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A REPORT

ON

VACCINATION AND ITS RESULTS,

BASED ON THE EVIDENCE TAKEN BY

THE ROYAL COMMISSION

DURING THE YEARS

1889–1897.

COLLEGE OF PHYSICIANS

VOL. I.

THE TEXT OF THE COMMISSION REPORT.

LONDON:
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NOTICE.

It is intended to follow this Volume by another containing extracts from the evidence taken by the Commission, more especially with reference to the ill consequences which occasionally result from Vaccination. It was originally proposed to include part, at any rate, of these extracts in the present Volume, but it has been finally thought best to avoid further delay by publishing the Report separately and in its present form. In itself it constitutes an excellent history of Vaccination, and comprises also a summary of most of the facts which will hereafter be cited in more detail. The material for the second Volume is in advanced preparation, and will, it is hoped, soon be ready for press.

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FINAL REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

MAY IT PLEASE YOUR MAJESTY,

WE, the undersigned Commissioners appointed to inquire into the subject of vaccination, desire humbly to submit to Your Majesty our Final Report.

2. In the First Report which we submitted to Your Majesty we indicated the method we proposed to adopt in pursuing the investigation committed to us. In a later Report we recommended certain changes in the law, upon the expediency of which all the members of the Commission were agreed, whatever the conclusion to which they might ultimately be led on the specific questions on which they were required to report. As no steps have been taken to give effect to those recommendations, we shall have to advert to the matter again hereafter.

3. Our inquiry has been a prolonged one. We would gladly have concluded our labours at an earlier date; but we thought it desirable to give full scope to the evidence of those who were opposed to vaccination, as well as those who favoured the practice, in order that, whatever the value of the opinions we expressed, they should at least be the fruit of an exhaustive inquiry. Moreover, a thorough and systematic investigation of certain local epidemics necessarily involved much expenditure of time, and it would not have been possible for us to arrive at a satisfactory conclusion as to the risk attending vaccination unless our examination of

cases of alleged injury had extended over a considerable period.

4. We have held 136 meetings for the examination of witnesses, and have examined 187 witnesses. In addition to this, we have caused important investigations to be conducted for our assistance.

5. On the eighteenth occasion on which we met, we were invited to make a personal examination of two children who were alleged to have suffered from the effects of vaccination. Some of the members of the Commission, at the request of their colleagues, made the desired examination. It was felt, however, that it would be neither practicable nor expedient to pursue the same course in other cases in which injury from vaccination was alleged. Authority was accordingly obtained from the Treasury to secure the services of competent observers to make such investigations as might be called for. A large number of cases of alleged injury from vaccination brought to the notice of the Commission have thus been the subject of careful investigation.

6. In addition to an examination of cases of this nature, it seemed expedient that a complete and systematic inquiry should be made into the circumstances connected with important local epidemics of smallpox which occurred from time to time, with a view especially to see what light they threw on the question of the protective effect of vaccination. Inquiries were therefore instituted as regards local outbreaks in the Dewsbury Union in 1891–2, in London, in Warrington, and in Leicester, in 1892–3, and in Gloucester in 1895–6.

7. As regards other local outbreaks of smallpox, which occurred in Glasgow, in Liverpool, in Salford and Manchester, in Oldham and Chadderton, in Leeds, in Sheffield, in Halifax, and in Bradford, during the years 1892–3, more limited inquiries were instituted to ascertain the extent and character of the various outbreaks and the steps taken by the local authorities to deal with them.

8. The examination of cases of alleged injury from vaccination was made by Dr. Thomas Barlow, Dr. Theodore Dyke Acland, Dr. Sidney Coupland, Dr. Arthur Pearson Luff, and Dr. Thomas Dixon Savill; the local outbreaks of smallpox were reported on by Dr. Coupland, Dr. Luff, and Dr. Savill. We desire to record our sense of the value of the services which these gentlemen have rendered.

(*A.*) *As to the effect of vaccination in reducing the prevalence of, and mortality from, Smallpox.*

9. The first of the questions submitted to us by Your Majesty is as to "the effect of vaccination in reducing the prevalence of, and mortality from, smallpox." This is obviously a fundamental question. It has been strenuously maintained by some that vaccination has not had, and, indeed, could not have had, any effect in controlling the spread of smallpox or in diminishing its virulence. They insist that the notion that it is, to any extent, a protection against smallpox rests on no scientific basis, that there is no relation between vaccinia and variola, and therefore no reason why those who have been subjected to vaccination should enjoy any immunity from, or protection against, smallpox. They insist, further, that as a matter of experience it is not proved that any such protection or immunity has been enjoyed by the vaccinated. The latter is manifestly the more important point. If the facts which have been accumulated, when fairly and impartially viewed, do really show that the vaccinated are either less liable to be attacked by smallpox, or if attacked suffer less severely, than the unvaccinated, any theory which rests on the basis that there is no possible connection between vaccination and susceptibility to smallpox must evidently be regarded with distrust. If the protective effect of vaccination be thus established, then even if the relation of vaccinia to smallpox could not be explained, nor the reason why or the manner in which it affects human susceptibility to smallpox contagion elucidated, it would still be quite reasonable to accept and act upon the conclusions to which experience directed us. The reason why the introduction of a particular drug into

the human body produces certain phenomena may be incapable of explanation, but that it operates to produce these phenomena may be none the less certain. If, then, it be shown that vaccination has a protective influence against smallpox, or modifies the character of the disease, it is not necessary for the purpose of the inquiry upon which we are engaged to determine what is the true theory by which the effect is to be accounted for. To embark on such a scientific inquiry in any detail would be beyond the scope of our functions. If, again, experience does not warrant the assertion that vaccination tends to prevent the spread or mitigate the effects of smallpox, it is obviously immaterial whether this was *a priori* to be expected. At the same time, as it has been asserted with much confidence that science forbids a belief in the protective influence of vaccination, we have not thought it right to abstain altogether from dealing with this question. We shall, however, for the reasons we have given, discuss it much less in detail than the question what inferences ought to be drawn from the facts accumulated by the history of vaccination and smallpox in the period, now nearly a century, during which vaccination has been in use.

10. There was at the close of the eighteenth century, if not earlier, in districts where cow-pox had appeared, a belief among the dairy folk that those who had taken the cow-pox never took the smallpox; and indeed one Jesty, a Dorsetshire farmer, had in 1774, in the case of his wife and sons, purposely introduced the matter of cow-pox into the human subject with the view of protecting from smallpox.

11. The practice, however, of inoculating with the matter of cow-pox, or vaccination as it was subsequently called, may be considered as dating from the publication of the 'Inquiry into the Causes and Effects of Variolæ Vaccinæ' of Edward Jenner, published in the summer of the year 1798. The practice rapidly spread, and prevailed widely in this country and other parts of Western Europe during the first quarter of the present century. It was, beyond all question, so adopted in the general belief that it afforded protection against smallpox. Two questions at once present themselves.

First, upon what was this belief founded ; and, secondly, does the history of smallpox mortality from the time when the practice of vaccination became prevalent, support the view that it has such a protective influence ?

12. Vaccinia or cow-pox is a disease affecting milch cows and marked by an eruption on the udder and teats. The disease can be communicated from the cow to man. Dairymen and maids engaged in milking cows affected with cow-pox are apt to have sores of a special kind on their hands or elsewhere, the development of the sores being frequently accompanied by febrile symptoms. There can be no doubt that, in a certain number of cases at all events, such sores are the local manifestations of cow-pox ; the virus from the eruption on the cow being introduced into some scratch or other imperfection in the skin of the milker, and there producing its local effects, accompanied more or less by general symptoms.

13. In the treatise to which reference has been made, Jenner records in the first place a number (19) of cases in which a person who had accidentally taken cow-pox from the cow, had never had smallpox and appeared incapable of taking that disease ; the insusceptibility being shown on the one hand by the failure to contract the disease after ample exposure to contagion, such as nursing and attending to or even sleeping with persons suffering from smallpox, and on the other hand by the fact that when the person in question was inoculated with the matter of smallpox in the manner then usual (the matter being tested as to its efficiency on susceptible persons) the inoculation failed to excite smallpox. In the course of the inoculation practice it had been observed that when the operation was performed upon a person who had already had smallpox, either naturally or by inoculation, the wound of inoculation, instead of developing as it did when the operation was successful in a person who had not had the smallpox, into a vesicle and so into a pustule with the variolous characters (the development being accompanied by febrile symptoms and, save in exceptional cases, by the

appearance of a smaller or greater number of variolous pustules on parts of the skin other than the seat of inoculation), presented as a rule nothing more than some slight inflammation, dying away in a few days without any other symptom, or even healed at once without any symptoms at all, local or general; and in the exceptional cases in which further changes took place in the wound, these were not accompanied or followed by an eruption of pustules or even by the febrile and other general symptoms of smallpox. Accordingly, in cases of smallpox inoculation where it was doubtful whether the disease had been communicated, it had become not an uncommon practice to repeat the operation, in order to judge by the effects produced whether the earlier inoculation had or had not produced the disease; and the practice, thus originating in connection with smallpox inoculation, had come to be spoken of as the "variolous test." We discuss the "variolous test" in greater detail in an Appendix on pp. 143–5.

14. In his treatise Jenner distinguishes between what he calls true cow-pox, and other eruptions which he speaks of as spurious, and which he regarded as not affording protection against smallpox, although he gives no details to show that the cases quoted by him as affording protection were cases of his true cow-pox. He also developed the view that matter derived from horses suffering from the disease known as the grease is capable of giving rise to cow-pox in the cow, and indeed is the real origin of the true disease. It will be desirable to consider the questions relating to the grease of horses later on. It may be added that Jenner also expressed the opinion that the protection thus afforded by cow-pox was permanent in character.

15. Jenner further recorded in the same treatise how he had in 1796 inoculated a healthy boy of eight years of age in the arm with cow-pox matter taken from a sore on the hand of a dairymaid who had been infected with the disease by milking cows suffering from cow-pox. He describes the appearances subsequently presented by the wounds, and states that, six weeks afterwards, the results of inoculating

the boy with variolous matter were those commonly seen to follow the inoculation of persons who had previously had the cow-pox or the smallpox ; that is to say, the "variolous test" showed the boy to be insusceptible to smallpox. Some months afterwards the boy was again inoculated, but no sensible effect was produced on the constitution. Jenner then relates that subsequently, in the spring of 1798, he inoculated a child and obtained a similar result, with matter taken directly from the nipple of a cow infected with cow-pox ; from the pustule on the arm of this child he inoculated another, and from this again several, and from one of these latter a fourth in succession, and then a fifth. To three of these the "variolous test" was applied, and, it is stated, with the same results.

16. In considering the value of the "variolous test" as a proof of the immunity conferred by cow-pox, it must be borne in mind that most of the medical men at the close of the eighteenth century, Jenner included, had very considerable experience of the practice of inoculation ; they were familiar with the varying effects of inoculation under different circumstances, from the cases where a genuine development of smallpox with a copious eruption resulted to the cases where the effect was no more than the normal consequence of a puncture or incision by a clean lancet in the sound skin of a healthy man ; they were called upon to decide, in cases giving rise to doubt, whether the effect of the operation had been the conferring of smallpox with the attendant immunity against future attacks, the welfare of the patient in view of subsequent exposure to contagion being dependent on the correctness of their judgment ; and, making every allowance for errors which must necessarily intervene in this as in other human judgments, there can be no doubt, as is pointed out in the detailed discussion of the "variolous test" to be found in the appendix on pp. 143–5, that they had by experience learnt to know as a general rule whether or not the operation had so far produced the effects of smallpox as to confer the desired immunity. Nor is there any reason whatever to think that their attitude of mind was different when they used inoculation merely as a

test of insusceptibility from what it was when they used the operation with the intent to provoke the disease. There does not seem then to be any sufficient ground for regarding the variolous test applied to cases of cow-pox in proof of immunity towards smallpox, as invalid, remembering of course always that in this, as in other things, a sanguine hasty person might be led by the desire of seeing his expectations fulfilled to minimise the effect of the operation; he might be led to overlook results which a more cautious observer would regard as evidence that smallpox had been really produced.

17. It is certain that Jenner believed that those who had suffered from cow-pox, whether naturally or artificially produced, exhibited when the variolous test was applied, phenomena similar to those witnessed in the case of persons who had suffered from smallpox, and differing from the phenomena observed in those who enjoyed no kind of immunity or protection. If vaccination be without protective influence this ought not to have been the case. The symptoms should have been those of persons who had not suffered from smallpox, and enjoyed no protection against it. If Jenner was an honest witness it is scarcely possible to believe that this was the case. His tests were applied for the very purpose of determining whether vaccination afforded protection. If the results presented were the same as would have been exhibited in unprotected persons, it is difficult to conceive that he should have arrived at the conclusion that vaccination secured the same immunity as a previous attack of smallpox. It is true that in exceptional cases persons, who had never suffered from smallpox, showed when tested by inoculation the same absence of definite variolous symptoms as those who had been subject to the disease. These persons were spoken of as "naturally insusceptible" of taking the smallpox. It is just possible that all the vaccinated persons to whom Jenner applied the variolous test were thus naturally insusceptible. But that this should have chanced to be the case is of course in the highest degree improbable.

18. The experiences of Jenner did not stand alone. His results and views attracted great attention, and in the early part of the year 1799 Woodville and Pearson, who were physicians to the Smallpox Hospital in London, commenced making experiments with vaccine matter with a view to ascertain whether it afforded protection against smallpox. They arrived like Jenner at the conclusion that it did.

19. In January, 1799, Woodville, having found cow-pox to be present in a "dairy" at Gray's Inn Lane, inoculated seven persons at the Smallpox Hospital with matter from one of the cows at the "dairy," and other persons with matter from sores on a dairymaid employed at the same place who had become infected from the cows. From these cases he inoculated in succession others at the Hospital, eventually to the number of many hundreds, and thus established the stock of what has been spoken of as "Woodville's lymph." Pearson also at the same time occupied himself with the question of inoculation with the cow-pox, writing a pamphlet about it. Woodville and he distributed to many persons in this country and abroad quantities of the lymph from the Hospital; and this was the beginning of the more general practice of vaccination, for Jenner's stock of lymph, the results of which he had described in his treatise, had come to an end.

20. Although Woodville's "Hospital lymph" appears to have been widely distributed by himself and by Pearson, and thus to have been the source of the lymph used in various places in the early days of vaccination, it was not the only source, even in those days. Pearson also obtained lymph from cow-pox at a dairy in the Marylebone Road, and used this "in certain situations," which may be presumed to include places elsewhere than in the hospital. He also speaks of having obtained lymph from the cow from a third source. Jenner, again, who received and used some of Woodville's hospital lymph, also obtained lymph from some other sources; for instance from a cow at a Mr. Clark's farm in Kentish Town. Further, Woodville, in 1800, speaks of his having at various times procured the vaccine virus as produced in different cows, which when

used at the hospital produced the same effects as the Gray's Inn Lane lymph. We are not justified in assuming that an account of every new source of lymph was published ; and there may have been others, it is impossible to say how many, than those just mentioned. In any case Woodville's hospital lymph was not the only lymph used in those early days ; not, only, however, was it largely used (indeed we have no evidence of so widespread a use of lymph derived from any other source), but the use of it marks the definite beginning of the practice of vaccination ; and the history of it demands special notice.

21. Of the cases recorded by Woodville in his Reports, the larger number, about three-fifths, presented an important and, as compared with Jenner's cases, a new feature, in that, in addition to the changes taking place at the seat of inoculation and constituting what Woodville called the "cow-pox tumour," which may here be spoken of as the "vaccine vesicle," an eruption over the body of a greater or less number of pustules was observed. These eruptive pustules occurred in the very first cases ; of the seven cases inoculated from the cow, four, and of the five inoculated from the dairymaid, four had such pustules ; and their appearance is recorded again and again in the series, down to the case which appears last but one in the tabular statement forming part of the Reports.

Moreover an eruption of pustules is described in certain of the cases of which accounts were published at about the same time by Pearson and many others. In some of these cases the lymph used was supplied from the Smallpox Hospital by Woodville or Pearson.

22. It must be admitted, as will be seen from the detailed discussion which we give in an appendix at pages 145—153, that these pustules were pustules of smallpox, and that, therefore, Woodville's cases, which did so much to establish the practice of vaccination, were not cases simply of cow-pox but of cow-pox mixed, so to speak, with smallpox. It has indeed been maintained that Woodville's cases were not cases of cow-pox at all, that smallpox was inadvertently introduced into the very first cases ; that the history of the whole series

is the history of a series of smallpox cases putting on special characters, and that therefore the lymph used and distributed by Woodville and Pearson was in reality not cow-pox lymph but smallpox lymph. But a detailed discussion of all the facts such as will be found at pages 145—153, shows this view to be untenable. A review of all the evidence available leads to no other conclusion than that, however much in Woodville's, Pearson's and other cases, cow-pox was mixed up with smallpox, the lymph used and distributed by Woodville and Pearson and called by them cow-pox lymph (excluding of course all the cases, of which there were not a few, in which matter was taken not from the local "cow-pox tumour" at the seat of inoculation, but from one of the eruptive pustules) was veritable cow-pox lymph having the true characters of cow-pox lymph only.

23. It of course follows that the cases, both in Woodville's practice and in that of others, in which the inoculation of cow-pox matter was accompanied by an eruption of pustules, due to smallpox being present as well as cow-pox, when appealed to as showing immunity against smallpox (by the test either of exposure to contagion or of inoculation), furnished false evidence as to that immunity being due to cow-pox; it might have been due to the accompanying smallpox. So far then as the adoption of vaccination was assisted by cases of this description, it may be held to have rested on erroneous data.

But the test of immunity, whether that of exposure to natural contagion or that of inoculation, was applied not only to the cases with eruption but to the cases without it, not only to cases where Woodville's lymph was used but to cases where lymph of other origin was used. We have no accurate records enabling us to distinguish these latter cases as regards immunity. Marshall makes a general statement that he found no difference between the cases inoculated with the lymph which we otherwise learn came originally from Woodville's case of Bumpus, and the cases in which the lymph employed was obtained from Clark's farm; but, though we learn from many scattered records that cases vaccinated by different persons showed immunity, we possess,

as a rule, no details enabling us to distinguish the cases in which lymph obtained from the hospital was used from those in which the lymph was obtained from other sources, or indeed between the cases inoculated with lymph traceable to Woodville's earlier cases of Gray's Inn Lane origin and those inoculated with the various lymphs of other origin employed by Woodville. Yet it is clear that no contrast, as regards the immunity afforded, was presented between the cases where one lymph was used and those in which another was employed, or between those cases in which pustules appeared and those in which they did not. The reality of the immunity, so far as we can tell, was as great in the one class as in the other.

Moreover, admitting the error introduced by the pustular cases, it must be remembered that the error was of brief duration. The pustular cases, relatively numerous, at the outset, in the experience of Woodville and in that of some other observers, soon became exceptional in the experience of all. Within one or two years the error was recognised, and it was generally acknowledged that inoculated cow-pox differed clearly from inoculated smallpox in being, as a rule, unaccompanied by an eruption of pustules, and especially in not being contagious.

24. The view that cow-pox protects against smallpox thus put forward by Jenner, and supported by Woodville and Pearson, speedily attracted great attention among both the profession and the general public. Controversies, as might be expected, arose both on the main point whether protection was really afforded, and on various subsidiary points; but, within a very short time, the new doctrine found general acceptance in England.

In 1800 a declaration of adhesion to the doctrine was issued with the signatures of many of the leading physicians and surgeons of London, and to this in the following year many others added their names. In various large cities the resident medical men made known collectively their approval.

In 1802 a Committee of the House of Commons made a report[1] on the utility of the discovery of the protective power

[1] 1, App. 94–6.

of cow-pox, and upon Jenner's claim to be considered as the discoverer. A number of witnesses of extensive experience in the profession were examined. It is important to notice that the Committee not only stated the result of the evidence to be favourable to the protective effect of vaccination, but that vaccine inoculation "introduces a milder disorder in the place of the inoculated smallpox, which is not capable of being communicated by contagion."

25. A few years later, controversies still continuing, the Royal College of Physicians made at His Majesty's command a report[1] on the subject of vaccination to the House of Commons. This report was presented in 1807. The inquiry appears to have been a thorough one. No facts were regarded as proved, but those stated from actual observation. The College was made acquainted with the results of several hundred thousand cases, and the conclusion arrived at was that, though in some instances vaccination failed to protect, it afforded greater security against smallpox than the inoculation previously in use, whilst the illness induced by it was milder and less hazardous. It was further observed that in almost every case where smallpox had succeeded vaccination, whether by inoculation or casual infection, the disease had varied much from its ordinary course; it had neither been the same in violence nor in the duration of its symptoms, but had with few exceptions been remarkably mild. Moreover, it was pointed out that vaccinated persons spread no infection, and that cow-pox could only be communicated by inoculation. The report stated that towns and districts of the country in which vaccination had been general had afterwards had the smallpox prevalent on all sides of them without suffering from the contagion. Although the evidence before the College was not universally favourable to vaccination, it was nearly so, and the important statement was made that many who were once adverse to the practice had been convinced by further trials, and were to be ranked amongst its warmest supporters. The College, as the result of the inquiry, felt it to be their duty strongly to recommend the practice of vaccination.[1]

[1] 1, App. 97–9.

26. From England the doctrine and the practice of vaccination rapidly spread to the continent of Europe. In Denmark a number of the most respectable physicians of Copenhagen formed themselves, in 1804, into a society to collect and investigate all grounds and arguments for and against the anti-variolous agent proposed by Jenner. A Royal Commission composed of medical men was at the same time appointed to investigate the subject.[1] It is stated that after the lapse of a few years the private committee as well as the Royal Commission, although many of the members had at the commencement entertained a doubt as to the doctrine of Jenner, arrived unanimously at the conviction that vaccine virus was a preservative from smallpox.

In several European countries the utility of vaccination was early recognised by State action of one kind or another. Nor was this confined to Europe. In 1809–10 the State of Massachusetts passed statutes providing for inoculation with the cow-pox and giving power to raise money to pay for the operation.[2]

Thus the doctrine that cow-pox protects against smallpox found an acceptance in most countries of Europe, and in the New World as great as it did in its birth-place, England. And without insisting too much on authority we may at least say, especially when it is remembered how slow men are to adopt new methods and how much prejudice is apt to exist against a novel treatment which is foreign in its origin, that such a widespread and rapid acceptance of the doctrine, in spite of hostile criticism, which was not wanting, shows that the evidence for it must at the time have appeared very strong.

27. It is impossible to trace with absolute certainty the source of the lymph used on the Continent and in other foreign countries. Pearson claims to have been the chief agent of the first distribution ; and probably much, though, as has already been urged, not all, Pearson's lymph came from the Smallpox Hospital. Woodville started vaccination

[1] 1, App. 110, 108.

[2] 6, App. 772–3.

in France presumably with hospital lymph. Indeed, it is clear that in many instances the lymph with which vaccination was started in places abroad was supplied by Pearson or Woodville, and it is probable that much at least of this lymph had its origin in the cases of Woodville at the Smallpox Hospital spoken of above. But it is at the same time also clear that foreign observers obtained lymph from others than Pearson or Woodville. We learn that Jenner, who naturally was much appealed to for supplies of lymph, himself sent lymph to Stromeyer of Hanover (*Med. Phys. Jl., III.*, 471), to De Carro of Vienna (*Baron, I.*, 348), to Berlin (*Baron, I.*, 348), to Waterhouse in America (*Baron, I.*, 439), to Barbadoes (*Baron, I.*, 533), and to Newfoundland (*Med. Phys. Jl., V.*, 340) ; he may have sent lymph to other places, but his having done so does not seem to be recorded. Again, lymph derived from supplies originally obtained from Jenner, and sometimes spoken of as "Jenner's lymph," or the "stock of Jenner," was sent abroad by several persons. Thus Waterhouse's first supply of lymph came through Haygarth from Creaser, of Bath, "whose stock was produced from the stock of Jenner," and Ring states (*Treatise*, p. 20) that he distributed to "various parts of Europe and America," lymph derived from a supply sent to him by Jenner through Paytherus. Lymph from Jenner, "Jenner's lymph," must have been largely used abroad.

The lymph used by Jenner in those early days of vaccination was of two sources ; that sent to him by Woodville, taken from the case of Bumpus at the Smallpox Hospital, and that obtained through Tanner direct from a cow at Clark's dairy-farm in Kentish Town. (Somewhat later he made use of another stock also furnished him by Tanner and supposed to be of equine origin.) We know of one instance in which he sent out lymph of the first of the above two strains, Woodville's lymph ; he sent it to Ring, in whose hands it failed (*Baron, I.*, 358), and he may have sent it to others. But he certainly also largely used and distributed the Clark's farm lymph (*Baron, I.*, 343 ; *Crookshank, II.*, 258) ; he sent some of it to Woodville, who used it at the Smallpox Hospital. "Jenner's lymph" was certainly in part at least, probably largely, lymph derived from Clark's farm.

We do not know how far Jenner's lymph was successively carried on by the recipients abroad. Stromeyer (*op. cit.*), gave up the use of the lymph sent to him by Jenner, preferring that sent by Pearson; but at Berlin the use of Jenner's lymph seems to have been continued. The lymph sent to Waterhouse by Haygarth, though apparently successful at first, became useless later on; according to Waterhouse this was due to careless and ignorant management. Of the later supply sent by Jenner himself no such complaint is recorded, and this probably, together with that sent to Waterhouse from Ring, which also was "Jenner lymph," continued to be used in Massachusetts; though it is impossible to separate the use of this lymph from that of the lymph received by Waterhouse from Woodville and Pearson (which was probably "Hospital lymph") and from Lettsom (*Baron, I.*, 471).

Unless we are prepared to assume (1) that all the lymph distributed abroad by Pearson and Woodville was derived from Woodville's original cases, and none of it from the other sources used by Pearson and even by Woodville himself; (2) that all the "Jenner's lymph" sent abroad by Jenner hmself or by others was derived from the Hospital lymph sent to Jenner by Woodville, and none of it from the Clark's farm lymph, which Jenner used and distributed so largely; or (3) that all the Clark's farms strain sent abroad, failed or was discontinued, the lymph of Hospital source alone maintaining its position; we must conclude that the lymph by means of which vaccination was established abroad was not exclusively that derived from Woodville's original cases. For such assumptions there is no positive evidence at all, and probabilities at least are entirely against them. Further, all the lymph employed abroad in the early days of vaccination did not come from England. Sacco, for instance, discovered natural cow-pox in Lombardy, and both he and De Carro, of Vienna, made large use, with positive results, of the lymph obtained from this source; its effects were identical with those of the lymph obtained from England, *i. e.* from Woodville or Jenner. This Lombardy cow-pox is stated by De Carro to have been the origin of the lymph which he sent to Constantinople, and which started vaccination in

the East. (*De Carro ; Histoire de la Vaccine,* 1804, p. 23, *et seq.*)

Whatever may have been the case in the first instance as regards Woodville's and Pearson's lymph, it seems impossible to believe that the virus generally used in the early part of this century, whether in this country or elsewhere, was smallpox, and the process the old and well-known one of inoculation with that virus. If the evidence of the protection conferred by cow-pox be numerically lessened by some of the early supposed cases of cow-pox being really cases of smallpox, it is strengthened qualitatively by the absence of any contrast as to the immunity conferred between those who had been given cow-pox only and those who had been given smallpox as well or instead.

28. The data available for determining to what extent vaccination was practised in England in the first quarter of the nineteenth century do not permit of any exact numerical statements being made, but they at least show that the amount was considerable. Woodville, Pearson, Jenner himself, and others distributed virus to various practitioners all over the kingdom, and contemporary writings show that in the years immediately succeeding the publication of Jenner's treatise vaccination was practised with enthusiastic activity. The operation was repeatedly performed not only by doctors but by persons outside the profession ; by clergymen and others, and even by ladies as an exercise of benevolence. All this activity must have led in a few years to the vaccination of a considerable proportion of the population ; and Jenner, writing in 1801, says that at the lowest computation some 100,000 of the inhabitants "within these realms" had already been vaccinated. A little later the number was spoken of as several hundred thousands.

29. Beyond such general statements, however, one cannot go. Records exist, it is true, up to about the year 1807 of the numbers vaccinated in certain large towns in England, and there are also records of the numbers vaccinated during the first quarter of the century at the institutions established in London for the vaccination of the poor. But these hardly do more than support the general statement that vaccination

was largely practised. An attempt has been made to calculate upon the basis of the returns of the above institutions, the proportion of the population in London which was vaccinated during the first twenty years or so of the century; but the data are too uncertain to allow of any value being attached to the result.

30. Incidental references in contemporary writings seem to show that, after about 1805, the first enthusiasm for vaccination somewhat diminished and the practice tended to decrease; but the check seems to have been transient only, for such scattered data as can be obtained show that the practice was very prevalent during the latter part of the first quarter of the century. This is strikingly illustrated by two records, one in London, the other in the country.

Of the children (over 8000, all under 12 years of age) admitted into the Royal Metropolitan Infirmary between October, 1820, and April, 1822, 41 per cent. had been vaccinated, and 6 per cent. inoculated.

At Cambridge, in 1824, of the 8112 inhabitants under 25 years of age (who had been born therefore since the introduction of vaccination) 48·7 per cent had been vaccinated.

At Norwich, in 1819, it was calculated that out of a population of 40,000 about 10,000 had been vaccinated; but there is no statement as to the ages of the vaccinated. The distribution of the vaccinated was irregular, for of 603 persons forming families specially examined, only 91 had been vaccinated, and of these only 57 previously to 1819.

There are no reasons for thinking that, so far at least as towns are concerned, Cambridge was in any way exceptional as regards vaccination. On the other hand, the great similarity of the results in places so different as London and Cambridge, go far to justify the supposition that, could data be obtained, they would show a like state of things in the towns generally. If so it may be concluded that at the end of the first quarter of the nineteenth century, at any rate in towns, a proportion approaching the half of the children born during that quarter were vaccinated. As to the vacci-

nation of those who were adults at this period, hardly any information exists, but incidental references show that at least in the early days of vaccination many adults were vaccinated. To the number of the vaccinated young there must therefore be added an unknown number of persons vaccinated in adult or advanced life. No statistical information is available to show whether the state of vaccination in rural districts differed, and if so to what extent, from that which prevailed in towns.

31. Passing to countries other than England, Sweden deserves attention on account of the relatively complete records existing there. These give not only the population, the births, the total deaths, and the deaths from smallpox from the year 1774 onward, but also from 1804 onward the numbers vaccinated. Vaccination was introduced into Sweden in 1801, and in 1816 was made compulsory in so far that a fine was imposed for nonconformance. In 1804 the number of vaccinations during the year amounted to a third of the number of births, and after some fluctuations in succeeding years reached, in 1825, 70 per cent. of the births. Smallpox was very prevalent in Sweden during the latter part of the eighteenth century, and the year 1800 had been marked by a most severe epidemic. Hence a large proportion of the population at the introduction of vaccination had had the smallpox, and would consequently not be vaccinated; the vaccination during the nineteenth century would fall chiefly on those born during that century; and the near approach of the number vaccinated to the number born shows that a very large proportion of the total population not protected by previous smallpox was vaccinated.[1]

32. In Denmark, into which vaccination was introduced in 1801, being made compulsory in 1810, similar records exist, and here the number of those vaccinated more closely approaches, and in some years even exceeds, the number of births; so that a still greater proportion of the population, not protected by previous smallpox, was vaccinated.[2]

[1] 6, App. 752.

[2] 1, App. 110, 108.

33. If vaccination have the protective influence alleged, in view of the extent to which we have shown that it was practised in the first quarter of the present century, its fruit ought to be seen in a diminution of the mortality from smallpox during that period. This brings us to the second of the two questions which we have said presented themselves: Does the history of smallpox mortality since vaccination was introduced afford warrant for a belief in its protective effect? This, of course, involves an inquiry into any other possible causes affecting the amount of smallpox mortality. We enter then upon the first stage of this inquiry, confining our attention for the present to the period we have indicated.

