed smallpox after arrival in this country dispersed in the way described in the previous section. Their established or assumed relationship with indigenous cases is indicated at Figure II. The position of cases S.74, S.119 and particularly S.283 and S.381 remained uncertain. In this section the evolution of the outbreak in this country will be considered in relation to each of the geographical areas to which the importations travelled.

Greater London Area

Importation No. 1 may well have been ill on arrival at the airport. Persons who were most likely to have been placed at risk were his fellow countrymen who travelled with him in the taxi from London Air Terminal to St. Pancras, the occupants of the house in which his cousin and his wife lived and of the tenement in which he spent the nights of Christmas Eve and Christmas Day, and those who were present in the Casualty Department at University College Hospital during his examination there.

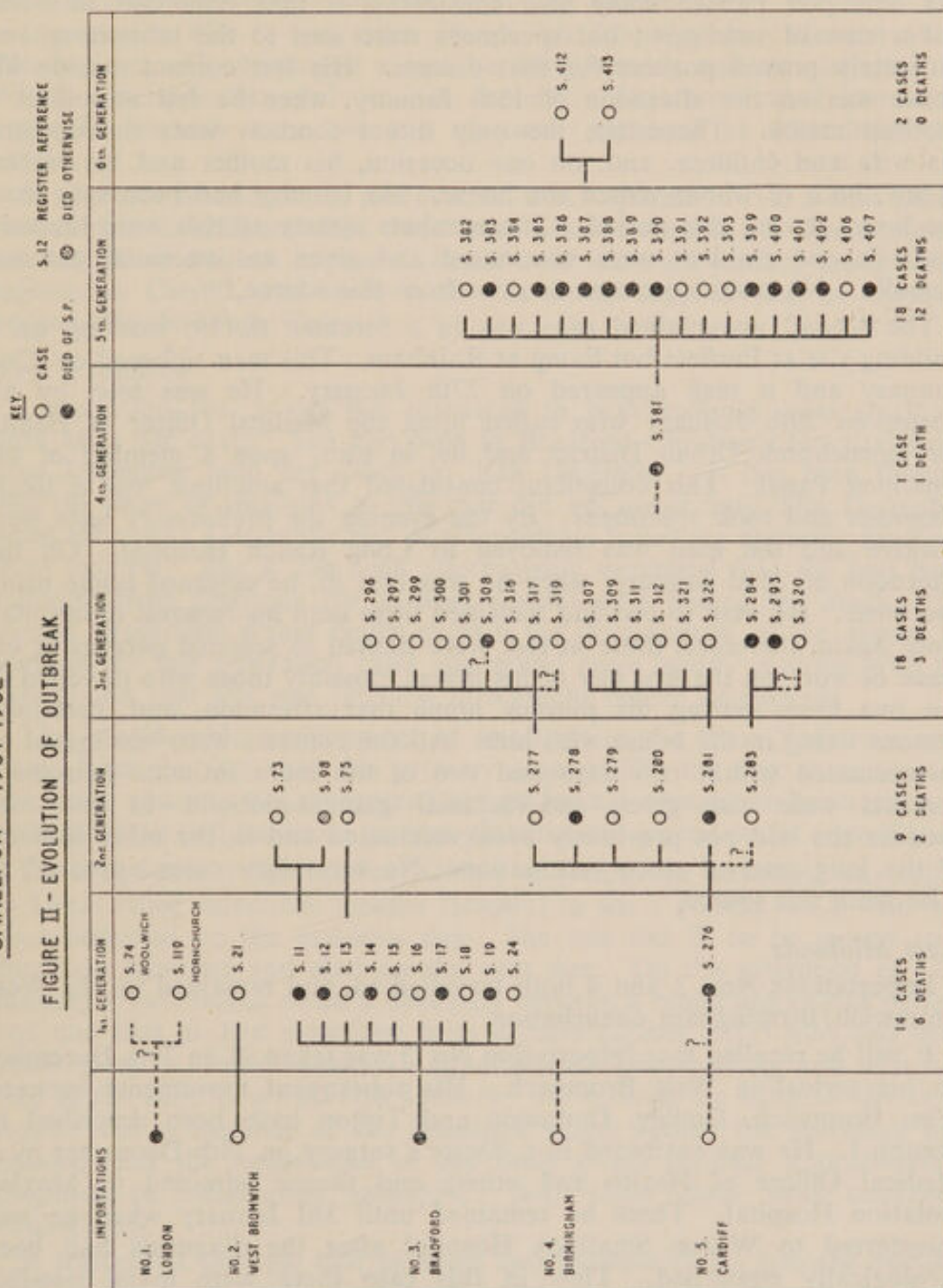
Of those thus observed only two gave rise to serious anxiety. The first of these was the taxi driver who drove the patient and his compatriots from the Air Terminal to St. Pancras. He was successfully re-vaccinated on 30th December. On 7th January he produced a crop of vesicles on both forearms but these were similar to lesions he had had many times before. A member of the Smallpox Panel felt he could not totally exclude smallpox in this case and the patient was therefore admitted to Long Reach Smallpox Hospital, Dartford, Kent. Subsequent laboratory tests proved negative.

The other contact who caused anxiety was the wife of the patient's cousin; it will be remembered that she had nursed the imported case during the daytime from the time of his arrival in St. Pancras until she accompanied him to University College Hospital. She had been vaccinated in infancy and had shown a strong accelerated response to re-vaccination, which had been performed on 28th December. On 11th January she developed two tiny macules on her hands and her temperature, which had been sub-normal, rose to above normal. On the next day one lesion under her wedding ring became papular. Expert opinion was against smallpox but, as her temperature rose to 100°F. that night, it was thought wise to admit her to Long Reach Smallpox Hospital. Next day her temperature settled and all laboratory investigations were negative. She was not notified or recorded as a case of smallpox but the possibility of this being a case of *variola sine eruptione* cannot be absolutely excluded.

Thus there were no notified cases of smallpox directly associated with this importation. However, two unexplained cases arose in the Greater London area during the first three weeks of January. The significance of these is discussed in Section III. The first (S.74) was in an insurance agent living in Woolwich Metropolitan Borough but based, for business

SMALLPOX — 1961-1962

FIGURE II — EVOLUTION OF OUTBREAK



purposes, upon Dartford. He sickened on the afternoon of 13th January and took to his bed on 14th January, where he remained until his admission to Long Reach Smallpox Hospital on 24th January. He was at first believed to be suffering from chickenpox, but doubt arose and, on 21st January, he was seen by the Medical Officer of Health and a member of the Smallpox Panel. They also considered at that time that this was not a case of smallpox; but specimens were sent to the laboratory and ultimately proved positive for that disease. His last contact outside his house was on the afternoon of 13th January, when he felt unwell at a football match. Thereafter, the only direct contacts were the doctors, his wife and children, and, on one occasion, his mother and his father-in-law, both of whom visited the house. No laundry had been sent from the house during this period. The numbers clearly at risk were limited; his wife and children were vaccinated and given anti-vaccinial gamma-globulin. No cases were seen to arise from this source.

The second unexplained case was in a foreman (S.119) working on a building site at Purfleet but living at Rainham. This man sickened on 22nd January and a rash appeared on 27th January. He was seen by his doctor on 29th January who called upon the Medical Officer of Health for Hornchurch Urban District and he, in turn, upon a member of the Smallpox Panel. This consultant considered that smallpox was a likely diagnosis and took specimens. By the evening the preliminary tests were positive and the man was removed to Long Reach Hospital. On the afternoon of 22nd January, when he was first ill, he returned home using two buses. He went to bed and remained there until his removal to hospital. Once again, therefore, those at risk were limited to selected persons at his place of work on the first day of his illness, possibly those who travelled in the two buses during his journey home that afternoon, and, certainly, persons living in the house with him. All the contacts were vaccinated or re-vaccinated within two days and two of the more intimate household contacts were also given anti-vaccinial gamma-globulin—in one case because she had not previously been vaccinated and in the other because of the long interval since vaccination. No secondary cases appeared to arise from this source.

West Midlands

Importations Nos. 2 and 4 both travelled to, and remained in, the West Bromwich/Birmingham conurbation.

It will be recalled that Importation No. 2 was taken ill on 20th December on his arrival in West Bromwich. His subsequent movements between West Bromwich, Dudley, Darlaston and Tipton have been described in Section I. He was examined in a doctor's surgery on 28th December by a Medical Officer of Health and others and thence admitted to Moxley Isolation Hospital. There he remained until 3rd January when he was transferred to Witton Smallpox Hospital after the diagnosis had been virologically confirmed. Thus in this case there were many possible contacts, although the numbers in whom the degree of probable risk justified formal surveillance were relatively few.

Of all these, only one (S.21) was subsequently recognized to have developed smallpox; he was the Medical Officer of Health who had examined the patient on 28th December. This doctor, who was last

vaccinated in 1951, fell sick on 11th January and developed a prodromal rash on 14th January. He was seen by a member of the Smallpox Panel on the evening of 15th January and admitted to Witton Smallpox Hospital. After the onset of his symptoms the only intimate contacts were members of his immediate family and the doctors who examined him. No further cases appeared to arise from this source of infection.

Importation No. 4 was taken ill on 8th January after his arrival in Birmingham. He developed a rash on 14th January and was admitted to Witton Smallpox Hospital on 15th January. The numbers of known or probable contacts were few and no cases appeared to arise from this source.

It might be mentioned, in parentheses, that Importation No. 5 who finally remained in Cardiff, travelled there from London Airport via Birmingham; but his illness did not appear to begin until the train journey from Birmingham to Cardiff, and there is no reason to suppose that he infected anyone outside South Wales.

West Yorkshire

Importation No. 3 was not suspected to have suffered from smallpox until after her death. She had been in Bradford Children's Hospital from 23rd December until her death on 30th December. It has been thought that the onset of smallpox in this case did not occur until 29th December when there was a dramatic rise of temperature following apparent recovery from malaria. But it has been alternatively suggested that she had been suffering from smallpox for at least several days before her death; this second hypothesis would better explain the development of the disease in some of the first generation cases and would more readily conform with the assumption that she was infected in Karachi before emplaning.

The considerable development of smallpox in the West Yorkshire area stems from the fact that this primary case, unlike the first three already discussed, was thus not recognized in time for her contacts to be vaccinated, perhaps given anti-vaccinal gamma-globulin and placed under surveillance.

On 11th January the Medical Officer of Health for Bradford was called to Leeds Road Infectious Disease Hospital to see a patient (S.12) who had been admitted on the previous day. She was too ill to be moved to a Smallpox Hospital and died on the next day. On the afternoon of 11th January a pathologist noted a similarity between a blood film of this patient and one that he had examined from a male patient (S.11) who had been admitted to St. Luke's Hospital, Bradford, on 10th January and who had died in the early hours of 11th January. As a result the Medical Officer of Health and a member of the Smallpox Panel visited the mortuary and decided that the appearance of the body (S.11) justified a presumptive diagnosis of fulminating smallpox. Both these cases were confirmed virologically.

It transpired that the first of these two patients (S.12) was the resident cook at Bradford Children's Hospital and that she had been taken ill on 6th January with headache and backache. On 7th January she took to bed and on 9th January she developed a generalized, bright red scarlatini-form rash. The second patient (S.11) had visited his child who was an in-patient in a side ward adjacent to A.1 Ward at Bradford Children's Hospital.

On 11th January it was then appreciated that 4 children (S.14, S.15, S.16, S.17) under observation in A.1 Ward at Bradford Children's Hospital, who had developed rashes, were likely to be cases of smallpox. A fifth child (S.13) who had been transferred to Wharfedale Children's Hospital, also came under suspicion and they were all immediately transferred to Oakwell Smallpox Hospital. A further suspected case was in a nurse (S.18) on the staff of the Bradford Children's Hospital who had sickened on 8th January and had been transferred to Leeds Road Fever Hospital with a maculo-papular rash on 11th January. She was transferred to Oakwell Isolation Hospital on 12th January.

It had become clear that the primary case was likely to have been the Pakistani child who had died in A.1 Ward on 30th December. And amongst those at particular risk was the unvaccinated pathologist (S.19) who had performed the post mortem examination upon her. He was therefore vaccinated on 11th January but the following evening he became pyrexial and, on the morning of 13th January, was admitted to Oakwell Smallpox Hospital where he died on 23rd January.

Finally, on 13th January, a child (S.24) who had been placed under surveillance, having been discharged from A.1 Ward on 3rd January, was taken ill. She developed a focal rash on 14th January and was admitted to Oakwell Smallpox Hospital.

Thus, between 11th and 13th January, 10 first generation cases of smallpox had been discovered. All of these were virologically confirmed. Two of them were fulminating cases and these, and three others in this generation, subsequently died.

The very considerable control problem set by this situation is considered in Sections V and VI. The formal surveillance of contacts was extended rather beyond the classes for which this is deemed absolutely necessary; reactions to vaccination amongst contacts tended to confuse the issue.