34. It becomes necessary at the outset to consider the subject of smallpox mortality and its prevalence prior to the introduction of vaccination, and especially during the latter part of the eighteenth century, the period immediately prior to its introduction.

35. The early history of smallpox, like that of many similar diseases, is obscure, is subject to much debate, and, save perhaps on one point, is of antiquarian interest only.

The records of the eighteenth century show that the disease was very prevalent in western Europe during the whole of that century; we shall discuss the history of the disease during that period in some detail presently. The records of the seventeenth century also show that smallpox was a very common disease during that century; this is especially the case as regards the latter half of the century. The statistics which exist with respect to Geneva, and various scattered statements, further show that smallpox was a well-known disease in the sixteenth century, but except for the records which are said to exist of severe epidemics in Iceland taking place as early as 1241, as we go further back the evidence as to the existence of the disease becomes less and less clear, and indeed debatable, depending as it does largely on the interpretation of incidental statements in various medical and other writings. There seems, however, to be adequate proof of the preva-

lence of smallpox in the East, in Asia Minor and other countries, even in the earlier centuries of the Christian era.[1]

A view very generally taken teaches that smallpox, introduced from the East, began to be common in Western Europe during the fifteenth century, though perhaps existing still earlier, that it increased during the sixteenth and seventeenth centuries, especially the latter, and that it was very prevalent during the eighteenth century. It will be desirable not to discuss this view at length, but to confine our attention to the history of the disease in the seventeenth and eighteenth centuries.

36. In dealing with the eighteenth century it must be borne in mind that during the second half of the century the natural conduct of smallpox, as we shall see later on, was modified by the practice of inoculation, that is, by the artificial giving of the disease by the introduction of the virus through a wound in the skin; but it will be convenient to consider in the first place the century as a whole, and to discuss later on the effects of the practice of inoculation.

37. Our knowledge of the history of smallpox in Western Europe during the seventeenth and eighteenth centuries is very largely based on the official records known as the "London Bills of Mortality." Official records bearing on smallpox are furnished by Geneva, going back as far as the sixteenth century, by Sweden, going back to the year 1749, and by some other places. Data are also furnished, especially for the latter part of the eighteenth century, by parish records in various parts of Great Britain reaching over a variable number of years, as well as by scattered statements in various works. But it is chiefly to the London Bills of Mortality that appeal is made for support to the different views maintained as to the behaviour of smallpox during the period with which we are dealing.

38. These Bills, which when established were issued weekly, with a general *résumé* at the end of the year, purport to give an account of all the burials and christenings

1, App. 109-10.

taking place in certain enumerated parishes within and without the walls of the city, and also within and without the "liberties." The earlier Bills, issued before the year 1629, gave only the total deaths and the deaths from plague; but from 1629 down to 1845, with a gap from 1637 to 1646 (both years included), the causes of death, including smallpox, are specified. From 1629 to 1636 and from 1647 to 1686 inclusive the entry is for "flox and smallpox," and from 1687 to 1700 inclusive measles are included with "flox and smallpox." These Bills accordingly afford data of some value for judging of the effects of smallpox in London from 1629 to the close of the eighteenth century and beyond.

39. Their value, however, for exact purposes will be seen to be diminished when the following considerations are borne in mind:

The Bills record not all the deaths taking place within the area of the Bills, but only those made known to the parish clerks in view of burial in the parish churches. Hence the deaths given in the Bills must always have been less in number than those actually taking place. For, on the one hand, it was a not uncommon practice when a person died in London for the corpse to be taken into the country for burial; and, on the other hand, many Dissenters and many Catholics were buried elsewhere than in the Church of England burial-grounds. But it is not possible to ascertain how many deaths there were thus in excess of the deaths recorded in the Bills; and, what is a matter of no little moment, this excess probably varied considerably from time to time.

Even if we accept the record of the deaths recorded as approximately correct, this cannot be trusted implicitly to yield exact conclusions as to the mortality from smallpox, since the population of the area covered by the Bills is not known with certainty. Further, when one period is compared with another, a difficulty is introduced by the fact that from time to time fresh parishes were added to the area from which the Bills were gathered. Then, again, it must be remembered that even at that early time, as now,

the population of London differed from an ordinary population,—from that, for instance, of a country district, inasmuch as it was not so largely determined by the relation of the births to the deaths. A large number of persons, chiefly adults, were continually entering into and taking up their residence in London, and in like manner a large number of adults were for one reason or another continually leaving it. It has been calculated that in 1685 the population within the Bills of Mortality was 530,000, and in 1750, 653,900; but it is obvious that such calculations can have an approximate value only. In 1801 the population was ascertained by census to be 746,233.

It may be added that the women searchers, "ancient matrons" of low estate and uneducated, were directly responsible for the statements as to the cause of death. Though these women were probably guided in their statements by the opinions of the doctors attending the cases, or by the reports of such opinions, they must have given rise to much error. In the case of death from smallpox, however, there was in all probability less liability to error than in some other diseases.

40. Quite apart from all calculations, the Bills clearly show that from 1629 onwards, throughout the remainder of that century and the whole of the next, very many persons died in London from smallpox. During the latter half of the seventeenth century the yearly deaths fell below 500 on eight occasions only. The return of one year, 1666, conspicuous for the smallness of the number of deaths, 38 only, is intelligible when it is remembered that this is the year succeeding that of the Great Plague. The Bills also show that in both centuries the disease had an epidemic character, the returns of certain years being much greater than those of others. In many instances the epidemic increase is marked in one year only, the returns of the succeeding year being, as a rule, low, but not unfrequently the epidemic lasted over two or more years; and this appears to have occurred more frequently in the eighteenth than in the seventeenth century. Indeed, the variations of

the numbers are, as a rule, more abrupt in the latter than in the former period.

41. When we turn to the important question of the mortality from smallpox, that is to say, the proportion of deaths to the number of persons living, we are met with the difficulty of the population not being exactly known. As already stated, it has been calculated that the population in 1685 was 530,000. On the basis of this datum, the average yearly death-rate of, or *mortality* from, smallpox in the ten years around this date, namely, in the years 1681–90, was 3·139 per thousand; the mortality from all causes of death being 42·2 per thousand. Similarly in the ten years 1746–55, on the calculation that the population in 1750 was 653,900, the yearly mortality from smallpox was 3·044, that of deaths from all causes 35·5 per thousand. Taking the same calculations as to population we find that in years when the deaths from smallpox were very high, the mortality from smallpox, both in the seventeenth and eighteenth centuries, was frequently 3, 4, 5, or even more per thousand. Even if we take the years in the eighteenth century in which the returns of deaths from smallpox were the lowest, viz. 1702, 1753, 1782, we find, still using the above calculations, the mortality from smallpox 0·6, 1·2, and 1·0 respectively; and in 1797, using the census of 1801, the death-rate was 0·7. And in most of the years of that century the mortality from smallpox was either not far below, or very distinctly above, 2 per thousand. All this means, even when every allowance is made for the insecurity of the calculations, that the mortality from smallpox in London was, during the eighteenth century, very high. This is a broad conclusion which may be considered as definitely proved.

42. It is further confirmed by the indirect measure of the mortality of smallpox, which is offered by the proportion of deaths from this cause to deaths from all causes. This has the value of being independent of the actual population; and, so far as can be judged, is not vitiated by the record of the smallpox deaths being influenced by anything which

did not also influence the records of the other deaths. On the other hand, its value is very largely lessened by the fact that the ratio is determined and influenced by circumstances affecting other diseases and not smallpox itself. It may, however, be trusted so far as to show that the ratio during the seventeenth and eighteenth centuries was very high, and, on the whole, higher during the eighteenth than during the seventeenth century. Further, if we assume, as we have probably the right to do, that the total death-rate was during those centuries very high, as compared, for instance, with the present time, we may infer that the death-rate from smallpox was very high, and the disease either very fatal or very prevalent.

43. The Bills give no information whatever about the number of persons attacked by the disease, and therefore teach us nothing as to the *fatality* of the disease,—that is to say, the proportion of deaths to the number of cases attacked. We learn, however, by the incidental statements of various authors, that the fatality varied very much in different years,—that is, in different epidemics. An epidemic was often spoken of as being either mild or malignant; in some epidemics, though many might be attacked, the proportion of those who died was small; in others the disease proved fatal to a large number of those attacked.

44. Although from 1728 onwards the Bills give the ages at death, the numbers have not been analysed so as to show the "age incidence" of the smallpox mortality, that is to say, the relative mortality at different ages. And the Bills furnish no data for determining how such influences as those of station in life, sanitary conditions, and other circumstances affected the mortality.

45. These Bills of Mortality form, as we have said, by far the most complete source of our knowledge of smallpox in England in past times; but it must be borne in mind that in respect to any contagious disease like smallpox the conditions of London were peculiar. The population was to a marked extent a moving one; a large number of

persons were continually entering London or leaving it, were passing to and from it, from and to the provinces of England and other countries. Of these persons some, coming from infected districts, brought into London fresh sources of contagion; others again, coming from districts free from smallpox, and never having had the disease, brought into London fresh material to serve as food for the disease. Further, London presented in an exaggerated degree the two features of a great city which have a great influence on the progress and characters of a contagious disease like smallpox. The crowding both of the dwelling-places and the thoroughfares, as well as the movement continually going on, multiplied the opportunities for the spread of disease; and the accompanying insanitary conditions, as well as the greater inducement to irregular living, tended to increase the severity of the disease when taken, and to heighten the mortality from it. The history of smallpox in London must not be taken as representative of the history of smallpox in England generally.

46. Apart from the London Bills of Mortality, our information concerning smallpox in England in past times is limited to the records of various scattered places, records confined in most cases to short periods, chiefly in the middle or latter part of the eighteenth century, or to incidental accounts and remarks. From these it would appear that in some places and at times smallpox was exceedingly prevalent, and at other places or at other times at least rare if not exceedingly so.

47. A valuable and instructive record is that given by Haygarth of an epidemic of smallpox in Chester in the year 1774. Out of a population of 14,713 there occurred during the year 1774, 1202 cases of smallpox, of whom 202 died. On the 1st January, 1775, it was ascertained that 1060, that is about 7 per cent. of the population, had not had the smallpox during the previous year or at any earlier time. This was after the epidemic, which, as the figures showed, was severe; before the epidemic, on the supposition that none of those who took the disease in 1774 had suffered from

it before, the numbers who had not had it on the 1st January, 1774, were 2262, or 15 per cent. of the whole population, and of these more than half were attacked before the end of the year. Although experience shows that the hypothesis that none of those who were attacked in 1774 had previously suffered from the disease is not likely to be accurate, it shows also that the number of those who suffered a second time is not likely to have been so numerous as seriously to affect the calculation.

A record exists of an epidemic at Warrington in 1773. In a population estimated at 8000 there were, during that year, 211 deaths from smallpox. The deaths from all causes during the same period amounted to 473.

Again, in the small town of Ware in 1722, out of a population of 2515 at the beginning of the epidemic, 1601 had previously had the smallpox, leaving 914 susceptible persons. Among these there were during the epidemic 612 cases with 72 deaths, leaving at the end of the epidemic 302 persons who, having escaped the attack, are spoken of in the record as "to have the smallpox."

48. These records do not merely show the severity of the epidemics with which they deal, comparable with those of London, but those of Chester and Ware also show, what is much more important, how small a portion of the population in such places had not suffered from smallpox at some time or other. They show that in a provincial city, and in a small agricultural country town, there were epidemics of smallpox during the period with which we are dealing comparable with those disclosed by the London Bills of Mortality. There is no reason to think that the condition of things in Chester or in Ware was exceptional; it may probably be taken as illustrative of like towns elsewhere.

49. On the other hand, there is evidence that in the eighteenth century in some districts of England smallpox was very rare. Thus in three small rural parishes in Kent, with a united population of 1088, there were recorded during twenty years in the latter half of the century, only ten deaths from smallpox.[1]

[1] 4, App. 398.

There are no means of ascertaining to what extent a like paucity of smallpox existed in other rural districts of England. Haygarth, in referring to the rural parishes just quoted, states it as his opinion that in his own neighbourhood such a freedom from smallpox was unknown, and was probably so wherever inoculation was practised.

50. In one respect the provinces differed from the metropolis. In London, as we have seen, smallpox was always present during the eighteenth century; though in some years the deaths from smallpox were more numerous than in others, a large number died every year; even in the years quoted above as yielding the lowest returns, the yearly number of deaths is still considerable. In the provinces, as is shown by records and numerous incidental statements, the disease had a more distinctly epidemic character, especially in towns other than the great cities and in rural districts. Thus in the small parish of Kilmarnock the records show that the smallpox was severe every few years, between which there were no deaths at all from smallpox or very few only.[1] Hence we may conclude that though in the districts where for one reason or another epidemics did not make their appearance, as in the Kentish rural parishes, the mortality from smallpox was low, yet where epidemics did make their way the prevalence of smallpox was great and the mortality from it high, comparable, indeed, with that of London.

51. Records exist of the deaths from smallpox in the times previous to the nineteenth century in countries other than England.[2] Thus in Sweden, records from 1774 to the end of the century (and beyond) give both the population and the deaths from smallpox. (The records go back to 1749, but up to 1774 the deaths from smallpox and measles were not distinguished.) These show great variations in the yearly mortality from smallpox. In some (epidemic) years the mortality was very great, greater even than that of London, as calculated from the Bills of Mortality in the manner described above; on the other hand, in many years

[1] Q. 24823, 24979.

[2] 6, App. 752; 1, App. 112.

the mortality was much lower than that ever reached in London during the same period. In Sweden, as a whole, as in the provinces of England, the disease had a very marked epidemic character. Similar records relating to Copenhagen and Geneva, the last reaching back to 1580, and other places all confirm the conclusion as to the great prevalence of, and high mortality from smallpox in Western Europe during the eighteenth century and earlier.[1]

52. But perhaps the most striking evidence in favour of this conclusion is to be seen in the fact that the chance of taking the disease and of dying from it was made the subject of mathematical treatment by distinguished mathematicians of the time. Thus Daniel Bernouilli, writing in 1760–65, takes as one of the bases of his calculation the datum (arrived at by means of various records in various places) that smallpox carries off the thirteenth or fourteenth part of each generation; or in other words, that the deaths from smallpox are about one thirteenth or one fourteenth of the deaths from all causes. The same author uses another datum obtained in a similar way, namely, that the eighth or the seventh part of those attacked die of it. From this it follows that something like 40 per cent. of those born died without having smallpox. Since of these so dying a large number died at an early age, the number of those dying in adult and in advanced age without ever having had the disease would be much less. And in this sense, probably, must be read the statement of Haygarth, which he gives without supplying the data on which it is based, namely, that "some persons are incapable of infection by the smallpox. The proportion of mankind thus exempted has been observed to amount to one in twenty," that is to 5 per cent. The persons here referred to are probably those who lived to an advanced age without taking smallpox, though exposed to infection, and possibly (for Haygarth wrote in the inoculation period) subjected to inoculation.

That Bernouilli should use data like the above for an elaborate work, and that a careful observer like Haygarth should make such a statement as that above quoted, empha-

[1] 1, App. 107.

sises the conclusion as to the great prevalence of smallpox in the times in question.

53. We may pass now from the mere prevalence of or the mere mortality from smallpox to its fatality in those days. Much controversy has arisen on this point, and much has been made of the statistics of Dr. Jurin on this head. The returns furnished to him of the number of cases attacked, and of the number of deaths of those attacked during epidemics in various places in England and America, showed an average rate of fatality of 16·5 per cent. amongst those attacked. This, which does not differ much from the datum employed by Bernouilli, has been put forward by many as being about the natural fatality of smallpox during the eighteenth century. It has been urged that the deaths of those dying under two years of age were excluded from Jurin's statistics, and that this must have led to the omission of many deaths, as the mortality in that class was high. The evidence relied on to show that cases under two years of age were excluded certainly cannot be regarded as establishing it. It is to be observed that although the average fatality in what are known as Jurin's cases was only 16·5 per .cent., the fatality in the various epidemics from which those statistics were compiled varied greatly, ranging from 10 to 36 per cent. There are instances where the fatality has been even less than 10 per cent. As has been already remarked, the fatality of smallpox differed very greatly in different epidemics. Bernouilli, in taking the average fatality quoted above, remarks on its great variability, it may be as high as 1 in 3 (and indeed still higher results have been recorded), or as low as 1 in 40. The records of the London Smallpox Hospital from 1746 to 1763 showed a fatality of 25·3 per cent., and it has been stated that during the last twenty-five years of the last century 32 per cent. of those admitted succumbed to the disease. In the Bill of Mortality of the town of Warrington for the year 1773, by the Rev. J. Aikin, communicated by Dr. Percival to the Royal Society of London, it is stated that in one neighbourhood, out of 29 who had the disease 12 (that is to say, 41·3 per cent.) died.

He states, further, that in other neighbourhoods the fatality was still greater, and that he had reason to believe that it was not less on the whole. There can be no doubt that the fatality of smallpox differed very greatly in different epidemics. So great are the variations that only very large numbers would justify an average being accepted as showing what may be called the normal or natural fatality. It is much more important to bear in mind that the fatality differed widely on different occasions.

54. One character of the smallpox in the eighteenth century (and there is nothing to prove the state of things before the eighteenth century to have been different) is brought out in all the records in which the ages are given, namely, the large proportion of the deaths contributed by the very young. Thus in Chester, in the epidemic of 1774, all the 202 deaths were of those under ten years, and a quarter of them under one year. In Warrington, in 1773, all the deaths were of those under nine years. In Kilmarnock, of the 622 deaths occurring between 1728 and 1763, the ages of nine not being given, only seven were of those above ten years.[1] The burial registers for the graveyard of St. Cuthbert's, Canongate, and Buccleuch Street, Edinburgh, show that during the years 1764–83 the proportion of deaths from smallpox of those below the age of ten years, to every thousand deaths from that disease at all ages, was 993.[2] Indeed, in all records of epidemics in which the ages are given, the mortality was mainly amongst infants. It is also seen in the larger records, covering periods including both epidemic years and years which were not epidemic, as in those of Geneva (1580—1760),[3] which show that the feature was apparent earlier than the eighteenth century, in those of Sweden (1774–1800) and in those of other places. Incidental references in various writings show that the fact was recognised at the time; thus Haygarth observes that in Chester in the years 1772–77, of those under ten years, "half as many die of the smallpox as of all other

[1] Q. 24823, 24979.
[2] 6, App. 642.
[3] 1, App. 76.

diseases;" and this feature of smallpox is assumed in the calculations of Bernouilli referred to above.

55. The first quarter of the nineteenth century was characterised in this and other countries by a striking decrease of smallpox.

56. In the London bills of mortality the returns of smallpox for the year 1800 are 2409. This was the last return so high as 2000. From thence onward the number of deaths from smallpox fell, especially after 1810, reaching in 1818 so low a figure as 421; the fall being irregular and marked by epidemics as in 1812, 1817, and 1825. This decline is all the more striking since during this period the population of London within the limits of the Bills, increased from 746,233 in 1801 to 1,180,292 in 1831. As has been already urged the Bills were imperfect, and there is ground for believing that during this quarter of the century the imperfections were greater than in former times. This is confirmed by the fact that the returns of the total deaths, in spite of the increased population, were on the whole not greater, in many years even less, than in the preceding century. Making every allowance for the effects of improved sanitary conditions, this feature of the returns may be taken as evidence of their imperfection. Still, in spite of their imperfect character, the Bills show that during this quarter of the century a striking change took place in smallpox in London.

57. Adequate records of the prevalence of and mortality from smallpox in parts of England other than London during the first twenty-five years of the nineteenth century are not available; but that in the provinces, as in London, a very great change had taken place is shown by comparing the condition as regards smallpox of towns at, or towards the end of, this period with that of towns during the last century.

In Cambridge, with a total population of 14,142 in 1821, the number of persons who, up to the summer of 1826, had had smallpox during the preceding twenty-five years was

3560, or about 25 per cent. These figures result from the answers given to inquiries in a house-to-house visitation, and, being dependent on the memory of those interrogated, can have only an approximate value. Moreover they of course omit all who had smallpox anterior to the twenty-five years. On the other hand, a severe epidemic of smallpox took place in Cambridge in 1823–4, and the deduction of the 686 cases of that epidemic from the numbers above reduces the percentage to about 20. The population born during the above twenty-five years amounted to 8112; of these 34·4 per cent. had had smallpox, 12·7 per cent. by inoculation.

In Chester, of which previous mention has been made, with a population in 1774 almost the same as that of Cambridge in 1821, viz. 14,713, by the 1st January, 1775, all but 1060, that is about 93 per cent., had had smallpox at some time or other. The year 1774 was marked by a severe epidemic of smallpox, the number of cases being 1202; hence of the population on the 1st January, 1774, all but 2262, or about 85 per cent., had had smallpox.

Again, in Ware in 1722, of which mention has also previously been made, of a population of 2515 all but 302, or about 82 per cent., had had smallpox. That, again, was after an epidemic of 612 cases; so that the percentage before the epidemic was about 64.

Data, more fragmentary, exist concerning Norwich in 1820, which city, with a then population of about forty thousand, had had epidemics of smallpox in 1805, in 1807–9, in 1813, and in 1818–9; the last being very severe, the deaths for the year 1819 being 530, a mortality of about thirteen per thousand. Mr. Cross (*History of a Variolous Epidemic*, p. 38) states that visiting 500 families, with 1377 persons under twenty years of age, he found that 715 (or more probably 726), *i. e.* about 52 per cent., had had smallpox. But of these 357 (more probably 368) had had the disease during the recent epidemic, and 358, or about 26 per cent., had had it earlier. He further states that of 603 persons, forming the 112 different families in which the 200 cases of smallpox which came under his notice during the epidemic occurred, 497 (or roughly 70 per cent.) had had the smallpox at some time or other. Of these 297 (or

about 50 per cent.) had had the disease previous to the epidemic. No mention of age is made in the latter statement, and the former statement probably gives a more correct idea of the general condition of the city. If so, Norwich did not differ as to its condition in regard to smallpox very widely from Cambridge, and like it presents a contrast to Chester,—not so striking a one, but still instructive, since Norwich in the first quarter of the present century, like Chester in the last century, suffered from severe epidemics of the disease.

58. The data of the two epochs are not exactly comparable, though, from what has been stated concerning the age-incidence of smallpox in the eighteenth century, the greater part of those who suffered in Chester and Ware had probably had smallpox within the previous twenty-five years. Moreover the data in any case are approximative only. Still, making every allowance, the contrast between the two epochs confirms the conclusion as to the decline of smallpox in the provinces in the first quarter of the nineteenth century.

59. If, leaving England, we turn to other countries, to Sweden, for instance, in which, as has been seen, records more exact than those in England exist,[1] the same marked change is apparent,—indeed, is still more clear. As has already been stated, the smallpox mortality in Sweden from 1774 to 1801 was very high, comparable to that of London, though more strongly marked by epidemic variations.[2] This state of things is shown as far back as 1749, but less exactly, on account of measles and smallpox being returned under the same head between 1749 and 1773. In 1800, a great epidemic year, the mortality was over 5 per thousand, and the yearly average of the period 1774—1801 was over 2 per thousand. From 1801 onward there is a fall, becoming great after 1809; the yearly average reaching 1 per thousand in one year only, 1809, falling after 1816 often below 0·1 per thousand, and, indeed, in one year reaching 0·04 per thousand, but rising again to nearly 0·5 per thousand in 1825.[3]

[1] 6, App. 752. [2] 1, App. 112. [3] 1, App. 107-8.

60. A similar change is shown by the exact records of Copenhagen, which reach back to 1750. Smallpox was prevalent up to 1801, then suddenly declined; indeed, for a while it quite disappeared, no deaths being recorded between the years 1810 and 1824.

61. And a similar change is seen in such records as are available relating to other countries of Western Europe and to the United States. In all cases the first quarter of the new century is marked by a great diminution of smallpox deaths.

62. What was the cause, or what were the causes, of this marked decline of smallpox in the first quarter of the nineteenth century? Was it due to the introduction of vaccination, or is it to be otherwise explained?

63. One effect of the introduction of vaccination was a very great decrease in the practice of inoculation, which had become very prevalent during the later part of the previous century. And the view has been put forward that, the prevalence of inoculation having greatly increased the amount of smallpox, the diminution of smallpox in question was the result of the decrease of inoculation.

64. The practice of inoculation for the smallpox, that is the artificial introduction of the virus into the system by the insertion of fluid from a variolous pustule into wounds of the skin made for the purpose, began definitely in England towards the end of the first quarter of the eighteenth century. Attention was directed to the matter by letters from Timoni of Athens (dated 1713) and Pylarini, published in the twenty-ninth volume of the *Philosophical Transactions* (1716), and especially by a letter from Lady Mary Wortley Montagu in 1717. Though there are indications that in Great Britain and Ireland, as in other countries, some sort of inoculation had occasionally been practised at a much earlier date, the first clearly recorded case in England is that of the daughter of Lady Mary Wortley Montagu (whose son had some time before been inoculated at Constantinople), inoculated by Maitland, in

London, in April, 1721. Other cases soon followed in England, and about the same time the practice was also introduced in other countries of Western Europe, and into the United States of America, namely, at Boston.

65. It was found that the attacks induced by inoculation were as a rule milder, and very much less fatal than the attacks of the "natural" disease, the fever and constitutional disturbance being less and of shorter duration, and the eruptive pustules much fewer; the number of these varied, being commonly a dozen or two, sometimes only two or three, sometimes a hundred or more. In some cases there was no eruption at all, the effect being limited to constitutional disturbances and to changes in the wounds of inoculation themselves; it was maintained that in such cases the disease had really been taken, and immunity against a subsequent attack secured, as in cases of natural smallpox or of inoculated smallpox manifesting itself in an eruption of pustules.

66. In England the practice of inoculation at its introduction, though much lauded and strongly urged by some, was bitterly opposed by others. Moreover the initial enthusiasm in favour of it soon declined, so that in the years 1730–40 very little inoculation seems to have been practised. About 1740, however, a revival appears to have taken place; in 1746 an Inoculation and Smallpox Hospital was started in London; and during the whole of the latter half of the eighteenth century the practice may be said to have been very general. It was especially so during the last quarter of the century, the increase being at least largely due to the "improved methods" of inoculation introduced by one Sutton in 1763, and known as "the Suttonian method."

67. This method, carried out by Sutton himself and his immediate associates, as well as in a more or less modified form by Dimsdale and others, had for its object the securing that the attack induced by inoculation, while remaining a veritable attack of smallpox and so bringing immunity against future attacks, should be as mild as possible; that

the constitutional disturbance should be slight and of short duration; that the eruptive pustules should be few, or even absent altogether; and that a fatal issue, the somewhat frequent occurrence of which had in the early days been a great obstacle to the spread of the practice, should be rendered at least very rare indeed, if not impossible. Concerning the essentials of the method, which Sutton attempted to keep a secret, there has been much discussion; they seem to have consisted partly in a proper care or regimen of the patient before, during, and after the inoculation, partly in the mode of inserting the virus, and partly in making use of the fluid of the variolous vesicle at a relatively early stage.

68. There can be no doubt that between the years 1770 and 1780 inoculation was very widely practised in England, and there is no evidence to show that any marked decline in the practice took place during the remainder of the century. But the distribution of the practice was very unequal. It was much more common among the rich, or at least among the well-to-do, than among the poor, though many benevolent efforts were made "to extend its advantages" to the latter. Again, in some districts, as in Essex and Herts, the home of Sutton and Dimsdale, and in Yorkshire, the practice was very wide-spread. On the other hand, parts of Kent and Sussex are quoted by Haygarth in 1793 as having been practically free from inoculation, and similar statements as to the paucity of inoculation in this or that district are made by other writers of about the same period.

There are no records giving exact information as to the amount of inoculation practised in London, but seeing that it was favoured by the rich, and that, on the other hand, opportunities for the poor were afforded by the inoculation hospital, we may, perhaps, conclude that the practice was at least very general.

69. What influence, then, had the practice on the prevalence of, and on the mortality from smallpox during the latter half, and especially during the latter quarter of the eighteenth century?

70. Since an inoculated person was infectious, each inoculation was a source of danger to those, not protected by a previous attack, who came into the company of, or even near, the inoculated person during the attack; and this danger was increased by the fact that the mild character of the inoculated disease permitted, in many cases at least, the patient to move about among his fellows. Moreover, as Haygarth, himself a zealous advocate of inoculation in a systematic regulated manner, points out, the beneficial results of inoculation had robbed the disease of its terrors to so great an extent that the rich and powerful no longer made the efforts which they formerly did to prevent its entrance into, or its spread in their neighbourhood, and thus favoured its spread among the unprotected poor; so that inoculation, "though eminently useful to the rich, appeared to be injurious to the poor." Adding, therefore, together the cases of inoculated smallpox, and the cases of natural smallpox of which the inoculated cases were in one way or other the cause, it seems probable that inoculation did tend to increase the *prevalence* of smallpox; but there are no recorded data to show that this really was the case, and this supposed influence may have been counterbalanced by other influences.

71. The evidence as to the influence which inoculation had on the mortality from smallpox is in many respects conflicting. Haygarth, though he admits that in other parts of the kingdom the practice may have saved many lives, was persuaded that in his own part of England and Wales the deaths by the smallpox had been augmented by it; and he points out that in London, Geneva, and other "towns in different situations and circumstances the mortality from this distemper has increased since the introduction of inoculation." Several writers in the latter part of the last and the early part of the present century held a similar view. Other writers, again, opposed this view.

72. Much use has been made of the London Bills of Mortality as bearing on the question. These, as has been pointed out, seem to show, in spite of all their imperfections, that the smallpox mortality in London was greater during

the eighteenth than during the seventeenth century; and it has been urged that the increase was, in part at least, or even largely, due to the introduction of inoculation.

The several quarters of the eighteenth century need, in respect to this point, to be distinguished. During the first quarter there was, broadly speaking, no inoculation at all; the few cases from 1721 to 1725 may be neglected. During the second quarter there was very little inoculation, the practice not beginning really to increase until after 1740. During the third quarter the practice rapidly increased, culminating with the introduction of the Suttonian system in 1763. And the great prevalence of the practice appears to have continued during the whole of the last quarter.

Had inoculation been the main cause, or even a large cause, of the increase of mortality during the eighteenth century, this increase would be expected not to be prominent until about the middle of the century, to rise rapidly during the third quarter, and to be more or less stationary during the last quarter. On the contrary, whether the severity of the disease be judged by the total deaths recorded in the bills, or by the proportion of smallpox deaths to deaths from all causes, or by the mortality calculated on the supposed number of inhabitants, or by the relative severity, frequency of occurrence and duration of the epidemics, such increase as the bills show in the severity of the disease during the first quarter, when there was no inoculation at all, and during the second quarter, when there was very little, is as marked as, or more marked than, during the latter quarter, when inoculation was most prevalent. The bills, therefore, do not show that inoculation was the main, or a large, cause of the greater mortality from smallpox in London during the eighteenth century.

73. It must be borne in mind that inoculated smallpox was on the whole much less fatal than that naturally acquired. The class of inoculated persons may thus have contributed less to the fatal cases of smallpox than if they had been left to the chances of natural contagion.

74. That inoculation might have the effect of diminishing very largely the mortality from smallpox is shown by the

records of Boston, U.S.A. In these the cases of and deaths from smallpox, both natural and inoculated, are given for a series of years; and, the population being known, the mortality can be exactly determined. The diminution both in the whole mortality from smallpox and in the cases of natural smallpox is very great indeed. Making every allowance for greater care being taken in Boston than in London—for instance, that the cases of inoculation should not serve as causes of infection, —these records afford very strong evidence in support of the view that, on the whole, inoculation did not, at least materially, increase the mortality from smallpox.

75. The general conclusion which may be drawn seems to be that inoculation had a double influence, one favourable, the other unfavourable, as regards smallpox; and, owing to the conflict between these two influences, it produced but little effect upon the prevalence of or mortality from smallpox.

There is no adequate evidence that inoculation did increase the mortality from smallpox. There was certainly, so far as the evidence goes, no such increase of smallpox, coincident in point of time with the increase of inoculation, as to justify the decrease of the latter being considered the main cause of the marked decline of the former. Nor is there sufficient even to show that it was a distinct subsidiary cause.

76. It is to be observed that some opponents of vaccination, whilst insisting that the decline in smallpox mortality in the first quarter of the present century was due to the discontinuance of the practice of smallpox inoculation, have contended that what was supposed to be vaccination during that period was in reality inoculation with smallpox virus. It is obvious that these theories are mutually destructive. If the so-called vaccination was in truth smallpox inoculation, and the latter practice increases the prevalence of smallpox, the disease should have increased and not diminished during the period under review.

77. Another view has been put forward, attributing the decline in question to the improvement of sanitary conditions.

78. The question how far the behaviour of smallpox in the

eighteenth century and earlier was influenced by sanitary conditions, is one rendered difficult by the lack of exact information. We may distinguish between overcrowding as one insanitary condition and all other insanitary conditions, such as lack of cleanliness and the like. *A priori* we should expect that a dense population, especially one of great internal movement, and one in continual interchange with surrounding populations, by offering greater facilities for the conveyance of contagion would lead to a greater amount of smallpox. London was a conspicuous instance of the above, and the apparent greater prevalence of smallpox in London than in the provinces may be attributed to these causes; but it would appear that the increase was felt, as indeed would, *a priori*, seem probable, rather in the constant presence of smallpox to a considerable amount at all times than in the mortality of the epidemics when these occurred. And the same seems also to be shown to a less extent in other large cities, such as Liverpool. But in this matter of dense and moving populations the eighteenth century did not differ markedly from the early part of the nineteenth. We might *a priori* expect the other acknowledged imperfect sanitary conditions of the eighteenth century to increase the fatality of, and so to a corresponding extent the mortality from, smallpox; but there is no exact evidence to confirm this supposition. If, on the contrary, we recognise that in the course of the eighteenth century the general mortality, the relative number of deaths from all causes, went on decreasing, and attribute, as has been done, this decrease to improved sanitary conditions, no like decrease of smallpox took place. Again, the places which were deemed the most salubrious appear to have been visited by epidemics of smallpox as severe as those which fell on unhealthy places. Thus the epidemic in Chester in 1774 was undoubtedly a severe one, and yet Haygarth writes, "The healthiness of Chester," as shown by statistics, "must appear so very extraordinary as to be almost incredible." And in general both the incidence of, and mortality from, smallpox seem to have been far less affected by sanitary conditions than might *a priori* have been expected.

79. It may be urged against the view that the decline of

smallpox was due to improved sanitary conditions, in the first place, that, admitting the introduction of sanitary improvements, no evidence is forthcoming to show that during the first quarter of the nineteenth century these improvements differentiated that quarter from the last quarter, or half, of the preceding century in any way at all comparable to the extent of the differentiation in respect to smallpox. In the second place, admitting *a priori* that crowded dwellings tend to increase the liability to contagion, and so the prevalence of the disease, while other insanitary conditions tend in addition to increase the fatality among those attacked, so that insanitary conditions as a whole must tend to increase the mortality from smallpox, no evidence is forthcoming which distinctly shows that the dependence of the prevalence of, or the mortality from, smallpox, on the lack of sanitary conditions, was a feature of the history of smallpox during the eighteenth century.

80. It has, indeed, been urged that the London Bills of Mortality show, in respect to the heading "Fevers," a decline during the first quarter of the nineteenth century comparable to the decline of smallpox during the same period; that the former is to be explained by the improvements in sanitary conditions, and that therefore the latter is to be explained in the same way.

But it must be borne in mind that while there is no difficulty in recognising and naming the disease smallpox, so that the heading "Smallpox" in the bills may be taken to have included very few cases which were not smallpox, and to have omitted very few which were, the case is very different with the heading "Fevers," the returns under which were so dependent on diagnosis and nomenclature, that a difference in these respects would produce a large change in the number of cases found under this heading, without any change in the actual disease or diseases themselves. Scarcely any heading in the bills can be less safely trusted as an indication of the conditions affecting disease.

If we turn to some other diseases—as, for example, measles—we find no trace of the influence of sanitary improvements in the early part of this century as compared

with the period preceding it. There was no decline of the mortality from that disease, but, on the contrary, an increase. Moreover some of the diseases which contributed to the heading "Fevers" are dependent on sanitary conditions to an extent and in a manner wholly different from smallpox.

We shall return to this question hereafter, and discuss more fully the influence exercised by sanitary changes upon the mortality from smallpox.

81. Moreover it must be remembered that the decline in smallpox mortality was observed in Western Europe in countries where the sanitary conditions were widely different. Whatever may have been the sanitary improvements during the first quarter of this century in England and some other countries, there seems no ground for supposing that throughout Western Europe the period was marked by great changes in the direction of improved sanitation. Indeed, in many countries down to a recent period, in some it may perhaps be said even to the present time, insanitary conditions have continued to prevail.

82. There is no proof that sanitary improvements were the main cause of the decline of smallpox under discussion. And no adequate evidence is forthcoming to show to what extent such improvements may be considered as a subsidiary cause.

83. The decline in question followed upon the introduction of the practice of vaccination. The records of Western Europe and the United States show that, in all places whence returns were obtained, the introduction of vaccination was followed by a decline of smallpox; the decline becoming especially apparent after the lapse of such time as may be supposed to be necessary for the due spread of the practice.

Moreover the spread of the practice and the decline of the disease do not stand as two phenomena simply following the same course, but without any tie joining the two. The experimental evidence offered at the time, namely, that the class of vaccinated persons did not take smallpox, by way

either of exposure to natural contagion or of inoculation, as the unvaccinated did, connects the two, and points to the spread of the practice as the cause of the decline.

84. It has been suggested that the decline was due to some general unknown conditions, which have been spoken of as "cosmic" or "secular." It has been urged that such general "cosmic" conditions led, on the one hand, to the spread of smallpox in Europe during the seventeenth and especially during the eighteenth centuries, and, on the other hand, conversely to its decline in the beginning of the nineteenth century. The possibility of such general "cosmic" conditions influencing smallpox cannot be denied; but at present, at all events, the appeal to such conditions is the result, not of positive knowledge, but of our inability to explain the phenomena otherwise. Moreover it is not certain that the relative paucity of smallpox in Europe before the seventeenth century was not apparent rather than real, being due merely to absence of information; if so, there is no necessity to seek in "cosmic" influences the cause of the supposed later increase.

In attempting to judge of the decline in question being due to such "cosmic" influences, we are met with the difficulty that exact records of the prevalence of smallpox during the period under discussion are wanting in respect to countries where vaccination was not practised. But such information as is available goes to show that in the countries where vaccination did not become general, smallpox prevailed in the first quarter of the nineteenth century very much as it had prevailed in the eighteenth. Thus in Egypt vaccination was not introduced until 1827,[1] and up to that time smallpox was extremely prevalent; the decline, which in Western Europe was marked during the first quarter of the century, appears to have been absent there. Again in America,[2] though in the early days of vaccination efforts were made to spread the practice among the native tribes, these (especially the tribes of the West) remained unvaccinated, and among them the ravages of smallpox in the

[1] 6, App. 746, and Enclosure A, there referred to, at pages iii, iv, 9 and 23; 6, App. 747–9.

[2] 1, App. 63, foot-note (last).

first quarter of the nineteenth century are described as of extreme severity. So in Brazil,[1] vaccination, though introduced early, was not carried on with the same energy as in Europe, and here severe epidemics of smallpox occurred. There is no adequate evidence of a decline in unvaccinated countries like that which took place in vaccinated countries, and there is no sound reason for attributing the latter to any theoretical "cosmic" influences.

85. Upon the whole, then, we think that the marked decline of smallpox mortality in the first quarter of the present century affords substantial evidence in favour of the protective influence of vaccination.

86. It has been urged that the decline was too great to have been due to the amount of vaccination which prevailed. It has been shown, however, that the amount which was carried out was very considerable, and the argument that such an amount was insufficient to produce the decline in question is based on the premiss that such an amount of vaccination would at the present day be considered wholly insufficient protection. But it must be borne in mind that in the countries so often mentioned a large proportion of the population were protected by previous attacks of smallpox, either natural or inoculated; only a portion of the population needed the protection claimed for vaccination. And if the vaccination in the early years of the century was as general as we have seen reason to think it was, that, added to the protection afforded by previous attacks of smallpox, may be regarded as adequate to have produced the decline in question.

Of course, as years went on, the proportion of the population immune through previous smallpox became, owing to the mere decline of smallpox, continually less and less, as the large number who had had the smallpox in the previous century gradually died out. After the first quarter of the century that part of the population which depended for immunity on vaccination alone became, in the absence of serious epidemics, greater and greater;

[1] 6, App. 742–4.

and an amount of vaccination adequate to afford great protection in the earlier years ceased to be adequate for the latter years. But this brings us to the periods succeeding the first quarter of the century, which will be considered hereafter.

87. We have dealt thus with the evidence afforded by the first quarter of the present century, because it constituted a convenient epoch for inquiring whether mortality from smallpox had shown signs of diminution in the period immediately succeeding the introduction of vaccination, and not because the close of that quarter of a century was in any respect a dividing line. So far as England is concerned a new epoch commenced in 1837. There was nothing to distinguish the phenomena observable between 1825 and 1837 from those of the preceding years of the century, and the only mortality statistics in our possession relating to those intervening years became not more but less accurate and satisfactory.

88. In the year 1837, however, the present system of registration of deaths commenced in England, so that from that period more exact statistics of smallpox mortality are available. In Scotland a similar system of registration was not initiated until 1855, and in Ireland until 1864. In the latter country, however, information with reference to the mortality in preceding years was, prior to the registration of deaths, acquired when the decennial census was taken. This practice commenced at the period of the census in 1841.

89. Before proceeding to inquire what light the records of smallpox mortality in England, Scotland, and Ireland, during the years when more accurate information has existed as to smallpox mortality, throw upon the question of the effect of vaccination, it will be convenient to make a brief statement of the laws which have been from time to time passed with reference to that practice. This is important, because it has been argued that a connection may be observed between the diminution of smallpox in the epochs subsequent to the different Acts passed by the Legislature, for the

purpose of encouraging or compelling vaccination, and the increase of vaccination which would naturally result from those enactments.

90. Although the House of Commons had made grants to Jenner in 1802 and 1806, and annual grants to the National Vaccine Establishment, which was founded by Royal Warrant in the following year, no statute was passed dealing with the matter until the 23rd July, 1840. On that day the Act 3 and 4 Victoria, chapter 29, entitled "An Act to extend the practice of Vaccination," received the Royal Assent.

91. By that Act the Guardians and Overseers of every parish or union in England and Wales were empowered, and they were thereby directed to contract with their medical officers or with any legally qualified medical practitioners, for the vaccination of all persons resident in such unions or parishes respectively. Payments were to be made dependent on the number of persons who, not having been previously successfully vaccinated, should be successfully vaccinated by the contracting medical officer or practitioner. In making their arrangements Guardians and Overseers were by Section 2 to conform to regulations made by the then existing Poor Law Commissioners, who had power conferred on them for the purpose.

By the eighth section of this statute inoculation of the smallpox was declared to be illegal, and the use of it was made penal.

The provisions of this Act by its sixth section applied to Ireland.

92. In the next year, on the 21st June, 1841 (4 and 5 Victoria, chapter 32), there was supplementary legislation (1) charging the expenses of carrying out the Act of 1840 on the poor rates, and (2) enacting that "the vaccination, or surgical or medical assistance incident to the vaccination of any person resident in any union or parish, or of any of his family, should not be considered parochial relief," nor should he by reason "of such vaccination or assistance be deprived of any right or privilege or be subject to any disability or disqualification whatever."

93. These Acts were repealed by the Consolidation Act of 1867, but the Act of 1840 is important historically as being the first of the series of Acts relating to vaccination; and especially so because of the terms of the 8th section forbidding inoculation; and, again, because it not only speaks of vaccination itself, but of surgical or medical assistance incident to the vaccination, which contemplates the duty of providing the surgical or medical assistance which the operation might render necessary or expedient, and the necessary expenditure in respect thereof.

94. It is to be further observed that in the legislation of 1840 and 1841 there was no compulsion on parents or others to procure or to submit to vaccination. The services of the vaccinator were to be provided, and he was to vaccinate all who might choose to come to him for that purpose. It is not clear whether re-vaccination was contemplated. Although there is a difference in the language of Sections 2 and 6 relating to England and Wales and Ireland respectively, yet it is probable that, looking to the mode of payment provided in Section 1, a second vaccination was not contemplated by the Act.

95. At the suggestion of the Epidemiological Society, which had been formed in 1850, Lord Lyttelton introduced into the House of Lords the measure which afterwards passed into law on the 20th August, 1853, without opposition or division. This was really the first measure for compulsory vaccination. It is entitled "An Act to extend and make compulsory the Practice of Vaccination." It applied only to England and Wales.

The principal provisions of this Act were as follows:— The Guardians and Overseers, when the parishes were not in union, were required, subject to the approval of the Poor Law Board, to divide their unions and parishes into convenient districts (Section 1) for the purpose of giving increased facilities for the vaccination of the poor. They were to appoint a convenient place for the attendance of the vaccinator, and to give notice of place and time when he would attend to vaccinate, and to inspect the progress of the vaccination. The vaccinations were limited to those persons

only who had not already been successfully vaccinated. It seems, therefore, that re-vaccination was not contemplated by this Act.

The second section contains the compulsion. It was enacted that within *three* months of the birth the father or mother or, in the event of their death or inability, the person in charge of the child, within *four* months, should take the child to the appointed vaccinator, unless such parent or person should have obtained a certificate of previous vaccination from some other practitioner; and the vaccinator was required thereupon, or as soon after as it might be conveniently and properly done, to vaccinate the child. It was enacted by the third section, "Upon the eighth day following vaccination the father, &c., shall take or cause to be taken the child to the vaccinator for his inspection, that he may ascertain the result of the operation." By the fourth section it was provided that the vaccinator was to give a certificate of successful vaccination to the father, &c., and to transmit a duplicate to the Registrar of Births and Deaths of the sub-district in which the vaccination was performed. Section 5 made provision for children who, in the opinion of any medical officer or practitioner, were not in a fit and proper state to be successfully vaccinated. In such a case the medical officer or practitioner was to deliver a certificate to that effect, which was to remain good for two months, and to be renewable from two months to two months until the child should be considered fit for vaccination, when it was to be taken to be vaccinated. So long as the certificate or its renewal should last, it was a sufficient defence against any complaint against the father, &c., for non-compliance with the Act.

The sixth section contained provisions for the payment to the Public Vaccinator of not less than 1*s.* 6*d.* when the vaccination was at the residence of the vaccinator or not more than two miles therefrom, and not less than 2*s.* 6*d.* if over two miles therefrom; and the seventh related to certificates of insusceptibility to the vaccine disease.

Then followed provisions as to the duties of the Registrar. The Registrar of the sub-district was to keep a register of

persons whose successful vaccination certificates had been transmitted to him by the vaccinator. By Section 9 the Registrar was required on or within seven days from the registration of the birth of a child to send to the father, &c., notice in a given form, to take care that the child should be vaccinated, and of the time and place of the attendance of the vaccinator; and it was enacted that if after such notice the father, &c., of the child should not cause the child to be vaccinated, or should not on the eighth day after vaccination take, or cause to be taken, the child for inspection, then the father, &c., should forfeit a sum not exceeding 20*s*. These penalties were recoverable before two justices according to 12 Vict., c. 43, and paid into the funds for the relief of the poor.

96. The statute just referred to, though repealed, is notable by reason of a legal decision upon it which probably gave rise to an amendment of the law by a subsequent statute, out of which difficulties arose which will be shortly referred to. In the case of Pilcher *v.* Stafford, reported 4 Best and Smith, 775: 33 L.J. (M.C.) 13, the defendant had on the 18th February, 1863, been convicted and fined 2*s*. 6*d*. on an information and summons brought before magistrates by the Registrar for a breach of this Act, in not having after notice and within three months of the birth taken his child to the appointed vaccinator for vaccination. Subsequently, the child not having been vaccinated, the Registrar brought a fresh information and complaint for the same cause. The Justices dismissed the information, because they held that the offence of not taking the child to be vaccinated within the three months was a single definite offence, and that the defendant having been once convicted and fined for this offence, it was contrary to law to convict and fine the defendant a second time for the same offence.

The Court of Queen's Bench (Cockburn, Chief Justice, and Blackburn and Mellor, Justices) on this ground decided against the Registrar, and confirmed the decision of the magistrates.

97. By an Act passed on the 1st August, 1861, permission

was given to Guardians and Overseers to appoint persons to institute and conduct proceedings for the purpose of enforcing obedience to the Vaccination Acts, and further enacting that proceedings might be taken at any time during which the parent remained in default, and that the expenses of prosecuting might be charged upon the poor rate. This statute is noteworthy, as by some persons a difference in results, favourable to vaccination, has been insisted upon, between the *permission* to appoint such persons and the *obligation*, afterwards imposed, to appoint them.

98. Attention must here be called to a statute of great importance in the administrative history of the Vaccination laws. In the year 1858 an Act was passed with the short title of "The Public Health Act, 1858," and entitled in full "An Act for vesting in the Privy Council certain Powers for the Protection of the Public Health." A Board, called the General Board of Health, had about ten years before been constituted, and had had certain powers entrusted to it. The Board was appointed only to continue till the 1st of September, 1858, and the Act now under consideration vested in the Privy Council, not only certain other duties and powers with reference to public health, but also certain special powers and duties with reference to the Vaccination laws. It was enacted by the second section that the Privy Council might from time to time issue regulations as to the due qualification of persons to be thereafter contracted with by Guardians and Overseers under the Vaccination Acts, and for securing the efficient performance of vaccination by the persons with whom such contracts were made; and it was further enacted that money voted by Parliament for or towards defraying the expenses of the National Vaccine Establishment or otherwise providing for the supply of vaccine lymph should be applied under the direction of the Privy Council. Section 3 gave the Privy Council power to inquire generally as to matters concerning the public health, and particularly as to the observance of the regulations under the Act. For the purpose of aiding the Privy Council in the execution of their duties they were to have the power of appointing a

medical officer and other persons. One of the principal duties (Sections 5 and 6) of the medical officer was to report to the Privy Council generally upon health matters, and especially once a year on all proceedings taken under the Act. This report was to be presented annually to Parliament.

The Act also contained a provision that "penalties under the Vaccination Act might be proceeded for by any Registrar, public vaccinator, or officer authorised by the Guardians and Overseers, and that the cost of such proceedings should be defrayed out of the common fund of the union, or out of the poor rates of any parish not included in any union.

99. This Act (which with the exception of its eighth section was made perpetual by the Statute 22 and 23 Vict., cap. 3), and the powers of the Privy Council conferred by it, were practically administered under the Vice-President of the Committee of the Privy Council on Education.

The Poor Law Board still continued to exercise control over the form of the contracts between Guardians and Overseers with public vaccinators, but the Privy Council, with the aid of their medical officers, were charged with the duty of supervising the efficient performance of vaccination.

How this Act was administered by the Privy Council, their medical officer and their staff, is recorded in the annual reports presented and laid before Parliament by their medical officer in accordance with the Act.

The Privy Council continued to exercise jurisdiction under the Act of 1858 and the Act of 1867, hereinafter referred to, until the Local Government Board Act, 1871, came into force. This vested in the new Board the powers which, under the statutes of 1858 and 1867, the Privy Council had exercised.

100. The Act of 1867 (30 and 31 Vict., cap. 184), besides being a consolidating statute, introduced some important additional provisions. The sections which it is important to notice contained the following provisions :—Sections 1 and 3 dealt with the division of the county into vaccination districts. This was to be done by the Guardians under the control of the existing Poor Law Board, to which body in

1871, by virtue of the statute before referred to, the Local Government Board succeeded. The contracts and their form were also to be subject to the approval of the Poor Law Board. The Privy Council were authorised to pay to the public vaccinators additional sums to those which the Guardians and Overseers had to pay under their contracts. The intention of this clause appears to have been to enable the Privy Council to reward the public vaccinators for good and successful work, and to stimulate their diligence and care in the performance of their duties. The following clause increased the remuneration to be allowed to public vaccinators to not less than 2*s*. where the vaccination was performed at more than a mile, but less than two miles, from the residence of the vaccinator, and to not less than 3*s*. where the vaccination was performed at a distance exceeding two miles.

By the 8th section provision for the encouragement of re-vaccination was specifically made by Parliament. The Privy Council was authorised to issue regulations in respect of the re-vaccination of persons who might apply to be re-vaccinated, and in that case the Guardians were required to pay fees for successful re-vaccinations performed in accordance with such regulations of an amount equal to two thirds of the primary vaccination fees. It would appear from the language of this section that the wording of some existing contracts had included re-vaccination. By the eighth section, however, it was enacted that these contracts should not apply to re-vaccination upon the Act coming into operation.

The sixteenth section enacted, as to every child born in England, that within *three* months after the birth of such child, or where by reason of the death, &c., of the parent any other person should have the custody of such child within three months after receiving such custody, the parent or such person should take it or cause it to be taken to the public vaccinator, . . . or should within such period cause it to be vaccinated by some medical practitioner. If the child were brought to a public vaccinator in compliance with the conditions in the Act, he was required to vaccinate the child.

By Section 17 it was enacted that upon the same day in the week following, in cases in which the operation was performed by the public vaccinator, the parent or person must again take the child to the vaccinator or his deputy, so that he might inspect the child and ascertain the result of the operation, and, if he should think fit, take from such child lymph for the performance of other vaccinations ; in the event of the vaccination having been unsuccessful, the parent or other person was required, if the vaccinator so directed, to cause the child to be forthwith again vaccinated.

By Section 27 a new and important provision was made with reference to the enforcement of the Act. This provision was repealed by the Act of 1871, and another scheme of legislation adopted to which future reference will be made. By this section it was enacted—"The Registrar of each district shall, within one week after the first day of January and the first day of July in each year, make a list of all cases in which certificates of vaccination have not been received by him during the preceding half-year, and shall submit the same to the next meeting of the Guardians for whom he acts, and the said Guardians shall forthwith make inquiries into the circumstances of the cases, and if they find that the provisions of the Act have been neglected, shall cause proceedings to be taken against the persons in default."

This section imposed a duty on the Guardians to prosecute, and Section 28 provided for their expenses, and authorised them to pay any officer appointed by them to prosecute persons charged with offences against the Act, or otherwise to enforce its provisions. Provision for the appointment of such officers had been made by the Act of 1861, 24 and 25 Vict., c. 59, and their appointment was afterwards by the Act of 1871 made compulsory.

By Section 29 it was provided as follows :—"Every parent or person having the custody of a child who shall neglect to take the child or cause it to be taken to be vaccinated, or after vaccination to be inspected, and shall not render a reasonable excuse for his neglect, shall be guilty of an offence, and be liable to be proceeded against summarily,

and upon conviction to pay a penalty not exceeding 20*s*." This clause was in substance a re-enactment of the clause in the Act of 1853 (Section 9) upon which the case of Pilcher *v*. Stafford was decided, but it is important to refer to it again in connection with the changes of the law contained in other sections of the Act.

A point of some importance has been raised with reference to the construction of Section 29. It will be observed that it provides that every parent or person having the custody of a child who neglects to have the child vaccinated, "and shall not render a reasonable excuse for his neglect," shall be guilty of an offence, and be liable to be proceeded against, and upon conviction to pay a penalty. It has been contended that this points to the reasonable excuse being rendered before proceedings are taken. There is much to be said for this contention. The parent "guilty of an offence" and "liable to be proceeded against" is one who neglects and shall not render a reasonable excuse for his neglect. The section does not say that the parent who, without reasonable excuse, neglects to have his child vaccinated shall be guilty of an offence, as one would expect if the intention were that the excuse should be rendered to the magistrate as a defence when proceedings have been instituted. The section is certainly so framed as to afford countenance to the contention we are considering. On the other hand, no body or person is indicated to whom an excuse can be rendered before the proceedings are instituted. There is no machinery provided for hearing and adjudicating upon excuses at that period, and for giving a certificate that a reasonable excuse has been rendered to serve as a bar to further proceedings. On the whole, then, although it is not for us to express an opinion on the legal construction of the clause, which is very unhappily framed, it would probably be construed as intending that the excuse should be rendered to the tribunal before which proceedings for the neglect to vaccinate are pending.

We now come to the much-discussed Section 31. It seems probable that Section 31 was enacted for the very purpose of supplementing the provisions of Section 29. Its purpose seemed to be to enable those who prosecuted (and

this duty had by Section 27 been imposed upon the Guardians) to follow the parent responsible for the vaccination so long as the child remained unvaccinated, and by penalties to compel the parent to do what according to the law was his duty. Nevertheless no conviction could take place under this section without a previous order of a magistrate, and the first step in the transaction was to inform the magistrate and obtain a summons to the parent to appear with the child before him. Thereupon, when the parent appeared, absolute discretion was left to the magistrate before whom the case was brought. He might or might not make the necessary order. If he did not, no further penalty could be inflicted. If he did, and it was obeyed, no penalty could follow. But if he did, and it was disobeyed, one penalty alone could be inflicted for the disobedience. A further order must be made, and that order disobeyed before another penalty—not for disobedience to the first—but to the second order, could be inflicted. This is evident from the words of the section. The magistrate "may, if he thinks fit"—words of absolute discretion—make an order for vaccination; and there is nothing in the section to bind the magistrate's discretion to refrain from making an order should he for any reason come to the conclusion that it was expedient to do so. The words of the section seem purposely framed to leave the discretion to the magistrate. It is true that if the order was once made and disobeyed without the justification of one or other of the two matters of excuse mentioned in the section the disobedience must be punished, and the parent prosecuted (the words are "shall" be proceeded against), but the discretion was to be exercised before the order was made, and this discretion is left to the magistrate.

101. Accordingly it was held in the case of Allen and Worthy, reported L.R., 5 Q.B. 163, that, notwithstanding the principle laid down in Pilcher *v.* Stafford, a second conviction could follow disobedience to a second order under the section just referred to. Lord Chief Justice Cockburn said, "I think that the intention of the Legislature was not simply that a penalty should be imposed on a person once

for all if he omitted to do that which, in the view of the Legislature, public health and safety required, but that a penalty might be imposed so long as disobedience to its enactments continued. I therefore hold that the powers given by Section 31 are not confined to one order and one conviction, but that the proceedings may be repeated *toties quoties* so long as disobedience continues."

Another point arose in Allen *v.* Worthy which it is needless to refer to, for it can scarcely be supposed that as a matter of discretion a magistrate would make an order, if a *bonâ fide* certificate of unfitness, made less than two months before the order, was still in force.

102. There is no doubt that those magistrates who, in the exercise of their discretion, made repeated orders in respect of the same child, were in the opinion of many mistaken, and harsh results often followed, and the evidence of this, which was brought before them, doubtless led to the recommendation in the Report dated 23rd May, 1871, of the Select Committee of the House of Commons on the Vaccination Act (1867), that no more than two penalties or one full penalty should be imposed in respect of the same child.

103. It was also contended that persons convicted of disobedience to orders and committed to prison under this Act ought to have been treated as debtors, and not as criminal prisoners. An action was brought against the officials of Portsmouth Gaol, in which a person who had been fined and had been imprisoned on non-payment was dealt with according to the ordinary prison rules, and not as a debtor. Lord Justice (then Mr. Justice) Lindley tried the case at Winchester Assizes in January, 1884, and afterwards, by a considered judgment in which he drew a distinction between a conviction imposing a fine, and an order made for payment of money, held that in this case there was a breach of a statutory duty punishable by a fine, which was in the eye of the law a criminal offence. In the result he found the defendants had acted rightly in dealing with the plaintiff according to the prison rules applicable to criminal prisoners,

and that the plaintiff had no legal right to be treated as a debtor. He gave judgment for the defendant with double costs. (Kennard *v.* Simmons, Cutt and Woods, Winchester Assizes, January, 1889.)

104. The Act of 1867 remained unaffected by subsequent legislation until the 1st January, 1872, when the Vaccination Act, 1871, came into force.

Meanwhile a Select Committee had been appointed to inquire into the working of the Act of 1867, and this Act of 1871 was introduced into the House of Commons by Mr. Forster, its chairman. The Act was entitled "An Act to amend the Vaccination Act, 1867," and was to be construed as one with it.

A change of importance was made by the 5th section, which rendered the appointment and payment of officers to prosecute and to enforce the provisions of the Acts obligatory upon the Guardians, whereas it had theretofore been permissive only. These officers were to be called Vaccination Officers. They were to perform all the duties imposed on the Registrars by the principal Act, except giving the notices to the parents within seven days of the registration of the births under Section 15 of the Act of 1867.

By Section 8 it was provided that every Registrar of Births and Deaths for any place should once at least transmit to each vaccination officer a return of all births and deaths of infants under twelve months of age, which since the date of the last return had been registered by him. Section 9 deals with re-vaccination. It enacts that when the operation of re-vaccination is performed gratuitously by a public vaccinator on the application of any person, he shall deliver to such person a notice requiring him to attend for inspection, and if that notice is not complied with, such person is rendered liable to pay to the Guardians a fee of *2s.* 6*d.*

Section 10 imposes a fine of *20s.* on any person who prevents a public vaccinator taking lymph from any child as provided by Section 17 of the principal Act. Section 11 imposes a similar penalty on any parent who fails to produce a child when required by summons under Section 31 of the

principal Act. By the same section any complaint may be made and any information laid at any time not exceeding twelve months from the time when the matter of complaint or information arose, and not subsequently. This is a new provision as to limitation. There is a further provision as to re-vaccination in Section 13 granting fees to the medical officer of the union if, while attending as such medical officer upon a smallpox patient, he either (1) vaccinates a person who has never been vaccinated or had smallpox, or (2) re-vaccinates any person who is resident in the same house with the person sick of the smallpox, and has never been re-vaccinated, being of the age at which public re-vaccination is paid for to a public vaccinator under the regulations for the time being of the Privy Council.

105. By the joint effect of the Vaccination Act, 1874, the 5th section of the Vaccination Act, 1871, and the Local Government Act, 1871, the Local Government Board was clothed with the same powers with respect to the Guardians and vaccination officers in matters relating to vaccination as the Poor Law Board[1] possessed with regard to Guardians and officers of Guardians in matters relating to the relief of the poor, and had power to make rules and regulations, and it was enacted that all enactments relating to such powers and to such orders, rules, and regulations by the Poor Law Board[1] should apply, *mutatis mutandis*, to the Local Government Board, including rules, orders, and regulations prescribing the duties of Guardians and their

[1] The Poor Law Commissioners were constituted by the 4 and 5 Wm. IV, c. 76. By the 10 and 11 Vict., c. 107, another Commission with similar powers was appointed, the name of which was changed by 12 and 13 Vict., c. 103, sect. 21, to the Poor Law Board. By sect. 15 of 4 and 5 Wm. IV, c. 76, the Commissioners had powers conferred on them to make and issue orders, rules, and regulations for the guidance "and control of all" Guardians, vestries, and parish officers so "far as relates to the management or relief of the poor, and the keeping, &c., of accounts, and making and entering into contracts in all matters relating to such management or relief." By sect. 41 the Commissioners were empowered "to make orders to direct Guardians to appoint paid officers for superintending or assisting in the administration and relief and employment of the poor, and to direct the execution of the duties of such officers."

officers in relation to the institution and conduct of the proceedings to be taken for enforcing the provisions of the Vaccination Acts of 1867 and 1871, and the payment of the costs and expenses relating thereto; and rules, orders, and regulations under the Act of 1874 were to be deemed to be made under Section 5 of the Act of 1871.