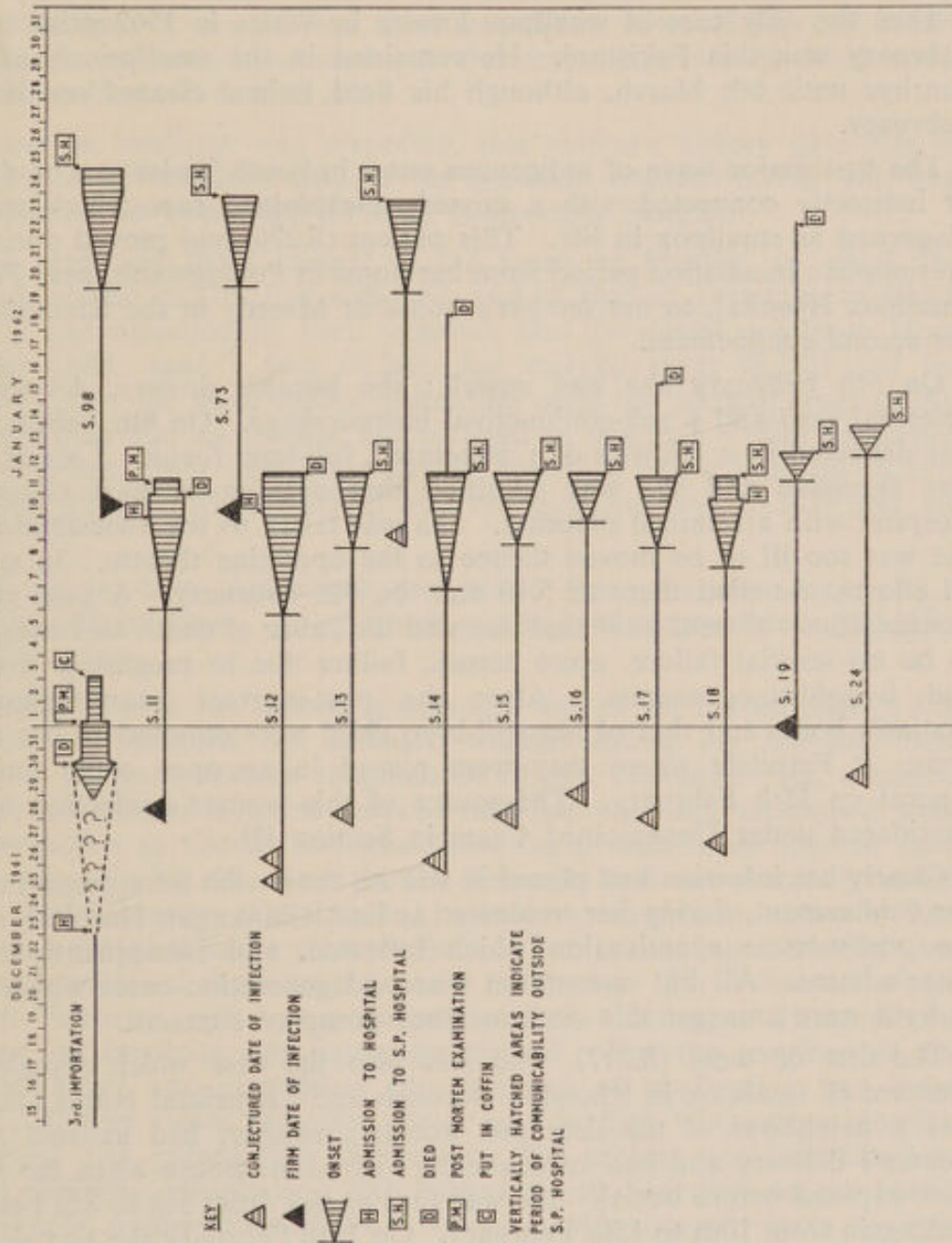
From amongst the hundreds thus observed only three second generations came to light. The first two of these were elderly male patients in the ward of St. Luke's Hospital to which the second fulminating case (S.11) had been admitted just prior to his death. They had been exposed during 10th January and had been successfully vaccinated within 24 hours. The first (S.73) fell sick on 20th January and developed a rash on 23rd January; he was admitted to Oakwell Smallpox Hospital on 24th January. The second (S.98) developed a highly modified rash on 24th January and his date of onset is thought to be 20th January although this cannot be clearly established. He was not embarrassed by this infection; but he was already suffering from a stroke which had caused his admission to hospital, and he died as a result of this on 6th February.

The last second generation case occurred in a boy (S.75) who had been placed under surveillance at Wharfedale Children's Hospital because of his contact with the first generation case (S.13) which had presented there. He had been at risk from 9th to 12th January but had been successfully vaccinated on the last day of this period. His date of onset appeared to be 20th January and a rash appeared on 21st January. He was transferred to Oakwell Smallpox Hospital on 24th January. This child recovered. All three second generation cases were confirmed virologically.

Thus the West Yorkshire incident, including Importation No. 3, comprised 14 cases of smallpox of whom 7 died—6 from smallpox itself. At Figure III the presentation of these cases is shown chronologically.

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FIGURE III — WEST YORKSHIRE OUTBREAK



South Wales

The movements of Importation No. 5, have already been described in Section I. Although he remained indoors at the Pakistani Restaurant from the night of 13th January until his admission to hospital on 15th January his room was entered by a number of persons, both by day and night, and an ill-defined group were thus placed at risk. As far as possible these were all traced and placed under surveillance and in none of them was smallpox observed to develop.

Thus the only case of smallpox known in Wales in 1962 prior to 25th February was this Pakistani. He remained in the smallpox hospital at Penrhys until 6th March, although his final lesions cleared on the 23rd February.

The first major wave of indigenous cases in South Wales can be directly or indirectly connected with a missed, unexplained case which was not diagnosed as smallpox in life. This patient (S.276) had moved during her presumptive incubation period from her home in Pontygwaith, near Penrhys Smallpox Hospital, to her mother's house at Maerdy in the Rhondda* for her second confinement.

On 5th February she was unwell; she became drowsy, developed a petechial rash and a sub-conjunctival haemorrhage. On 8th February she was delivered by a midwife of a macerated, full-term foetus. Loss of blood was excessive and she was admitted that evening to East Glamorgan Hospital with a retained placenta. She was taken to the anaesthetic room but was too ill to be moved thence to the operating theatre. In spite of all efforts, she died there at 5.10 a.m. on 9th February. A post mortem examination was held later that day and the cause of death was considered to be myocardial failure, acute hepatic failure due to pregnancy toxæmia and hypofibrinogenaemia. After the post-mortem examination this woman's body, and that of her still-born child were removed to her sister's house at Ferndale where they were placed in an open coffin until the funeral on 15th February. The source of this woman's infection will be considered under Unexplained Cases in Section III.

Clearly her infection had placed at risk all those who were present during her confinement, during her treatment at East Glamorgan Hospital, during the post-mortem examination which followed, and subsequently at her sister's home. All but one of the 6 second generation cases which came to light were amongst this circumscribed group of contacts.

The first of these (S.277), who was also the case which revealed the presence of smallpox in Rhondda Borough and Llantrisant Rural District†, was a neighbour of the deceased woman's mother, had assisted at the woman's delivery and had subsequently visited the house when the bodies were exposed before burial. She was thus at risk from 5th to 8th February and again from 10th to 15th February. On 16th February she had sickened and on 20th February she developed a maculo-papular rash; she travelled to her mother's home at Edmondstown to be nursed there. The general practitioner was in attendance and he called upon a consultant physician

* Rhondda Borough is 17 miles north-west of Cardiff, which is one of its main shopping centres. The Rhondda comprises of two valleys (Fach and Fawr) and has coal as its main industry.

† Llantrisant is 10 miles north-west of Cardiff.

on two occasions ; but the diagnosis of smallpox was not entertained until 25th February. On this day a member of the Smallpox Panel was invited to see the patient and he suspected smallpox. Specimens were taken and by the evening the preliminary tests were positive for that disease. She was removed to Penrhys Smallpox Hospital on 26th February. This lady infected 7 of her relatives in Edmundstown who appeared as third generation cases. These were her husband (S.296), her father (S.299), and mother (S.300) her brother (S.297) and three sisters (S.301, S.316, S.317). There were also 2 unexplained third generation cases (S.308 and S.319) which can be indirectly associated with this case ; these are discussed under Unexplained Cases in Section III.

As soon as smallpox was suspected, this patient's history gave rise to the suspicion of smallpox also in the deceased woman (S.276) who had been admitted in emergency to East Glamorgan Hospital.

Three others of those present in the house at Maerdy, in which the deceased woman (S.276) had sickened, and in that at Ferndale, to which her body had subsequently been removed, also developed smallpox. These were her child, aged 1 year (S.280), her married sister (S.281) and her brother (S.279). Of these second generation cases her married sister (S.281) ultimately died but, meanwhile, had infected no less than 6 third generation cases—her next door neighbour (S.307) and this lady's husband (S.309), 2 of their children (S.311, S.312) and her own husband (S.322) and son (S.321).

Thus far we have considered the missed first generation case and 4 second generation cases, two of which can be held responsible for 15 third generation cases.

The fifth case in the second generation was in an obstetrician (S.278) who had not attended the deceased woman during life but had been present at her post-mortem examination on 9th February. He, alone, of the East Glamorgan Hospital medical staff had not been vaccinated when the importation in Cardiff had stimulated the protection of hospital staffs in this way. He felt off colour on 21st February and was definitely unwell on the 22nd February. On that day he held an out-patient session at East Glamorgan Hospital and a private clinic at Pontypridd but thereafter went home and remained there until seen by his doctor. He developed a rash on 25th February and was admitted to East Glamorgan Hospital, the diagnosis of smallpox not being entertained. But the member of the Smallpox Panel who established the diagnosis of smallpox in the index case (S.277) was aware that this doctor was in East Glamorgan Hospital and visited him immediately thereafter. The patient was transferred to Penrhys Smallpox Hospital on 26th February and died there on 6th March of malignant confluent smallpox. No cases subsequently came to light which could be attributable to this source of infection.

There is a sixth case which may be of this second generation but cannot readily be directly associated with the deceased woman. This will be discussed further under Unexplained Cases in Section III. However, it should be stated that it was in a child (S.283) who had been admitted to the East Glamorgan Hospital on 6th February for a major operation. His mother was admitted with him and was allowed to remain with him in

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Enquiry elicited the fact that a 75 year old patient, who had been confined to this ward since February, 1961, had died there on 25th March, 1962. On 17th March she had collapsed and the following day had signs of pneumonia. Penicillin had been administered to her and on 20th March she had vomited dark brown fluid and developed a discrete macular rash. This was considered to be allergic in nature as she had reacted similarly to penicillin six to seven months previously. At this time she had a sore throat and great difficulty in swallowing. On 23rd March she became more unwell; on 24th March the rash covered her body, and she had conjunctivitis and ulceration of the tongue. No post-mortem examination was performed and death was certified as due to broncho-pneumonia and myocardial degeneration. In retrospect a diagnosis of smallpox seemed inescapable. This was clearly an unexplained case and as such is discussed under Unexplained Cases in Section III.

A further 10 cases (S.390, S.391, S.392, S.393, S.399, S.400, S.401, S.402, S.406, S.407) came to light by 13th April, and were admitted to Blackmill Smallpox Hospital. All of them may be regarded as fifth generation cases directly infected by the missed (4th generation) case. Of the 18 fifth generation cases, whose ages ranged from 59 to 88, no less than 12 died.

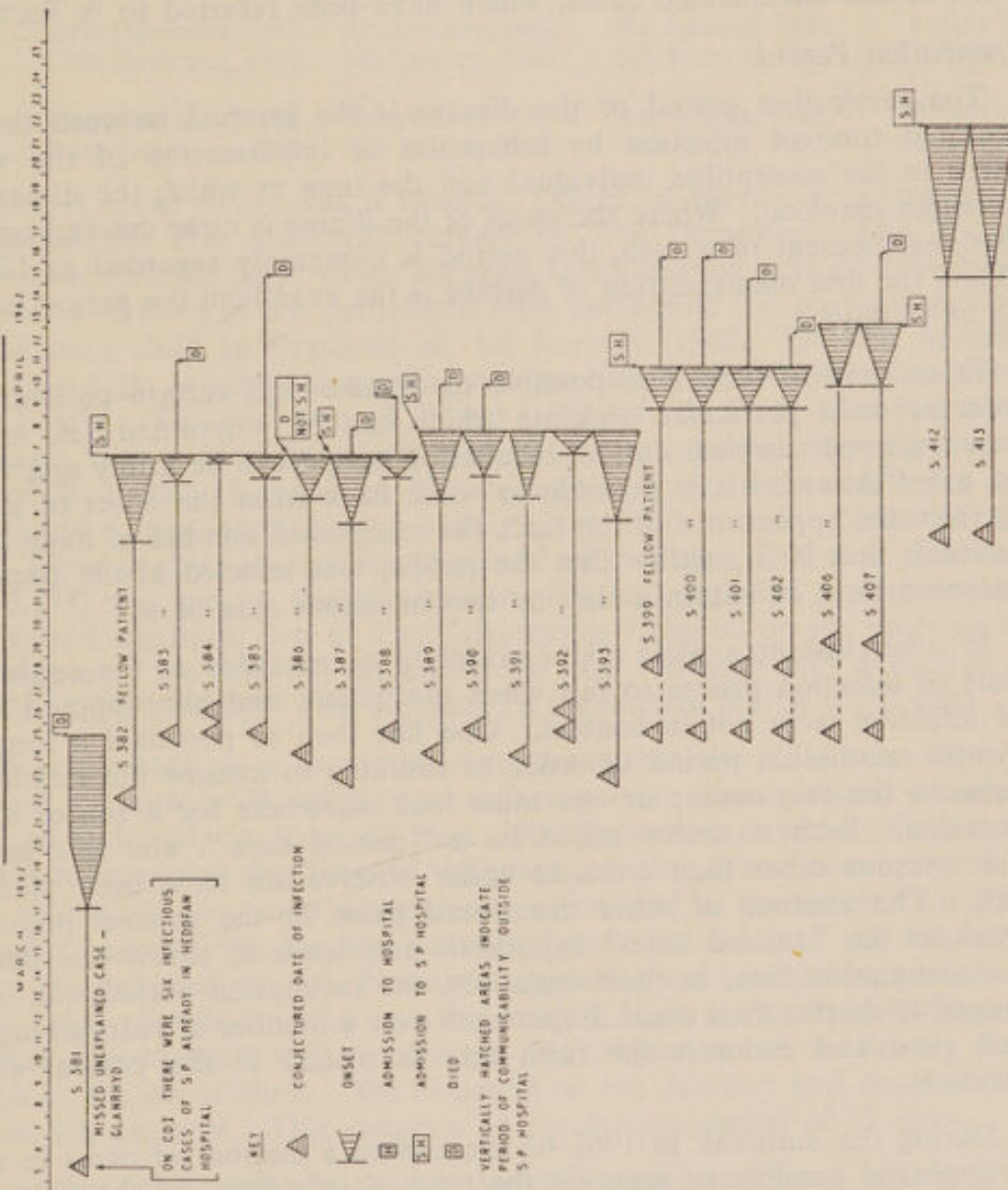
Two further cases (S.412, S.413) occurred in this ward. Their dates of onset have been reported to be 15th April. They were admitted to Blackmill Hospital on 22nd April. Both of these patients were vaccinated on 7th April and one again on 16th April—they developed discrete smallpox and recovered uneventfully. They may be regarded as sixth generation.

Thus of the 45 old ladies, 21 developed smallpox and 13 of these died. The chronological relationship of this group is illustrated at Figure V.

The first indigenous case of smallpox in England and Wales was detected on 11th January, 1962 and the last was admitted to a smallpox hospital on 22nd April, 1962. Surveillance of the contacts of the sixth generation cases was completed by 9th May and the infected local area in South Wales was considered clear of infection by 21st May, 1962.

SMALLPOX - 1961-1962

FIGURE V - SOUTH WALES - SECOND WAVE



SECTION III

SOME EPIDEMIOLOGICAL ASPECTS

The issues to be considered in this section are (a) the incubation period of the disease in the recent series (b) the explanation of the appearance of each of the unexplained cases, which have been referred to in Section II.

Incubation Period

The incubation period of the disease is the interval between the conjectured time of infection by inhalation or implantation of the variola virus in the susceptible individual and the time at which the disease first becomes manifest. Where the onset of the illness is clear cut and precedes the development of a rash, this period is commonly regarded as 12 days. When the first manifestation of disease is the exanthem the period is taken to be 14 days.

From time to time it is possible to assume that certain patients were infected on a particular occasion which can be pinpointed; if, in these cases, the onset is clear cut, an incubation period can be firmly established. In other instances it is possible to work back from the onset of disease, or from the appearance of the rash, the recognized number of days, and to establish that it is *possible* that the patient was infected at the commonly accepted time or within a day or two on either side of it.