106. By the machinery thus introduced, provision was made in substitution for that contained in the 27th section of the Act of 1867, which was repealed by the Act of 1871; that section, as has been pointed out, imposed upon the Guardians the duty of prosecuting cases brought to their knowledge by the Registrar. The new machinery gives power to the Local Government Board to regulate this matter among others, and they have acted on this power.

107. The Bill, as introduced by Mr. Forster, the Chairman of the Select Committee, contained a clause (1) so framed as to carry out the recommendation in the Report as to repeated prosecutions in the case of the same child. This was struck out in the House of Lords, the amendment being carried by eight votes against seven. When the Bill was returned to the Commons Mr. Forster at that period of the session felt compelled to accept the amendment, being anxious to pass the Bill.

108. One other point remains for notice arising under the Act of 1871. It is provided by Section 11 that the defendant in any proceedings under the Acts of 1867 and 1871 may appear by any member of his family, or by any other person authorised by him in that behalf.

109. Such are the provisions of the Acts which have from time to time been passed with direct reference to the subject of vaccination. The legislation is founded on the assumption of its efficacy, and that its advantages are so manifest that it is the duty of the State to enforce it even by the imposition of penalties for its neglect.

110. It is obvious that the most important part of the

work rests with the public authorities to whom the vaccination of the population has been entrusted, subject to the general control of the central authority.

111. The superintendence, direction, and inspection of the work of vaccination was vested in the Privy Council in accordance with the terms of the Act of 1858 and the Act of 1867. Since 1871 the duties have been transferred to the Local Government Board.

112. How this part of the work of the Local Government Board is now carried on, and how it has been carried on since 1871, will be found in the evidence of Dr. Thorne Thorne.[1]

Mr. Farn and Dr. Cory also in their evidence describe how vaccination is practised under the supervision of the Local Government Board and its officers.[2]

113. With regard to proceedings by way of prosecution, the following order as to repeated prosecution has been made under Section 5 of the Act of 1871 and the Act of 1874, viz. the Order of the 31st October, 1874, Sections 16 and 17, which are explained by the letter of the Local Government Board to the Evesham Guardians of the 17th September, 1875. The 16th section of the Order is clear in its terms, that the Guardians shall, in all cases in which the provisions of the Vaccination Acts for enforcing vaccination have been neglected, cause proceedings to be taken against the persons in default, and for this purpose shall give directions to the Vaccination Officer to institute and conduct such proceedings, but no such directions shall authorise the Vaccination Officer to take further proceedings under Section 31 of the Vaccination Act, 1867, in any case in which an order has been already obtained and summary proceedings taken under that section until he shall have brought the circumstances of the case under the notice of the Guardians and received their special directions therein. Article 17 is to the effect that the Vaccination Officer shall

[1] Q. 3834—4010.

[2] Q. 4011-266; Q. 4267-307.

take such proceedings as may be necessary under the Vaccination Acts in any case in which the Local Government Board desire him to do so.

114. With regard to the statute law relating to vaccination in Ireland and Scotland it is not necessary to state it at length, for it is founded on the English law. It will suffice to indicate generally the scheme of the Acts, and point out any special provisions or differences.

115. First as to Ireland. The earliest legislation for Ireland in respect to vaccination is contained in the two Acts of 1840 and 1841, which applied equally to England and Wales and Ireland; they have been already set out sufficiently. It will be remembered that by the Act of 1840 the practice of smallpox inoculation is forbidden and made punishable by imprisonment.

116. The first statute specially dealing with Ireland only in the matter of vaccination was the 14th and 15th Vict., cap. 168, sect. 13. By that statute the medical officer of every district in Ireland constituted under that Act was required to vaccinate every one coming to him for that purpose, subject to regulations of the Poor Law Commissioners for Ireland; and in 1858, by 21 and 22 Vict., cap. 64, the committee of management for each dispensary district in Ireland was required to divide their district into vaccination districts, subject to the approval of the Poor Law Commissioners. The committee were to require the medical officer at each district to attend at some convenient place within the district to be approved by the committee at such times as they should approve; and the medical officer was required to vaccinate all persons resident in his district who might come to him for that purpose, or whom he might be requested to vaccinate, being fit subjects for vaccination, subject to any such regulations as might be fixed by the Poor Law Commissioners; the medical officer was to report as to the number of persons successfully vaccinated by him in each year, and the payments were to be charged to the divisions comprising such dispensary, as all other medical relief was charged.

117. In 1863, by the 26 and 27 Vict., cap. 52, vaccination was made compulsory, and by Section 1 parents and guardians of children born in Ireland after 1st January, 1864, were required within six calendar months to take them to the medical officer of the district to be vaccinated, who was required to vaccinate them.

By Section 2 parents and guardians were required to take the child again on the eighth day following the vaccination to the medical officer for inspection.

Similar provisions are made with reference to certificates as to children unfit for vaccination, and as to the insusceptible as in the English statute of 1853.

One shilling was under this Act the appointed fee for the medical officer for a successful vaccination.

By Section 8 a similar provision to that of the English Act was made (except that the period of birth was fixed at six months instead of three), for notice being given by the Registrar to the parents of the duty to vaccinate, and imposing a fine of 10*s.* on the parent or guardian who might be in default in not carrying the child to be vaccinated, or in not taking it for inspection.

By Section 13 the Guardians of any union in Ireland were authorised to direct proceedings against defaulters, and it was enacted that such proceedings might be taken at any time during default.

118. By a short Act passed in 1868 (31 and 32 Vict., c. 87) it was enacted that the vaccination or surgical or medical assistance incident thereto should not be considered as parochial relief, and in the words of the English Act the practice of inoculation with variolous matter was made penal.

119. In 1878 a section similar in effect and almost in words to Section 31 of the English Act of 1867 was introduced into the Public Health Act for Ireland passed in the year 1878. It is striking evidence of the importance then attached to the provisions of that section by the Legislature that they introduced it into the Irish Code of Sanitary Law.

120. In 1879 an Act (42 and 43 Vict., c. 70) to amend the Acts relating to vaccination in Ireland was passed, whereby the age within which children were to be brought for vaccination was altered to three months, thus assimilating the law to that in force in England, and the provisions as to bringing the child for inspection on the eighth day following vaccination were re-enacted; and it was added as an additional reason for this, that, if the vaccinator thought fit, he might take lymph from the child for the performance of other vaccinations, these amendments being taken from the English statutes.

By Section 6 the vaccination fee was raised to *2s.*, and not only in the case of successful vaccination but also of re-vaccination; provided that the vaccinator had made his report to the committee of management as required by the 21 and 22 Vict., c. 64.

By Section 7 penalties of *20s.* were imposed (1) on persons preventing any dispensary medical officer from taking lymph from a child as provided by Section 4; (2) failing to produce a child when required by any summons under the Acts; (3) upon every parent or person having custody of a child who should neglect to produce it for vaccination or inspection as provided.

It was also provided by this section that a defendant in proceedings under the Vaccination Acts might appear by any member of his family or any person authorised by him.

These provisions were similar to those of the English Acts.

By Section 10 it was enacted that the Guardians of any union in Ireland might direct proceedings for the purpose of enforcing obedience to the Vaccination (Ireland) Acts; and the medical officers of the dispensary district who might be required to attend and did attend were to receive pay not exceeding a guinea a day.

There are also contained in these Acts provisions as to certificates, returns, and registration, *mutatis mutandis*, similar to those in the English Acts.

121. The Vaccination (Ireland) Acts now in force are 21 and 22 Vict., c. 64; 26 and 27 Vict., c. 52; 31 and 32 Vict., c. 87;

and 42 and 43 Vict., c. 70; except Sections 1, 2, 3, and 13 of 26 and 27 Vict., c. 52, which are repealed by Section 13 of 42 and 43 Vict., c. 70. The other Acts mentioned above are inserted as part of the history of vaccination legislation for Ireland.

122. The mode in which the Vaccination law in Ireland is administered will be found in the evidence of Sir F. MacCabe and of Dr. Grimshaw.[1]

123. The law of vaccination in Scotland is really comprised in one statute passed in 1863—26 and 27 Victoria, chapter 108—and entitled "An Act to extend and make compulsory the Practice of Vaccination in Scotland."

After reciting that it was expedient to extend and in certain cases to make compulsory the practice of vaccination in Scotland, and to make further provision for the vaccination of the poor, the Act by its first section enacted that within two months after the passing of the Act the Parochial Board of any parish or combination of parishes in Scotland should appoint a registered practitioner to be the vaccinator within such parish or combination.

By Section 3 the remuneration to the vaccinators is made to depend on the number of persons not previously vaccinated who have been successfully vaccinated by each vaccinator, varying, as in the English Act, according to distance, between 1*s.* 6*d.* and 2*s.* 6*d.*

By Section 4 notice must be given by the Parochial Board of the appointment and name of each vaccinator to the Board of Supervision, the Registrar-General, and the Registrar for the district.

By Section 5 the Parochial Board, and every vaccination and other officer, were to exercise their functions in conformity with the regulations from time to time issued by the Board of Supervision, and which it was authorised and required to make.

By Section 6 provision was made for payment, from the rates and grant for medical treatment of the poor, of the expenses incurred in the execution of the Act, and by

[1] Q. 3033—3151; 2687—3032.

Section 7 it was provided that the vaccination or any surgical or medical treatment incidental to it should not be considered parochial relief, and should not affect the parochial settlement.

By Section 8 the duty was imposed on parents or persons having custody of any child, within six months of the birth, to cause it to be vaccinated by a medical practitioner, and a certificate of the vaccination was to be given to the parents, and by them transmitted to the Registrar, and registered by him.

Then followed similar provisions to those in the English Acts (Section 9) for the case of children not in a fit state to be vaccinated, and of those who are (Section 10) insusceptible. Similar provisions were also (Section 11) made imposing on the Registrar the duty of delivering to any person registering the birth of a child a notice of the duty to vaccinate, with copies of the certificates in the schedule.

Section 12 made provision for the special dealing with insular, Highland, and other districts on the application of the Parochial Boards to the Board of Supervision, who might appoint a medical practitioner to travel through the districts to vaccinate.

Then followed certain provisions for the registration of vaccinators, and by the 17th section penalties not exceeding 20*s*. were imposed upon parents if they did not within ten days of notice from the Registrar send in a certificate of the vaccination or its postponement, and failing payment the defaulters might be committed for a term not exceeding ten days.

The 18th section imposed the duty on the Registrar once in every six months to transmit to the inspector of the poor of the parish, or combination in which the district was situate a list of such persons as had failed to transmit or lodge a certificate of vaccination in terms of the Act. This list was to be laid before the Parochial Board, which was required to issue an order to vaccinate the persons named in the list. Notice of the order was then directed to be given to the parents or persons having the custody of the children, and in pursuance of the order the vaccinator was required to vaccinate the persons named therein at a time not less

than ten days or more than twenty days after the date of the notice ; and if any person or parent should refuse to allow the operation to be performed, such person or parent was to be liable to a penalty not exceeding 20*s*., and failing payment to be imprisoned for a period not exceeding ten days.[1] It was subsequently held by the Court of Session in Scotland that the section permitted repeated prosecutions so long as the child or person remained on the list.

Provisions were then made by Sections 19 to 23 as to certificates and registration, which need not be particularised.

Section 24 prohibited under a penalty inoculation with variolous matter or by wilful exposure to any variolous matter, or anything infected with smallpox, or wilfully by any other means producing the disease of smallpox in Scotland.

Section 25 dealt with the recovery of penalties. It provided that the warrant for imprisonment should specify the amount of penalty and expenses, and also specify a period (not exceeding in any case two months) at the expiration of which the party should be discharged notwithstanding such penalty or expenses should not have been paid. By Section 26 proceedings might be taken at any time during default, and that section provided that the penalty should be awarded to the support of the poor.

An important section, the 27th, enacted that wherever the Parochial Board should fail to do or perform any of the acts or duties by the Act required of them, it should be lawful for the Board of Supervision without prejudice to the right to compel performance thereof, to do and perform the same, and the acts of the Board of Supervision should be as valid and effectual as if done or performed by the Parochial Board.

124. This Act is the only one now in force in Scotland with direct reference to Vaccination, except that by a section (57) of the Public Health (Scotland) Act, 1867, the Local Authority under that Act may defray the cost of vaccinating such persons as to them may seem expedient, not being children of paupers or persons ordered to be

[1] 6, App. 653–4.

vaccinated in terms of the 18th section of the Act 26 and 27 Vict., c. 108.

125. By Section 5 of the Secretary for Scotland Act, 1885 (48 and 49 Vict., c. 61), all powers vested in or imposed on one of Her Majesty's Principal Secretaries of State, or by the enactments mentioned in Part 1 of the Schedule to the Act, are transferred to the Secretary of State for Scotland created by the Act. Among the Acts mentioned in the Schedule is the Vaccination (Scotland) Act, 1863 (26 and 27 Vict., c. 108).

Under the provisions of the Local Government (Scotland) Act of 1894, the Local Government Board for Scotland has been substituted for the Board of Supervision and Parish Councils for the Parochial Boards; but, except in this substitution, no alteration has been made in the legislation as to vaccination.

126. Details of the mode in which the vaccination law of Scotland is administered will be found in the evidence of Mr. John Skelton, then Chairman of the Board of Supervision.[1] Both the statute law and the method of administration differ very materially from those which prevail in this country. Some of the points of difference in the two systems have so material a bearing upon questions submitted to us for report that it will be well here to call attention to them. An official vaccinator is appointed by each parochial board. Beyond the vaccination of paupers and the children of paupers, however, his duty is confined to vaccinating defaulters. The great majority of vaccinations in Scotland are performed by private medical practitioners at the expense of the parent or guardian. In all cases in which certificates are not received by the registrar of compliance with the requirements of the Act, the names are inserted in a list of defaulters sent every six months to the parochial board. It then becomes the duty of that board to see that these defaulters are vaccinated. They go through the list transmitted to them, and notify to the parent or guardian of each child that its name is contained

[1] Q. 27,884—28,110.

in the list, and that if not privately vaccinated it will be vaccinated by the official vaccinator.[1] The parochial board issue an order to the vaccinator to vaccinate the persons named in the list not less that ten days nor more than twenty after the date of the notice to the parent or guardian. A large number of the defaulters are privately vaccinated in consequence of these notices before the visit of the official vaccinator. If this has not been done the vaccinator calls on each of the defaulters and offers to vaccinate. If the parent's consent is obtained the child is vaccinated; if consent is refused, a certificate is given stating the fact and the ground of refusal. Any other reason for not vaccinating a child, such as insusceptibility, previous vaccination, or condition of health, is also embodied in a certificate. The power conferred upon local authorities under the Public Health Act by Section 57 of that Act to afford gratuitous vaccination appears to be exercised chiefly when epidemics are present within the district of the local authority. A house-to-house visitation is often made by medical men appointed for the purpose, and a large number of re-vaccinations are thus effected. The distinguishing feature of the Scotch system which deserves special attention is that the operation is carried out in almost all cases at the house where the vaccinated person is residing. The official vaccinator visits the case there after an interval of eight days to see whether the operation has been successful. Although he pays no visit in the interval he would often be sent for if any untoward symptoms presented themselves, inasmuch as the official vaccinator is in ninety-nine cases out of a hundred the officer whose duty it is to afford medical assistance to the poor.

127. We have now to consider the records of smallpox mortality in the United Kingdom since the time when the number of deaths and their causes came to be accurately registered, to inquire into the prevalence and progress of the practice of vaccination during the same period, and to see how this evidence bears upon the question

[1] As stated in § 125, the Parish Council has now taken the place of the Parochial Board.

whether vaccination exercises a protective influence against smallpox.

128. The following table shows the mortality from smallpox in England and Wales[1] during each of the years

[1] The table given in § 128 is for England and Wales, including the metropolis. When considering the earlier statistics of smallpox mortality, we had in the absence of figures relating to the whole country to confine ourselves, in the main, to the material to be obtained from the old London Bills of Mortality. Accordingly, though it must be remembered that the area of London for registration purposes is a much larger one than that covered by the old Bills of Mortality, the following table, which shows the mortality from smallpox in registration London during each of the years 1838—1894, may be of interest. (The figures relating to the last eleven years of the table include the deaths, of London residents, in the Metropolitan Asylums Board's hospitals situated outside London.)

Year.	*Population.*	*Number of deaths from smallpox.*	Deaths from smallpox to every 100,000 living.
1838	*1,766,169*	*3,817*	216
1839	*1,802,751*	*634*	35
1840	*1,840,091*	*1,235*	67
1841	*1,878,205*	*1,053*	56
1842	*1,917,108*	*360*	19
1843	*1,954,041*	*438*	22
1844	*2,033,816*	*1,804*	89
1845	*2,073,298*	*909*	44
1846	*2,113,535*	*257*	12
1847	*2,202,673*	*955*	43
1848	*2,244,837*	*1,620*	72
1849	*2,287,302*	*521*	23
1850	*2,330,054*	*499*	21
1851	*2,373,081*	*1,062*	45
1852	*2,416,367*	*1,159*	48
1853	*2,459,899*	*211*	9
1854	*2,503,662*	*694*	28
1855	*2,547,639*	*1,039*	41
1856	*2,591,815*	*531*	20
1857	*2,636,174*	*156*	6
1858	*2,680,700*	*242*	9
1859	*2,725,374*	*1,158*	42
1860	*2,770,181*	*898*	32
1861	*2,815,101*	*217*	8
1862	*2,860,117*	*366*	13
1863	*2,905,210*	*1,996*	69
1864	*2,950,361*	*547*	18
1865	*2,995,551*	*640*	21
1866	*3,040,761*	*1,391*	46
1867	*3,085,971*	*1,345*	44

1838—1842 and 1847—1894. The figures for the years 1843—1846 are not available.

Year.[1]	*Population.*	*Number of deaths from smallpox (with those returned as from chicken-pox).*	Deaths from smallpox (with those returned as from chicken-pox) to every 100,000 living.
1838	*15,287,699*	*16,268*	106
1839	*15,514,255*	*9,131*	59
1840	*15,730,813*	*10,434*	66
1841	*15,929,492*	*6,368*	40
1842	*16,130,326*	*2,715*	17
1843	*16,332,228*	Causes of death not abstracted by Registrar-General.	
1844	*16,535,174*		
1845	*16,739,136*		
1846	*16,944,092*		

(*Note continued.*)

Year.	*Population.*	*Number of deaths from smallpox.*	Deaths from smallpox to every 100,000 living.
1868	*3,131,160*	*597*	19
1869	*3,176,308*	*275*	9
1870	*3,221,394*	*973*	30
1871	*3,267,251*	*7,912*	242
1872	*3,319,736*	*1,786*	54
1873	*3,373,065*	*113*	3
1874	*3,427,250*	*57*	2
1875	*3,482,306*	*46*	1
1876	*3,538,246*	*736*	21
1877	*3,595,085*	*2,551*	71
1878	*3,652,837*	*1,417*	39
1879	*3,711,517*	*450*	12
1880	*3,771,139*	*471*	12
1881	*3,824,980*	*2,367*	62
1882	*3,862,956*	*430*	11
1883	*3,901,309*	*136*	3
1884	*3,940,042*	*1,236*	31
1885	*3,979,160*	*1,419*	36
1886	*4,018,666*	*24*	·6
1887	*4,058,565*	*9*	·2
1888	*4,098,860*	*9*	·2
1889	*4,139,555*	*0*	0
1890	*4,180,654*	*4*	·1
1891	*4,222,157*	*8*	·2
1892	*4,264,076*	*41*	1
1893	*4,306,411*	*206*	5
1894	*4,349,166*	*89*	2

[1] 1, App. 114–5; 6, App. 779.

Year.	*Population.*	*Number of deaths from smallpox (with those returned as from chicken-pox).*	Deaths from smallpox (with those returned as from chicken-pox) to every 100,000 living.
1847	*17,150,018*	*4,227*	25
1848	*17,356,882*	*6,903*	40
1849	*17,564,656*	*4,644*	26
1850	*17,773,324*	*4,665*	26
1851	*17,982,849*	*6,997*	39
1852	*18,193,206*	*7,320*	40
1853	*18,404,368*	*3,151*	17
1854	*18,616,310*	*2,808*	15
1855	*18,829,000*	*2,525*	13
1856	*19,042,412*	*2,277*	12
1857	*19,256,516*	*3,936*	20
1858	*19,471,291*	*6,460*	33
1859	*19,686,701*	*3,848*	20
1860	*19,902,713*	*2,749*	14
1861	*20,119,314*	*1,320*	7
1862	*20,371,013*	*1,628*	8
1863	*20,625,855*	*5,964*	29
1864	*20,883,889*	*7,684*	37
1865	*21,145,151*	*6,411*	30
1866	*21,409,684*	*3,029*	14
1867	*21,677,525*	*2,513*	12
1868	*21,948,713*	*2,052*	9
1869	*22,223,299*	*1,565*	7
1870	*22,501,316*	*2,620*	12
1871	*22,788,594*	*23,126*	102
1872	*23,096,495*	*19,094*	82
1873	*23,408,556*	*2,364*	10
1874	*23,724,834*	*2,162*	9
1875	*24,045,385*	*952*	4
1876	*24,370,267*	*2,518*	10
1877	*24,699,539*	*4,395*	18
1878	*25,033,259*	*1,970*	8
1879	*25,371,489*	*631*	3
1880	*25,714,288*	*754*	3
1881	*26,046,142*	*3,231*	12
1882	*26,334,942*	*1,439*	5
1883	*26,626,949*	*1,056*	4
1884	*26,922,192*	*2,363*	9
1885	*27,220,706*	*2,936*	11
1886	*27,522,532*	*368*	1
1887	*27,827,706*	*593*	2
1888	*28,136,258*	*1,142*	4
1889	*28,448,239*	*106*	·4
1890	*28,763,673*	*111*	·4
1891	*29,082,585*	*140*	·5
1892	*29,405,054*	*554*	2
1893	*29,731,100*	*1,584*	5
1894	*30,060,763*	*928*	3

129. In order to make the figures in the above table comparable throughout, we are obliged to include with the deaths returned as from smallpox those returned as from chicken-pox, the Registrar-General not having distinguished between such returns in his abstracts for the years 1838—1842 and 1847—1854.[1] In this connection, however, the inclusion or exclusion of deaths returned as from chicken-pox makes no material difference;[2] the number of deaths at all ages so returned being but small in comparison with the deaths at all ages returned as from smallpox, except as regards the years 1889, 1890, and 1891, when the smallpox mortality was very small.

Had the number of deaths returned as from chicken-pox been large enough to affect to any material extent the figures in the table, we should have excluded these deaths so far as we were able, though we think it possible and even probable that some of them may have been mistaken cases of smallpox. It is highly improbable that the number of such cases was considerable, seeing that, since deaths from chicken-pox have been separately recorded, the number of them has been small and approximately the same, year by year, whether smallpox was prevalent or not.

130. There exist no figures, comparable throughout the period 1838—1894,-by which we can measure the extent to which, at one time as compared with another, the practice of vaccination prevailed in England and Wales in those years. That there has been, speaking generally, during that period a large spread of the practice is beyond doubt. We have given an account of the legislation from time to time enacted to this end, and we shall therefore merely recapitulate here the dates of the principal Acts of Parliament relating to the practice of vaccination in England and Wales, which have come into force during this period.

In 1840–41 the means of vaccination were provided at the expense of the poor rates for every person in England and Wales.

In 1853 the practice of vaccination was made compulsory in regard to children born in England or

[1] Q. 348. [2] 1, App. 115; 6, App. 779.

Wales after the 1st August, 1853, and penalties were imposed for non-compliance. The provisions for this purpose then enacted were found in working to be very imperfect;[1] and, indeed, the obligation to be vaccinated remained little more than nominal down to the date of the appointment of paid vaccination officers. At the same time, however, the fact that the law required vaccination within a prescribed period from birth no doubt increased the spread of the practice.[2]

In 1867 the laws relating to vaccination in England and Wales were consolidated and amended; and the provisions then enacted, as regards those unions where the power given to appoint paid vaccination officers was exercised, were such as to make effective the obligation to be vaccinated.[3] In many unions, however, this power was not at once exercised. From the evidence taken by the Select Committee of the House of Commons in 1871 it appears that of 260 unions inspected by the Medical Department of the Privy Council in the course of the year 1870, two years and more after the Act of 1867 had come into force, 121 were reported as not having at the date of inspection appointed vaccination officers, and 127 as having made such appointments, there being no report on the point as to the remaining 12 unions (Appendix No. 15 to the Committee's Report); and in May, 1871, Dr. Seaton informed the Committee that there were still a great many unions in which vaccination officers had not been appointed (Question 5499).

In 1871 the Act of 1867 was amended by making the appointment of paid vaccination officers compulsory in all unions, by simplifying and improving the arrangements for the registration of vaccination, and in other ways. The effect of the amending Act towards increasing the spread of vaccination would be thus more marked in unions where the power to appoint paid vaccination officers had not before its

[1] Q. 682.

[2] Q. 682–3; 692. [3] Q. 683.

enactment been exercised ;[1] but the amendment of the law as to the registration of vaccination was such as to render it, in every union, less likely that the obligation to be vaccinated would be evaded.

131. The records kept under the Vaccination Act of 1871, and tabulated by the Local Government Board, show the amount of primary vaccination, performed within a certain period of birth, of children whose births were registered in England or Wales during the years 1872—1893. The following table (p. 76) gives the figures.

From these figures it may be inferred that, as regards those children whose births were registered during each of the years 1872—1883, the proportion primarily vaccinated remained practically the same. The effect of the opposition to the practice of vaccination, which in some parts of the country has grown of recent years (though to some extent, at all events, it has existed in England during the whole period now dealt with), is shown by the gradual diminution of the proportion primarily vaccinated in the case of children whose births were registered in England or Wales during each of the ten years 1884—1893. The diminution of this proportion did not, of course, necessarily result at once in a diminished proportion of the population who had, at some time in their lives, been vaccinated.

132. The materials before us do not allow us to make any numerical statement of the proportion, as time went on, during the period 1838—1894, of the population of England and Wales who had at some time been vaccinated. So far as we can judge of the effect of the efforts made during that period to extend the practice of vaccination, the proportion of the population who had at some time been vaccinated has steadily grown, though with no even rate of increase, during the years from 1840 onwards, down to a recent date at all events. The rate of increase was greater in 1853 and the few years immediately following it than in previous years, and again expanded still more considerably in the years from 1868 to 1872, and perhaps in some few succeeding years.

[1] Q. 31–5.

Year.[1]	Births registered during year.	Of the Children whose births were registered during the year given in the first column, by the 31st January in the year next but one following that year there were—						
		Successfully vaccinated.	Certified as insusceptible of vaccination.	Had smallpox.	Died unvaccinated.	Vaccination postponed by medical certificate.	Remaining.	The children not finally accounted for (including cases postponed) being per cent. of births.
1872	821,856	698,137	1,693	905	78,594	42,527		5·1
1873	826,508	704,666	942	86	80,512	4,264	36,038	4·8
1874	854,787	727,065	920	96	85,325	5,677	35,704	4·8
1875	850,354	722,466	838	38	86,673	5,914	34,425	4·7
1876	887,694	763,277	848	107	84,930	5,528	33,004	4·3
1877	887,947	766,824	926	118	79,497	6,681	33,901	4·5
1878	891,743	760,982	840	44	87,936	6,475	35,466	4·7
1879	880,222	756,835	742	26	78,478	6,670	37,471	5·0
1880	881,652	750,203	859	46	87,361	5,930	37,253	4·9
1881	883,744	765,162	1,017	81	77,471	6,302	33,711	4·5
1882	889,082	763,525	993	45	81,498	7,598	35,423	4·8
1883	890,780	762,080	1,012	93	81,955	8,110	37,440	5·1
1884	906,581	764,975	1,363	81	90,134	8,693	41,335	5·5
1885	894,263	757,714	1,278	42	83,686	9,323	42,220	5·8
1886	903,846	754,059	1,278	20	90,774	10,187	47,528	6·4
1887	886,198	733,980	1,556	27	87,827	10,402	52,406	7·1
1888	879,813	719,103	1,888	12	83,287	12,282	62,701	8·5
1889	885,909	707,161	1,758	2	88,995	13,366	74,627	9·9
1890	875,188	682,560	1,672	2	91,768	13,615	85,571	11·3
1891	914,079	693,117	1,806	9	96,351	13,823	108,973	13·4
1892	890,695	663,657	1,983	26	92,490	13,278	119,261	14·9
1893	914,557	661,513	3,394	39	102,442	13,845	133,324	16·1

[1] 6, App. 775.

133. Speaking generally of the period since 1838, there has been, as the table given in § 128 clearly shows, a marked though irregular decline in the death-rate from smallpox.

It may be well, too, to note at once a striking feature of this decline. During the period 1838—1894 the decline in the death-rate at all ages from smallpox has not been shared alike by the population at every age. While the decline in the death-rate of the population under ten years of age has been even more marked than the decline shown by the table in § 128 in the death-rate at all ages, there has been amongst the population over ten years of age a far less marked decline, or, at certain of the higher ages, an actual increase in the death-rate. We shall have presently (§§ 168—201) to discuss fully this question of the altered age incidence of fatal smallpox both in England and Wales, and in Scotland and Ireland.

134. The following table shows the mortality[1] from smallpox in Scotland during each of the years 1855—1894:

Year.[2]	*Population.*	*Number of deaths from smallpox (with those returned as from chicken-pox).*	Deaths from smallpox (with those returned as from chicken-pox) to every 100,000 living.[1]
1855	*2,978,065*	*1,309*	48
1856	*2,995,771*	*1,306*	46
1857	*3,012,310*	*845*	30
1858	*3,027,665*	*332*	11
1859	*3,041,812*	*682*	24
1860	*3,054,738*	*1,495*	51
1861	*3,069,404*	*766*	26
1862	*3,097,009*	*426*	14
1863	*3,126,879*	*1,646*	55
1864	*3,156,021*	*1,741*	58
1865	*3,185,437*	*383*	12
1866	*3,215,129*	*200*	6
1867	*3,245,098*	*100*	3
1868	*3,275,350*	*15*	·5
1869	*3,305,885*	*64*	2
1870	*3,336,707*	*114*	3
1871	*3,368,921*	*1,442*	44
1872	*3,404,798*	*2,448*	74

[1] NOTE.—The death-rates given in the table in § 134 are not solely based on the numbers, also given in that table, of the population and of the deaths; but allowance is made for cases in which the cause of death was not specified.

[2] 6, App. 632.

Year.	*Population.*	*Number of deaths from smallpox (with those returned as from chicken-pox).*	Deaths from smallpox (with those returned as from chicken-pox) to every 100,000 living.
1873	*3,441,056*	*1,126*	33
1874	*3,477,704*	*1,246*	37
1875	*3,514,744*	*76*	2
1876	*3,552,183*	*39*	1
		From smallpox only.	From smallpox *only.*
1877	*3,590,022*	*38*	1
1878	*3,628,268*	*4*	·1
1879	*3,665,443*	*8*	·2
1880	*3,705,994*	*10*	·3
1881	*3,742,564*	*19*	·5
1882	*3,770,657*	*3*	·1
1883	*3,798,961*	*11*	·3
1884	*3,827,478*	*14*	·4
1885	*3,856,307*	*39*	1
1886	*3,885,155*	*24*	·6
1887	*3,914,318*	*17*	·4
1888	*3,943,701*	*3*	·1
1889	*3,973,305*	*8*	·2
1890	*4,003,132*	*0*	0
1891	*4,033,180*	*0*	0
1892	*4,063,452*	*11*	·3
1893	*4,093,959*	*68*	2
1894	*4,124,691*	*129*	3

135. It will be seen that the figures in the above table are not strictly comparable throughout, in that the deaths returned as from chicken-pox are included with those returned as from smallpox in each of the years 1855—1876, while excluded as regards the later years 1877—1894. The inclusion of deaths returned as from chicken-pox during the years 1855—1876 makes, however, no material difference; the number of deaths at all ages so returned being but small in comparison with the deaths at all ages returned as from smallpox except as regards the years 1868 and 1876, when the mortality from that disease was very small.

136. During the years 1855–63 the practice of vaccination was not obligatory in Scotland. Since 1848, however, under rules issued in that year by the Board of Supervision for the Relief of the Poor, the means of gratuitous vaccination had been provided in such parishes as from time to time participated in the Parliamentary grant in aid of medical relief.

In 1863, as has been stated, the practice of vaccination was made compulsory in regard to children born in Scotland after the 1st January, 1864. The provisions of this Act, and certain of the provisions of two later statutes having some bearing on the practice of vaccination in Scotland, are stated in §§ 123—125.

137. The records kept under the Vaccination Act, and tabulated by the Registrar-General of Births and Deaths in Scotland, show the amount of primary vaccination performed within a certain period of birth, of children whose births were registered in Scotland during the years 1864—1893. The following table (p. 80) gives the figures; for convenience of comparison we state them as nearly as we can in the same form as the somewhat similar figures, given in § 131, relating to the primary vaccination of children in England and Wales.

From these figures it may be inferred that, as regards those children whose births were registered during each of the years 1864—1893, the proportion primarily vaccinated remained practically the same.

138. We are unable to make any numerical statement of the proportion, at one time as compared with another during the period 1855—1894, of the population of Scotland who had at some time in their lives been vaccinated. We are able to state, however, that the proportion of the population who had at some time been vaccinated was not, during the years from 1855 to 1863, a high one. This is clearly indicated by the vaccination returns, from parishes participating in the Parliamentary grant, given by the Board of Supervision in their eighteenth annual report (at pages 219–20), by that Board's comment on those returns (at page x), and by the evidence given by Dr. Wood before the Select Committee of the House of Commons in 1871 (Questions 4355, 4371, 4474). During the years from 1864 onwards, down to the present time, that proportion has without doubt steadily grown, probably with a very even rate of increase. At no time during that period has there been any considerable opposition in Scotland to the practice of vaccination.

Year.[1]	Births registered during year.	Of the children whose births were registered during the year given in the first column, by the 31st December in the year following that year there were—						
		Successfully vaccinated (including those found insusceptible of vaccination from having been previously vaccinated).	Certified as insusceptible of vaccination.	Had smallpox.	Died unvaccinated.	Vaccination postponed by medical certificate.	Remaining.	The children not finally accounted for (including cases postponed), being per cent. of births.
1864	108,851	95,487	667	154	9,180	662	2,701	3·1
1865	113,129	99,855	474	34	9,366	719	2,681	3·0
1866	113,730	100,635	332	30	9,433	579	2,721	2·9
1867	114,181	101,290	233	16	9,355	670	2,617	2·9
1868	115,514	102,370	277	7	9,440	914	2,506	3·0
1869	113,441	99,439	177	17	10,069	966	2,773	3·3
1870	115,446	102,104	215	28	9,724	843	2,532	2·9
1871	116,184	102,098	241	142	10,280	841	2,582	2·9
1872	118,959	105,224	184	64	10,325	811	2,351	2·7
1873	119,810	105,340	162	39	10,527	1,113	2,629	3·1
1874	123,861	108,227	206	33	11,288	1,229	2,878	3·3
1875	123,651	108,348	190	1	11,326	1,211	2,575	3·1
1876	126,706	112,163	177	5	10,760	1,034	2,567	2·8
1877	126,900	112,709	180	4	10,374	1,304	2,329	2·9
1878	126,854	112,100	190	3	10,905	1,196	2,460	2·9
1879	125,782	111,818	180	3	9,999	1,290	2,492	3·0
1880	124,674	109,740	155	0	11,016	1,404	2,359	3·0
1881	126,277	111,360	150	0	10,587	1,586	2,594	3·3
1882	126,162	110,543	192	4	11,073	1,713	2,637	3·4
1883	124,516	109,271	194	2	10,713	1,884	2,452	3·5
1884	129,123	112,387	242	0	11,694	1,964	2,836	3·7
1885	126,152	110,094	225	0	10,872	2,073	2,888	3·9
1886	127,968	111,105	201	0	11,282	2,325	3,055	4·2
1887	124,467	107,450	236	0	11,269	2,465	3,047	4·4
1888	123,294	107,131	216	0	10,434	2,417	3,096	4·5
1889	122,849	105,217	235	0	11,479	2,692	3,226	4·8
1890	121,612	103,883	222	2	11,779	2,710	3,016	4·7
1891	126,076	107,762	268	1	12,293	2,637	3,115	4·6
1892	125,119	107,568	345	0	11,693	2,468	3,045	4·4
1893	127,155	108,390	509	1	12,781	2,474	3,000	4·3

[1] 6, App. 634. Q. 27,883; 27,914.

139. During the period 1855—1864 the death-rate from smallpox in Scotland, though varying from year to year, gave no indication of decline. Speaking generally of the peried since 1864, there has been, as the table given in § 134 clearly shows, a marked though irregular decline in the death-rate from smallpox.

With this decline there has been in Scotland, as in England and Wales, a striking change in the age incidence of fatal smallpox.

140. Exact statistics of the mortality from smallpox in Ireland are only available from the year 1864 onwards. On the taking, however, of the census in 1841, in 1851, and in 1861 (and again in 1871), inquiries were made as to the number and causes of death amongst the population since the date of the previous census.[1] From the information so obtained it has been calculated that the average annual death-rate from smallpox in Ireland per 100,000 living was 73 during the inter-censal period 1831–41, 49 during the inter-censal period 1841–51,[2] and 21 during the inter-censal period 1851–61.[3] It has not been suggested that these calculations, from materials depending on the recollection of the people who answered the census questions and based on the assumption that every death from smallpox was returned, and returned but once, give any but approximate figures; there is reason to believe that the mortality from smallpox was probably even higher during the periods in question than the figures so obtained would indicate.

The following table shows the mortality from smallpox in Ireland during each of the years 1864—1894:

Year.[4]	*Population.*	*Number of deaths returned from smallpox only.*	Deaths returned from smallpox *only* to every 100,000 living.
1864	*5,640,527*	*842*	15
1865	*5,594,589*	*457*	8
1866	*5,522,942*	*191*	3
1867	*5,486,509*	*16*	·3
1868	*5,465,914*	*21*	·4
1869	*5,449,094*	*14*	·3
1870	*5,418,512*	*30*	·6

[1] Q. 2712. [2] 2, App. 256.
[3] Q. 2716; 2742–55; 2764–5. [4] App. 256.

Year.	*Population.*	*Number of deaths returned from smallpox only.*	Deaths returned from smallpox *only* to every 100,000 living.
1871	*5,398,179*	*660*	12
1872	*5,372,890*	*3,243*	60
1873	*5,327,938*	*496*	9
1874	*5,298,979*	*566*	11
1875	*5,278,629*	*531*	10
1876	*5,277,544*	*19*	·4
1877	*5,286.380*	*65*	1
1878	*5,282,246*	*864*	16
1879	*5,265,625*	*662*	13
1880	*5,202,648*	*381*	7
1881	*5.145,770*	*72*	1
1882	*5,101,018*	*129*	3
1883	*5,023,811*	*16*	·3
1884	*4,974,561*	*1*	·02
1885	*4,938,588*	*4*	·1
1886	*4,905,895*	*2*	·04
1887	*4,857,119*	*14*	·3
1888	*4,801,312*	*3*	·1
1889	*4,757,385*	*0*	0
1890	*4,717,959*	*0*	0
1891	*4,681,248*	*7*	·1
1892	*4,638,169*	*0*	0
1893	*4,615,312*	*1*	·02
1894	*4,600,599*	*72*	2

141. There are no available figures, comparable throughout the period 1831—1894, by which we can measure the extent to which, at one and another time, the practice of vaccination was accepted in Ireland in those years. There is no doubt that there has been, speaking generally, during that period a large spread of the practice. In §§ 115–121 we have given an account of the legislation from time to time enacted to this end, and we shall therefore merely recapitulate here the dates of the principal Acts of Parliament relating to the practice of vaccination in Ireland which have come into force during this period.

In 1840–41 provision was made for vaccination in Ireland, as in England and Wales, at the expense of the Poor Rates.[1] The arrangements made in consequence, appear, however, to have been by no means so complete in Ireland as they were in England and Wales; and in October, 1846, in 57 out of the 130 unions

[1] Q. 3045.

into which Ireland was then divided, no arrangements had been made.

In 1851 it was provided that the medical officer of every dispensary district then constituted in Ireland should vaccinate all persons who might come to him for that purpose.

In 1858 it was provided that the committee of management of every dispensary district in Ireland should divide the district into so many vaccination districts as they might deem advisable and necessary, and should require the medical officer of the district to attend at some convenient place within each vaccination district for the purpose of vaccinating all persons resident in his district who might come to him.

In 1863 the practice of vaccination was made compulsory, within six months after birth, in regard to children born in Ireland after the 1st January, 1864, and penalties were imposed for non-compliance.

In 1878 provisions similar to those contained in Section 31 of the English Vaccination Act of 1867 were enacted ; the maximum penalty for non-compliance with the Justice's order directing vaccination being, as in the English Act, twenty shillings, whereas the maximum penalty under the Irish Vaccination Act of 1863 for non-compliance with the requirement of vaccination was ten shillings.

In 1879 the Acts relating to vaccination in Ireland were amended ; the practice of vaccination being made compulsory within three months after birth, or within three months after being brought into Ireland, in regard to children born in or brought into Ireland after the passing of the Act. The maximum penalty under the Vaccination (Ireland) Acts for non-compliance with the requirement of vaccination was fixed at twenty shillings ; the arrangements for the registration of vaccination were improved ; and the Acts were amended in other ways. This amendment of the law was such as to render it less likely that the obligation to be vaccinated would be evaded.[1]

[1] Q. 3045–7; 2738–9.

142. We are unable to make any numerical statement of the proportion, at one time as compared with another during the period 1831—1894, of the population of Ireland who had at some time in their lives been vaccinated.[1] At no time during that period has there been any considerable opposition in Ireland to the practice of vaccination : and, so far as we can judge of the effect of the efforts made during that period to extend the practice, the proportion of the population who had at some time been vaccinated has steadily grown, though with no even rate of increase, during the years from 1840 onwards down to the present time. The rate of increase, though varying considerably in different years, has no doubt on the whole been far greater since 1863 than in previous years.

143. The approximate figures given in § 140 in regard to the death-rate from smallpox in Ireland during the intercensal periods 1831—1841, 1841—1851, and 1851—1861, so far as they go, tend to show that the death-rate from smallpox was on the whole considerably less in the second period than in the first, and again considerably less in the third period than in the second ; and that the death-rate from smallpox even in the third period was on the whole considerably greater than it has been in any ten years since 1863. Speaking generally, then, of the period since 1831, we find that there has been a marked though irregular decline in the death-rate from smallpox.

With this decline there has been in Ireland, as in England and Wales and Scotland, a striking change in the age incidence of fatal smallpox.

144. We have dealt so far with the evidence afforded by the statistics of the mortality from smallpox at different epochs in view of the spread or continued practice of vaccination. It seems to us scarcely possible to deny that, speaking generally of the British Isles, a more vaccinated population has exhibited a diminished mortality from smallpox. It was not, of course, to be expected that this should be seen year by year, or that the correspondence should be

[1] Q. 2900-3 ; 3050 ; 6299-311.

exact, even assuming vaccination to be the principal cause of this diminished mortality. We have already pointed out that smallpox tends at times to become epidemic, *i. e.* to spread more readily than at other times. The occurrence of the conditions, whatever they may be, which cause the disease to be thus epidemic have of course no relation to the state of the population as regards vaccination, even conceding to the full that it has a protective effect. The only result of wide-spread vaccination, in a case where smallpox became epidemic, could be to render the extent of the epidemic more limited, and its fatality less than it would otherwise be. All that we should anticipate, then, would be a general correspondence over a long series of years between a vaccinated condition of the people and a diminished mortality from smallpox.

145. In considering whether vaccination has been the principal cause of the decline, we must inquire whether the other causes suggested by those who deny the efficacy of vaccination will satisfactorily account for it.

146. It is said that the decline has, in the main, been due to changes in the general conditions of life in the different parts of the United Kingdom, apart from the spread of the practice of vaccination; amongst other things, to improvement of sanitary conditions.

147. It is beyond doubt that an infectious disease like smallpox is, other things being equal, more likely to spread in towns than in country districts, and more likely to spread in crowded town districts than in others not so densely populated; so that we should expect a lessened proportion of over-crowded dwellings, by diminishing the opportunities for contagion, to check the prevalence of the disease, and consequently to render its mortality less.

148. Now it may be that during the period of the decline under consideration (that is in England and Wales during the period from 1838 onward, in Scotland from 1865 onward, and in Ireland from 1841), a diminishing proportion of the

population has, in the towns, been living in densely built areas and in over-crowded dwellings. So far as this has been the case, it has tended to the diminution of the prevalence of, and mortality from, smallpox.

149. On the other hand, it is certain that, during the period of the decline, there has been in England and Wales and in Scotland, though not in Ireland, a large increase of the population; so that the density of the population in two out of these parts of the United Kingdom, taking each of them as a whole, has been increasing.

And it is equally certain, and probably far more important, that in all of them, during the period of the decline, there has been a continually growing proportion of the population living in the towns, and particularly in the larger towns. [Census reports: of England and Wales, in 1881, vol. iv, pp. 8–10; in 1891, vol. iv, pp. 9–12: of Scotland, in 1871, vol. i, pp. xvi and xxiii—xxv; in 1881, vol. i, pp. xiv and xviii; in 1891, vol. i, pp. xiii and xviii: of Ireland, in 1841, pp. vii, viii; in 1851, part vi, pp. xiii—xv; in 1861, part v, pp. ix, x; in 1871, part iii, pp. 12, 13; in 1881, part ii, p. 6; in 1891, part ii, pp. 8, 9.] This growth of the proportion of the population living in towns has been a condition tending to an increased prevalence of, and mortality from, smallpox.

150. There has also been, during the period of the decline, another change in the conditions of life, affecting all three countries, which would seem, at all events on *a priori* grounds, to have largely tended to an increased prevalence of smallpox; namely, the enormous and continued extension of movement among the population and of communication with other countries, following the increasing facilities for such movement and communication.

151. We have already pointed out that on *a priori* grounds it is reasonable to think that improved sanitary conditions would tend to diminish the fatality of, and so to a corresponding extent the mortality from, smallpox. And there can be no doubt that the period with which we are

dealing has been characterised by an improvement of this description. There has been better drainage, a supply of purer water, and in other respects more wholesome conditions have prevailed.

152. It may be useful at this point to furnish a brief summary of the principal Sanitary Acts which have been passed relating to the different parts of the United Kingdom.

In 1848 was passed the first great and comprehensive measure, which may be called the groundwork of our sanitary legislation as regards England. The Public Health Act of 1848 was, however, principally designed for towns and populous places in England and Wales, not including the metropolis, which was dealt with in Acts passed in the same year. The powers of local government supplied by the Act were generally an extension of those before given by sundry local Acts to Commissioners of Sewers in the metropolis, and to authorities in a few large towns. Many provisions corresponding to sections in the Towns Improvement Clauses Act of 1847 are found in the Public Health Act, and communities were thus enabled to obtain by a simple process powers which they could not previously obtain except by a local Act incorporating sections of the Towns Improvement Clauses Act.

In 1848 was also passed the Nuisances Removal and Diseases Prevention Act of that year, in substitution for a similar Act of 1846 which was about to expire; and in 1849 this Act of 1848 was amended. The provisions of all these three Acts extended to England, Scotland, and Ireland. In 1855 a comprehensive Nuisance Removal Act was, as regards England, substituted for the Acts passed in 1848 and 1849; and in the following year there was similar legislation for Scotland. In 1860 the English Act was amended, and in 1866, by the Sanitary Act of that year (to which we shall again refer), the provisions of the English Acts of 1855 and 1860, as then amended, were applied to Ireland.

In 1855, by the Metropolitan Local Management Act of that year, provision was made for the appointment of a medical officer of health and an inspector of nuisances by

every vestry and district board in the metropolis. This provision did not extend to the City of London, where, in 1848, a medical officer of health had been appointed under power given by a local Act.

In 1858 the Local Government Act of that year, to be construed with the Public Health Act of 1848 as one Act, was passed, and took effect in all places where that Act was in force at the time of its passing; and, as regards England, these two Acts together constituted until 1872 the principal sanitary legislation on the statute-book.

There followed, however, within the next ten years many public Acts having sanitary objects, some applying to all, and some to particular, parts of the United Kingdom, besides numerous other Acts of local application. We need only now specially refer to one of these public statutes, the Sanitary Act of 1866, which was probably the most important, and applied, in part at least, to England, Scotland, and Ireland. This Act, amongst other things, extended the powers of local authorities for the disposal of sewage, and, in amending the English Nuisances Removal Acts of 1855 and 1860, added to the definitions of nuisances, especially as regards crowded houses and workshops, and to the duties and powers of local authorities for their abatement, especially in the way of providing means for disinfection and places for the reception of dead bodies.

In 1867 the Public Health (Scotland) Act was passed, a comprehensive measure which consolidated into one Act, with certain amendments, the whole statute law relating to the public health in Scotland.

In 1872 a complete distribution of England into sanitary districts took place, and some further amendments were made in the sanitary laws. In 1875 these laws were consolidated in the Act of that year. In 1891 a Sanitary Act was passed relating to the metropolis.

In 1874 an Act was passed for Ireland containing substantially the same provisions as those which had been enacted in the case of England in 1872.

153. We have seen, then, that if some changes have occurred tending to diminish mortality from smallpox, other

changes have been simultaneously in progress tending in the contrary direction. We do not think it possible to strike the balance between the two, and assert that it would tell in favour of a smaller mortality. In saying this we do not mean to indicate an opinion that sanitary improvements have been without an effect on smallpox mortality, but only that when all the changes which have occurred are considered it cannot be asserted that they afford an adequate explanation of the diminished mortality from smallpox.

154. If, however, improved sanitary conditions were the cause of the mortality from smallpox becoming less, we should expect to see that they had exercised a similar influence over almost all other diseases. Why should they not produce the same effect in the case of measles, scarlet fever, whooping-cough, and, indeed, any disease spread by contagion or infection, and from which recovery was possible? Why should they not lead to these diseases also prevailing less, and to those attacked by them being better able to combat the disease?

155. We have had put before us no satisfactory answer to these questions. It has, indeed, been urged that whilst the diseases we have just mentioned almost exclusively affect children, smallpox largely attacks adults. We cannot feel that this circumstance is of much weight. It must be remembered that in former days smallpox was more fatal to children than to any other class. But apart from this we fail to see why improved sanitary conditions should enable children (and, as we have said, it is amongst them that the diminution of smallpox mortality has been greatest) to escape attacks of smallpox and overcome the disease rather than to escape from and overcome any of the other diseases to which we have referred.

156. In the case of measles there has not been during the period in question any diminution in the mortality corresponding with that displayed in the case of smallpox.

The following table shows the mortality from measles in

England and Wales during each of the years 1838—1842 and 1847—1894. The figures for the years 1843—1846 are not available.

Year.[1]	Deaths from measles to every 100,000 living.	Year.	Deaths from measles to every 100,000 living.
1838	43	1867	30
1839	71	1868	53
1840	59	1869	46
		1870	34
1841	43		
1842	54	1871	41
1843	Causes of death not abstracted by Registrar-General	1872	37
1844		1873	32
1845		1874	52
1846		1875	26
1847	51	1876	41
1848	40	1877	37
1849	31	1878	31
1850	40	1879	36
		1880	48
1851	52		
1852	32	1881	28
1853	27	1882	48
1854	50	1883	35
1855	39	1884	42
1856	37	1885	53
1857	31	1886	43
1858	48	1887	59
1859	49	1888	35
1860	48	1889	52
		1890	44
1861	45		
1862	48	1891	44
1863	55	1892	46
1864	40	1893	37
1865	41	1894	39
1866	51		

157. The following table shows the mortality from measles in Scotland during each of the years 1855–94.

[1] 6, App. 645.

Year.[1]	Deaths from measles to every 100,000 living.	Year.	Deaths from measles to every 100,000 living.
1855	43	1875	30
1856	37	1876	36
1857	36	1877	29
1858	54	1878	39
1859	33	1879	21
1860	54	1880	39
1861	33	1881	27
1862	47	1882	34
1863	74	1883	43
1864	37	1884	38
1865	39	1885	37
1866	34	1886	17
1867	44	1887	40
1868	37	1888	35
1869	52	1889	49
1870	26	1890	63
1871	63	1891	44
1872	28	1892	56
1873	43	1893	90
1874	32	1894	19

158. From the report on the census of Ireland in 1861 (Part III, vol. ii, p. 20) we are able to obtain the number of deaths from measles ascertained by the census inquiries to have occurred in Ireland during each of the inter-censal periods 1831–41, 1841–51, and 1851–61. Calculating from these figures the average annual death-rate during each of these periods from measles, in the same way as the average annual death-rates for the same periods from smallpox (given in § 140) were calculated, we find that the approximate average annual death-rate from measles in Ireland per 100,000 living was thirty-eight during the inter-censal period 1831–41, thirty-eight again during the inter-censal period 1841–51, and twenty-two during the inter-censal period 1851–61.

The materials for the following table, showing the mortality from measles in Ireland during each of the years 1864–94, have been obtained from the annual reports of the Registrar-General of Births and Deaths in Ireland.

[1] 6, App. facing p. 641.

Year.	Deaths from measles to every 100,000 living.	Year.	Deaths from measles to every 100,000 living.
1864	11	1880	20
1865	19		
1866	15	1881	8
1867	24	1882	30
1868	23	1883	16
1869	17	1884	11
1870	18	1885	27
		1886	6
1871	10	1887	27
1872	26	1888	40
1873	24	1889	12
1874	13	1890	15
1875	17		
1876	12	1891	5
1877	29	1892	26
1878	41	1893	23
1879	16	1894	26

159. It will be seen that the death-rate from measles in all three countries has, as might be expected, varied considerably from year to year. Neither in England and Wales, nor in Scotland or Ireland, has that death-rate, however, shown any indication of a decline at all comparable with the decline in the death-rate from smallpox which has distinguished the period now under consideration, viz. in England and Wales the period from 1838 onward, in Scotland from 1865 onward, and in Ireland from 1841.

We find, indeed, as regards England and Wales, that though the death-rate from measles was higher in the three years 1838, 1839, and 1840 than it has been in any three consecutive years since, there has been no material decline in that death-rate during the years 1838–94. As regards Scotland we find that there has been no material decline in the death-rate from measles during the years 1855–94. As regards Ireland we find that the death-rate from measles was on the whole considerably less during the inter-censal period 1851–60 than during the earlier inter-censal periods 1831–40 and 1841–50, but that there has since been no material decline in that death-rate.

160. The total effect, then, of the changes in sanitary conditions to which we have referred on the mortality from

measles would seem, in England and Wales and in Scotland, to have been scarcely appreciable; and in Ireland to have been limited to a decline in the death-rate, trifling in amount in comparison with the decline in the death-rate from small-pox, and manifested, moreover, during a part only of the period of that decline.

161. The following table shows the mortality from scarlet fever and from diphtheria in England and Wales during each of the years 1838–42 and 1847–94. We are unable, for the earlier years included in the table, to separate those causes of death.

Year.[1]	Deaths from scarlet fever to every 100,000 living.	Deaths from diphtheria to every 100,000 living.	Year.	Deaths from scarlet fever to every 100,000 living.	Deaths from diphtheria to every 100,000 living.
1838	38		1866	55	14
1839	67		1867	57	12
1840	126		1868	100	14
1841	89		1869	124	12
1842	79		1870	145	12
1843	Causes of death not abstracted by Registrar-General		1871	82	11
1844			1872	52	9
1845			1873	56	11
1846			1874	105	15
1847	86		1875	85	14
1848	118		1876	69	13
1849	75		1877	59	11
1850	75		1878	75	14
			1879	69	12
1851	76		1880	68	11
1852	104				
1853	85		1881	55	12
1854	100		1882	52	15
			1883	47	16
1855	89	2	1884	40	19
1856	71	3	1885	23	16
1857	65	8	1886	22	15
1858	121	34	1887	28	16
1859	98	52	1888	23	17
1860	49	26	1889	24	19
			1890	24	18
1861	45	23			
1862	73	24	1891	17	17
1863	148	32	1892	19	22
1864	142	26	1893	24	32
1865	84	20	1894	17	29

[1] 6, App. 645.

162. The following table shows the mortality from scarlet fever in Scotland during each of the years 1855–94.

Year.[1]	Deaths from scarlet fever to every 100,000 living.	Year.	Deaths from scarlet fever to every 100,000 living.
1855	79	1875	137
1856	108	1876	68
1857	79	1877	39
1858	94	1878	53
1859	126	1879	44
1860	101	1880	59
1861	60	1881	42
1862	43	1882	42
1863	115	1883	35
1864	111	1884	33
1865	75	1885	24
1866	89	1886	27
1867	104	1887	30
1868	143	1888	18
1869	136	1889	18
1870	4	1890	19
1871	79	1891	18
1872	64	1892	22
1873	66	1893	20
1874	186	1894	20

163. As regards Ireland, obtaining from the report on the census in 1861 the number of deaths from scarlet fever ascertained by the census inquiries to have occurred during each of the inter-censal periods 1831–41, 1841–51, and 1851–61, and calculating, as before, from these figures, the average annual death-rate during each period, we find that the approximate average annual death-rate from scarlet fever per 100,000 living was 10 during the inter-censal period 1831–41, 26 during the inter-censal period 1841–51, and 43 during the inter-censal period 1851–61.

The materials for the following table, showing the mortality from scarlet fever in Ireland during each of the years 1864–94, have been obtained from the annual reports of the Registrar-General of Births and Deaths in Ireland :

[1] 6, App. facing p. 641.

Year.	Deaths from scarlet fever to every 100,000 living.	Year.	Deaths from scarlet fever to every 100,000 living.
1864	46	1880	47
1865	66		
1866	63	1881	26
1867	39	1882	24
1868	49	1883	35
1869	66	1884	28
1870	55	1885	23
		1886	17
1871	41	1887	20
1872	46	1888	18
1873	39	1889	10
1874	76	1890	7
1875	73		
1876	42	1891	7
1877	21	1892	9
1878	20	1893	10
1879	32	1894	13

164. It will be seen that the death-rate from scarlet fever in all three countries has varied considerably from year to year. Neither in England and Wales, nor in Scotland or Ireland, has that death-rate, however, exhibited a decline comparable with the decline in the death-rate from small-pox which has distinguished the period now under consideration, viz. in England and Wales the period from 1838 onward, in Scotland from 1865 onward, and in Ireland from 1841.

We find, indeed, than in England and Wales, in Scotland and in Ireland, there was no sign of any decrease in the death-rate from scarlet fever until about 1880 or shortly before that year. During the last ten to twelve years there has undoubtedly been in each part of the United Kingdom a marked decline in that death-rate. We think that the steps which have been taken in various ways to isolate persons suffering from scarlet fever have largely contributed to this decline.

165. We do not think it necessary to burden our report with similar details in reference to the mortality from whooping-cough during the period under discussion. It will be sufficient to say that there has been no decline in the

mortality from that disease corresponding with the decline in smallpox mortality.

166. Great stress has been laid on the fact that the records of the Registrar-General show that the mortality returned under the head "fevers" has very largely diminished. But it is notorious that in comparatively recent years the nomenclature and classification of diseases where fever is present have undergone great changes, owing to improved diagnosis. In the case of many such diseases where the cause of death was formerly returned merely as "fever," it is now attributed to some other disease separately specified. The apparent diminution is therefore not entirely a real one. Changes in nomenclature and classification, however, cannot wholly explain the diminution in the number of deaths returned as due to fever, though they prevent exact quantitative comparison, such as can be made in the case of diseases like smallpox, measles, &c. The mortality from fevers has undoubtedly decreased largely. In considering the relation of this decrease to improved sanitary conditions, it is important to advert to the nature of these sanitary improvements. They may be broadly classed as follows:—(*a*) Drainage, including in the term the removal of moisture from damp and swampy places, and the adequately rapid and effectual removal of the excreta of the bowels and the kidneys. (*b*) Ventilation of dwellings, or the rapid and effective renewal of the air surrounding the inhabitants. (*c*) Lighting of dwellings. The means taken to secure this also entail greater ventilation; the two go together, but besides this the effect of light on organisms or microbes, to which contagia seem analogous, would lead one to suppose that increased light, at least sunlight, tended to destroy contagia. (*d*) A supply of pure water for drinking purposes. (*e*) Personal cleanliness. This, apart from its influence on general health, would have a tendency to render an individual less likely to receive contagion and less likely to convey it to another. (*f*) The increased general recognition, during the last ten or twenty years especially, of contagion as the source of certain diseases, and increased knowledge of the means of avoiding its spread, may be recognised as a sanitary

improvement of no slight value. It is obvious that these sanitary changes are not calculated to affect even all zymotic diseases in the same manner and to the same extent. The chief fevers are (1) malarial fevers, (2) typhus, (3) typhoid. There is much uncertainty concerning the fever classed as "simple continued," nor does this appear ever to have contributed largely to the returns. Now malarial fevers are directly dependent on the development of the contagia in swamps and marshes; when these are adequately drained the fevers disappear. Typhus fever, which seems to have furnished the largest share of "fevers" in the last and in the beginning of this century, is found to prevail in connection with over-crowding in dark ill-ventilated dwellings, combined with deficient nutrition. When these conditions cease the fever disappears, and typhus has thus become almost unknown in this country at the present day. Typhoid fever is directly dependent on the contagia furnished by the excreta of one case being introduced into the alimentary canal. Where, by means of adequate drainage and personal cleanliness, this is prevented, the disease is prevented also. In the case of each of these fevers, then, there are special circumstances developing the disease, which sanitary improvements tend directly to remove. There is no like feature in the case of smallpox. It resembles measles in this, that the spread of it is not connected with any particular sanitary fault, as distinguished from those general conditions which tend to the spread of infectious disease. There is no evidence in the history of smallpox, either before or during the nineteenth century, to connect outbreaks of that disease in a special way either with imperfect removal of excreta, or with lack of air and light, or with deficient food, or with lack of personal cleanliness. Moreover, the general tendency of sanitation to lower the prevalence and the fatality of the disease is largely neutralised both in the case of smallpox and measles by the greater facility of intercourse. Whilst, then, there is ample reason to regard the decrease in the case of typhus and typhoid fever (and it may perhaps be said of fever generally) as the result of improved sanitary conditions, since each of these is specially dependent on conditions which sanitary improvements have removed,

there is no adequate reason to attribute the decrease of smallpox in the nineteenth century to a similar cause, though we fully recognise that sanitary improvements have had an effect in reducing the mortality from smallpox as from the other diseases to which we have just been referring. This view is strongly confirmed by the fact that in spite of sanitary improvements the mortality from measles and whooping-cough has remained undiminished, and the diminution in the mortality from scarlet fever has only been apparent in comparatively recent years.

167. It has been maintained that the decline in smallpox mortality is largely due to more frequent and systematic attempts to isolate those suffering from smallpox. We think an answer to this contention is to be found in the fact that, as we shall presently show (§§ 460—479), it is only in quite recent years that there has been any systematic practice of isolating smallpox patients, and that it has been confined even then to a very limited number of localities. The fact to which we are about to call attention in greater detail than hitherto, that the decline in the deaths from smallpox is found almost exclusively among those of tender years, appears also to militate against the contention. The risk of contagion is not confined to children. Adults also are subject to it. If a better system of isolation had been a main cause of the reduced mortality, we should have expected to see it operate in the case of adults as well as of children. At the same time we are far from thinking, as will appear when we come to deal with that subject, that the efforts at isolation which have characterised recent years have been without a beneficial effect on smallpox mortality.