In other instances what might normally be regarded as the conjectured time of infection proves to fall when the patient and his supposed source of infection were not in contact. One has then to postulate a longer or shorter incubation period in order to continue to assume the relationship between the two cases; or one must look elsewhere for a source on this occasion. Such a source might be a "missed case", and this suggests that persons other than contacts under observation have been placed at risk. The absence of other discovered cases in the general population weakens the "missed case" hypothesis and tends to throw one back on the assumption that, in these instances, the incubation period was in fact longer or shorter than usual. Experience over a number of years strengthens this view and endorses the faith that is placed in the present control methods.

During the outbreak in 1961-62 there were a number of cases in which it appeared possible to pinpoint the time of infection and the subsequent onset of illness. These are listed in Table II.

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with above, it is not possible to say with certainty when these cases amongst contacts actually incurred their infection. But, in the majority the conjectured date of infection, based on the "normal" incubation period of 12 days, falls at a time when they were known to be in contact with the supposed source.

In the series occurring in Glanrhyd Hospital amongst the elderly ladies, a number developed rashes later than expected if the normal incubation period began before the removal of the "missed case" from the ward. Dates of onset were difficult to elicit. One must accept extended incubation periods or postulate infection from virus unsuspectedly remaining in the ward environment after removal of the patient's body.

Unexplained Cases

An unexplained case is one occurring in a person who has not been established as a contact of a known case of smallpox. As soon as such a case is discovered the patient's history at the conjectured time of infection and for two days on either side is meticulously traced in an effort to establish his relationship with other known cases which were infectious at that time. If no such relationship can be established the disquieting assumption must be made that "missed cases" have occurred in the community and that the population at large has been placed at an unknown risk. This might weaken faith in the established control methods and would certainly lead to a widespread demand for vaccination and an undue strain upon the Public Health Departments at a time when their whole resources are directed towards the surveillance of contacts of established cases. The search for the missed case not only entails the investigation of illness in the patient's contacts at the conjectured time of infection but the perusal of death records in the area to determine whether smallpox may have occurred unsuspected amongst these. If these investigations prove fruitless, no other unexplained cases come to light in the community, and, at the same time, any reasonable possibility of a link can be suggested between this case and an earlier known case, that link *must* be accepted as a working hypothesis and confidence regained. Effort can then be more properly applied to the vaccination and surveillance of those who have come in contact with this "missed case" since he became infectious, in order that further cases amongst persons at known risk can be ascertained at the earliest possible moment.

Woolwich

This patient (S.74) has already been referred to on page 10 in Section II. He sickened on the afternoon of 13th January and his conjectured date of infection was therefore about 1st January, 1962. He was closely interrogated as to his movements around this time by members of the smallpox hospital staff and by two doctors from the Ministry of Health. It is interesting that a detailed story which was built up as a result of this questioning proved, on collateral evidence, to have been displaced by the patient, so that the events he referred to occurred not at the conjectured time of infection but exactly one week before. However, the true story was largely established and the search for a missed case pursued with great vigour. The investigation of deaths in the area gave negative results.

Examples of the hypotheses examined are these. The patient's father-in-law was a window cleaner. He held the contract to clean windows at an Institution in which an elderly patient had been seen in death by a member of the Smallpox Panel who confidently diagnosed chicken-pox. It transpired that the father-in-law had only cleaned the outside of the windows, that the diagnosis of chicken-pox was affirmed and that the father-in-law himself, on careful physical examination, revealed no stigmata of smallpox. Another line of investigation revealed the fact that the ambulance car which had deposited the first imported case at Long Reach on 28th December had, on its return journey through Dartford, passed premises in which it is known that this unexplained case had been at the material time. There is a precedent for thinking that an ambulance car may on rare occasions be the source of infection but this time it points to an incubation period of 16 days to onset, which is possible but unlikely. There remains the fact that during the conjectured period of infection this patient was working in and around the Dartford area not more than $\frac{3}{4}$ mile from the smallpox hospital at Long Reach in which the first imported case was isolated in an infectious condition. This fact on its own might be thought to have little significance; but it should be considered in conjunction with observations made later in this section on certain unexplained cases and their proximity to smallpox hospitals.

Hornchurch

The history of this unexplained case has also been considered in Section II, page 12. His conjectured date of infection was 10th January. The most careful examination failed to connect this case with that which had appeared in Woolwich. In view of the time intervals involved, if it is assumed that both these cases arose from a single missed source in the community then one must also assume that the Woolwich case was infected directly but that a further "missed case" intervened between the first and the Hornchurch case. In this instance, once more, some significance may be attached to the fact that the patient was working, on the conjectured date of infection, as foreman on a building site at Purfleet—immediately adjacent to the northern river bank opposite the site of Long Reach Hospital on the southern bank and not more than $\frac{3}{4}$ mile away; although it is true that the imported case had died on 7th January and had been buried on 9th January.

South Wales

The first unexplained case in South Wales (S.276) is referred to on page 16, Section II. If this woman is to be brought into line with Importation No. 5 when he was ill in Cardiff before his disposal into Penrhys Smallpox Hospital on 16th January, 1962, it is necessary to suppose that a "missed case" interposed, since the conjectured date of infection of the case under consideration was not until 24th January, 1962. A number of theories and rumours arose to connect her directly, or through her husband, with the associates of Importation No. 5, but no substantial evidence was forthcoming. Once again one must draw attention to the fact that, at the conjectured date of infection and before moving to her mother's house for her confinement, she was resident in Pontygwaith in the smaller Rhondda Valley a distance of about half a mile from Penrhys Smallpox Hospital; and that at this time, Importation No. 5 was infectious and isolated there.

At this point it would be appropriate to consider the circumstances in which the unexplained case occurred in Glanrhyd Hospital, which gave rise to the second main wave of the South Wales outbreak. If, as must be assumed, this woman died of smallpox, her conjectured date of infection was around 5th March, 1962. She had been admitted to F.3 Ward of this hospital in February, 1961, and had not left the ward since that time. She had received no personal visitors around the conjectured time of infection nor was there any evidence of infection in the general community at this time; and the surveillance of known contacts of earlier cases was meticulously observed without bringing any cases to light. General practitioners were on the look-out for rashes and, as a result of considerable Press publicity, the public were well aware of the possible significance of unexplained rashes. On the other hand many vaccinations have been done and post-vaccinal rashes were not uncommon; so that it is possible that a modified, transient, ambulant case might have been missed. The fact remains that, at the conjectured time of infection of this lady, six infectious smallpox patients were in the Smallpox Hospital at Heddfan, three quarters of a mile away from F.3 Ward.

Proximity of Smallpox Hospitals

Before considering the other unexplained cases, those already discussed should now be taken as a group in relation to the possible escape of infection from smallpox hospitals. In order to explain the occurrence of these cases in any other way one must in aggregate suppose the existence in the community of at least four "missed cases", which never subsequently came to light. Each of these four "missed cases" must then be supposed to have infected only one other person (in one instance, two persons) although they remained at large and undetected throughout their clinical history. On the other hand, by supposing that the proximity of the four cases to smallpox hospitals at the conjectured time of infection is relevant, we are establishing a single working hypothesis which will cover all instances, and, at the same time, will explain away the absence of other trouble arising from the alleged "missed cases", for these need no longer be supposed to have existed. Infection could escape from a smallpox hospital by the movement of some person or thing from the hospital to a place of contact with the unexplained case and need not cause more than one infection by that contact. It is not necessary to assume a continuing leakage of a diffused infective agent.

It is many years since some experts came to believe that infection appeared to escape from smallpox hospitals. At the turn of the century this occurred to the extent that it was possible to compute rates per 1,000 occupied houses at increasing distances from smallpox hospitals. It has been shown that as the distance increased the rate of infected houses fell off. Much learned discussion (and fruitless argument) centred around the issue. Was this explained by breaches of discipline resulting in infection being conveyed directly by members of the hospital staff? Or, indirectly, through inanimate articles leaving the hospital? Or was it explained by emission of virus into the atmosphere from the hospital? These possible explanations are not susceptible of proof, but it is clear that on each occasion in the present outbreak the infective agent was conveyed to one person only in the area.

Remaining Cases Not Positively Associated by Direct Contact

The first of these was in a child who was operated upon at East Glamorgan Hospital on the morning that an earlier case, (S.276) died there. His story

is given on pages 17/18 of Section II. It is possible that his onset was 14th February when he was mildly unwell. He developed a high temperature and sore throat on the 16th but it must be remembered that his mother sickened on 26th February, having been in close contact with him all the time, and this would place her conjectured date of infection on 14th February. If we suppose that this boy was himself infected before his admission to hospital the conjectured date of infection would thus be 2nd February. At this time it was known that he was to have a very serious operation, and he and his mother went everywhere together until his admission on 6th February. Thus, if he had been infected on 2nd February, it is interesting that his mother, who subsequently proved her susceptibility by catching the infection from her son and dying of smallpox, did not also contract the disease when he did. If, therefore, he was infected before admission to hospital it must have been by someone or something which did not have the same opportunity of infecting his mother and no such intermediary came to light. Furthermore, although he had not been vaccinated and had been submitted to a major operation, he did not succumb to the disease when it developed. One possible explanation for this was that he received 200 millilitres of whole blood before operation and this might have been given by a donor recently vaccinated. This was unlikely because, as far as could be traced, the blood had been given some 3 weeks before by a Cardiff donor. In order to offer a reasonably high level of antibody to vaccinia virus he would have to have been vaccinated some three weeks before giving blood, and this would have been before the Cardiff importation came to light. Indeed investigation suggested that the donor had not been recently vaccinated. We must therefore consider the possibility that this child was infected when he was in the anaesthetic room, in which the woman had died earlier that morning. This would suggest an incubation period of 7 or possibly 5 days. The glandular enlargement which appeared on the boy's neck on the 16th could have been secondary to a primary inoculation lesion on the fauces. The primary vesicle in *variola inoculata* may appear as early as the fifth day and the rise of temperature on the seventh day (2, 3). The secondary rash may appear as early as the ninth day, becoming vesicular by the eleventh day, and pustular by the twelfth day. In the boy's case fever appeared on the fifth day, a rash on the eighth and the rash became pustular on 22nd February, the thirteenth day if infection occurred on 9th February. No lesion of inoculation was seen, of course, but an unobserved faucial lesion is possible. He was presumably infective by the 5th day and he had a generalised vesicular rash on the 9th day after his operation; these intervals are less than those recorded for *variola inoculata*. Though there is a hypothesis which could link the child with the main line of infection and would explain why he was infected before his mother it depends upon acceptance of most unusual time relations in a disease which is normally predictable.

This boy himself must be considered as the possible source of the next unexplained case (S.320). This patient sickened on 5th March and his conjectured date of infection was therefore about 21st February. In fact on 20th February he was awaiting discharge from East Glamorgan Hospital and was in the ward above that in which the boy was still highly infectious with smallpox. There is no reason to suppose he came in contact with a "missed case" after his discharge from hospital and there are a number of theoretical

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in theory, be eliminated if perfect discipline and complete isolation were achieved. The possibility of airborne spread cannot be excluded now any more than in the past, but the occurrence of a series of unexplained cases which are all single infections suggests individual exposures to contact infection rather than the presence of infective particles widely diffused through the atmosphere.

SECTION IV

DIAGNOSIS AND CLASSIFICATION OF CASES

Diagnostic Problems

In the United Kingdom a list ⁽⁴⁾ is maintained of practitioners designated to assist Medical Officers of Health in the diagnosis of smallpox. These experts can only be called upon by the Medical Officer of Health of a district; this is to ensure that the Medical Officer of Health is the first person to be brought in when smallpox is entertained as a diagnosis in any particular case. During normal times, when smallpox is not present in the country, members of this panel are called out, in England alone, some 50 to 60 times a year. During the first 5 months of 1962 no less than 370 consultations were given, apart from those at which smallpox was actually diagnosed. An analysis of the diagnoses made as a result of these consultations is given at Table III.

Table III

Analysis of Diagnoses—Panel of S.P. Opinion—England, 1st January—31st May

Chickenpox	...	...	...	...	...	...	...	...	...	131
Vaccination Reactions	...	...	...	...	...	...	...	...	...	76
Sensitivity Eruptions (including Erythema multiforme)	...	...	...	...	...	...	...	...	...	38
Papular Urticaria	...	...	...	...	...	...	...	...	...	14
Other Skin Conditions (including dermatitis, folliculitis, pityriasis rosea, acne, impetigo, sepsis, scabies, trauma)	...	...	...	...	...	...	...	...	...	34
Influenza, tonsillitis	...	...	...	...	...	...	...	...	...	20
URI (with or without sudamina)	}	...	...	...	...	...	...	...	...	9
Rubella		...	...	...	...	...	...	...	...	
Meningococcal infections	...	...	...	...	...	...	...	...	...	8
Scarlatina	...	...	...	...	...	...	...	...	...	2
Measles	...	...	...	...	...	...	...	...	...	2
Pneumonia	...	...	...	...	...	...	...	...	...	2
Pneumococcal meningitis	...	...	...	...	...	...	...	...	...	1
Lymphocytic meningitis	...	...	...	...	...	...	...	...	...	1
Septicaemia	...	...	...	...	...	...	...	...	...	1
Acute Rheumatism	...	...	...	...	...	...	...	...	...	1
Glandular Fever	...	...	...	...	...	...	...	...	...	1
Echo virus infection	...	...	...	...	...	...	...	...	...	1
"Foot, hand, and mouth disease"	...	...	...	...	...	...	...	...	...	1
Travel sickness	...	...	...	...	...	...	...	...	...	1
Nil or ill-determined	...	...	...	...	...	...	...	...	...	26
										370

Similarly in South Wales the members of the panel available there during the outbreak saw 262 patients, in many cases on more than one occasion.

The importance of general reactions to vaccination as a time consuming and befogging issue is re-emphasized. One member of the panel during the West Yorkshire outbreak was called upon to examine 19 persons not suffering from smallpox, and of these, 15 were suffering from complications of vaccination. Similarly, the difficulty of differentiating confidently on clinical grounds between some cases of chicken-pox and smallpox is clear. One importation, one unexplained case in Woolwich, 5 cases in Bradford,

and 5 cases in South Wales were initially regarded as chicken-pox but were subsequently confirmed virologically as smallpox. This points to the advisability, in areas where smallpox is occurring, of arranging for all cases of chicken-pox observed in adults, or at any age where there are unusual features, to be immediately reported to the Medical Officer of Health concerned. Alternatively chicken-pox can be made locally and temporarily notifiable under Section 147 of Part V of the Public Health Act, 1936.

Classification of Cases

It would seem more appropriate that details of clinical cases seen during the recent outbreak and consideration of their diagnosis and treatment should be discussed in the Medical Journals (⁵, ⁶).

There is no reason to suppose that these cases did not fall within the diagnostic pattern associated with variola major infections.

At Table IV the cases diagnosed during the outbreak are designated as accurately as possible in accordance with Dixon's classification by areas and by generations—and their mortality experience is also shown.

This evidence reaffirms the tendency for the more serious forms of the disease to present in first and second generations; consequently the highest case fatality rates occur at this time also. The second wave in South Wales represents a special situation in which the disease attacked a number of frail, elderly women.

The evidence also underlines the epidemiological importance of fulminating cases, which die rapidly and unsuspectedly of smallpox, and which give rise to a further generation before the disease appears in an easily recognized form.

One physician (⁶) drew particular attention to the fact that the distribution of rash in patients who have been confined to bed from other causes for long periods appears to be modified by the protection of the extremities from normal irritants, and that the lesions are profuse on the buttocks in these patients when they are incontinent of urine or faeces.

The vaccinal state of the patients in relation to their mortality experience and to the severity of their illness is discussed in Section V.

Laboratory Diagnoses

The above observations emphasise the great importance of up-to-date laboratory methods in confirming a clinical diagnosis of smallpox. The chief burden during this outbreak fell upon the virus laboratories at Colindale, Leeds and Cardiff.

Confirmation of the clinical diagnosis was made by the isolation of variola virus on the chorioallantoic membranes of fertile eggs. Characteristic and recognizable pocks appeared after 60 to 72 hours so that a positive or negative report was usually given after this time. In some cases where there was doubt sub-culture of the egg membrane delayed the positive confirmation.

The virologist in charge of the Leeds laboratory established the diagnosis of variola in four fatal cases by culture from samples of liver, skin or blood after death.

Table IV

Cases Classified—(Dixon)

Importations	1st Generation	2nd Generation	3rd Generation	4th Generation	5th Generation	6th Generation
No. 1. Type I(d) (London)	Type VI—2 cases					
No. 2. Type VII (W. Bromwich)	Type VII—1 case					
No. 3. ?Type I(d) (Bradford) (? Type VIII)	Type I—3 cases (3d) Type II—2 cases (2d) Type VI—5 cases	Type VII—3 cases				
No. 4. Type VI (Birmingham)			Type I—2 cases (1d) Type III—2 cases (2d) Type IV—1 case Type VI—2 cases Type VII—6 cases Type VIII—5 cases	?Type I—1 case (d)	Type II—2 cases (2d) Type III—7 cases (5d) Type IV—1 case (1d) Type V—1 case (1d) Type VI—2 cases (2d) Type VII—4 cases (1d) Type VIII—1 case	Type VII—2 cases
No. 5. Type IV <i>Cardiff</i>	Type I—1 case (d)	Type II—2 cases (2d) Type V—1 case Type VI—2 cases Type VII—1 case				

Totals (Indigenous)	Types					
		4 (4d)	2 (2d)	2 (2d)	1 (1d)	2 (2d)
I	I	4	2	2	1	2
II	II	—	—	—	—	7
III	III	—	—	—	—	1
IV	IV	—	—	—	—	1
V	V	—	—	—	—	2
VI	VI	7	2	2	—	4
VII	VII	1	4	6	—	1
VIII	VIII	—	—	5	—	—
IX	IX	—	—	—	—	—
						2

Key

- Type I—fulminating
- Type II—malignant confluent
- Type III—malignant semi confluent
- Type IV—benign confluent
- Type V—benign semi confluent
- Type VI—discrete
- Type VII—mild
- Type VIII—abortive
- Type IX—sine eruptions
- (d) —died

Except for 3 cases in which the diagnosis was only presumed retrospectively on circumstantial evidence, all the cases in the present outbreak were confirmed virologically by means of egg culture.

As well as infectious virus particles, soluble antigenic material is present to a variable extent in the skin lesions of smallpox patients. This antigen is a group component, common to smallpox, vaccinia, cowpox, ectromelia and monkey-pox viruses. When found, it gives a preliminary indication of infection by one of these viruses and, because the first two are the most likely to be encountered in man tests are usually described as positive or negative for vaccinia-variola.

The test used in the recent outbreak for demonstrating this antigen was the *Agar Gel Diffusion Test*. This test is so arranged that the antigen and antiserum can diffuse through agar towards each other. A specific reaction is indicated by the formation of a visible line of precipitate. When adequate test material was available a positive result, distinguishing the pox group of viruses from the viruses of chicken-pox, herpes simplex or other exanthemata was available in some two to six hours. A negative test, which can result from an inadequate specimen, did not exclude a diagnosis of smallpox.

An analysis of the specimens examined by the three named laboratories during the outbreak is shown at Table V.

Table V
Laboratory Examinations
(excluding serological)

(a) Colindale and Leeds, 1st January–31st May

	January	February	March	April	May	Total
Smallpox +ve ...	20	1	—	—	—	21
Vaccinia +ve ...	9	38	18	4	3	72
SP & Vacc —ve ...	92	84	45	30	25	276*
Total ...	121	123	63	34	28	369

* Of this number 39 Agar Gel Diffusion Tests were positive for varicella (chickenpox).

(b) Cardiff

Variola isolated	...	...	56
Vaccinia isolated	...	...	41
No pox isolated	...	...	105
			—
			202
			—

Retrospective serological studies

The Director of the Virus Laboratory at Leeds undertook a series of tests in an attempt to identify infections with variola virus amongst persons who had been in contact with cases of smallpox and who had subsequently developed ill-defined minimal illnesses when they might have expected to present with smallpox. These tests were carried out because it had been shown some years ago that patients who have been infected with smallpox

virus frequently respond with complement fixing antibody to the pox group antigen whereas people who have been vaccinated recently usually have either no complement fixing antibody or only a low titre.

The serological results of these tests showed suggestive evidence that some of the contact illnesses were due to variola virus (*variola sine eruptione*), although attempts to isolate variola virus from the blood and garglings of these patients had been negative.

Illness of Contact

Apart from the minimal illnesses, already discussed, which were experienced by some well vaccinated members of smallpox hospital staffs, others encountered a different form of contact illness. Some eleven days after taking up duties a pyrexial illness developed with headache, nausea and generalized body pain followed two days later by a sensation of tightness in the chest. In some frank bronchitic signs ensued. Characteristic x-ray findings were coarse miliary mottling of the lung fields with fluffy areas of confluence. Bacteriological and virological investigations were negative. Clinical recovery took place in from 4-7 days, but the lung picture cleared more slowly. This is thought to be an allergic reaction.

SECTION V

VACCINAL STATE OF PATIENTS

The vaccinal state of each of the patients in the 1961-62 outbreak, as determined by best available evidence, is presented at Table VI and is related visually to date of onset at Figure 6.

Table VI

Vaccinal States of Indigenous Cases

Serial No.	Age	Sex	Primary Vaccination	Revaccination		Date of onset	Died/ Survived
				(i)	(ii)		
S.11	40	M	?Forces/War	—	—	6.1.62	Died
S.12	49	F	Not vaccinated	—	—	6.1.62	Died
S.13	2½	F	12.1.62	—	—	9.1.62	Survived
S.14	3½	M	Not vaccinated	—	—	7.1.62	Died
S.15	7	M	Not vaccinated	—	—	9.1.62	Survived
S.16	3	F	10.1.62	—	—	10.1.62	Survived
S.17	2	M	Not vaccinated	—	—	9.1.62	Died
S.18	18	F	12.1.62	—	—	8.1.62	Survived
S.19	37	M	11.1.62	—	—	12.1.62	Died
S.21	61	M	Infancy	1933	1951	11.1.62	Survived
S.24	2	F	13.1.62	—	—	13.1.62	Survived
S.73	77	M	11.1.62	—	—	20.1.62	Survived
S.74	38	M	Infancy	1944	—	13.1.62	Survived
S.75	11	M	12.1.62	—	—	20.1.62	Survived
S.98	63	M	11.1.62	—	—	20.1.62	Survived (Died later)
S.119	49	M	Infancy	—	—	22.1.62	Survived
S.276	23	F	Not vaccinated	—	—	5.2.62	Died
S.277	24	F	Not vaccinated	—	—	16.2.62	Survived
S.278	58	M	Not vaccinated	—	—	21.2.62	Died
S.279	20	M	Not vaccinated	—	—	19.2.62	Survived
S.280	1	M	Not vaccinated	—	—	23.2.62	Survived
S.281	28	F	Not vaccinated	—	—	22.2.62	Died
S.283	4½	M	Not vaccinated	—	—	16.2.62	Survived
S.284	44	F	26.2.62	—	—	26.2.62	Died
S.293	9/12	F	27.2.62	—	—	4.3.62	Died
S.296	22	M	25.2.62	—	—	5.3.62	Survived
S.297	15	M	25.2.62	—	—	5.3.62	Survived
S.299	49	M	Infancy	1947	25.2.62	6.3.62	Survived
S.300	44	F	Infancy	25.2.62	—	5.3.62	Survived
S.301	23	F	25.2.62	—	—	4.3.62	Survived
S.307	42	F	27.2.62	—	—	6.3.62	Survived
S.308	49	M	2.3.62	—	—	6.3.62	Died
S.309	47	M	Infancy	1939	26.2.62	9.3.62	Survived
S.311	15	F	3.2.62	—	—	9.3.62	Survived
S.312	14	M	26.2.62	—	—	9.3.62	Survived
S.316	17	F	26.2.62	—	—	7.3.62	Survived
S.317	19	F	26.2.62	—	—	7.3.62	Survived
S.319	81	F	Infancy	1.3.62	—	6.3.62	Survived
S.320	50	M	26.2.62	—	—	5.3.62	Survived
S.321	8	M	5.2.62	—	—	9.3.62	Survived

Table VI—continued

Serial No.	Age	Sex	Primary Vaccination	Revaccination		Date of onset	Died/ Survived
				(i)	(ii)		
S.322	29	M	1951	26.2.62	—	9.3.62	Survived
S.381	75	F	No evidence	—	—	17.3.62	Died
S.382	74	F	Infancy	—	—	3.4.62	Survived
S.383	84	F	Infancy	—	—	6.4.62	Died
S.384	76	F	Infancy	—	—	3.4.62	Survived
S.385	67	F	Not vaccinated	—	—	6.4.62	Died
S.386	53	F	?Infancy	—	—	4.4.62	Died
S.387	89	F	Not vaccinated	—	—	4.4.62	Died
S.388	74	F	Not vaccinated	—	—	6.4.62	Died
S.389	76	F	Not vaccinated	—	—	5.4.62	Died
S.390	65	F	Not vaccinated	—	—	6.4.62	Died
S.391	71	F	Infancy	7.4.62	—	5.4.62	Survived
S.392	77	F	Infancy	7.4.62	—	7.4.62	Survived
S.393	73	F	Infancy	7.4.62	—	7.4.62	Survived
S.399	74	F	Infancy	7.4.62	—	9.4.62	Died
S.400	76	F	Infancy	7.4.62	—	9.4.62	Died
S.401	86	F	7.4.62	—	—	9.4.62	Died
S.402	59	F	Infancy	7.4.62	—	9.4.62	Died
S.406	83	F	Infancy	7.4.62	—	10.4.62	Survived
S.407	88	F	Infancy	7.4.62	—	10.4.62	Died
S.412	62	F	Infancy	7.4.62	16.4.62	15.4.62	Survived
S.413	61	F	7.4.62	—	—	15.4.62	Survived

Mortality Experience

On studying Figure 6 it would appear that survival is correlated with vaccination performed prior to the last few days of the incubation period. Table VII shows the fatal and non-fatal cases according to whether there had been any record of vaccination or revaccination carried out on or at any time prior to the sixth day before the onset of disease.

Table VII

	Died	Survived	Total	Fatality Rate
Record of vaccination on or prior to sixth day before onset	5	29	34	15%
No such record	16	9	25	64%
Uncertain	3	—	3	—
Total	24	38	62	—

For statistical purposes the three uncertain cases which died are assumed to have been vaccinated. There is a highly significant difference in favour of vaccination exerting an ameliorating effect on the disease in the circumstances described. This is the more impressive because of the unfavourable inclusion of the 3 uncertain cases. It should also be mentioned that the 5 deaths in the vaccinated group were all in old ladies primarily vaccinated in infancy.

SMALLPOX - 1961-1962

FIGURE VI VACCINAL STATE OF CASES

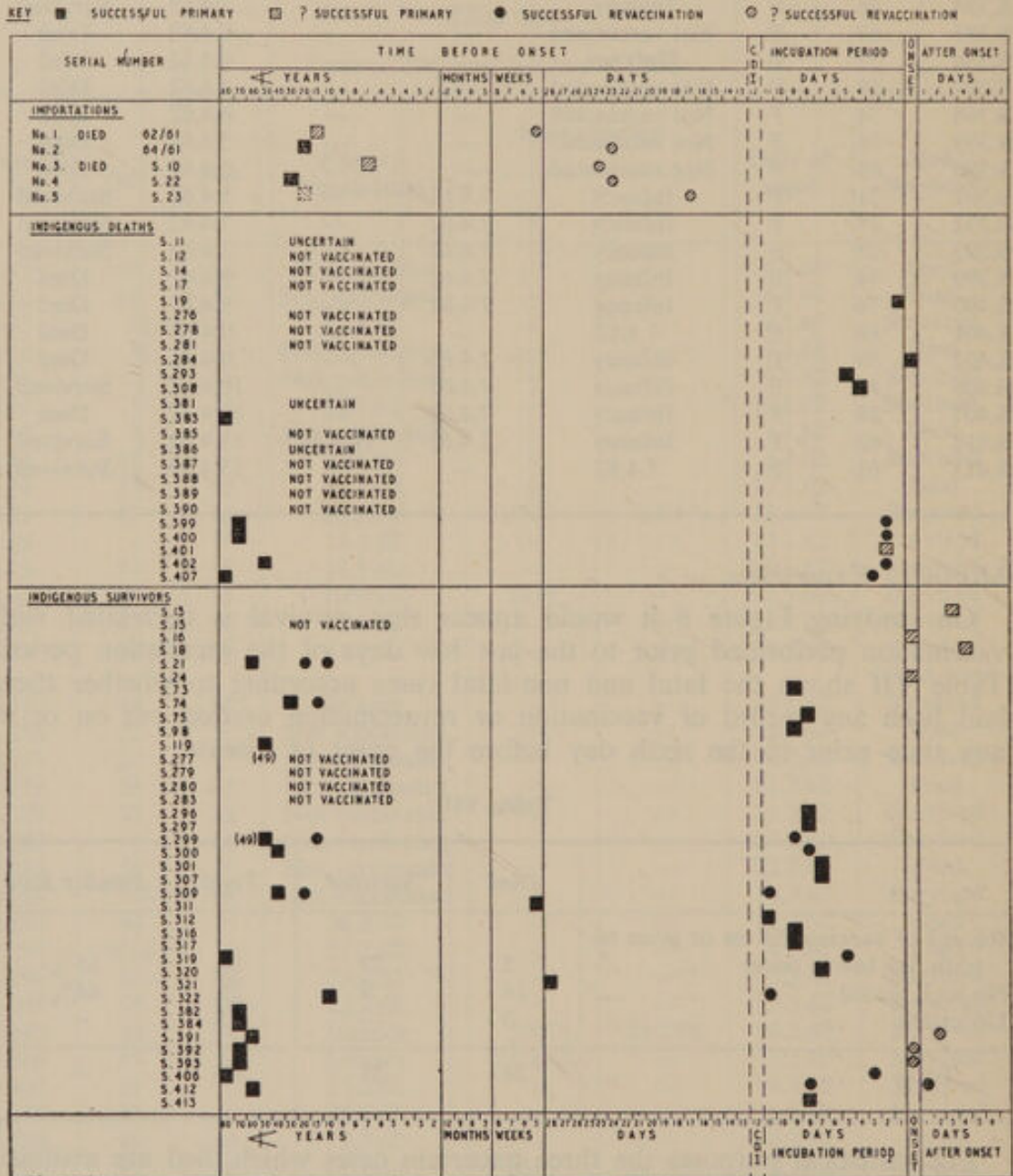


Table VIII shows the same thing for those cases whose last vaccination was at least ten years before onset. There were only two cases where vaccination had been performed more than two weeks but less than ten years before onset.