168. A study of the age incidence of smallpox mortality is very instructive. In connection with this point it is necessary to bear in mind that experience has led to the conclusion that whatever be the protective effect of vaccination, it is not absolutely permanent; the most convinced advocates of the practice admit that after the lapse of nine or ten years from the date of the operation, its protective effect against an attack of smallpox rapidly diminishes, and

that it is only during this period that its power in that respect is very great; though it is maintained that, so far as regards its power to modify the character of the disease and render it less fatal, its effect remains in full force for a longer period, and never altogether ceases. The experience upon which this view is founded is derived almost exclusively from the case of infantile vaccination. It has been supposed by some that the transitory character of the protection results from changes connected with the growth from infancy to adult years. Whether this be so or not, we have no means of determining.

169. No doubt when Jenner drew the attention of the public to the value of vaccination, he believed that a single successful inoculation of vaccine matter secured absolute immunity for the future from an attack of smallpox. It is certain that in this he was mistaken. It may well be doubted whether the anticipation was a reasonable one. No such immunity is secured by an attack of smallpox, though there are few who would maintain the proposition that it is without protective influence against another attack. *A priori* there would seem to be no sound ground for expecting that vaccinia would afford more potent protection than smallpox itself. The extent of the protection afforded (assuming that there is some protective influence) could only be determined by experience. It soon became apparent that Jenner had, in the first instance, overrated the effect of vaccination. That he should thus have over-estimated it is not to be wondered at, when the tendency to be unduly sanguine, which besets the discoverer of any new prophylactic, and, indeed, every discoverer, is borne in mind.

170. The fact has been already noted that in the eighteenth century (and there is no satisfactory evidence that there was a difference in this respect in earlier centuries, smallpox was fatal chiefly to children; indeed, in particular local epidemics of which we have records, the mortality was confined entirely, or almost entirely, to that class of the population. Adults were at that time very largely protected by a previous attack of smallpox. Children were

then the only class, for the most part, unprotected. During the present century this cause of protection has largely diminished; it is now only a very small section of the community which enjoys protection thus acquired. If, then, vaccination be most potent in its effect during the first few years after the inoculation of the vaccine matter, we should expect to find the conditions which formerly existed reversed—children would be the best, adults the worst protected class.

171. Applying ourselves now to the statistics on this head, we find a remarkable change in the age-incidence of smallpox mortality. The following table exhibits the change which has taken place in this respect. For the years 1848–54 cases of chicken-pox are unavoidably included, there being no means of distinguishing them. This, of course, tends to increase unduly the share of mortality borne by the earlier age periods, but the information which we possess with reference to chicken-pox mortality since mortality from that disease has been separately recorded, enables us to say that the error thus introduced cannot seriously affect the comparison. From 1855 onwards chicken-pox has been uniformly excluded, so that from that date there is nothing to affect it.

ENGLAND AND WALES:—*Deaths from Smallpox at certain Age Periods to* 1000 *Deaths from Smallpox at all Ages.*

	Under 1.	1—5.	5—10.	10—15.	15—25.	25—45.	45 and upward
1848—54	251	426	130	33	75	67	18
1855—59	231	328	144	37	117	112	31
1860—64	237	313	108	42	123	133	44
1865—69	231	314	103	33	126	145	48
1870—74	143	169	140	58	200	224	66
1875—79	112	129	113	72	218	266	90
1880—84	113	122	98	68	216	286	97
1885—89	112	81	54	51	229	344	129
1890—94	166	117	50	26	131	338	172

The first point calling for notice is that in the period 1855–59, as compared with the earlier period, there was a

considerable diminution in the share of smallpox mortality borne by those between one and five years of age. In the earlier period it was 426, in the latter 328. As regards those under one year of age the share fell from 251 to 231. It must, of course, be remembered that whatever the prevalence of vaccination amongst children, the age-period under one year will always contain a considerable unvaccinated class. We are naturally led to inquire whether there is anything in the history of vaccination to account for the remarkable change we have adverted to. In the year 1853 vaccination was made compulsory, and though no sufficient means were provided for rendering the law effectual it cannot be doubted that it was calculated to increase vaccination in the subsequent years.

The next marked change is seen in the quinquennium 1870–74. The proportion of smallpox mortality borne by those under one year of age decreased from 231 to 143, and of those between one and five years of age from 314 to 169. We have already called attention to the fact that in 1867 power was given to the Guardians to appoint Vaccination Officers, and that advantage was taken of this from time to time by different unions, though a large number remained without such officers until after 1871, when their appointment was made compulsory. There can be no doubt that the effect of this legislation was to cause an increasing extension of the practice of vaccination in 1868 and subsequent years, and very largely to increase the amount of vaccination in and subsequently to the year 1871. The effect of this would be at once felt in the earliest age-periods, and at a period correspondingly later in the succeeding age-periods. We have already pointed out the marked change in the incidence below five years of age in the quinquennium 1870–74, and it will be seen that in subsequent quinquennia there was a diminished incidence in the age-periods 5–10 and 10–15, and later still in the period 15–25. During the last quinquennium there has been some increase in the incidence of the disease in the first two life-periods. This has been coincident with some diminution in the practice of vaccination.

172. The following table shows the death-rates in England and Wales from smallpox per million living during the seven years from 1848–54, and for each decennium since that period. It is to be remembered that, as already stated, the deaths for the years from 1848–54 include those from chicken-pox as well as smallpox.

	Under 5.	5—10.	10—15.	15—25.	25—45.	45 and upwards.
1848—54	1,514	323	91	110	69	24
1855—64	788·8	209·5	68·7	118·9	87·8	36·2
1865—74	782·5	333·2	142·3	267·2	220·7	87·5
1875—84	127·8	62·9	46·4	82·4	76·6	33·9
1885—94	50·2	14·9	11·1	24·0	31·6	19·0

It will be observed that in the decennium 1855–64 there was a very large diminution of the mortality at the age-period under five years, a considerable though smaller diminution at the next age-period, and some diminution at the age-period from 10–15. Supposing the compulsory law of 1853 to have augmented to some extent infantile vaccination, its effect would be felt in the class under five years of age during the greater part of the decennium. It would affect the class aged 5–10 years during a smaller part of the decennium, and the class aged 10–15 only during the last year or two. The next decennium, 1865–74, included the years of the great epidemic, to which allusion has already been made. Its effects are apparent on most of the mortality rates of those years. As compared with the preceding decennium there was a very great increase of mortality at all the later age-periods. It is noteworthy that as regards those under five years of age the mortality was actually less, though very slightly so, than in the preceding decennium. And though there was increased mortality in the next age-period, the increase was less than in the later age-periods. It is impossible not to be struck by this fact when it is remembered that in 1867, and again in 1871, laws were passed calculated to increase the amount of infantile vaccination. The more stringent enforcement of the practice under these laws would considerably affect

the class under five years of age during the decennium 1865–74, and the effect of the Act of 1867 would be felt to some though only to a slight extent in the class aged 5–10. Again in the next decennium, 1875–84, the fall was very great in the mortality in the first two age-periods; it was reduced to 127·8 and 62·9 as compared with 1514 and 323 in the years 1848–54, or with 788·8 and 209·5, making the comparison with the decennium, 1855–64, when chicken-pox was not included. The results of the legislation of 1867 and 1871 would affect the class under five during almost the whole of this decennium, and would largely affect those in the next age-period. It would influence sensibly the class between ten and fifteen years of age, and slightly the next higher age-period. It would be without effect in the classes over twenty-five years of age. We find the mortality rate in these classes 76·6 and 33·9, being actually higher than in the years 1848–54, for which the figures are 69 and 24, and not much below the figures for the next decennium, viz. 87·8 and 36·2. Comparing, on the other hand, the rates at the age-periods 10–15 and 15–25, the figures are 46·4 and 82·4 as against 91 and 110 for the years 1848–54, and 68·7 and 118·9 for the next decennium. In the decennium 1885–94 there was much less smallpox than in either of the preceding terms of years with which we have been dealing. Isolation and measures of that description were, no doubt, having their effect. The decrease was, however, largest in the age-periods which would be most affected by the results of the legislation to which we have directed attention. Comparing the first and last terms of years, the reduction in the first three age-periods was from 1514, 323, and 91 to 50·2, 14·9, and 11·1, in the age-period 15–25 from 110 to 24, and in the two highest age-periods from 69 and 24 to 31 and 19 only.

173. It is right to observe that there must have been among those whose age exceeded ten a certain number who had been re-vaccinated. The effect of this operation would be to restore protection, if protection there be, and to place the re-vaccinated in a somewhat similar relation to those of the same age who had been once vaccinated as vaccinated

children bear to unvaccinated. It is not possible to ascertain the number of re-vaccinated persons in the class over ten years of age in the two epochs respectively. But it seems clear that the mass of the people were not at either epoch re-vaccinated, and we do not think that the number of the re-vaccinated was sufficiently large to affect materially the value of any inferences to be drawn from the contrast to which we have directed attention. We may observe, however, that in discussing the effect of vaccination the question of re-vaccination will have to be considered, and that any phenomena exhibited by the class of re-vaccinated persons, when compared with those of a similar age who have been only vaccinated in infancy, have a similar relevancy to the contrast afforded in the case of vaccinated and unvaccinated persons of a similar age.

174. It is not necessary to give in detail the statistics showing the change of age incidence in smallpox mortality in Scotland and Ireland. They exhibit the same general features.

There are, however, some particulars relating to Scotland which seem sufficiently important to deserve special notice. The following table (see next page) was furnished by the Registrar-General of Births and Deaths in Scotland.

It will be observed that the proportion of deaths borne by those under six months, who would be in both periods (substantially) an unvaccinated class, was almost exactly the same, whilst the proportion borne by those between six months and a year, and between one and five years of age, was greatly diminished. There was a slight increase in the proportion of those between five and ten years, but this was due to the very large decrease of the proportion borne by those of an earlier age, and not to any increase of the mean mortality in the class aged 5–10 in the later period, for the mean annual death-rate per million living fell greatly, viz. from 244 to 86. Above the age of ten, the mean annual death-rate remained about the same. There was a small increase in the ages 10–15, and a small decrease in the ages 15–25.

175. Specially valuable information bearing on the protective influence of vaccination is, we think, to be found in

DEATHS *at* VARIOUS AGES *in* SCOTLAND *from* SMALLPOX *during the periods* 1855–63 *and* 1864–87, *and the proportion of such deaths at each age to every* 1000 *deaths at all ages from the same disease, with the mean annual death-rate from* SMALLPOX *during those periods per* 1,000,000 *living at each age.*[1]

Period.		All ages.	0–6 months.	6–12 months.	0–12 months.	1–5 years.	5–10 years.	10–15 years.	15–25 years.	25–45 years.	45 years and over.	Age not stated.
1855–63. (*The nine years prior to the Vaccination Act.*)	Actual deaths in period . . .	8,807	1,227	1,345	2,572	3,639	795	222	627	688	256	8
	Proportion of deaths at each age to every 1,000 deaths at all ages .	1,000	139	153	292	413	90	25	71	78	29	—
	Mean annual death-rate during period per 1,000,000 living at each age .	321	—	—	3,175	1,243	244	77	119	99	48	—
1864–87. (*The twenty-four years subsequent to the Vaccination Act.*)	Actual deaths in period . . .	9,240[2]	1,276	437	1,713[3]	1,265[4]	881[5]	749	1,867	2,137	624	12
	Proportion of deaths at each age to every 1,000 deaths at all ages .	1,000	138	47	185	137	95	81	202	231	67	—
	Mean annual death-rate during period per 1,000,000 living at each age .	108	—	—	679	139	86	81	115	100	38	—

[1] 6, App. 636.

[2] This 9,240 includes 59 deaths from chicken-pox.

[3] This 1,713 includes 38 deaths from chicken-pox (20 of them being included in the 1,276 deaths under six months, and 18 in the 437 deaths between six and twelve months).

[4] This 1,265 includes 19 deaths from chicken-pox.

[5] This 881 includes 2 deaths from chicken-pox.

the careful and scientific investigations which have been instituted in the case of several recent local epidemics. The first of these was the work of Dr. Barry during the Sheffield epidemic of 1887–8. This inquiry was made at the instance of the Local Government Board, Dr. Barry being one of the Board's medical inspectors. Five others have been conducted by medical men appointed by ourselves. Dr. Coupland reported on the epidemics in Dewsbury and Leicester, which took place in 1891–2 and 1892–3 respectively; Dr. Luff on outbreaks in London in 1892–3; Dr. Savill on an epidemic which visited Warrington in 1892–3; and Dr. Coupland on an epidemic in Gloucester in 1895–6.

176. We now proceed to consider the evidence derived from these reports so far as it bears on the age incidence of smallpox mortality. In the first place, we may notice the interesting comparison in this respect, to which Dr. Barry called attention, between the epidemic at Sheffield in 1887–8, which he investigated, and previous epidemics which had visited that town.

177. During the 1857–8 epidemic,[1] out of every 100 smallpox deaths among people of all classes the share borne by children under ten years of age was 85, as against 15 borne by persons of ten years and upwards. During the 1863–4 epidemic the share borne by the class under ten years was 86, as against 14 borne by the class over ten years of age. During the 1868–9 epidemic the share borne by the class under ten years of age was 84, as against 16 borne by the class above that age. During the 1871–2 epidemic the share borne by the class under ten years of age was 64, as against 36 borne by the class above that age. During the 1887–8 epidemic the share borne by the class under ten years of age was 27, as against 73 borne by the class above that age.

178. The percentage of the total deaths from smallpox of those dying between the ages 0–10 amongst the population enumerated in the census at Sheffield in 1887–8 was

[1] Q. 2047.

25·6. This percentage is calculated upon a total of 500 deaths, of which the deaths of those in that age-period were 128. The particulars are contained in Tables XCVI and XCIV, pp. 178 and 176 of Dr. Barry's report, which were compiled from the census taken in February, 1888, and included all the deaths which had occurred up to the end of the enumeration. Inasmuch, however, as Dr. Barry excluded from Table XCVI,[1] all deaths of children under one month, these have been added, so that for the purposes of comparison the basis of the statistics relating to Sheffield and the other towns should be the same.

179. In Dewsbury[2] in 1891–2 the deaths between the ages of 0–10 were 57 out of a total of 110, or 51·8 per cent. of the total deaths.

180. In London[3] in 1892–3 the deaths between the ages of 0–10 were 67 out of 182, or 36·8 per cent. of the total deaths.

181. In Warrington[4] in 1892–3 the deaths between the ages of 0–10 were 14 out of 62, or 22·5 per cent. of the total deaths.

182. In Leicester[5] in 1892–3 the deaths between the ages of 0–10 were 15 out of 21, or 71·4 per cent. of the total deaths. In consequence of the proximity of a scarlet fever ward to the hospital in which smallpox cases were treated, several children in that ward were attacked by smallpox, of whom three died. It may be suggested that this circumstance would be likely to render the infant mortality exceptionally high at Leicester as compared with the other

[1] Note.—We have in this (§ 178) and the following paragraphs referred to the particulars contained in this table (Table XCVI) rather than to those found in the table based upon the records in the Health Office (which is Table CI on page 191 of the report), because as regards most of the matters with which we are concerned, at all events, it seems more to be relied on. If the figures relating to age incidence be taken from the latter table the percentage of deaths at the ages 0–10 works out at 26·9.

[2] App. III, p. 29.

[3] App. IV, pp. 2 and 12.

[4] App. V, p. 35.

[5] App. VI, p. 43; and pp. 26 and 27.

towns. If, however, these three deaths be excluded altogether from the calculation, it only reduces the percentage from 71·4 to 66·6.

183. In Gloucester in 1895–6 the deaths between the ages of 0–10 were 280 out of 434, or 64·5 per cent. of the total deaths.[1]

184. It will be convenient for purposes of comparison to place them together in the following table :

	Percentage of the total smallpox deaths borne by those between the ages of 0—10.
Warrington . .	22·5
Sheffield . . .	25·6
London . . .	36·8
Dewsbury . .	51·8
Gloucester . .	64·5
Leicester. . .	71·4 [or 66·6. See § 182.]

185. It will be seen that whilst at Leicester and Gloucester the deaths under ten years of age were considerably more than half the total deaths, the deaths of children of a similar age at Dewsbury slightly exceeded one half. In London the deaths under ten were considerably less than half. At Sheffield and Warrington they were about a quarter of the total deaths. The variations are very striking, ranging from 22·5 at Warrington to 71·4 at Leicester, and the approximation between the percentages at Sheffield and Warrington, as compared with those of the other towns, is also worthy of note. One is naturally led to inquire what is the explanation of these remarkable differences in the age incidence of the fatal cases of small-pox ?

186. According to Dr. Savill, the requirements of the law with reference to vaccination had been very well complied with in Warrington, and the percentage of the population unvaccinated was very small. Dr. Barry's report with regard to the vaccination of Sheffield is to the same effect.

[1] App. VII.

187. Turning to the returns of vaccination in Sheffield for the years 1878–87, we find that the children not finally accounted for (including cases postponed) amounted during that period to 4·5 of the births.

The return for the union of Warrington (which includes the borough) shows for the ten years 1883–1892 that the children not accounted for (including, as before, postponed cases) was 4·8 per cent. of the births.

There was probably not much difference between the condition of Sheffield and Warrington as regards vaccination, though it is of course not possible to ascertain with perfect accuracy their relative position in this respect.

188. In London there had been a considerable falling off in the amount of vaccination for some years prior to 1892. In 1883 the percentage of births left unaccounted for (including, as before, the postponed cases) was 6·5. It was not materially different in the following year. In 1885 it had increased to 7 per cent.; in 1886 to 7·8; in 1887 to 9 per cent.; in 1888 to 10·3 per cent.; in 1889 to 11·6 per cent.; in 1890 to 13·9 per cent., and in 1891 to 16·4 per cent. Taking these years together, the percentage left unaccounted for is 9·9. The percentages we have given are derived of course from a very large number of births, so that the increase in the number appearing thus to be left unvaccinated is very considerable. Thus in the year 1883 the number unaccounted for was 7,816, whilst in 1891 it was 19,806. There seems to be no doubt, therefore, that, so far as regards the class under ten years old, London compared unfavourably as regards the amount of vaccination both with Warrington and Sheffield.

189. In Dewsbury vaccination had been greatly neglected. In the year 1882 the percentage of children born and unaccounted for was 12·6; in 1883, 20·0; 1884, 37·6; 1885, 47·2; 1886, 37·5; 1887, 29·6; 1888, 32·2; 1889, 37·3; 1890, 39·1; 1891, 32·5; 1892, 37·7. Taking these years together, the percentage is 32·3. It will thus be seen that the child population of Dewsbury was in a condition less vaccinated than that of London.

190. In Leicester, the practice of vaccination had been very largely abandoned for some years prior to the epidemic.

In the years preceding the epidemic the percentages of births left unaccounted for were as follows:

1883	43·8	1888	77·0
1884	47·9	1889	79·8
1885	52·1	1890	78·7
1886	69·1	1891	79·9
1887	72·2	1892	80·1

191. In Gloucester, as in Leicester, the practice of vaccination fell into disuse for some years prior to the epidemic, in the ten years preceding which the percentages of births left unaccounted for were as follows:

1885	10·6	1890	83·2
1886	18·1	1891	84·7
1887	58·8	1892	86·9
1888	79·3	1893	86·0
1889	83·2	1894	85·1

192. We thus find that with a well-vaccinated child population, such as that of Warrington or Sheffield, the proportion of the total deaths borne by that class was very small.

In Leicester and Gloucester, where the child population was very ill-vaccinated, the proportion of deaths borne by that class was very large; whilst in London and Dewsbury the proportion of the total mortality borne by children lay between the rates at Warrington and Sheffield on the one hand, and Gloucester and Leicester on the other, being considerably higher in Dewsbury (which as regards vaccination was in closer approximation to the condition of Gloucester and Leicester) than in London. If the proposition that vaccination has a very potent protective influence for nine or ten years be a sound one, the difference in the degree of vaccination of the child population in the several towns at the time when they were visited by the epidemics would account for the particular phenomena we have been examining.

193. We cannot but lay stress upon the facts thus revealed by the investigation of recent epidemics in these six towns. These facts are not open to the same chance of error as is involved in a comparison of the mortality among persons said to be vaccinated or unvaccinated. The age at which deaths occur may be said to be practically a matter of certainty, whilst the proportion of deaths below a given age to deaths above that age is free from liability to error. And even if the proportion of vaccinated to unvaccinated children under ten be not capable of precisely accurate ascertainment, there can be no doubt that the proportion was very great in Warrington and Sheffield and very small in Gloucester and Leicester, whilst in London and Dewsbury it lay somewhere between the two; and the proportion of the unvaccinated in Dewsbury may with confidence be asserted to have been greater than in London.

194. We have said that the phenomena are accounted for on the supposition that vaccination has the protective influence alleged. Is there any other satisfactory explanation of them? It is argued that improved sanitary conditions would tend to diminish the mortality amongst children, but if this were the explanation similar changes of age incidence ought to be seen in the mortality from all other diseases. This, however, is not the case.

195. Reverting to the statistics for England and Wales, it appears from the figures given in the reports of the Registrar-General that the proportion of the total mortality from measles, whooping-cough, and scarlet fever respectively borne by children has remained almost uniform, the variations have been very trifling.[1] In the case of Scotland also, whilst the same change in the age incidence of smallpox mortality is to be observed, there, as in England and Wales, no similar change of age incidence is to be found in the mortality from measles, scarlet fever, or whooping-cough.

196. In Sheffield[2] the age incidence has scarcely varied in the case of measles and scarlet fever, and only slightly so

[1] 6, App. 636–7. [2] Q. 1957–9.

in the case of whooping-cough during the last thirty years, and there is no reason to think that the circumstances are materially different in this respect in any of the other towns with the epidemics in which we have been dealing.

197. It has been suggested that smallpox is specially amenable to improved sanitary conditions, and that this appears from the influence which they have in diminishing the proportion in which those under five years of age die of smallpox in healthy districts as compared with towns, where the sanitary conditions are inferior. In proof of this reliance is placed on a comparison of two tables of mortality, showing of what diseases and at what ages a million live-born children might be expected to die, which appeared in a supplement to the 35th annual report of the Registrar-General, the one derived from a Liverpool life-table, and the other from a life-table for certain selected "healthy districts" in different parts of England and Wales. The tables were, in the main, based on the experience of the years 1861—1870, and of course assume that the conditions which then obtained would remain unchanged. It is quite true that it appears from these tables that whilst in Liverpool the percentage of deaths from smallpox expected under five years of age was 63·5, in "healthy districts" it was only 25·5. But in order to judge whether this difference (so far as it really represents a different incidence of fatal smallpox on the ages under and over five) can be attributed to the superior sanitary conditions of what are termed the "healthy districts," it is necessary to define what is meant by sanitary conditions, and also to see how the case stands with regard to other diseases. A supply of pure water, good drainage, sufficient light and air, and cleanliness, these and the like are usually regarded as the elements which render one area superior to another in its sanitary condition. Different areas may be better or worse in these respects or some of them, and this superiority may largely influence zymotic disease.

But in relation to diseases of this class there are other respects in which a great town differs from rural districts. In the former a large population is collected in close

proximity, whilst in rural districts the population is scattered over a wide area, and the people collected in close proximity are comparatively few in number. The necessary effect of this, as we shall presently show, is that the cases of zymotic disease would be more numerous in the former area than in the latter districts, and that as regards certain zymotic diseases, a larger proportion of the deaths would occur under five years of age.

In the case of whooping-cough, according to the tables referred to, whilst the percentage of deaths under five to be expected in "healthy districts" was 94·2, in Liverpool it was 95·6, or not substantially different. The explanation of this is not far to seek. Whooping-cough rarely causes death in persons over five years of age, the share borne by that class is therefore the same whatever the sanitary condition of the districts in which they occur, though the disease may be more frequently epidemic in large towns than in the country.

Again, if we turn to the heading "fevers," the percentage of the expected mortality under five is only 12·1 in Liverpool, as compared with 9·1 in healthy districts, yet it can hardly be doubted that fever is a form of zymotic disease affected in a special degree by sanitary conditions. It must be remembered too, that, just as in the case of whooping-cough, the disease is seldom fatal to those above five years of age, in the case of "fevers" the disease is seldom fatal below that age.

Passing now to the headings "measles" and "scarlatina" in the same table, we find in the case of measles the variation in the percentage borne by children under five is 94·5 in Liverpool, as compared with 76·0 in "healthy districts." It is a disease to which all persons who have not suffered from it are liable, but it is rarely fatal except in the case of the young. In great towns where measles are more frequently epidemic than in rural districts, more children under five years of age will be exposed to the infection of the disease, whilst in districts in which epidemics are not so frequent and the epidemics may occur at intervals of only five years or more, more children will be for the first time exposed to the infection above the age

of five years. It was to be expected, therefore, that the proportion of deaths under five years of age would be greater in a large town than in what are termed healthy districts. The same considerations, so far as the recurrence of epidemics is concerned, apply to the case of scarlatina, and the table shows that the percentage of the expected mortality under five from this disease is in healthy districts 53·1, and in Liverpool 70·0.

A consideration of the facts to which we have been calling attention, appears to us sufficient to show that sanitary conditions do not affect the proportion which the mortality of children under five years of age bears to the total mortality from zymotic diseases unless amongst sanitary conditions that which constitutes the essential difference between towns and rural districts is included. In a town where large numbers are gathered in close proximity the chances of contracting an epidemic disease are necessarily greater than in a rural district where the population is distributed over a wide area in which no large numbers are anywhere living in close proximity. If a difference such as this is to be included amongst sanitary conditions a few badly-drained, ill-ventilated houses remote from other habitations would have to be regarded, as in some respects, in a superior sanitary condition to the best drained and ventilated houses in a large town. A use of the expression "sanitary conditions" which involves such a consequence appears to us to be an abuse of it.

Reverting to the case of smallpox the observations already made in relation to other diseases are, in our opinion, one explanation of the disparity in the expected mortality under five from that disease in Liverpool as compared with healthy districts. In a large town smallpox may be almost constantly present, and frequently become epidemic. In a country district it may be more rarely present and affect only a particular part of the district. It is to be expected, therefore, that more persons over the age of five years would be susceptible and liable to contract the disease in the case of the latter area than of the former.

In addition to the points to which we have invited attention there is another matter which must be remem-

bered. The comparison made between Liverpool and "healthy districts" necessarily involves a fallacy unless it be borne in mind that, of a million born alive, a much larger number will attain ages beyond five years in "healthy districts" than in a large town like Liverpool. The tables referred to show that, whilst in "healthy districts" 175,410 are expected to die below five years of age, in Liverpool the number is no less than 460,370. 824,590 are, therefore, estimated as living beyond the age of five years in "healthy districts" as compared with 539,630 in Liverpool. It is obvious, therefore, that in the case of a disease like smallpox, which attacks and is fatal at all ages, it was to be expected that a much larger proportion of the deaths should occur at ages above five years in "healthy districts" than in Liverpool. In the case of a disease like whooping-cough, which is hardly ever fatal to those above five years of age whether in town or country, the difference in the expected survival beyond that age in the districts compared is of no practical importance. An observation of the same kind applies, though, of course, in a less degree, both to measles and scarlatina. In the case of "fevers," though the causes referred to would lead us to anticipate a larger proportion of deaths above five years of age in healthy districts than in Liverpool, the comparison loses much of its value owing to the fact that such a fever as typhus is far more prevalent in a large town like Liverpool than in a "healthy district;" the "fevers," therefore, which are contracted in the two cases are almost certainly not the same.

198. It has been suggested that the change in the age incidence of smallpox, to which we have referred, is deprived of its importance by the fact that a similar change is to be observed in the case of mortality from "fevers." We have already called attention to the fact that the deaths which have occurred from "fevers" at different times do not admit of the same comparison as the deaths due at different epochs to smallpox owing to changes of nomenclature and diagnosis. Prior to 1869, for example, the term "fever" in the records of the Registrar-General included typhus fever, infantile fever, and remittent fever. Enteric fever was not recognised

statistically. There was then a new departure: infantile fever disappeared from the records of the Registrar-General, and remittent fever (so far as children 0–5 were concerned) was classed with enteric fever. Since 1880, however, remittent fever deaths, ages 0–5, have been transferred to malarial diseases. So far we have dealt with classification, but there can be no doubt that in recent years better diagnosis has led to the same disease being returned under a different designation to that which would have been employed at an earlier period. For example, causes of death are now certified as tuberculous which would formerly have been returned as typhoid. But taking the cases of deaths since 1871 recorded as due to typhus and typhoid fevers we find no change of age incidence of the slightest importance until the quinquennium 1881–85. The percentage of deaths under five to deaths at all ages for four successive quinquennia are as follows:

—	1871–75.	1876–80.	1881–85.	1886–90.
Typhus . .	6·4	6·1	3·5	3·4
Typhoid . .	17·4	16·0	9·3	7·5

It will be seen that not only, as already noted, was there no substantial change until 1881–85, but that the fall was suddenly large, and that since that time there has been no considerable change in the age incidence. The phenomona would certainly seem to point to the conclusion that the change is at all events largely due to the causes already referred to. There has certainly been no change in the age incidence of these diseases which can be said to correspond with the change in the age incidence of smallpox to which we have called attention.

199. It has been suggested that, comparing the deaths registered as due to influenza per million living at separate age-periods during the epidemics of 1847–48 and 1890–91, a change of age-incidence is found parallel to that to which we have called attention in the case of smallpox. A comparison of this kind, relating as it does in each case to the

effect of the epidemic in two years only, appears to us of little or no value. Moreover, whilst the comparison shows a considerable diminution in the deaths under ten years of age in the epidemic of 1890–91, as compared with the epidemic 1847–48, and a small decrease in the case of those between ten and fifteen, there was not an increase in the later epidemic in the case of all those above fifteen years of age. The increase was great as regards those between fifteen and forty-five years of age, and there was some increase up to sixty-five years of age, but above that age there was again a considerable decrease. In addition to this, it must be borne in mind that during an epidemic of influenza many deaths which have their origin in that disease are ascribed to pneumonia, bronchitis, heart disease, and other secondary effects of influenza. It is impossible to tell whether in the case of the two epidemics the same proportion of deaths were attributed to these secondary causes, and whether the deaths were thus attributed uniformly at all ages.

200. A comparison has been made of the total share of the smallpox mortality of children under five of all classes with the share of the smallpox mortality of unvaccinated persons borne by children under five years of age, for the quinquennium 1886—1890, for the purpose of showing that the percentage borne by unvaccinated children does not materially differ from that of all classes at all ages. This comparison is, however, quite valueless, for of the deaths at all ages in the case of more than one half it is not stated whether they were vaccinated or not. Of those in which the condition as to vaccination was not stated, the whole number or the greater part may, as far as appears, have been unvaccinated. Moreover, in the comparison thus made, considerably more than half of the deaths under five of all classes treated as deaths from smallpox were deaths returned as from chicken-pox.

201. Apart from the difference in the extent of vaccination, no cause has been suggested at all adequate to account for the variations in the age incidence of fatal smallpox

upon which we have been dwelling. It is not only that is seen at different epochs equally prominent in England and Wales, Scotland and Ireland, but a striking contrast in the proportion of mortality below and above ten years of age is witnessed also at the same epoch in different towns where smallpox happened to become epidemic—places which differ, so far as is known, only in this, that the extent of vaccination amongst the child population was different. If improved sanitation were the cause of the diminished mortality amongst children, in proportion to that borne by those of older years, it is quite impossible to understand how its effect should have varied so greatly in these different towns, and why in Gloucester and Leicester the mortality from the disease should have been so largely amongst children, approaching in that respect the experience of the epoch preceding vaccination.