Table VIII

	<i>Died</i>	<i>Survived</i>	<i>Total</i>	<i>Fatality Rate</i>
No record of previous vaccination ...	12	9	21	55%
Last previous vaccination at least ten years before onset	1	8	9	11%
State uncertain	3	0	3	—
Total	16	17	34	—

Here again the 3 uncertain cases have been assumed to have been vaccinated more than 10 years before onset. The difference here is not significantly in favour of vaccination although the trend is in the same direction.

Table IX shows the date of the *last* recorded vaccination in relation to onset of cases vaccinated within 12 days of onset, together with the outcome of the disease.

Table IX

<i>Number of days vaccination was performed before onset of disease</i>				<i>Survived</i>	<i>Died</i>	<i>Total</i>
11				3	0	3
9				5	0	5
8				4	0	4
7				3	0	3
6				1	0	1
5				1	1	2
4				0	1	1
3				1	1	2
2				0	4	4
1				0	1	1
On day of onset	...	...	...	4	1	5
After onset	...	...	...	*4	0	5
Total	...	...	...	26	9	35

* One of these was also vaccinated six days before onset.

Although numbers on any one day are small, there seems to be little doubt that vaccination up to about a week prior to the onset of the disease has an attenuating effect on its course and this contributes materially to the findings at Table VII.

Tables similar to Tables VII and VIII have been constructed excluding the old ladies already referred to; these did not justify any change in the observations already made.

Table IX relates to the last vaccination given regardless of any previous vaccination. The table below (Table X) shows data according to their previous vaccinal state.

Table X

<i>Number of days vaccination was performed prior to onset</i>		<i>No previous vaccination</i>		<i>Previous vaccination</i>	
		<i>Survived</i>	<i>Died</i>	<i>Survived</i>	<i>Died</i>
7-11		12	0	5	0
1-6		0	4	2	4
On day of, or after onset	...	4	1	3	0

Numbers are again very small but the attenuating effect (if such it is) of vaccination or revaccination performed at this time is apparently unaffected by the previous vaccinal state.

In considering the above tables it should not be forgotten that the data relate only to cases. Nothing is, or can be, known about those persons in which previous vaccination may have prevented the occurrence of smallpox.

Severity of Illness

At Table XI the vaccinal state is correlated with the severity of clinical attack.

Table XI

Type	Number	Deaths	Number known to have been vaccinated successfully at any time on or prior to six days before onset
I	7	6	1 old lady who survived.
II	6	6	1 old lady vaccinated in infancy.
III	9	7	4 old ladies vaccinated in infancy, of whom 2 survived.
IV	2	1	2 (1 old lady vaccinated in infancy who died).
V	2	1	1 old lady vaccinated in infancy who died.
VI	13	2	4, all of whom survived.
VII	17	1	15, all of whom survived.
VIII	6	—	6, all of whom survived.
IX	—	—	
Total	62	24	

It will be noted that of those 22 patients experiencing fulminating or malignant attacks with high mortality, only 6 were known to have been vaccinated on or prior to 6 days before onset and these were all old ladies, 5 of whom had been vaccinated solely in infancy. Of the 40 patients experiencing less severe attacks, with 5 ensuing deaths, 28 were known to have been vaccinated successfully on or at some time prior to 6 days before onset.

SECTION VI

SOME ADMINISTRATIVE ASPECTS—IN THE COMMUNITY

The district Medical Officer of Health is the pivot around whom the control of smallpox continues to revolve. He is concerned with the ascertainment of cases and with their disposal to hospital; with the identification, vaccination and, where necessary the surveillance, of contacts of cases; and with concurrent and terminal disinfection. But around this intense exercise there is a penumbra of almost equally demanding activity, which is concerned, as much as anything, with the acceptance and dissemination of medical intelligence and with allaying public anxiety in all its forms.

When a single case of smallpox has occurred and contacts are easily identified and not too numerous, it is not too much to expect the district Medical Officer of Health to undertake these peripheral tasks also. This was, for instance, the pattern which evolved in the Metropolitan Boroughs of St. Pancras and Woolwich and the Urban District of Hornchurch.

St. Pancras

The problems arising from the occurrence of a case of smallpox in St. Pancras have been ably described by the Deputy Medical Officer of Health for that Borough⁽¹⁾. All the necessary control measures were taken by the Medical Officer of Health and her Deputy and their staff. Ingenuity was shown in tracing contacts and in maintaining surveillance over them. To this end the Medical Officer of Health liaised directly with the air line which had brought the man to London and arranged for Press and radio publicity when this was considered necessary. The Medical Officer of Health assumed responsibility for the necessary measures to be taken at University College Hospital including disinfection of the casualty department where the patient had remained before and after diagnosis.

Liaison was established with Medical Officers of Health in whose areas contacts were residing or working. The Health Department was kept open until late each evening with the Medical Officer of Health or her Deputy present and the telephone was manned night and day by a senior member of the staff. Many queries were dealt with from general practitioners, other Medical Officers of Health and the Press. It may be said that all Press enquiries received elsewhere were redirected to the Medical Officer of Health to this Borough.

A weekly bulletin was issued from the Health Department to local medical practitioners, hospitals and clinics and in it was the request that suspicious cases should be reported to the Medical Officer of Health at once. In consequence she or her Deputy were called to see a number of suspects outside the contacts already under surveillance.

The situation was made more difficult towards the end of the surveillance period when publicity was given to the Bradford outbreak and newspapers carried pictures of persons waiting for vaccination at clinics there. Vaccination, other than that of contacts, was a London County Council

responsibility but the Medical Officer of Health made day to day arrangements for this in the Borough Clinics at the Town Hall and at one other centre, and some 12,000 people were thus vaccinated during the next three days. The problem of coping with a public demand for vaccination is discussed in Section VIII, page 58.

Woolwich

The administrative pattern which evolved in the Borough of St. Pancras was repeated in the Borough of Woolwich when the unexplained case was diagnosed there. Here there was additional anxiety because of the possibility that a "missed case" had occurred, which would account for this patient's infection. This involved a minute examination of the patient's relevant history and careful local enquiries both in this Borough and, by liaison, in neighbouring Boroughs e.g. Dartford. The numbers of contacts requiring to be placed under medical surveillance were few. Here again a considerable public demand for vaccination led to the opening of special clinics—the demand increasing when a small child was admitted to Long Reach Hospital from the Borough as a suspected case of small-pox (this proved not to be the correct diagnosis). Once more the Medical Officer of Health was responsible for liaison, for ascertainment of the patient's condition day by day and for press releases on the situation.

Hornchurch

The Medical Officer of Health of Hornchurch Urban District⁽⁷⁾, immediately his unexplained case came to light, took steps to notify neighbouring Medical Officers of Health and the County Medical Officer. He also told the local police as he felt they would be valuable in maintaining contact control. All general practitioners in the district were told by telephone. He maintained liaison with the Ministry of Health and with the hospital in which his case was housed. In this instance he received considerable help from the Area Medical Officer of the County, who assumed responsibility for the vaccination programme and for part, at least, of the exhaustive enquiries attempting to discover the source of this case.

A different pattern of control began to evolve elsewhere.

West Midlands

When the West Bromwich case (Importation No. 2) came to light it was soon appreciated that there were many contacts in a number of neighbouring districts. For this reason the Medical Officer of Health for West Bromwich C.B. convened a meeting which was attended by all the other Medical Officers of Health concerned, the Senior Administrative Medical Officer of the Birmingham Regional Hospital Board and a representative of the Ministry of Health. The Chair was taken on this occasion by common consent by the County Medical Officer of Health for Staffordshire (and not by the County Borough Medical Officer of Health *directly* responsible for control measures). At this meeting, which was followed by others, local policy was determined in relation to:

- Vaccination,
- Contact surveillance and quarantine,
- Review of chickenpox cases,
- Hospital and ambulance facilities,
- Communications.

In order to relieve individual Medical Officers of Health of some of their liaison responsibilities it was agreed that information from local districts in Staffordshire should be collated by the County Health Department and from County Boroughs by the Health Department of the City of Birmingham. The Medical Officer of Health of West Bromwich continued to issue statements e.g. giving a full history of the importation for distribution to general practitioners in his own district, and to hospital doctors through the Regional Hospital Board. The Senior Administrative Medical Officer of the Regional Hospital Board sent all relevant information, including a comprehensive memorandum on the procedure to be followed by the hospital service in dealing with confirmed or suspected cases of smallpox, to hospital authorities, group medical committees, physicians in charge of infectious disease hospitals and Medical Officers of Health. Thus, although at this stage there was only one importation and this led to only one first generation case, an ad hoc organization evolved which could have provided support to Medical Officers of Health, in the event of a subsequent outbreak. It will be seen in Section VIII that the distribution of smallpox vaccine for instance, was effectively co-ordinated by this means. And, when the Birmingham case (Importation No. 4) came to light this supporting machinery was already in existence.

West Yorkshire

The outbreak in West Yorkshire was already sizeable when it came to light; and the mere task of ascertaining contacts and keeping them under surveillance was a full time commitment for the Health Department of the City of Bradford. It is estimated that over 1,400 contacts were kept under surveillance in that city by the medical staff of the Health Department or of hospitals during the course of the outbreak. When this complex duty was coupled with the great public demand for vaccination, the resources of the County Borough Health Department was stretched to the limit. The Medical Officer of Health held daily press conferences which proved to be a wearing and a demanding exercise. He also bore the brunt of enquiries from all sources, leaving his Deputy free to handle the control proper. The problem has been considered very thoroughly in two papers by the Deputy Medical Officer of Health for Bradford⁽⁸⁾, one of these in conjunction with the Medical Officer of Health⁽⁹⁾.

The Medical Officer of Health convened a meeting of the Medical Officers of Health of adjacent areas at which he explained the circumstances of the outbreak and particularly the control measures which were being applied in the City in the hope of achieving some agreement and uniformity of vaccination surveillance of contacts and disinfection.

Outside the direct control and press relation responsibilities exercised by the Medical Officer of Health of the County Borough concerned, there were many collateral aspects of the problem which came to the notice of the County Medical Officer for West Riding and these are discussed fully in a paper written by him in conjunction with his Deputy⁽¹⁰⁾. The question of vaccination policy is considered in Section VIII. Assistance was offered in the following ways.

1. Medical, nursing and clerical staff of the County Council were allowed to volunteer to assist where the need arose. Volunteers were

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SECTION VII

SOME ADMINISTRATIVE ASPECTS—IN HOSPITALS

The first and most vexing problem to be considered is that rising from the discovery of a case or cases of smallpox in a department of a general hospital.

It will be remembered that Importation No. 1, was conveyed, seriously ill, to the casualty department of University College Hospital, where smallpox was diagnosed. Luckily this was during the quiet hours, after midnight on 27th/28th December, and the patient was removed early on the morning of 28th December to the smallpox hospital at Long Reach. The contacts, who were few in number, were easily identified and before the patient had been removed from the hospital, all had been vaccinated.

As soon as the patient had gone the department was sealed and disinfected; the bedding and other potentially infected articles were removed in a van to be disinfected—the van itself being dealt with subsequently. The department was reopened during the late afternoon of Thursday, 28th December. It was decided to offer vaccination to all staff, inpatients and medical students at this hospital, amounting to some 2,000 persons. The hospital contacts were placed under surveillance by a registrar, and special provision was made for their temporary isolation should they become ill. The issue was thought likely to be confused by the prevalence of influenza at the time. Accommodation was cleared in one floor of the hospital and a meticulous one-way traffic system instituted with plans for strict barrier nursing. In fact only one patient required admission, a nurse with fever due to tonsillitis.

The situation is only slightly less disturbing if a case admitted for observation to an infectious disease hospital subsequently proves to be one of smallpox. It will be recalled that Importation No. 2 was at first thought by a competent opinion to be suffering from chickenpox and was removed to Moxley I.D. Hospital as such although smallpox was suspected soon afterwards. Luckily the patient had been admitted to a single room, one of seven in a cell isolation wing of one of the hospital ward blocks—separated by about 20 yards of open space from the nearest of the other ward blocks. As a precaution, before the patient was admitted, all the rooms in this wing had been emptied of occupants and two of them were adapted to serve as a changing room and a washing and disinfecting room for staff. All staff who were to handle the patient were revaccinated. The patient was admitted through a side door which was subsequently used by staff in attendance upon him; the main ward entrance was used by staff attending patients in the adjacent open ward and for delivery of food to the ward kitchen. On the day after this patient's admission vaccination was offered to all members of the hospital staff and to the patients occupying the adjacent open ward. Two days later patients in other parts of the hospital were offered vaccination.

Throughout the period that this patient remained in the hospital only one visitor, to a seriously ill patient, was admitted and this person was

vaccinated. After the patient's transfer to a smallpox hospital, other patients were discharged, when ready, if they had been successfully vaccinated or revaccinated, and surveillance was maintained upon them by the Medical Officer of Health. The intention was to empty the hospital. The cell the patient had occupied was disinfected. His laundry was disinfected and boiled and that of the patients in the rest of the hospital was boiled. The laundry was then retained at the hospital. This practice was continued until the hospital was closed for terminal disinfection.

It will be recalled that, when this case emerged, conferences were held at which the Senior Administrative Medical Officer of the Regional Hospital Board was either in attendance or represented and that he distributed widely a full memorandum on the procedure to be followed by the hospital service in dealing with confirmed or suspected cases.

A far more serious situation came to light in West Yorkshire⁽¹²⁾ when by 12th January it was appreciated that the following hospitals were involved.

1. Bradford Children's Hospital—missed case and four first generation cases in children (S.10/14/15/16/17).
2. St. Luke's Hospital—one haemorrhagic case, deceased (S.11).
3. Leeds Road Hospital—one haemorrhagic case, deceased (S.12).
4. Bradford Royal Infirmary—postmortem performed on missed case (S.10).
5. Wharfedale Children's Hospital—one case in a child (S.13).

This clearly was potentially a more dangerous situation, not only because of the deprivation of hospital facilities but because of the possibility of a large number of cases occurring in contacts of these already discovered.

A meeting was held in the Town Hall at Bradford which was attended by the Medical Officer of Health, the Senior Administrative Medical Officer of the Regional Hospital Board, the Secretary of the Bradford Hospital Group and a Senior Medical Officer from the Ministry of Health. It was decided that the Leeds Road Hospital and the Bradford Children's Hospital should remain closed with no admissions, no discharges and no visiting.

The position at St. Luke's Hospital was reviewed the following day, and appreciating that the duration of the deceased patient's illness in hospital had been very short and that there was a clear cut ring of immediate, identifiable contacts, consideration was given to re-opening. However the ban on admissions and discharges continued and it was decided to isolate the block in which the man had died and the mortuary in which his body had lain. All close contacts were vaccinated. The consultant pathologist was appointed Hospital Control of Infection Officer. He assumed responsibility for surveillance of contacts remaining in the hospital, examination of vaccination reactions and revaccination where necessary, and liaison with the Medical Officer of Health. A ward was evacuated with the intention of using it for the immediate isolation of any suspected cases arising. When these measures had been taken, in view of the greatly diminished hospital services available in Bradford, it was decided that St. Luke's Hospital should be reopened for medical and surgical emergencies only, but the affected block and the close contacts within it were kept in rigid isolation.

For the same reason the Bradford Royal Infirmary, which was minimally involved, was also released for these limited purposes.

Subsequently the Regional Hospital Boards' medical staff visited Bradford Children's Hospital and discussed the situation with the Matron and the two paediatricians concerned. Special arrangements were made for the surveillance of immediate contacts and for the disposal of the hospital linen.

That same evening the Senior Administrative Medical Officer and his medical staff convened a meeting of all the Bradford consultants at Bradford Royal Infirmary, where the full story was explained. In the surrounding areas special arrangements were made with Hospital Management Committees to restrict admissions to ensure that a minimal emergency service for Bradford could be maintained. The restriction on hospital services thus imposed aroused considerable Press interest and it proved necessary to open an information bureau in Harrogate for thirteen hours a day to disseminate information and relieve the affected hospitals of this load.

It will be recalled that three second generation cases arose amongst the contacts under surveillance in hospitals—one boy in Wharfedale Children's Hospital (S.75), and two men in St. Luke's Hospital (S.73/98) in the isolated block. Other than these there were no further cases and, in consultation with the Medical Officer of Health for Bradford, it was decided that the patients in the Children's Hospital could, if fit, be discharged on 29th January, and that both this hospital and the Leeds Road Hospital could be regarded as out of quarantine following disinfection. Leeds Road Hospital opened for admissions on 29th January and the Bradford Children's Hospital on 7th February.

St. Luke's Hospital was back to normal on 28th February after the evacuation and disinfection of the affected block.

Two important issues arise from this experience. The first is the absolute necessity to maintain the protection of hospitals staffs by repeated revaccination as recommended in Hospital Memorandum R.H.B.(50)75 (a nurse at Bradford Children's Hospital (S.18) was one of the first generation cases and she had not been vaccinated; the pathologist who performed the postmortem (S.19) upon the missed imported case had also never been vaccinated before he was infected). The second is that even in these very difficult circumstances, the cases of smallpox subsequently diagnosed were amongst persons already under surveillance as contacts. A detailed and well reasoned appreciation on the spot enabled a practical solution to be evolved which led to the maintenance of minimal hospital cover in circumstances of extreme anxiety.

The dominant feature of this whole outbreak was the extent to which hospitals were involved when cases first came to light. This is doubly true in South Wales when both the first and second waves were heralded by "missed" unexplained cases occurring in hospitals.

It will be recalled that the first of these was in a woman (S.276) who had been admitted to East Glamorgan Hospital with a retained placenta following delivery of a macerated foetus. She got no further than the anaesthetic room adjacent to the main theatre. But several members of the hospital staff were present and on the next day a postmortem examination was held which a number of them attended; on this occasion the obstetrician (S.278), who

had not been present the day before, attended the postmortem dissection and subsequently developed smallpox from which he died. (He alone of all the hospital staff had not availed himself of the opportunity for vaccination when the occurrence of the fifth importation in Cardiff became known.) This obstetrician was admitted, when he sickened, to a side ward in East Glamorgan Hospital.

A small boy (S.283) who had been operated upon in the theatre shortly after the dead woman's body had been removed from the anaesthetic room also developed smallpox. The child, whose smallpox was atypical, was first diagnosed as suffering from chickenpox and moved out of a main ward into a side ward, accompanied by his mother, where he remained for twelve days before a diagnosis of smallpox was made. Before the true diagnosis was established, his mother (S.284) sickened. Four days later, a child (S.293) who had been admitted to the ward, recently occupied by the affected boy, was also diagnosed as suffering from smallpox. Finally, there is sufficient evidence to justify the assumption that a man (S.320) who had occupied a bed in the ward above that in which the boy was isolated, acquired his infection at this hospital.

As soon as the boy was suspected as suffering from smallpox all children in the ward from which he had been withdrawn were vaccinated with the exception of those on cortico-steroid therapy; antivaccinial gamma globulin was obtained and the remaining children were vaccinated under this cover. The patients and staff of this ward were placed in strict quarantine. Children who had been discharged before the discovery of these cases were notified to the appropriate Medical Officer of Health. When antivaccinial gamma globulin arrived in sufficient quantity, children who had already had vaccination alone were offered further protection by this means. It is interesting to note that those who had been receiving cortico-steroid therapy developed florid vaccination reactions with secondary vesiculation by the twelfth day after vaccination, whereas the remainder were by that time dry and crusted.

A meeting had been held on 27th February at the hospital at which were representatives of the Welsh Board of Health, consultants, Deputy Senior Administrative Medical Officer and Deputy County Medical Officer. The main decisions taken were:

- (1) All hospital staff to be revaccinated.
- (2) All patients to be vaccinated except for certain babies where parental consent was awaited.
- (3) Only emergencies to be admitted and these to be vaccinated. Arrangements to be made for admission elsewhere.
- (4) Outpatients department to be reopened when all staff working there had been successfully revaccinated.
- (5) All discharges to be notified to the Medical Officer of Health concerned.
- (6) A ward to be set aside for observation of nursing staff with intercurrent illness.
- (7) Visitors or clergy visiting seriously ill patients to be allowed in if recently vaccinated or vaccinated on the occasion.
- (8) Disinfection of laundry, operating theatres and wards to be arranged.

Surveillance of hospital staff was carried out by hospital doctors. An interesting difficulty was that buses would not stop to pick up non-residential nursing staff—a reflection of the public attitude to the disease at this time. Matters improved when it was pointed out in the Press that these nurses had been successfully vaccinated and changed their clothing before leaving the hospital.

No further cases developed and quarantine was lifted on 25th March.

The second wave of the South Wales outbreak was heralded by a “missed” unexplained case of smallpox in an old lady (S.383) who died in Ward F3 of Glanrhyd Hospital. The significance of her death was not appreciated, it will be remembered, until eight secondary cases occurred amongst her ward companions. Immediate steps were then taken as follows:

- (1) Suspension of admissions, discharges and leave of absence and parole of patients.
- (2) Suspension of visiting.
- (3) Closing down of the industrial unit of the hospital which sent finished articles to various other hospitals.
- (4) Retention of patients who went to work outside the hospital precincts.

The affected ward was part of a block containing three other wards. The ward itself was completely quarantined and the volunteer nursing and ancillary staff were isolated with the patients and housed in caravans. Mail from the ward was stopped and laundry was handled in the ward, using portable equipment. Refuse was disposed of in polythene bags and burnt in a furnace. Library books were destroyed as it was impossible to identify those which had recently been in use in the affected ward block.

The patients in the other wards of this block were placed in quarantine but the staff were allowed freedom of movement, under surveillance, having been successfully vaccinated. From these wards all laundry was adequately disinfected before dispatch, and the laundry staff were revaccinated where necessary. Laundry from other general hospitals using the group laundry concerned was stopped to obviate cross infection; and temporary provision made elsewhere. Infected linen known already to have left the ward was set aside; but it was subsequently deemed that the laundering process would be sufficient to deal with infection.

Especial attention was paid to welfare problems in the hospital group. The isolated nursing staff, many of whom were married women, were provided with an ex-directory telephone line to enable them to keep in touch with their families. Extra entertainment and recreation in the hospital complex was provided to offset the deprivation of parole. Midday religious services were held by the Chaplain and relayed over the hospital public address system. Extra films were hired for ward performances.

It had been found possible to trace, through ward visitors' books, all visitors to the hospital since the day when the “missed case” was first deemed to be infective, and the names of these, together with those of patients who had been discharged after that date, were made known to the appropriate Medical Officers of Health. Psychiatric outpatient clinics held by the hospital staff in neighbouring general hospitals were suspended temporarily and the County Medical Officer offered substitute emergency outpatient service in local County Council clinics.

The County Medical Officer provided two of his senior medical officers to reside at the hospital and to advise on the epidemiological aspects. They had obtained considerable experience in the first wave of smallpox in South Wales and their presence was invaluable. They also established effective liaison between the hospital staff and their public health colleagues in the area. Indeed they assumed full responsibility for control measures of both patients and staff and were given the authority necessary to accomplish what they felt desirable.

It will be remembered that further cases came to light amongst the old ladies in F3 ward as might be expected, but no cases outside this ward occurred and surveillance was completed uneventfully. Gradually the hospital returned to normal working conditions. The affected ward was emptied by transfer, and terminal disinfection carried out.

From this hospital experience in South Wales, it is important to derive at least these lessons:—

- (1) That it is possible that haemorrhagic smallpox or indeed discrete smallpox will be missed even when it is known that a case or cases of smallpox have been diagnosed in the general area within the last month.
- (2) That these "missed cases" will, in a closed hospital community where prolonged proximity to infection is inevitable, give rise to other cases amongst patients.
- (3) That infection can feasibly be transferred mechanically unless disinfection techniques are immaculate.
- (4) Once more, that unvaccinated members of hospital staffs are exposed to special risk.

Hospital provision for smallpox cases

Under present arrangements each Regional Hospital Board is required to have available for immediate use a small (10 to 20 beds) first line hospital for the reception of smallpox cases. These are preferably sited in isolated positions and the general criteria have been laid down in a Ministry Circular (H.M.(56)79). Nursing and ancillary staff are earmarked amongst volunteers and their vaccinal state is constantly maintained at a high level. Behind this first line provision there should be second line accommodation of upwards of 50 beds in each Region. These second line hospitals are usually occupied by other kinds of patients until the emergency arises, when they are evacuated if the threat of a larger outbreak appears.

Opening a smallpox hospital is a considerable undertaking, involving the withdrawal of staff from other duties, and other special arrangements involving considerable disturbance and expense. A decision to open should not therefore be made without good reason. However when smallpox is strongly suspected on clinical grounds alone, unless exceptionally the patient can be isolated in a well vaccinated household in strict quarantine until the results of the preliminary tests are received from the laboratory, it is always better to set the wheels in motion and to admit the case.

During the recent outbreak no less than 11 smallpox hospitals were opened and 93 patients were admitted to them.

In each instance varying degrees of administrative difficulty were encountered in opening these units. This was in no small measure due to the inclement weather, but the difficulties were surmounted and, in general, hospitals were opened promptly when they were needed. The experience gained will be useful on any subsequent occasion.

Long Reach Smallpox Hospital

This hospital is on the traditional site to which smallpox cases were brought at the turn of the century either for accommodation on the river bank or in mid-stream in the floating smallpox hospitals. It is capable of expansion from 50 to 170 beds and a ward block is maintained in constant readiness to accept cases from the Port of London and all four Metropolitan Regional Hospital Board areas. The hospital is well isolated on the landward side, but the tow-path is parallel with the northern wall of the hospital compound, which can thus be overlooked from here.

Into this hospital were admitted Importation No. 1 from St. Pancras, the suspected case in his cousin's wife, the unexplained cases from Woolwich and Hornchurch and three other suspected cases. The hospital is controlled by a physician with great experience in this field, and he has at his disposal at Joyce Green Hospital key personnel who have considerable smallpox experience. The likelihood of breaches of discipline is remote.

The hospital was brought into use on 28th December, 1961.

West Midlands

First line accommodation in this area is at Witton Hospital in which 24 patients can be housed. There was some initial difficulty when the second imported case was to be admitted there because the central heating system had been affected by the bad weather. Ultimately this hospital accepted both Importations No. 2 and No. 4, the Medical Officer of Health infected by Importation No. 2 and 4 suspected cases. No unexplained cases appeared to arise in the area served by this hospital. This hospital was first opened on 3rd January, 1962, and was finally closed for terminal disinfection on 13th February, 1962. At no time was it deemed necessary to evacuate the second line accommodation in this Region.

West Yorkshire

In this Region the first line smallpox hospital at Oakwell is within the curtilage of a larger hospital earmarked for second line accommodation although well separated from it. Together these had a potential bed strength of 66. They are situated well away from built up areas but are readily accessible; and the staff had benefited from comparatively recent experiences at the time of the outbreaks of smallpox at Todmorden and Rochdale.

In view of the anxiety of the Medical Officer of Health for Bradford, who had been called upon to see a number of suspected cases of smallpox amongst Pakistanis (of whom there was a large influx to the area) after Importation No. 1 was diagnosed, the Regional Hospital Board⁽¹²⁾ took steps to put this smallpox hospital in a state of readiness early in January. This included preliminary arrangements for the evacuation of the geriatric patients

from the second line accommodation. As the initial scare eased, readiness was maintained although evacuation was put in abeyance. When the first generation cases came to light on 11th January in Bradford immediate instructions were given for the opening of the smallpox hospital at Oakwell. Some 4 hours later the hospital had been opened, and staffed and was ready for the reception of cases. At the same time, in view of the numbers of cases of smallpox already revealed, instructions were given for the evacuation of the geriatric unit and, by the co-operation of the West Riding County Ambulance Officer and his staff, this task was completed in the space of 6½ hours on the following day. A resident physician was installed and this constant medical cover not only proved invaluable from the clinical viewpoint, but meant that the relatively large staff required could be kept under observation for strain during their period of isolation.

It is interesting that when volunteers for emergency nursing were called for within the Region no less than 272 nurses volunteered, amongst whom were 5 Matrons, 1 Deputy Matron, 8 Assistant Matrons and 1 Assistant Chief Male Nurse. In fact, the original allocation of nursing staff for this hospital from the 11th January were:—

- 1 Matron
- 4 Sisters
- 1 Charge Nurse
- 1 Staff Nurse
- 6 State Enrolled Nurses
- 1 Student Nurse
- 1 Pupil
- 2 Ward Orderlies

After 4 weeks this staff were offered release and a few replacements were made.

Orderlies and domestic staff were provided by the Dewsbury Hospital Management Committee. A few of these were released as circumstances permitted but the progressive reduction began on 15th February and the hospital was handed over to the appropriate Medical Officer of Health for complete disinfection after the discharge of the last patient on 26th February.