202. We proceed now to consider the evidence derived from a comparison of the fatality of smallpox as it has affected the vaccinated and unvaccinated respectively. The most important information on this head is undoubtedly to be found in the reports upon recent epidemics to which we have already referred. Great pains were taken to ascertain the condition as to vaccination of the persons attacked, and the results are shown, not merely at all ages, but at different age periods. We shall deal, therefore, in the first place, with the facts recorded in those reports, though they are later in date than other statistical records which will be noticed hereafter.

203. It may be convenient at the outset to point out that percentages are of comparatively little value unless the number which is converted into a percentage be substantial. If, for example, it were found that of two persons attacked one died, it would be as unsafe to assume that 50 per cent. was the normal fatality of the disease, as it would be, if both died, to assume that it was always fatal, or if neither died, that it never was so. The observation we have made as to the value of percentages, though stated in this connec-

tion, applies of course to all cases in which percentages are taken.

204. Commencing with the earliest of the reports, that relating to Sheffield,[1] we find that at all ages, of 4151[2] vaccinated persons in the enumerated population of Sheffield attacked by smallpox up to the date of the census, 200, or 4·8 per cent., died of that disease. Of 552[2] unvaccinated persons in the enumerated population attacked by smallpox up to the same date 274, or 49·6 per cent., died of the disease, so that relatively to their number, and apart from any question of age, for each individual vaccinated person suffering from a fatal attack of smallpox, 10·3 unvaccinated persons were fatally attacked by that disease.

Of 353 vaccinated children under ten years of age in the enumerated population attacked by smallpox up to the same date, six, or 1·7 per cent., died of the disease. Of 228 unvaccinated children attacked by smallpox up to the same date 100, or 43·9 per cent., died of the disease, so that relatively to their numbers for each individual vaccinated child from 0—10 years of age suffering from a fatal attack of smallpox, 25·8 unvaccinated children were fatally attacked by that disease.

Of 3774 vaccinated persons over ten years of age in the enumerated population attacked by smallpox up to the same date 194, or 5·1 per cent., died of the disease. Of 322 unvaccinated persons over ten years of age in the enumerated population attacked by smallpox up to the same date 174, or 54·2 per cent., died of the disease, so that relatively to their numbers, for each individual vaccinated person, aged ten years and upwards, suffering from a fatal attack of smallpox 10·6 unvaccinated persons of a similar age were fatally attacked by that disease. The same features are, broadly speaking, indicated in a comparison of the fatality amongst the vaccinated and unvaccinated in different districts of

[1] Q. 1976.

[2] NOTE.—The age of 24 of the 4151 vaccinated, and of two of the 552 unvaccinated, persons attacked was not ascertained. The figures, therefore, in the second and third paragraphs of § 204 do not exactly correspond with those in the first paragraph.

Sheffield. The percentages differ somewhat, and in some districts the numbers are too small for a percentage rate to be of much value, but they all have this feature in common, that the fatality amongst the unvaccinated is distinctly in excess of that amongst the vaccinated.

205. The facts recorded by Dr. Barry[1] have been subjected to a severe scrutiny by the opponents of vaccination, but they have not, in our opinion, been materially displaced. It has been shown that three or four of those attacked have been included in the class of unvaccinated who ought to have been placed in the vaccinated class, but, on the other hand, it is probable, as Dr. Barry suggests,[2] that of the doubtful cases which have been included amongst the vaccinated, quite as many ought to have been transferred from the vaccinated to the unvaccinated class. Many were put in the vaccinated class of whose vaccination there was very meagre evidence.[3] Some, no doubt, may have been vaccinated after the date of the census, in which they were enumerated as unvaccinated. Making full allowance for this, we do not think it would modify the conclusion that the fatality was much higher amongst the unvaccinated than the vaccinated. It is obvious that a considerable transfer might be made from the one class to the other without altering the result in this respect.

206. In the outbreak of smallpox in London in 1892–3,[4] of the vaccinated under ten, 110 were attacked, none of whom died. Of the unvaccinated of a similar age, 228 were attacked, of whom sixty-one died, or 26·7 per cent. Of the vaccinated ever ten years of age, 1643 were attacked, of whom thirty-nine died, or 2·3 per cent. Whilst of 181 unvaccinated of a similar age who were attacked, thirty-eight died, or 20·9 per cent.

Dr. Luff, when comparing in his report the fatality amongst the vaccinated and unvaccinated, dealt only with the persons undoubtedly falling within one or other of those classes, discarding all the doubtful cases. Of these cases

[1] Q. 19,349–20,200; 20,489–759. [2] Q. 29,345. [3] Q. 29,345–74.
[4] App. IV, pp. 2–5, and 12–15.

twenty were under ten years of age, with six deaths. Over ten there were 171 cases with thirty-eight deaths. It will be seen that the fatality in these doubtful cases was high, especially amongst those under ten years of age. The contrast between the fatality in this doubtful class of twenty, and that in the class of the undoubtedly vaccinated 110, of whom none died, is very striking. The probability is great that as regards children under ten years of age, unless where the eruption was such as to obscure the marks, the absence of any mark of vaccination indicates that the operation has never been successfully performed. Adding, however, all these doubtful cases to the vaccinated class the figures are as follows :

Of the vaccinated under ten, 130 were attacked, of whom six died, or 4·6 per cent., as compared with 26·7 per cent. in the unvaccinated class. Of the vaccinated over ten years of age, 1814 were attacked, of whom seventy-seven died, or 4·2 per cent., as compared with 20·9 per cent. in the unvaccinated class.

207. In Dewsbury,[1] 44 vaccinated children under ten were attacked, of whom 1, or 2·2 per cent., died. Of 174 unvaccinated children of a similar age, 56, or 32·1 per cent., died. One child under ten years of age, who did not die, is classed under the heading "alleged vaccination." If this case be added to the vaccinated class, the figures are 45 persons attacked, of whom 1, or 2·2 per cent., died. Of 577 vaccinated persons attacked who were over ten years of age, 15, or 2·6 per cent., died. Of 192 unvaccinated persons of a similar age attacked, 36, or 18·7 per cent., died. Twenty-four persons over ten years of age are classed under the heading "alleged vaccination." Of these 2 died. If the cases thus classified be added to the vaccinated class they would only alter the percentage to 2·8; the figures being 601 attacks with 17 deaths.

We have thought it well here and elsewhere to include in the unvaccinated class those described as "under vaccination." They appear properly to belong to it, and as their inclusion, though not making a material difference, tells on

[1] App. III, p. 114.

the whole in favour of the unvaccinated class as compared with the vaccinated, it seems fairer to take that course. Doubtful cases have been included in the vaccinated class.

208. In Warrington,[1] of 33 vaccinated children under ten years of age, 2 died, or 6 per cent. Of 32 unvaccinated children of a similar age, 12 died, or 37·5 per cent. Of 560 vaccinated persons over ten years of age, 36 died, or 6·4 per cent. Of 36 unvaccinated persons of a similar age, 12 died, or 33·3 per cent.

209. At Leicester[2] two vaccinated children under ten were attacked, neither of whom died. Of unvaccinated children of a similar age, 107 were attacked, of whom 15, or 14·0 per cent., died. Of vaccinated persons over 10 years of age, 197 were attacked, of whom two died, or 1·0 per cent. Of the unvaccinated of a similar age, 51 were attacked, of whom four, or 7·8 per cent., died.

210. At Gloucester[3] 26 vaccinated children under ten were attacked, of whom one, or 3·8 per cent., died. Of unvaccinated children of a similar age 680 were attacked, of whom 279, or 41·0 per cent., died. Of vaccinated persons over ten years of age, 1185 were attacked, of whom 119, or 10·0 per cent., died. Of the unvaccinated of a similar age, 88 were attacked, of whom 35, or 39·7 per cent., died.

211. The history of the disease shows us that smallpox epidemics vary from time to time in the degree of their fatality quite apart from any question of vaccination. If the death-rate in relation to attacks be compared in the six towns, in the case of those over twenty years of age, a class which was in those towns probably in about the same condition as regards vaccination, it will be seen from the following table that the variations were considerable:

[1] App. V, pp. 51 and 43.
[2] App. VI, p. 45.
[3] App. VII.

—	Persons over 20 years of age only.		
	Attacks.	Deaths.	Fatality.
Gloucester . . .	962	135	14·0
Sheffield (to date of census)	2313	253	10·9
Warrington . . .	427	44	10·3
Dewsbury	510	41	8·0
London	1411	99	7·0
Leicester	180	4	2·2

212. The facts which we have quoted from the reports upon the epidemics in the six towns dealt with, certainly afford strong support to the view that vaccination exerts a powerful influence on the fatality of the disease. It is said that the division into the classes of vaccinated and unvaccinated cannot be relied on as accurate. It is quite possible that the classification may not be strictly accurate, though great pains appear to have been taken to make it so. Doubtful cases were in general included amongst the vaccinated class, and care was taken to see that none should be included in the unvaccinated class except those who properly came within it. Where the doubtful cases were separately stated in the reports we have added them to the vaccinated class for the purpose of our calculations. If all reasonable allowance be made for the possibility of error, it appears to us that the broad result would not be materially altered, and that the contrast between the fatality in the two classes would still be very remarkable.

213. It must be remembered that the argument to be derived from these statistics does not depend for its strength upon its being established that there was a strictly accurate discrimination between the vaccinated and unvaccinated. If those who contend that vaccination is altogether inefficacious be correct in their views, the fact that persons have been vaccinated can have no tendency to affect their liability either to be attacked or to die of the disease. Those, therefore, who are selected as being vaccinated persons might just as well be so many persons chosen at random out of the total number attacked. So far as any

connection with the incidence of, or mortality from, small-pox is concerned, the choice of persons might as well have been made according to the colour of the clothes they wore. How comes it, then, that those selected out of the mass merely because, on the hypothesis we are considering, they have been the subjects of a wholly ineffectual or even mischievous proceeding should suffer from attacks of small-pox so much less fatally than the mass from which they are drawn ?

214. The figures are worth a closer examination. Taking the six towns together they are large. The unvaccinated attacked amounted to 2321 ; of these 822 died, or 35·4 per cent. ; 1449 of those attacked were under ten years of age, of these 523 died, or 36·0 per cent. ; 870 were over ten years of age, of whom 299 died, or 34·3 per cent. It is very noteworthy that amongst these persons selected because they were unvaccinated, or believed to be so, the fatality under ten years of age was 36·0 per cent., over that age 34·3 per cent. ; the correspondence between these figures is singularly close.

215. Let us turn now to the mass of cases from which these were selected. It consisted of 11,065 attacks resulting in 1283 deaths, *i. e.* a percentage of 11·5. The cases selected from these as unvaccinated were, as we have seen, 2321, or 20·9 per cent., of the total number, a large sample, in fact, drawn from the bulk. Deducting from the total numbers the attacks and deaths of those said to be unvaccinated, the result is as follows : 2321 attacks and 822 deaths, or 35·4 per cent. fatality, as we have seen in the class said to be unvaccinated, and 8744 attacks with 461 deaths, or 5·2 per cent. fatality, in the rest of the population attacked by the disease. How is this to be accounted for ?

216. If we direct our attention to the case of children under ten, the result is still more remarkable. The total number of this class attacked in the six towns was 2038, of whom 539 died, or 26·4 per cent. ; 1449 of these are

recorded as unvaccinated, of whom 523 died, or 36·0 per cent.; amongst the remaining 589 the number of deaths was 16 only, or 2·7 per cent. In cases where the age exceeded ten years, 9001 were attacked, of whom 744 died, or 8·2 per cent; of these, 870 are classed as unvaccinated, of whom 299, or 34·3 per cent. died; deducting these from the total number, the result shown is that of 8131 attacked, who had been vaccinated, 445, or 5·4, died.

217. Upon the hypothesis, then, that vaccination has no relation to smallpox, and no tendency to mitigate the effect of the disease, we have before us an arbitrary selection which might just as well have been made by drawing lots of 20·9 per cent. of the total number of persons attacked; why should those thus selected display so remarkably different a proportion of fatal cases, a death-rate to attacks of 35·4 per cent. in the one class, and 5·2 per cent. in the other? What reason is there why there should be any substantial difference between the two classes? Or why should not the fatality have chanced to be higher even in the 8744 cases of attack than in the 2321? It may be said that children succumb more readily to any illness than adults, and that if there happened to be a larger proportion of children amongst those classed as unvaccinated than amongst the residue of the total number attacked, this would account for some disparity. Even conceding this, it cannot be said, in our opinion, to be an adequate explanation of so vast a difference.

Let us see, then, how the matter stands if child life, up to the age of ten years, be separately regarded. According to the view we are testing, a selection was arbitrarily made, out of 2038 cases of children attacked, of 1449 who were, or were said to be, unvaccinated. Why should the fatality amongst these 1449 have been 36·0 per cent., whilst amongst the 589, classed as vaccinated, it was 2·7 per cent. only? Why when the children attacked were arbitrarily divided into two classes, 1449 being placed in the one class and 589 in the other, should the fatality in the one class have been so enormously greater than in the other? It may be said, and there is some force in the point, that inasmuch as

children under three months would almost all be found in the unvaccinated class, whilst the vaccinated would almost all exceed that age, this circumstance would of itself account for a greater fatality in the unvaccinated than in the vaccinated class. It is remarkable that at Warrington,[1] whilst no vaccinated child under one year of age was attacked by smallpox, there were ten such attacks and eight deaths amongst the unvaccinated of that age, all these deaths occurring at the age of one month or under. Although this feature did not characterise the mortality of children under ten years of age in other towns, it will be well, in order to eliminate the suggested distinction between the two classes, to exclude from both classes all children under one year of age. Adopting this classification the result is as follows:

CHILDREN of the Age 1–10.

Vaccinated.	Unvaccinated.
Attacks 570; deaths 16 Fatality 2·8 per cent.	Attacks 1235; deaths 375 Fatality 30·3 per cent.

The contrast is the more striking when it is remembered that all the doubtful cases are included in the vaccinated class, though many of them had, in all probability, never been successfully vaccinated. The doubtful cases in London alone account for 6 out of the 16 deaths, and raise the fatality from 1·8 to 2·8 per cent.

Is the different fatality manifested in the two cases into which the children between the ages of one and ten years who were attacked by smallpox are thus divided according as they were or were not vaccinated, a mere freak of chance? It is scarcely possible to believe that it can be so. When it is found that the same contrast is exhibited on comparing the fatality amongst the classes of vaccinated and unvaccinated in each of the six towns with which we have been dealing, and even in different districts of Sheffield and Dewsbury where a similar discrimination between the vaccinated and unvaccinated was made, and when it is borne

[1] App. V, p. 54.

in mind that both classes lived in the same towns, were of similar ages, and suffered in the same epidemics, it is impossible to believe that there was nothing to distinguish the two classes from one another.

218. The relation of the fatality of the vaccinated to that of the unvaccinated class is not precisely the same in each of the towns. One would not expect it to be so on any hypothesis, but in every case the fatality in the unvaccinated class was very large. The fatality in the unvaccinated class was smallest at Leicester, where, as we have already indicated, the fatality generally was less than in the other towns ; even there the fatality in the unvaccinated class under ten was 14 per cent., whilst there was not a single death amongst the vaccinated class of that age.

219. The conclusion, then, is surely irresistible that some circumstance must have existed distinguishing the class selected as vaccinated from that selected as unvaccinated, and which rendered it less liable to suffer fatally from smallpox. The only condition which regulated the distribution of the cases into the one class or the other was the presence or absence of vaccination. Whatever mistakes may have been made in erroneously including persons in the one class or the other, it cannot be doubted that the great majority of the one class were vaccinated, whilst the great majority of the other class were unvaccinated. Unless, then, some circumstance existed other than the presence or absence of vaccination, which distinguished the two classes and could account for the remarkably different smallpox fatality which characterised them, it would be only reasonable to attribute this difference to vaccination. We will consider presently the causes which have been suggested, other than vaccination, as an explanation of the phenomenon we have been considering.

220. The evidence afforded by the experience in these towns does not stand alone ; the same phenomenon of a higher fatality amongst the unvaccinated than the vaccinated had been previously observed.

221. Mr. Marson's observations, made during thirty-two years in respect of 19,467 cases at the Smallpox Hospital, showed a fatality among the unvaccinated of 36·5 per cent., whilst the highest death-rate amongst those having vaccination marks, viz. those having one vaccination cicatrix only, was 12·8 per cent. We shall have to revert to his figures presently, when considering the question whether various degrees of vaccination differ in their protective effect.

222. Dr. Gayton furnished us with the results of an examination of 10,403 cases at the Homerton Hospital between the years 1873 and 1884.[1] The deaths amongst the vaccinated (in which class are included those said to be vaccinated, but who had no marks) were 869 out of 8234, or 10·5 per cent.; the deaths amongst the unvaccinated 43·4 per cent., the numbers being 938 out of 2169.

So far we have made no discrimination as regards the age of the persons attacked. Out of the total number of 1807 deaths, 700, *i. e.* 38 per cent., were under ten years of age. The fatality of the vaccinated under ten was 10·4, being 137 out of 1306. The deaths among the unvaccinated of a similar age were 563 out of 1187, or a fatality of 47·3 per cent. If the cases of children under one year of age be excluded, the figures are as follows:—In the vaccinated class 1286 cases with 130 deaths, or a fatality of 10·1 per cent.; in the unvaccinated class 1032 cases with 465 deaths, or a fatality of 45 per cent.

Over the age of ten, the fatality of the vaccinated was 10·5, being 732 out of 6928. The death-rate of the unvaccinated of a similar age was 38·1, being 375 out of 982.

223. Mr. Sweeting put before us statistics relating to 2584 cases at Fulham Hospital between the years 1880 and 1885.[2] Of these 428 died, or 16·5 per cent. The deaths among the vaccinated (in which class are included, as with Dr. Gayton's tables, those said to be vaccinated, but who bore no marks) were 263 out of 2226, or 11·4 per cent. The deaths amongst the unvaccinated were 165 out of 358, or 46 per cent. Discriminating again with reference to the

[1] 2, App. 243–5. [2] Q. 689.

age of the persons attacked. Of 202 under ten years of age in the vaccinated class, 16 died, or 7·9 per cent. Of 168 of a similar age in the unvaccinated class, 78 died, or 46 per cent. The fatality of the vaccinated over ten years of age was 12·2, being 247 out of 2024. Of the unvaccinated of a similar age, 87 out of 190, or 45·7 per cent., died.

224. It has been urged against these statistics that, even though every effort were made to classify the cases correctly, the classification was still open to error, inasmuch as persons might be brought to the hospital with the eruption of confluent smallpox upon them, which would prevent the marks even of efficient vaccination being visible. It is true that this might be so in some cases, but both Dr. Gayton and Mr. Sweeting assert[1] that it could have happened very rarely. We do not think that it could make such a difference as to modify substantially the contrast exhibited in the fatality amongst the vaccinated and unvaccinated classes.

225. Inasmuch as the vaccinated class includes, both in the case of Dr. Gayton's and Mr. Sweeting's tables, a considerable number who, though said to be vaccinated, showed no marks, it may be interesting to observe what was the fatality in that class when dealt with separately. It contained in all probability a certain proportion of unvaccinated persons. The fatality in this doubtful class in Dr. Gayton's table was 27·1 per cent., being 352 out of 1295.[2] Eliminating these cases from the total number hitherto treated as vaccinated, the result shown is a fatality of 7·4 per cent., being 517 out of 6939.

226. Dealing with Mr. Sweeting's statistics[3] in the same manner, we find the fatality in the doubtful class to be 33 per cent., being 88 out of 266, whilst in the vaccinated class, eliminating these doubtful cases, it is 175 out of 1960, or 8·9 per cent. It will thus be seen that there is a somewhat striking correspondence in the death-rate shown

[1] Q. 1822–6; 3724–5, 3728–31.
[2] 2, App. 243–5.
[3] Q. 3689.

by this doubtful class in the two cases, and that in each case that death-rate was considerably higher than the fatality in the vaccinated, but considerably lower than that in the unvaccinated class.

227. The statistics to which we have been directing attention have been subjected to criticism on the ground that they show a much higher death-rate in proportion to attacks amongst the unvaccinated class than was shown by records of smallpox mortality prior to the introduction of vaccination. The objection is chiefly founded upon the statistics collected by Dr. Jurin. We have already pointed out (§ 53) that these statistics cannot be relied on as establishing a normal fatality of smallpox in the epoch preceding the introduction of vaccination, as there was a great difference in the fatality of the epidemics from which the statistics were compiled. It seems well established that the fatality of smallpox varies greatly in different epidemics. The statistics given in the preceding paragraphs in our Report will show that in the local epidemics, with which we have specially dealt, the fatality among the unvaccinated cases exhibited very considerable variations. At Sheffield it was as high as 49·6 per cent., in Warrington it was 35·2, in Dewsbury 25·1, in London 24·2, in Leicester 12·0, and in Gloucester 40·8 per cent. At all events, the fact, or alleged fact, on which the criticism is founded, cannot be regarded as a proof that the classification into vaccinated and unvaccinated has not been accurately carried out.

228. We have already called attention in dealing with the statistics of the six towns to the improbability that a selection, solely on the ground of the presence or absence of vaccination, should by mere chance show so remarkably different a fatality in the two classes. That argument is strengthened when we see the same results exhibited on a division into vaccinated and unvaccinated, of 10,403 cases in the Homerton Hospital, and 2584 cases in the Fulham Hospital, and when we find, comparing the death-rate of the vaccinated in the two hospitals, that in the former it was

10·5 per cent. and in the latter 11·4 per cent., and that making a similar comparison of the unvaccinated classes, in the former it was 43·4 per cent., in the latter 46 per cent.

229. We proceed to consider the explanations of the contrast between the fatality of smallpox in the case of the vaccinated and the unvaccinated which have been suggested by those who deny that it is due to vaccination. It has been said, and this is the main argument employed, that the unvaccinated are mostly to be found in the poorer and more neglected classes of the population, who would on that account be constitutionally weaker and less able to resist an attack of smallpox, and to escape a fatal result. Speaking generally, this may be to some extent true, though it is not so at all times and in all places. There are facts stated in the reports we have so often quoted, especially those relating to Warrington, Dewsbury, Leicester, and Sheffield, and in the evidence with reference to the last-named town, which seem to show that the explanation suggested cannot be the correct one. In the report on the Warrington epidemic,[1] as we shall see immediately, it is expressly stated that the vaccinated and unvaccinated were of the same class, and lived in the same houses and in the same manner. Moreover, the persons admitted into the Homerton and Fulham Hospitals were for the most part, whether vaccinated or unvaccinated, of the pauper class or of the class immediately above it. It is not conceivable that in this section of the population the presence of vaccination or its absence should indicate so marked a difference of constitutional strength as to account for the difference of smallpox fatality which we are now considering. It is further to be observed that, taking the statistics of the six towns, in the case of the vaccinated aged 1–10, the fatality was 2·8 per cent., in the case of the unvaccinated of a similar age it was 30·3 per cent., whereas in the case of those over ten years the fatality in the case of the vaccinated was 5·4 per cent., in the case of the unvaccinated 34·3. It will be seen, therefore, that the disparity in the death-rate of those classed as vaccinated and unvaccinated was greater

[1] App. V, p. 26.

nearer the date of vaccination than it was at a later period. The same phenomenon is observable in the hospital statistics. We do not think it possible, then, to accept the suggestion that there were more of the poor in the unvaccinated than in the vaccinated class as a sufficient explanation of the contrast we have been considering. The difference of fatality in the two classes is, in our opinion, far too great to be thus accounted for, and the suggested explanation does not explain all the phenomena. We should think it much more reasonable to conclude that the remarkable difference of fatality was due to vaccination, even if it were only in that respect that the two classes differed in their relation to smallpox. But this is not the case. There are other points of distinction between the two classes. We are about to discuss the differences they exhibit both in the liability to be attacked by smallpox and in the type of the disease from which they suffer. And the bearing of these facts upon the question whether the smaller fatality in the vaccinated class is due to vaccination, which is obviously important, will afterwards be considered.

230. Another explanation given of the greater fatality which characterises the unvaccinated class has been that, inasmuch as the unvaccinated class includes those whose vaccination has been postponed for medical reasons, there would be amongst its number a larger proportion of children of delicate constitution who would on that account be more likely to succumb to an illness. With reference to this argument, it is to be observed in the first place that the number of those whose vaccination is postponed for medical reasons is but small, and in the next place that the postponement by no means necessarily shows that the child is of a delicate constitution. It often results from the presence of some ailment to which young children are subject, and which affects the strong no less than the weak. But besides this it must be remembered that those whose vaccination is postponed are frequently vaccinated at a later period, and thus pass from the class of the unvaccinated to that of the vaccinated. Giving due weight to these considerations, we find it impossible to believe that the cause suggested can account

to any material extent for the difference to which we have been adverting between the fatality among children under ten, observed in the classes of vaccinated and unvaccinated. It must always be borne in mind that the difference is not a narrow one, it is not measured by a small percentage. A broad margin might be allowed for error without the force of the argument derived from the contrast being seriously diminished.

231. The next point for consideration is the question whether the evidence shows that vaccination has a protective effect against an attack of smallpox. We have lately been considering whether it affords any protection against death from the disease in persons attacked by it. The question with which we have now to deal obviously presents greater difficulty in arriving at accurate results. The liability to attack depends on contact with or proximity to sources of infection. When an epidemic of smallpox visits a town, the liability to infection of the inhabitants of different parts of the town may differ widely. Those who are residing in a house where a person is suffering from smallpox are subject to a risk which does not attach to persons living in a house not so invaded. On the other hand, persons moving about the town, or congregating for purposes of business or pleasure may come in contact with sources of contagion, so that the risk of contagion is, of course, not confined to those who are living in a house where smallpox is present, though it may be greater in the case of this class than of the rest of the community. These considerations appear to have been kept in view by the medical men who have dealt with the matter in their reports on the local epidemics to which we have so often referred.

232. The following results are derived from an analysis of the returns relating to the total population enumerated in the census taken at Sheffield,[1] which we have already mentioned:

Of 268,397 persons of all ages returned as vaccinated, 4151, or 1·55 per cent., had been attacked by smallpox.

[1] Q. 1961, 1963.

Of 5715 persons of all ages returned as unvaccinated 552, or 9·7 per cent., had been attacked by smallpox.

Of 68,236 vaccinated children under ten years of age 353, or 0·5 per cent., had been attacked.

Of 2259 unvaccinated children under ten years of age 228, or 10·1 per cent., had been attacked.

Of 196,905 vaccinated persons aged ten years and upwards 3774, or 1·9 per cent., had been attacked.

Of 3429 unvaccinated persons aged ten years and upwards 322, or 9·4 per cent., had been attacked.

These results have been subjected to criticism on the ground that in the case of many of the persons classed as vaccinated the operation was performed in the course of the epidemic only; that at its commencement, and it may be for a considerable time afterwards, they belonged to the unvaccinated class; and that this transfer of them to the class of vaccinated persons renders the attack-rate amongst the unvaccinated, shown by the figures, higher than it really was. Dr. Barry[1] furnished us with particulars of the number of these returned as vaccinated and unvaccinated in particular districts, from which it appeared that if the persons vaccinated during the progress of the epidemic were added to the unvaccinated class its numbers would be increased by about 28 per cent. In his opinion the proportion of persons vaccinated during the epidemic in the districts referred to was probably at least equal to the proportion passing from the unvaccinated to the vaccinated class in the town generally.

In order to meet the objection made we have thought it well to modify the figures by adding in all cases 28 per cent. to the numbers of the unvaccinated, and by deducting from the vaccinated the numbers added to the unvaccinated classes. The result of these changes will appear from the following figures:

Of 266,797 vaccinated persons of all ages 4151, or 1·55 per cent., were attacked by smallpox.

Of 7315 unvaccinated persons of all ages 552, or 7·5 per cent., were attacked by smallpox.

Of 67,603 vaccinated children under ten years of age 353, or 0·5 per cent., were attacked.

[1] Q. 29,333–43.

Of 2892 unvaccinated children under ten years of age 228, or 7·8 per cent., were attacked.

Of 195,945 vaccinated persons aged ten years and upwards 3774, or 1·9 per cent., were attacked.

Of 4389 unvaccinated persons aged ten years and upwards 322, or 7·3 per cent., were attacked.

It will be noticed that the contrast remains very striking, and that it would be scarcely less so even if a considerably larger transfer were made from the vaccinated to the unvaccinated classes.

233. It is not necessary to give the figures, separately, for each of the nine districts, into which Sheffield is divided, but it may be stated that in each of them the same feature appears of a much higher rate of attack among the unvaccinated than among the vaccinated.

234. So far the comparison has been made between the classes of vaccinated and unvaccinated which together formed the entire enumerated population of the town without reference to any circumstance which might render any of them specially liable to attack. We turn now to the state of the case in the houses invaded by smallpox.[1]

Of the 18,020 vaccinated persons of all ages enumerated as living in invaded houses 4151, or 23·0 per cent., had been attacked.

Of the 736 unvaccinated persons of all ages enumerated as living in invaded houses 552, or 75·0 per cent., had been attacked.

Of 4493 vaccinated children under ten years of age 353, or 7·8 per cent., had been attacked.

Of 263 unvaccinated children under ten years of age 228, or 86·9 per cent., had been attacked.

Of 13,435 vaccinated persons aged ten years and upwards 3774, or 28·1 per cent., had been attacked.

Of 469 unvaccinated persons aged ten years and upwards 322, or 68·6 per cent., had been attacked.

Treating these figures in the same way as we did those relating to the attack-rate in the case of the population

[1] Q. 1963-5.

generally, by making a similar transfer from the vaccinated to the unvaccinated classes, we obtain the following results :—

Of the 17,814 vaccinated persons of all ages living in invaded houses 4151, or 23·3 per cent., were attacked.

Of the 942 unvaccinated persons of all ages living in invaded houses 552, or 58·6 per cent., were attacked.

Of 4419 vaccinated children under ten years of age 353, or 7·9 per cent., were attacked.

Of 337 unvaccinated children under ten years of age 228, or 67·6 per cent., were attacked.

Of 13,304 vaccinated persons aged ten years and upwards 3774, or 28·3 per cent., were attacked.

Of 600 unvaccinated persons aged ten years and upwards 322, or 53·6 per cent., were attacked.

235. It will be seen that, as was to be expected, the proportion attacked in each class was much higher than when we were dealing with the total enumerated population, but the contrast between the attack-rate of the unvaccinated and vaccinated classes is not less remarkable. We may observe, too, that the same contrast is seen if the attack-rate in the invaded houses in each of the districts of Sheffield is separately examined.

236. We pass on to consider the information, bearing on the question with which we are dealing, afforded by the report on the Warrington epidemic.[1] With reference to the inhabitants of houses invaded by smallpox during the epidemic at Warrington, Dr. Savill states that bearing in mind the social class affected with smallpox, it may be taken as nearly certain that all the inmates of an infected house were exposed in some degree to infection either before or after recognition of the disease, either from the patient, or from the same source as the patient.

The number of these infected houses was 457,[2] but as regards 20 of them precise information could not be obtained as to inmates other than those who contracted smallpox. In the remaining 437 infected houses, there resided 2535

[1] App. V, p. 26.

[2] App. V, pp. 22, 26 and 27.

persons, of whom 41 were stated to have had smallpox in previous years. Amongst the other 2494 inmates, there were 2387 persons who were classed as having been vaccinated at some time of their lives, before the house became infected. Of these 553, or 23 per cent., were attacked by smallpox. Included in this calculation there are 100 persons about whose vaccination Dr. Savill was unable to satisfy himself. On the information before him, some of them might or might not have been vaccinated.

In the same houses were found 107 unvaccinated persons, and of these 60, or 56·0 per cent., were attacked.

237. Of the 2535 people in these infected houses,[1] 688 were of the ages 0–10. Of these 633 were vaccinated, and 55 unvaccinated.