During the 7 weeks that the hospital remained open 18 patients were admitted; of these 11 were suffering from smallpox, and the eventual diagnosis in 6 was generalized vaccinia and in 1 was rubella. It will be appreciated that the mere fact that patients were suffering from generalized vaccinia was some indication of the protection they had been afforded against contracting smallpox in the hospital; the rubella case was also vaccinated.

A number of the staff, who were well vaccinated, suffered from minimal illnesses after being in contact with smallpox. Retrospective serological studies in these cases are mentioned in Section IV. Meanwhile, by the 14th January, the possibility that the local outbreak would become widespread and diffuse was foreseen; and preparations were made to open a further reserve hospital for the reception of smallpox cases.

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Here again a doctor was resident. He was one of the Smallpox Panel for Wales and this meant that his services in this capacity were withdrawn at a crucial time, but he remained in the hospital until it closed. The initial nursing staff were

- 1 Sister
- 2 Day Staff Nurses
- 1 Night Nurse

When the number of patients increased to 6 a further day nurse and night nurse joined them. The ancillary staff consisted of the caretaker and his wife, a porter and 2 ward maids ; and this proved to be adequate.

Heddfan Hospital

This hospital is sited on a hill 200 yards from a main traffic route and one and a half miles from Bridgend. It consists of two separate wards containing 18 beds in all. It normally accommodated geriatric patients but these were evacuated on the night of 25th/26th February and the first smallpox patient was admitted on 26th February. Visits were made daily by a smallpox consultant but once more a resident medical officer, a registrar from a neighbouring hospital, was installed. The nursing staff, who were housed in caravans, were

- 1 Sister in charge
- 3 S.E.Ns.
- 3 Nursing auxiliaries
- 1 Ward orderly—male
- 1 Assistant cook
- 1 Maid

In all between 26th February when it was opened and 6th April, when it closed, nine patients had been admitted to this hospital.

It will yet again be recalled that the second wave of the smallpox outbreak in South Wales was heralded by an unexplained case which occurred in F3 Ward of Glanrhyd Hospital and that this ward was not more than $\frac{3}{4}$ of a mile from Heddfan Hospital which was occupied by six smallpox cases in an infectious state at the time that this unexplained case was deemed to have become infected. Nevertheless, this patient was one of a group of susceptibles in identical circumstances and selective transfer of infection to one of the group argues some forms of individual carriage.

Blackmill Hospital

This is a small infectious disease hospital sited between the Ogmore and the Garw valleys rather near a housing estate. It is reasonably constructed and has an administrative block and three ward units with a total bed capacity of 30 and a laundry and mortuary.

It was first made ready to provide beds primarily for patients who were suspected of smallpox although the diagnosis was thought unlikely.

The hospital was staffed by a smallpox consultant, who made daily visits, and a registrar who was resident. This psychiatric registrar had experience of variola, and had precisely the required background when it was decided to use this hospital for the reception of smallpox cases occurring amongst the

disturbed elderly women in Glanrhyd Hospital. This decision was made because by this time Heddfan Hospital had been closed but Blackmill Hospital was already fully staffed by the following:—

- 1 Matron.
- 2 Sisters.
- 3 Staff Nurses.
- 2 Mentally Trained Nurses.
- 1 State Enrolled Nurse.
- 9 Nursing Auxiliaries.
- 1 Cook.
- 2 Laundresses.
- 6 Maids.
- 1 Stoker/handyman.

The maximum patients at any one time in this hospital were 12 but clearly more could have been dealt with.

Since highly infectious patients were being admitted to a hospital not ideally sited the adjacent road was closed. The district Medical Officer of Health, helped by local general practitioners, took active steps to vaccinate the local village population, some 750 in all. Some disquiet was nevertheless felt by the authorities and it is not intended to use this hospital again for the reception of smallpox cases despite its suitability from the structural viewpoint.

When the second wave of the outbreak appeared a further hospital, Fedw Hir Hospital, Aberdare, was evacuated. It was well sited, at least half a mile from surrounding property and was quickly fenced, equipped and staffed. It was not, however, used.

Facilities and morale

It is general experience in all these centres of activity that there is no shortage of nursing volunteers and that by and large these are willing to continue under difficult circumstances perhaps beyond advisable limits. They withstand segregation firmly and without grumbling. They tend to react rather more emotionally in these circumstances when patients who have been carefully nursed through severe illness subsequently die. It seems advisable that they should be relieved serially after some three weeks of continuous duty.

Married women with family responsibilities are particularly liable to the strain of isolation for three weeks and for this reason it may not be advisable to accept them as volunteers for service in smallpox hospitals.

Everything must be done to offer the best possible amenities more especially because the staff are least likely to grumble in these circumstances.

Illness of contact

Some members of the staff of smallpox hospitals, as has been stated, experienced illnesses after contact with smallpox cases. This condition is mentioned in Section IV.

SECTION VIII

VACCINATION AND VACCINE SUPPLIES

It has already been established in earlier sections that vaccination against smallpox when there is an outbreak is not only a prophylactic weapon for the defence of those placed at risk and thus, indirectly, for the community as a whole; but is also potentially a source of clinical and administrative embarrassment if indiscriminately applied.

Routine Vaccination

The policy in England and Wales is that, as a routine, infant vaccination should be encouraged. Primary vaccination over the age of 2 years is not advocated unless there are special indications. There are a number of well defined contra-indications to routine vaccination and in quiet times these can be considered in relation to individual patients by their medical advisers.

The importance of primary vaccination as a routine is that the antibody response to revaccination, when persons are placed at risk, is likely to be more rapid and to reach a higher level than can be attained by primary vaccination. The period of grace is important in offering protection to contacts from infection and the higher level of antibodies militates against a fatal outcome.

Routine vaccination (which includes the revaccination of children between the ages of 8 and 12) will incidentally protect the individual in many instances from smallpox infection for a number of years and may prevent severe illness or death from the disease for a much longer period. The partial immunity of the population as a whole offered by routine vaccination also has the advantage that a rapid spread of the disease through the community is less probable.

Epidemiological Control

When an outbreak of smallpox occurs, epidemiological control is exercised; by which we mean the ascertainment and isolation of smallpox cases, the identification, vaccination and surveillance of contacts, and effective concurrent and terminal disinfection.

Confidence in this control policy is based upon experience gained over a number of years in this country with a partially immune population. There is no evidence to justify the suggestion that epidemiological control would prove as effective in a totally non-immune population.

Responsibility

The vaccination of identified contacts is the responsibility of the Medical Officer of Health of the Local Authority using the powers given by Public Health (Smallpox Prevention) Regulations, 1917. Routine vaccination in the absence of smallpox and large scale vaccination when smallpox is present in the area—whether or not this is inspired or is a response to public demand—is the responsibility of the Local Health Authority under Section 26 of the National Health Service Act, supplemented by vaccinations performed by

general practitioners either under local health arrangements or as a part of their duties to their patients and by industrial medical officers at the place of work.

Variations in Local Pattern

Just as in Section VI it was seen that the control patterns varied in different areas with the size of the commitment and the special relationships between central government, Local Health Authorities and Local Authorities, so there were variations in the manner in which the vaccination policy was applied.

St. Pancras

In this Metropolitan Borough the vaccination of contacts was performed by the Medical Officer of Health or her Deputy. Vaccinations were examined for reaction during surveillance of contacts and revaccinations immediately performed where necessary during the visit to their homes.

All known or probable contacts were vaccinated; but, if the contact was less well established, certain contra-indications were observed—especially eczema, treatment with corticosteroids, severe intercurrent illness and the first three months of pregnancy. The local policy also entailed the vaccination of *all* members of the Health Department staff since any of them might be called upon in these circumstances to deal with patients or their contacts or articles infected by them.

There was no great public demand for vaccination during the first half of January and only a relatively few taxi drivers and others who felt they might have been in contact with the first imported case were vaccinated. But when the effect of the third importation in Bradford came to light and the Press carried pictures of queues waiting their turn outside vaccination clinics in that city the demand for vaccination in St. Pancras on 15th January began to outstrip the Health Department's resources. However, a plan had already been made and with the agreement of the Local Health Authority (London County Council) an emergency vaccination centre was opened in the Town Hall, staffed by doctors recruited from a number of sources and by local general practitioners. On the first day 2,500 people were vaccinated and the demand continued for the next three days by which time some 12,000 people had been vaccinated. It is difficult to believe that, in these circumstances, contra-indications to vaccination were observed in every case. Certainly, although each patient signed a consent form, no record was kept of which doctor performed the vaccination; and this proved embarrassing when a number of those vaccinated subsequently applied for International Certificates of Vaccination.

The lesson to be learnt from this experience is the very great influence of the Press and radio and television services upon public morale. The pictures of the queues in Bradford sparked off the demand for vaccination in St. Pancras. The pictures of the queues in St. Pancras stimulated a demand in Cardiff. To the extent that these vaccinations partially raised the local herd immunity, one might say that they contributed to the stated grounds upon which the vaccination policy is based. But in St. Pancras and elsewhere in London there was no reason to suppose that unexplained cases would appear nor that the population at large were in any way placed at unusual risk.

Woolwich

When the unexplained case appeared in Woolwich a clinic was opened for the vaccination of contacts. By this time the public were aware of all five importations and of the indigenous cases in the Bradford area. Public demand placed a considerable strain upon the vaccination clinic in this Borough and this was enhanced when, on 26th January, a young baby was incorrectly suspected of suffering from smallpox in the Borough and was also admitted to Long Reach Smallpox Hospital from a local clinic.

Hornchurch

In this situation household contacts were all revaccinated successfully in the period 29th to 31st January. In addition two were given anti-vaccinal gamma globulin. The public health staff had, with very few exceptions, been revaccinated during the previous month as a general precaution when smallpox had come to light elsewhere. Refuse collectors were vaccinated and vaccination was offered to the remaining Council staff two days later. Two clinics were opened, one in Rainham and one in South Hornchurch, under the control of the Area Medical Officer (i.e., Local Health Authority) to deal with special classes, e.g., police, teachers and firemen—and any members of the public who wished to be vaccinated. The Area Medical Officer also arranged for vaccination sessions to be held especially for the workers of three factories where Pakistani labour was employed. Some 12,500 people were vaccinated during the fortnight that followed the disclosure of the missed case; and in the same period general practitioners were thought to have vaccinated some 37,500 of their own patients.

West Midlands

When Importation No. 2 appeared in the West Bromwich area and the local Medical Officers of Health and representatives of the Regional Hospital Board met for planning purposes a statement was issued as follows:—

“It is obvious that the risk to the public is quite minute and certainly does not warrant the present clamour and anxiety for vaccination. Supplies of vaccine are adequate to protect those who are at definite risk and those who have been in contact with infection. This policy of vaccination will be adequate to prevent the spread of the disease. . . .

“General practitioners are being very seriously prevented from giving proper attention to ill patients through the clamour of perfectly healthy people for vaccination which is not indicated at the present time.”

This firm and concerted action, together with the limiting of vaccination to established contacts and medical and ancillary staffs placed at definite risk, and the rationing of vaccine lymph to general practitioners and industrial medical officers, on whom fell the public demand for vaccination, went far to maintain reasonable control in this area.

This is very close to the ideal solution in the particular circumstances as obtained locally. It calls for a strong will and maximum co-operation between authorities and the rest of the medical profession. It is, of course, easier to sustain if similar restraint is being shown elsewhere in the country.

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additional clinics were opened to meet the demand. Already general practitioners had found that they were called upon to vaccinate more and more of their patients and this was also happening in areas remote from the affected one, e.g., Monmouthshire, where there were queues outside doctors' surgeries.

Thus here, as in Bradford, it was felt that there was less ground in the light of local circumstances for dismissing the public demand for vaccination as totally unnecessary and irrelevant. It may be justifiable, if missed cases with no known source are already occurring in that community. However, in dealing with this category of potential contact, it is essential that the normal contra-indications to vaccination are given proper consideration; and that the possible confusion that may arise when the general reactions to vaccination begin to occur is fully appreciated.

In South Wales the public demand spread far beyond the localities actually involved. In these peripheral areas the local interpretation of policy varied. In some it was felt that opening clinics would cause alarm since the public might deduce that matters were getting worse; in others, clinics were opened promptly in the belief that the public could then not fear that vaccination might be unavailable if wanted. In other instances, the clinics were opened because the general practitioners were so pressed that ordinary work was seriously impeded.

The second wave of this outbreak exacerbated the demand for vaccination; but the peak had already passed.

It is thought that in all some 900,000 persons were vaccinated in South Wales during the spring of 1962 of which some 500,000 were vaccinated by general practitioners, rather more than 300,000 in Local Health Authority clinics and the remainder under industrial arrangements.

Vaccine Supplies

Most of the smallpox vaccine used in the National Health Service is centrally purchased by the Ministry of Health and, in England and Wales, is distributed to some thirty of the Public Health Laboratories and thence sent to clinics, general practitioners and hospitals on demand. A number of other public health laboratories hold small stocks for the convenience of local practitioners and hospital staffs.

In England and Wales, the vaccine is supplied to the Public Health Laboratories by the Lister Institute, and a reserve of vaccine amounting to one and a quarter million doses is kept at Oxford, Cambridge and Conway. A Liverpool firm supplies the Department of Health for Scotland and also maintains a rather small reserve at its own factory. Apart from taking part in Local Health Authority schemes and drawing their vaccine from the laboratory for this purpose, general practitioners can prescribe the vaccine on E.C.10; this is then dispensed by pharmacists who usually obtain it direct from the Liverpool firm or the Jenner Institute.

Table XII
Smallpox Vaccine issued to Public Health Laboratories (England and Wales)
1st January—9th February, 1962: Doses in thousands

Period	Lister Inst.		Liverpool Firm		Issued to Laboratories in Smallpox Areas					Total S. Areas As per cent. all Issues
	Own Stock	Epidem. Reserve	Own Stock	Imported	Total Issues	Birming- ham	London	Leeds and Wakefield	Cardiff	
Up to 12th January ...	239·25	—	—	—	239·25	50·0	52·00	70·0	—	72
13th–19th January ...	2,261·50	100·0	—	—	2,361·50	247·5	534·25	660·0	37·0	62
20th–26th January ...	1,088·50	—	56·0	559·50	1,704·00	200·0	781·00	5·0	253·0	75
27th January–2nd February	567·00	—	7·0	532·00	1,106·00	31·0	865·00	—	—	79
3rd–9th February ...	17·50	—	—	114·50	132·00	20·0	—	—	—	15
Totals ...	4,173·75	100·0	63·0	1,206·0	5,542·75	548·50	2,232·25	735·0	290·0	68

The ordinary supply to public health laboratories runs at approximately 100,000 doses each month. During the first fortnight of this outbreak twice this amount was supplied, yet all demands were easily met. But, on 13th January, it became evident that the Lister Institute needed advice about priorities in dealing with the many demands being made for supplies of lymph to laboratories in areas not affected by smallpox. It was also necessary to decide what use, if any, ought to be made of manufacturers' and other reserves of vaccine. A small office group was set up at the Ministry of Health for this purpose and this met daily until 30th January. In addition to stocks and reserves manufactured by the Lister Institute or the Liverpool firm, this group had at its disposal imported vaccine generously given by the Argentine Government or purchased by the Department and held, for distribution, by the Liverpool firm.

Except during the week of 13th to 19th January, when they took just over 60 per cent, laboratories in Birmingham, Greater London, Cardiff and Yorkshire received about 70 per cent of all the vaccine issued during the time in question (see Table XII).

Five and one half million doses were issued over the six-week period, four-fifths of which came from the Lister Institute. Over one million doses of imported vaccine were included in the total issued, but the epidemic reserves of vaccine had remained practically intact. A considerable quantity of the vaccine held in reserve is freeze dried and in multiple dose containers; it must be reconstituted before use. Medical practitioners in this country are familiar with and prefer to use a single dose capillary tube, and it is clear that if their demands are to be met on future occasions a higher proportion of the reserve must be maintained in this form.

When single tubes were used, and the supply of vaccine seemed to fall short of the demand, great ingenuity was exercised in extracting the maximum number of doses from each nominal single dose tube.

Normally, the number of doses issued each year proves to be some two and a half times the numbers of vaccinations and revaccinations which are declared to have been performed; and this may be partially accounted for by necessary wastage. Because of the extreme economy exercised during the outbreak, this ratio may well have been reversed; and thus it is not possible to deduce from the numbers of doses issued, how many vaccinations were actually performed. As, in the circumstances of mass vaccination, records are minimal, it is unlikely that even a crude denominator can be established against which the complications recorded during the outbreak can be measured. An age-specific breakdown for this purpose is not to be hoped for.

Seen from the centre, the vaccine supply situation was at no time one to cause anxiety, although supplies from abroad, especially a gift from Argentina, was most welcome. The logistic problem i.e., the time lag in getting supplies to the laboratories and the difficulties in breaking down these supplies and distributing them equitably, remained.

In the West Midlands the Medical Officer of Health for Birmingham called a meeting on 19th January attended by the Deputy Director of the Public Health Laboratory, and the Medical Officers of Health for the County of Staffordshire and the County Borough of West Bromwich. At this meeting note was taken of the stock position, the forecast of fresh supplies and the varying clamours for vaccination in the surrounding areas.

The Medical Officer of Health for Staffordshire arranged for demands in the County to be made through his area offices and thence relayed to the Stafford Public Health Laboratory where a sub-depot was established.

The Medical Officer of Health for West Bromwich undertook to approach Medical Officers of Health for neighbouring County Boroughs except Birmingham, asking them to receive vaccine into their cold storage and to distribute it to general practitioners in their areas. A specific allocation was reserved for industry on a basis of ten single tubes per 100 workers in the densely industrialized areas. General practitioners were allowed four tubes per 100 patients on their lists, and a 30 per cent excess was held for industry and public health purposes at each of the bulk distribution points. Each family doctor and factory doctor was written to and the basis for distribution was explained. The fact that five persons, at least, could be vaccinated from one tube and advice on technique and contra-indications were also included. This admirable arrangement, coupled with the restraint shown in not opening clinics, which was fully justified in the light of local circumstances, worked well.

In West Yorkshire the bulk supply of vaccine lymph was made available through the Director of the Wakefield Public Health Laboratory. He voluntarily placed much of the control of distribution into the hands of the County Medical Officer. Absolute priority was given only for the vaccination of contacts and the special risk groups. The Director made special provision for Bradford, and these supplies arrived by ambulance car at the Town Hall from the laboratory towards midnight each day during the peak period. The supplies were reconstituted and broken down for distribution by the Medical Officer of Health and the Deputy Medical Officer of Health during the course of the night. This special and generous supply enabled the local policy of complying with public demand to be exercised.

In South Wales at the beginning of the Cardiff episode the Director of the Public Health Laboratory at Cardiff held 7,000 doses of lymph which would normally be a six months supply. For five days before the Cardiff importation came to light, there was an unusual drain on this stock by general practitioners—probably because the occurrence of smallpox in Bradford was known. Additional stocks had already been demanded from the Lister Institute when the Cardiff importation was diagnosed. A further urgent request led to a supply of 17,000 doses just after midnight on that day and these were available for distribution the next morning. A further supply arrived two days later but it proved difficult to keep pace with the demand from general practitioners. Nevertheless, by 13th January, 250,000 units had been supplied and thereafter even larger quantities were made available. In toto, during the South Wales outbreak, 1,300,000 doses of vaccine were issued through the Public Health Laboratory Service in Wales. In this area, where the brunt of the outbreak was borne and where the risk to the public was least well defined, supplies were adequate.

Complications of Vaccination

The complications of vaccination which are normally required to be reported by Medical Officers of Health to the Ministry of Health are:—

- (a) Generalized vaccinia
- (b) Post vaccinal encephalomyelitis
- (c) Deaths from complications of vaccination other than (a) and (b).

The particulars of these complications are provided on a special form in accordance with Appendix E to Circular 62/48. On 2nd February, 1962, a letter was sent to Senior Administrative Medical Officers, Regional Hospital Boards and Secretaries of Boards of Governors, drawing their attention to this requirement and suggesting that cases may be occurring in, or treated in hospital and not drawn to the notice of the Medical Officer of Health. They were asked to arrange for particulars of these cases to be sent direct to the Ministry and were given a note on the virological investigations thought desirable in certain of the fatal cases.

Other possible sources of information which have been explored are :—

- (i) Virological reports received by and through the Public Health Laboratory Service.
- (ii) Clinical reports received direct by the Ministry from " practitioners designated to assist Medical Officers of Health in the diagnosis of smallpox ".
- (iii) Copies of death certificates received from the General Register Office when smallpox vaccination or its complications are mentioned thereon.

The complications of smallpox vaccination which were noted in Wales have been separately analysed. The results are tabulated at Table XIII.

Inquiries into complications of vaccination in England are still continuing at the time of preparation of this report. The results shown in Table XIV must be regarded as incomplete particularly in respect of benign generalized vaccinia and eczema vaccination.

Vaccination Reactions

Apart from the more serious complications just discussed, widespread vaccination inevitably leads to a considerable number of reactions and these give rise to an increase in sick absence. This is particularly so in an area where employment is of the heavy manual type.

The bulk of the vaccinations performed in South Wales were done during the latter part of February and the first half of March. It is not unreasonable to assume that reactions to these vaccinations played a significant part in causing the increased claims to Sick Benefit in the various districts shown at Table XV. The underlined figures relate to periods where the claims exceeded 200 per cent of the 35 weekly average. There is further collateral evidence available to strengthen this supposition.

Table XIII

*Vaccination Complications—South Wales**(a) Benign Generalized Vaccinia*

Age	All Cases			Mild Cases			Severe Cases			Deaths		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
0—	1	—	1	1	—	1	—	—	—	—	—	—
1—	—	1	1	—	1	1	—	—	—	—	—	—
5—	2	—	2	1	—	1	1	—	1	—	—	—
10—	—	1	1	—	—	—	—	1	1	—	—	—
15—	1	3	4	—	3	3	1	—	1	—	—	—
20+	9	8	17	7	4	11	2	4	6	—	1	1
Total	13	13	26	9	8	17	4	5	9	—	1	1

(b) Eczema Vaccinatum—Vaccinated

Age	All Cases			Mild Cases			Severe Cases			Deaths		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
0—	—	1	1	—	—	—	—	1	1	—	—	—
1—	1	—	1	—	—	—	1	—	1	—	—	—
5—	—	—	—	—	—	—	—	—	—	—	—	—
10—	—	—	—	—	—	—	—	—	—	—	—	—
15—	1	1	2	1	1	2	—	—	—	—	—	—
20+	3	1	4	2	1	3	1	—	1	1	—	1
Total	5	3	8	3	2	5	2	1	3	1	—	1

(c) Eczema Vaccinatum—Not vaccinated but contact cases

Age	All Cases			Mild Cases			Severe Cases			Deaths		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
0—	2	—	2	2	—	2	—	—	—	—	—	—
1—	7	2	9	3	2	5	4	—	4	1	—	1
5—	1	2	3	1	2	3	—	—	—	—	—	—
10—	—	1	1	—	1	1	—	—	—	—	—	—
15—	—	—	—	—	—	—	—	—	—	—	—	—
20+	1	1	2	1	—	1	—	1	1	—	—	—
Total	11	6	17	7	5	12	4	1	5	1	—	1

Table XIII—continued

(d) Post-Vaccinal Encephalomyelitis

Age	Cases			Deaths		
	Male	Female	Total	Male	Female	Total
0—	—	—	—	—	—	—
1—	—	—	—	—	—	—
5—	—	1	1	—	—	—
10—	—	1	1	—	—	—
15—	2	2	4	—	—	—
20+	6	5	11	1	1	2
Total	8	9	17	1	1	2

There were, in addition, one other death associated with vaccination in a man aged 53, certified as due to I (a) Purulent Bronchitis, 1 (b) Chronic Bronchitis, 1 (c) Smallpox Vaccination, II Erythema Multiforme, and another in a woman aged 72, certified as due to 1 (a) Congestive Heart Failure, 1 (b) Bronchopneumonia II Vaccination Reaction.

Table XIV

Vaccination Complications

Data for England still incomplete (see p. 65)

England, 1st January–31st May, 1962

(a) Benign Generalised Vaccinia

Age	All			Mild			Severe			Deaths		
			Total			Total			Total			Total
0—	4	1	5	4	1	5	—	—	—	—	—	—
1—	3	7	10	3	6	9	—	1	1	—	—	—
5—	3	6	9	2	6	8	1	—	1	—	—	—
10—	3	2	5	2	2	4	1	—	1	—	—	—
15—	5	5	10	4	3	7	1	2	3	—	—	—
20+	26	34	60	21	20	41	5	14	19	—	—	—
Total	44	55	99	36	38	74	8	17	25	—	—	—

(b) Eczema Vaccinatum (Vaccinated)

Age	All			Mild			Severe			Deaths		
			Total			Total			Total			Total
0—	3	1	4	1	1	2	2	—	2	1	—	1
1—	1	4	5	1	1	2	—	3	3	—	—	—
5—	2	—	2	1	—	1	1	—	1	—	—	—
10—	1	—	1	—	—	—	1	—	1	—	—	—
15—	3	1	4	—	—	—	3	1	4	1	—	1
20+	3	2	5	1	—	1	2	2	4	—	1	1
Total	13	8	21	4	2	6	9	6	15	2	1	3

Table XIV—continued

(c) Eczema Vaccinatum (By Contact)

Age	All			Mild			Severe			Deaths		
			Total			Total			Total			Total
0-	2	2	4	—	1	1	2	1	3	1	—	1
1-	10	1	11	3	—	3	7	1	8	3	1	4
5-	—	2	2	—	1	1	—	1	1	—	—	—
10-	1	—	1	1	—	1	—	—	—	—	—	—
15-	2	—	2	1	—	1	1	—	1	—	—	—
20+	5	1	6	2	—	2	3	1	4	—	—	—
Total	20	6	26	7	2	9	13	4	17	4	1	5

(d) Post Vaccinal Encephalomyelitis

Age	All			Mild			Severe			Deaths		
			Total			Total			Total			Total
0-	1	2	3	—	1	1	1	1	2	—	—	—
1-	2	4	6	1	2	3	1	2	3	—	—	—
5-	3	2	5	2	—	2	1	2	3	—	1	1
10-	2	1	3	—	1	1	2	—	2	—	—	—
15-	4	2	6	1	2	3	3	—	3	1	—	1
20+	4	10	14	2	4	6	2	6	8	—	—	—
Total	16	21	37	6	10	16	10	11	21	1	1	2

In addition to the above, there were during this period 2 male cases, in patients aged 4 months and 32 years, diagnosed as vaccinia gangrenosa. The characteristic feature of each was a spreading necrotic lesion at the site of vaccination but secondary necrotic lesions did not appear and both recovered. There were also three deaths other than those already shown, where the certifying doctor considered there was some degree of association with prior vaccination. These were all in females, aged 3, 7 and 49 years.

Table XV

Weekly number of S.B. claims received and percentage in relation to 35-week average

Office	35 week average	Week- ending 13th Feb., 1962	Per cent.														Per cent.		
			20th Feb., 1962	27th Feb., 1962	Per cent.	6th Mar., 1962	Per cent.	13th Mar., 1962	Per cent.	20th Mar., 1962	Per cent.	27th Mar., 1962	Per cent.	3rd April, 1962	Per cent.	10th April, 1962	Per cent.	17th April, 1962	Per cent.
Llantrisant	83	112	86	110	132	124	149	231	278	200	241	118	142	113	136	105	126	97	117
Porth	178	202	218	191	107	282	158	449	252	293	165	199	112	189	106	210	118	133	75
Tonypandy	222	275	231	226	102	341	154	576	260	347	156	200	90	206	93	187	84	185	83
Tonypandy	129	180	147	138	107	225	174	383	297	283	219	167	130	132	102	147	114	157	122
Treorchy	289	333	405	364	126	461	159	880	304	552	191	328	114	421	146	325	113	250	87
Abercarn	99	94	130	115	116	152	153	143	144	270	273	241	243	130	131	124	125	75	76
Aberdare	227	268	305	300	132	327	144	477	210	617	272	362	159	264	116	231	102	203	90
Aberdare	150	175	191	193	129	215	143	225	150	382	255	359	239	187	125	169	113	142	95
Aberdare	137	157	210	177	129	208	152	230	168	464	339	238	174	168	123	117	129	157	115
Bridgend	121	179	159	133	110	199	164	231	191	384	317	278	230	186	154	154	127	114	94
Caerphilly	149	151	196	168	113	258	173	223	150	447	300	356	239	235	158	230	154	148	99
Maesteg	152	166	186	174	114	207	136	228	150	390	257	341	224	166	109	165	109	146	96
Merthyr Vale	81	86	81	93	115	107	132	191	236	274	338	143	176	84	104	77	95	101	125
Ogmore Vale	266	314	301	287	108	410	154	664	249	675	254	326	123	303	114	235	88	211	79
Pontypridd	61	76	72	81	133	76	125	133	218	253	415	130	213	75	123	72	118	55	90
Pontycymmer	66	82	90	101	153	104	158	128	194	222	336	129	196	104	158	95	144	79	120
Porthcawl	167	247	259	206	123	244	146	325	195	589	353	416	249	250	150	215	129	215	129
Port Talbot	70	80	90	77	110	90	128	101	144	189	270	103	147	106	151	50	71	62	89
Resolven	77	80	107	86	112	116	151	130	169	315	409	168	218	97	126	100	130	74	96
Risca	34	42	36	48	141	48	141	40	118	54	159	86	253	54	159	31	91	27	79
Burry Port	43	58	63	44	102	69	160	73	170	81	188	116	270	88	205	75	174	42	98
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— November, 1961

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