Of the 633 vaccinated children, 28 were attacked, or 4·4 per cent.

Of the 55 unvaccinated children, 30 were attacked, or 54·5 per cent.

Those over ten years of age were 1847 in number, of whom 560 were attacked. Excluding the 41 persons who were stated to have previously had smallpox (five of whom were again attacked), there remained 1806 persons, of whom 555 were attacked. Of the 1806, there were 1754 vaccinated and 52 unvaccinated.

Of the 1754 vaccinated persons over ten years of age, 525 were attacked, or 29·9 per cent.

Of the 52 unvaccinated persons over ten years of age, 30 were attacked, or 57·6 per cent.

238. With reference to the contrast between the attack-rate in the case of the vaccinated and of the unvaccinated living in infected houses, Dr. Savill says :[2] "I could ascertain no reason for this remarkable difference in the attack-rate in the two classes, unless the fact of vaccination protected the vaccinated persons from being attacked by smallpox. Being members of the same families, they lived in the same

[1] App. V, p. 49.
[2] App. V, p. 26.

houses (which, be it noted, were of a remarkably uniform type), ate the same food, often did the same work, and were exposed to the same hereditary and external influences."

239. Another comparison bearing on the same point is to be found in Dr. Savill's report.[1] It relates to the population in a highly infected area which he calls "The 300 yards Akin Street area." This area contained a population of 3394 persons (or 3330, excluding those who were stated to have had smallpox in previous years), of whom 29 only were unvaccinated. Among the 3301 persons forming the vaccinated class (including as elsewhere doubtful vaccination) there were 84 attacks, being 2·5 per cent., whilst in the unvaccinated class of the same population there were 6 attacks, being 20·6 per cent.

240. We turn now, with reference to the same point, to a consideration of Dr. Coupland's report[2] on the Dewsbury epidemic. In the course of the outbreak 648 houses were invaded, but Dr. Coupland was only able to obtain information on this point as regards 544 of them. In these 544 infected houses, which contained 3000 inhabitants, there were 2315[3] vaccinated persons, including cases of alleged vaccination. Of these 568 were attacked, the rate being 24·5 per cent.

Of unvaccinated persons in these infected houses there were 605, including as before persons described as "under vaccination." Of these 315 were attacked, or 52·0 per cent.

241. Discriminating according to ages:—

Of vaccinated persons under ten years of age there were 408, of whom 42 were attacked, or 10·2 per cent.

Of unvaccinated persons under ten there were 311, of whom 158 were attacked, or 50·8 per cent.

Of vaccinated persons over ten years of age there were 1896, of whom 526 were attacked, or 27·7 per cent.

[1] App. V, pp. 24 and 27.

[2] App. III, pp. 2 and 124.

[3] NOTE.—The age of eleven of these 2315 vaccinated persons was not ascertained.

Of unvaccinated persons over ten years of age there were 294, of whom 157 were attacked, or 53·4 per cent.

242. In his investigation of the Leicester epidemic,[1] Dr. Coupland scrutinised in the same manner the relation which the attacks of the vaccinated bore to those of the unvaccinated.

Of 1229 persons in invaded houses (320 of whom were attacked with smallpox) 841[2] were vaccinated, of whom 170 were attacked, a rate of 20·2 per cent., whereas 388 were unvaccinated, of whom 150 were attacked, a rate of 38·6 per cent.

Of vaccinated persons under the age of ten years there were 78, of whom 2 were attacked, a rate of 2·5 per cent.

Of the unvaccinated under the age of ten there were 283, of whom 100 were attacked, a rate of 35·3 per cent.

Of those over ten years of age, 754 were vaccinated, of whom 168 were attacked, or 22·2 per cent.; 105 were unvaccinated, of whom 50 were attacked, or 47·6 per cent.

The figures given require to be slightly modified if those who were stated to have had smallpox prior to the outbreak be eliminated; there were in all 19 such persons, none of whom suffered from smallpox on this occasion. Twelve of them were vaccinated, and five unvaccinated, and as to the vaccinational condition of the other two there is no information. Eliminating these cases, the rate among the vaccinated over ten would be raised to 22·6 per cent., and amongst the unvaccinated to 50 per cent. As they were all individuals above the age of thirty years, the attack-rates in the age period 0—10 would not be altered.

243. In the case of the epidemic at Gloucester,[3] Dr. Coupland was only able to obtain information, with reference to this point, as to 899 out of a total of 1097 invaded houses. There is, however, no reason to believe that the conditions were materially different as regards the other 198 houses invaded by smallpox.

[1] App. VI, 46 and 62.

[2] Note.—The age of nine of these 841 vaccinated persons was not ascertained.

[3] App. VII.

In the 899 houses there resided 4861 persons. Of these 3386 had been vaccinated at some time in their lives before their house became infected, including all those in whose case there was any doubt as to whether or not they had been vaccinated. The remaining 1475 were unvaccinated at the time their house became infected, though a considerable proportion of them (those described as "under vaccination") were subsequently vaccinated.

Of the 3386 persons forming the vaccinated class, 1028, or 30·3 per cent., were attacked. Of the 1475 persons forming the unvaccinated class, 689, or 46·7 per cent., were attacked.

244. In the vaccinated class there were 272 children under ten years of age, of whom 24, or 8·8 per cent., were attacked.

In the unvaccinated class there were 1331 children under ten, of whom 617, or 46·3 per cent., were attacked.

In the vaccinated class there were 3114 persons over ten years of age, of whom 1004, or 32·2 per cent., were attacked.

In the unvaccinated class there were 144 persons over ten, of whom 72, or 50 per cent., were attacked.

245. In the reports on the Sheffield, Dewsbury, and Leicester epidemics other data are given for the purpose of enabling a comparison to be made of the attack-rate in the classes of vaccinated and unvaccinated persons. It is not necessary to state here the details to be found in the reports; it is sufficient to say that they all indicate an attack-rate amongst the unvaccinated markedly in excess of that found in the class of vaccinated persons.

246. It is worth special notice that in all these cases the contrast between the attack-rate of the classes of vaccinated and unvaccinated respectively is much more striking in the case of children under ten years of age than in the case of those over that age.

This will be seen by a glance at the following table:

—	Attack rate under 10.		Attack rate over 10.	
	Vaccinated.	Unvaccinated.	Vaccinated.	Unvaccinated.
Sheffield . .	7·9	67·6	28·3	53·6
Warrington .	4·4	54·5	29·9	57·6
Dewsbury .	10·2	50·8	27·7	53·4
Leicester .	2·5	35·3	22·2	47·6
Gloucester .	8·8	46·3	32·2	50·0

247. In his report upon the outbreaks in London during 1892 and 1893,[1] Dr. Luff has not entered into the question of the rate of attack among the unvaccinated as compared with the vaccinated. His report nevertheless affords some data for such a comparison. Of a total number of 2353 cases as to which he obtained information there were 409 unvaccinated persons, or 17·3 per cent. It is not likely that the percentage of unvaccinated persons, whether in London or in the districts specially affected, was as great as this.

Dealing with the age period 0—10, there were 358 attacks.

Of the persons thus attacked, 228 were unvaccinated, or a percentage of 63·7.

It is not open to doubt that this was greatly in excess of the percentage of unvaccinated persons under ten years of age in London or in any part of it.

248. Turning now to the statistics of smallpox in London hospitals supplied by Dr. Gayton and Mr. Sweeting, we find that the percentage of unvaccinated persons treated in the Homerton Hospital was 20·8; the numbers being 2169, out of 10,403. Of children under ten years of age the number of unvaccinated admitted was 1187, out of 2493, or 47·6 per cent.

At the Fulham Hospital 358 was the number of admissions of unvaccinated persons, out of a total of 2584, the percentage being 13·8.

Out of the total number of 370 children under ten years of age admitted to the hospital 168, or 45·4 per cent., were unvaccinated. It will be remembered that all those who

[1] App. IV, pp. 2, 5, 12 and 15.

were said to be vaccinated, even though they showed no marks of it, were excluded from the unvaccinated class.

When these figures are examined they show a proportion of unvaccinated persons, especially children, admitted to the hospital which it is impossible to believe corresponded with the proportion of unvaccinated persons existing in the population of London or of any district of it.

249. It has been suggested that the inmates of these hospitals were drawn from the poorer class of the population, and that in that class there would be a larger proportion of unvaccinated persons than in the population at large. This, probably, is so to some extent. But it seems to us quite inadequate as an explanation of the very large proportion of unvaccinated children admitted to the hospitals. When the returns of vaccination in London are examined it will be seen that the children not finally accounted for between the years 1872 to 1884 had only ranged from 9·3 of the births in 1874 to 5·7 in 1881, the average for those thirteen years being but 7·4.

250. Our attention has been called to the fact that the proportion of vaccinated patients admitted to the Highgate Smallpox Hospital has often been as high as 94 or 95 per cent. And it has been suggested that this indicates an attack-rate in London in the class of vaccinated persons quite as high as that prevailing in the case of the unvaccinated. The experience at the Highgate Hospital certainly differs greatly from that of either Homerton or Fulham. The test was a larger one in point of number at the two latter hospitals than at the former. Moreover, the fact mentioned in the preceding paragraph must be borne in mind. In London the absence of vaccination is to be found chiefly in the poorer classes of the population. The inmates of the Highgate Hospital belonged in part to a more prosperous class. In that class the cases of non-vaccination would be very rare. Moreover, those who were admitted by contract with the Guardians of different Unions came from areas outside London. It will not do, therefore, to estimate what was the proportion of vaccinated and unvac-

cinated persons in the population of London when considering whether the unvaccinated contributed more than their share of the inmates of the Highgate Hospital.

251. We think, taking it altogether, that the evidence bearing upon the question whether the vaccinated are less liable to be attacked by smallpox than the unvaccinated, points to two conclusions; first, that there is, taking all ages together, less liability to attack among the vaccinated than among the unvaccinated, and next, that the advantage in this respect enjoyed by vaccinated children under ten years of age is greatly in excess of that enjoyed at a more advanced period of life.

We have been able to add the experience derived from the recent epidemic in Gloucester to that of the other five towns so far as regards the age incidence, fatality, and attack-rate of the disease. The combination of the Gloucester cases with those derived from other towns increases the total by more than 20 per cent. It is a striking fact that the addition of these cases, though it has necessitated some small changes in the percentages to which attention is called, has not rendered necessary any other alteration of the paragraphs, which were already in type when we received the Gloucester figures. All the contrasts which presented themselves when the combined figures of the other five towns were considered, are just as striking when the Gloucester figures are added.

It has not been possible for us to deal with the facts disclosed by the Gloucester epidemic in other respects than those alluded to, without delaying the presentation of our Report, which appeared to us undesirable.

252. It is alleged that vaccination not only diminishes the risk of attack by smallpox and the fatality of that disease, but that it renders the type of the disease in the vaccinated less severe than it would have been had they remained unvaccinated.

Smallpox differs greatly in the degree of its severity. It may be an illness of a very serious character, entailing grave after consequences, or it may be a comparatively trifling

ailment. The most severe forms of the disease have been termed malignant or hæmorrhagic. Next in severity comes the confluent type, which is also of a very serious character. The mildest species of the disease has been termed varioloid, or sometimes simply "mild." Between the confluent and the mild or varioloid come in order of severity the coherent and the discrete types.

Quite apart from the danger of a fatal termination to the illness, it is obviously a matter of great importance to those who suffer from the disease, that its type should in their case be of a mild rather than of a severe character, not merely because the illness is in the one case trifling and in the other painful and prolonged, but because evil consequences such as pitting of the countenance often follow in the one case, which in the other are absent. It is important, then, to test the validity of the assertion that vaccination has this beneficial influence, and that for two reasons. If it can be established it would show, first, that vaccination carries with it this distinct advantage independently of the others we have been considering; and next, it would add support to the view that vaccination has an influence upon the disease of smallpox, a point which has been contested. Let us inquire, then, what light the evidence throws upon the claims thus advanced in favour of vaccination.

253. Commencing with Sheffield:[1]—Of 825 vaccinated persons in the Borough Hospital in Winter Street during the 1887–88 epidemic:

293, or 35·5 per cent. suffered from the varioloid type,
413 „ 50·0 „ „ discrete type,
107 „ 13·0 „ „ coherent type, and
12 „ 1·5 „ „ confluent type.

Of 280 unvaccinated persons in the same hospital:
None had the varioloid type.
50, or 17·9 per cent. suffered from the discrete type,
175 „ 62·5 „ „ coherent type, and
55 „ 19·6 „ „ confluent type.

[1] Q. 2018–9.

Dealing now with those under ten years of age:

Of 27 vaccinated children:

22, or 81·5 per cent., had the varioloid type.
5 ,, 18·5 ,, ,, discrete type.

Of 67 unvaccinated children:

None had the varioloid type.
13, or 19·4 per cent., had the discrete type.
50 ,, 74·6 ,, ,, coherent type.
4 ,, 6·0 ,, ,, confluent type.

254. It will be observed that in the case of the vaccinated children, the disease was in all cases of one or other of the milder forms, varioloid or discrete, the great majority of them being of the mildest form, viz. varioloid. In the case of the unvaccinated, on the other hand, the great majority of the cases were of the severer forms, viz. coherent and confluent, and not one was of the mildest form, varioloid.

255. The type of the disease was examined in the same way in the other Sheffield hospitals. The numbers were, however, much less than in the Winter Street Hospital, and too small in each hospital to make a percentage of each type of the disease of value. The varioloid and the discrete on the one hand, and the coherent and confluent on the other, were therefore classed together.

256. There were in these other hospitals a few cases of vaccinated children whose disease fell within the confluent and coherent class.[1] It may be well, therefore, to state the result if the whole of the cases in the Sheffield hospitals are taken together.

There were 1298 vaccinated persons, with regard to whose cases the type of disease was recorded. Of these 1075, or 82·8 per cent., suffered either from the varioloid or discrete type; and 223, or 17·2 per cent., from the coherent or confluent type.

The number of unvaccinated patients in the hospitals, with regard to whose cases the type of disease was recorded, was 443: of these, 82, or 18·5 per cent., suffered from

[1] Q. 2019.

either the varioloid or discrete type; and 361, or 81·5 per cent., from the confluent or coherent type.

257. It will thus be seen that the relation which the severe and milder forms of the disease bore to one another in the two classes was almost exactly reversed. The proportion of the severer type in the case of the unvaccinated was nearly the same as the proportion of the milder type in the case of the vaccinated.

No mention is made of hæmorrhagic cases; if there were any such, they were, no doubt, included under the class "confluent."

258. Dealing next with the Dewsbury Report, Dr. Coupland classed the cases he investigated under the headings "confluent," "coherent," "discrete," and "mild."[1] In 273 cases placed under the heading confluent, three were included which were also hæmorrhagic. Dr. Coupland ascertained the percentage of attacks of the different types, according as they occurred among the vaccinated, the unvaccinated, those alleged to be vaccinated, and those who were undergoing vaccination. It may, perhaps, be thought a fairer test with respect to the point under consideration if, as before, we class those alleged to have been vaccinated with the vaccinated, and those undergoing vaccination with the unvaccinated, though the numbers of those alleged to be vaccinated and of those undergoing vaccination are small, and it does not make a substantial difference. Treating the case in this fashion, those vaccinated or alleged to have been vaccinated (whom we shall hereafter call the vaccinated) amounted to 644. The unvaccinated and those described as undergoing vaccination (whom we shall hereafter term the unvaccinated) were 364 in number.

Of the vaccinated there suffered—

From the confluent type	53,	or	8·2	per cent.
,, coherent	,, 63	,,	9·8	,,
,, discrete	,, 268	,,	41·6	,,
,, mild	,, 260	,,	40·4	,,

[1] App. III, pp. 134–7.

Of the unvaccinated there suffered—

From the confluent type 219, or 60·2 per cent.
„ coherent „ 61 „ 16·8 „
„ discrete „ 63 „ 17·3 „
„ mild „ 21 „ 5·8 „

259. Dealing separately, now, with the case of children of the age 0–10. Of the 45 vaccinated cases—

2, or 4·4 per cent., were confluent.
0 „ coherent.
9 „ 20·0 „ „ discrete.
34 „ 75·6 „ „ mild.

There was only one case of either the confluent or coherent type among the class undoubtedly vaccinated; the other confluent case was among those alleged to have been vaccinated.

Of the 171 unvaccinated cases—

94, or 55·0 per cent., were confluent.
26 „ 15·2 „ „ coherent.
35 „ 20·5 „ „ discrete.
16 „ 9·4 „ „ mild.

260. Reviewing next the information on the same point afforded by Dr. Coupland's report on the Leicester epidemic,[1] and including as before the cases described as under vaccination among the unvaccinated, and the cases described as doubtful vaccination among the vaccinated, we find the following results:

Of the 199 vaccinated cases—

17, or 8·5 per cent., were confluent.
20 „ 10·1 „ „ coherent.
50 „ 25·1 „ „ discrete.
112 „ 56·3 „ „ mild.

Of the 158 unvaccinated cases—

79, or 50·0 per cent., were confluent (including malignant).
36 „ 22·8 „ „ coherent.
28 „ 17·7 „ „ discrete.
15 „ 9·5 „ „ mild.

[1] App. VI, pp. 45–6.

261. Dealing again separately with children aged 0–10, there were only two vaccinated children attacked, and both suffered from the mild type of the disease.

Of the 107 unvaccinated cases—

54, or 50·5 per cent., were confluent (including the malignant).
23 ,, 21·5 ,, ,, coherent.
20 ,, 18·7 ,, ,, discrete.
10 ,, 9·3 ,, ,, mild.

262. From Dr. Luff's report on the outbreaks in London[1] we obtain the following information. His classification is somewhat different; he divides the cases into "very mild," "discrete," "severe discrete," "confluent," and "hæmorrhagic." The cases in the latter class are very few in number, and it will be more convenient to class them with the confluent cases.

The number of cases in which the type of disease was discriminated was 2353, of whom 1944 were vaccinated or doubtful and 409 unvaccinated.

Of the 1944 vaccinated cases—

108, or 5·6 per cent., were very mild.
1,622 ,, 83·4 ,, ,, discrete.
32 ,, 1·6 ,, ,, severe discrete.
182 ,, 9·4 ,, ,, confluent.

Of the 409 unvaccinated cases—

2, or 0·5 per cent., were very mild.
142 ,, 34·7 ,, ,, discrete.
64 ,, 15·6 ,, ,, severe discrete.
201 ,, 49·1 ,, ,, confluent.

263. Separating now children under 10 years of age—
Of the 130 vaccinated cases—

30, or 23·1 per cent., were very mild.
83 ,, 63·8 ,, ,, discrete.
4 ,, 3·1 ,, ,, severe discrete.
13 ,, 10·0 ,, ,, confluent.

[1] App. IV, pp. 2–5 and 12–15.

Of the 228 unvaccinated cases—

1, or 0·4 per cent., was very mild.
84 ,, 36·8 ,, were discrete.
45 ,, 19·7 ,, ,, severe discrete.
98 ,, 43·0 ,, ,, confluent.

264. In Warrington, Dr. Savill[1] reports on the type of disease in 661 cases, of which 593 were vaccinated or doubtful; 68 unvaccinated cases. He includes amongst the confluent cases those which were malignant or hæmorrhagic.

Of the 593 vaccinated cases—

323, or 54·5 per cent., were mild.
141 ,, 23·8 ,, ,, discrete.
129 ,, 21·8 ,, ,, confluent.

Of the 68 unvaccinated cases—

3, or 4·4 per cent., were mild.
17 ,, 25·0 ,, ,, discrete.
48 ,, 70·6 ,, ,, confluent.

265. Separating the cases of children aged 0—10, 33 of them were vaccinated and 32 unvaccinated.

Of the 33 vaccinated cases—

24, or 72·7 per cent., were mild.
7 ,, 21·2 ,, ,, discrete.
2 ,, 6·1 ,, ,, confluent.

Of the 32 unvaccinated—

2, or 6·2 per cent., were mild.
7 ,, 21·9 ,, ,, discrete.
23 ,, 71·9 ,, ,, confluent.

266. A somewhat closer examination of the distribution of the different types of disease is of importance.

Although the percentages are not identical in the different towns there is a noteworthy correspondence in them, as will be seen from the following table. We have divided the cases into two classes: the one comprising the milder types —varioloid, or mild and discrete; the other the more severe forms—coherent and confluent.

[1] App. V, pp. 51 and 43.

		Milder.	Severer.
Sheffield.	Vaccinated	82·8	17·2
	Unvaccinated	18·5	81·5
Dewsbury	Vaccinated	82·0	18·0
	Unvaccinated	23·1	76·9
Leicester	Vaccinated	81·4	18·6
	Unvaccinated	27·2	72·8
Warrington	Vaccinated	78·2	21·8
	Unvaccinated	29·4	70·6

It will be seen that in the case of the vaccinated the proportion of milder cases is very similar. It ranges only from 7·82 per cent. at Warrington to 82·8 per cent. at Sheffield, and the figures relating to Sheffield, Dewsbury, and Leicester are remarkably alike, viz. 82·8, 82·0, and 81·4 per cent. The variations in the percentages showing the proportion of milder to severer cases in the unvaccinated class are somewhat greater, though even these are comparatively unimportant. They range from 29·4 per cent. at Warrington to 18·5 per cent. at Sheffield.

267. In London a different classification of the types of disease renders comparison less easy. If, however, the severer class be composed of the severe discrete and the confluent, the milder class as before consisting of the mild and discrete, the result is as follows:

		Milder.	Severer.
London	Vaccinated	89·0	11·0
	Unvaccinated	35·2	64·8

268. If the proportion which the mild bear to the severe cases in those under ten years of age be examined, it will be seen that in the vaccinated class the ratio of the milder type is much greater than at all ages,—indeed, the proportion of severer cases is in all the towns quite insignificant.

269. Before passing to another branch of the subject it will be well to take account of the bearing upon one another of the facts relating to the fatality, the attack-rate, and the type of the disease of smallpox, which we have been considering. Between the facts with which we have been concerned when investigating the fatality of smallpox and those which have engaged our attention when considering the type of the disease, the connection is obvious and intimate.

In each of these cases we have had to deal with the same classes of vaccinated and unvaccinated persons—indeed, we may say with the very same persons; we have already pointed out that it is more than improbable that on a division of the persons who suffered from smallpox into two such classes, the fatality should be so strangely different unless there were something in the condition of the one class which differentiated it from the other, and rendered those within it less liable to suffer fatally from the disease. What is to be said when it is found that, apart from the fatality of the disease, its type in the two classes also differs, and, perhaps, even more widely than its fatality does, and that the milder type distinguishes the same class which exhibits the smaller fatality? That this should be a mere chance coincidence is incredible when it is observed that the phenomenon is uniform not only in the case of epidemics in five different towns, but in the case of the same epidemic in different parts of the same town. The facts surely afford strong corroboration of two propositions: first, that a classification was, on the whole, accurately made in these cases of persons whose condition in relation to smallpox differed from one another; and secondly, that this difference of condition was due to vaccination.

270. We have been concerned with the same elements only when investigating the fatality and type of the disease. We have had but to view the same sufferers under different aspects, ascertaining in the first place what was the death-rate in the two classes, and in the next place from what type of disease they suffered. When we came to deal with the attack-rate it was necessary to introduce a new element. Those living in the same houses and who, as far as could be

judged, were, from their locality and surroundings, equally liable to be attacked, had to be divided into vaccinated and unvaccinated in order that the attack-rate in these two classes might be ascertained. If strong ground has been given for believing that the discrimination, among the persons attacked, according as they were or were not vaccinated has been successfully accomplished, it is the more likely that the separation of those liable to be attacked into the classes of vaccinated and unvaccinated has also been made with substantial accuracy. At all events the same difficulty has to be encountered by those who maintain that vaccination is without any influence upon smallpox, which we have already indicated when dealing with the question of the fatality amongst the vaccinated and unvaccinated. How does it happen that when a division has, on their hypothesis, been arbitrarily made into two classes, the condition which guided the discrimination not being such as to render the one less subject to attack than the other, it is nevertheless found that with a singular uniformity the rate of attack in the one class is much less than that witnessed in the other? But this is not all; we have to ask, further, how it happens that, whether fatality, attack-rate, or type be regarded, the difference between the two classes is much more marked in the case of children under ten years of age who are nearer the period of vaccination than it is in the case of persons of more advanced years. To these questions those who deny that there is any efficacy in vaccination have furnished no satisfactory answers. If, on the other hand, it be conceded that there is virtue in vaccination, and that it renders the vaccinated less liable to be attacked, or to suffer severely from, or to die of, the disease than the unvaccinated, the phenomena are all explained and the difficulty vanishes.

271. We cannot but lay stress on the force of the facts relating to the fatality, the attack-rate, and the type of the disease, in the vaccinated and unvaccinated classes, when considered in combination with one another. So far as can be ascertained there was nothing materially to distinguish the two classes, except that the one contained, with some possible exceptions, unvaccinated persons only, whilst the

other consisted certainly for the most part of vaccinated persons, unless it be, as suggested, that the unvaccinated class comprised a larger proportion of weakly persons. We have already expressed our opinion that this suggested distinction is not an adequate explanation of the very different fatality in the two classes if that phenomenon stood alone. It appears to us in no way to account for the difference in the attack-rate and type of the disease which equally distinguish these same classes. Though a stronger constitution may enable a patient better to battle against the disease, and so avoid a fatal result, than a weaker one, we are not aware of any evidence that strength of constitution would determine the type of the disease. We believe that confluent cases are frequently found in those whose constitution is strong, and mild cases in those who are not of robust health. Nor, again, is there any ground for asserting that if both came equally within the reach of contagion a person of good physique would escape its influence while another less robust would be attacked by the disease. And yet the distinction between the vaccinated and unvaccinated is as marked or even more marked when the attack-rate and type of disease are studied than when the fatality of the disease is in question.

272. In dealing with the comparison between the attack-rate and fatality of the classes of vaccinated and unvaccinated persons, no distinction has hitherto been drawn in respect of the quality or character of the vaccination. Many (though not a large number proportionately) have been included in the vaccinated classes whose arms bore no marks of vaccination. In the case of some of these the operation of vaccination may have been performed without success. If vaccinia did not result from the operation, it could of course have no more effect than if it had never been performed. Amongst those whose bodies showed by the marks they bore that vaccination had undoubtedly been successful, the number of cicatrices varied from one to four and upwards. The cicatrices differed also in size. They have also been distinguished according as they exhibited, or did not exhibit, foveation. The question whether the protection afforded by

vaccination differs in proportion as it has been more or less thorough has been made the subject of investigation.

273. Beginning again with Dr. Barry's report, we find the following facts recorded with reference to the vaccinated persons who were treated in the Borough Hospital in Winter Street, Sheffield, from the commencement of the 1887 epidemic up to 31st March, 1888. These numbered in all 825, excluding 39 cases in which the records with respect to the character of the vaccination and the type of the disease were incomplete.[1]

95 of these had no visible primary cicatrix, or 1 cicatrix only. Out of this number 13 died, or 13·7 per cent.

259 had 2 primary cicatrices, of whom 24, or 9·3, died.

372 had 3 primary cicatrices, of whom 21, or 5·7, died.

99 had 4 or more primary cicatrices, of whom 2, or 2·0 per cent., died.

Dr. Barry also discriminated the cases with reference to the type of smallpox.

In the class with either no visible primary cicatrix or 1 cicatrix only, the type of smallpox was varioloid in 19, or 20 per cent.; discrete in 47, or 50 per cent.; coherent in 25, or 26 per cent.; and confluent in 4, or 4·2 per cent.

In the class with 2 primary cicatrices, the type was varioloid in 73, or 28 per cent.; discrete in 132, or 51 per cent.; coherent in 50, or 19 per cent.; and confluent in 4, or 1·5 per cent

In the class with 3 primary cicatrices, the type was varioloid in 149, or 40 per cent.; discrete in 193, or 52 per cent.; coherent in 27, or 7 per cent.; and confluent in 3, or 0·8 per cent.

In the class with 4 or more primary cicatrices, the type was varioloid in 52, or 52 per cent.; discrete in 41, or 41 per cent.; coherent in 5, or 5 per cent.; and confluent in 1, or 1 per cent.

It will be seen that there is a progressive diminution in the fatality, and also in the severity of the attack, in direct

[1] Report on an epidemic of smallpox at Sheffield during 1887–8, pages 212–13.

ratio to the increase in the number of primary vaccination cicatrices.

274. Dealing separately with those under ten years of age, we find that—

With no visible primary cicatrices, or 1 cicatrix only, there were 4 cases :—2 varioloid, 2 discrete.

With 2 primary cicatrices :—8 cases, all varioloid.

With 3 primary cicatrices :—8 cases; 6 varioloid, 2 discrete.

With 4 or more primary cicatrices :—7 cases ; 6 varioloid, 1 discrete.

275. Although the figures with regard to the cases treated in the other Sheffield hospitals during the epidemic are too small, when classified, for the results to be of themselves of much value, they show a general correspondence with the results at the Winter Street Hospital stated in the preceding paragraph.

276. In relation to the Dewsbury epidemic, Dr. Coupland[1] obtained particulars of the number and character of the marks produced by primary vaccination, in 480 instances, amongst the 627 vaccinated persons who contracted small-pox, but these particulars did not in all instances refer to each of the several points concerned. Thus the *number* of scars is recorded in 461 instances, the character as to *foveation* is recorded in 416, whilst the total *area* of the scars is only recorded in 290 cases.

Of the 461 persons whose marks were recorded there were—

With 4 or more marks 42, of whom 1 died, or 2·3 per cent.
„ 3 marks 210, of whom none died.
„ 2 „ 175 „ 10 died, or 5·7 per cent.
„ 1 „ 34 „ none died.

It may be of importance to note that, as regards age, the fatal case amongst those having four or more marks was in the age class 30–40, whilst the 10 fatal cases with two marks were distributed thus :

[1] App. III, pp. 115–16.

5 to 10 years	1
15 „ 20 „	1
20 „ 30 „	3
30 „ 40 „	3
50 „ 60 „	2

277. Dr. Coupland remarks that there is abundant scope for variation in the degree of foveation in vaccination marks. For the purpose of analysis he groups the cases into series according as all the marks are (*a*) plain and well foveated; (*b*) some foveated, others not, or in which the foveation and outline of the scar are indistinct; (*c*) those marks which present no foveation, but either a smooth surface, and perhaps a faint appearance, or else composed of more or less radiate cicatricial tissue, causing a mark of great prominence and irregular outline.

278. Of the 416 cases, of which the records are given, he places 294 in the first group, 32 in the second, and 90 in the third, remarking, however, that the classification is an arbitrary one, and that too much stress cannot be laid on the conclusions drawn from an analysis based upon it. The result shown is as follows:

Having foveate marks 294, of whom 4 died, or 1·3 per cent.

Having partly or faintly foveate marks 32, of whom none died.

Having smooth, faint, or thick scars 90, of whom 2 died, or 2·2 per cent.

279. In dealing with the area of scars, Dr. Coupland adopted the classification of the vaccination scars according to their areas, employed in the statistical tables of the Metropolitan Asylums Board. The groups he formed were three in number, viz. class A^1 having marks the total area of which measured $\frac{1}{2}$ or more of a square inch; class A^2 in which the total area of marks was $\frac{1}{3}$ but less than $\frac{1}{2}$ of a square inch; and class A^3 in which the total area was less than $\frac{1}{3}$ of a square inch. The area was obtained in 290 cases.

246 fall into Class A^1 with 3 deaths, fatality 1·2 per cent.
27 ,, ,, A^2 ,, 1 death, ,, 3·7 ,,
17 ,, ,, A^3 ,, 1 ,, ,, 5·8 ,,

280. From Dr. Coupland's report on the Leicester epidemic[1] we obtain the following particulars:—

In the vaccinated class, which consisted of 198 cases, the number of primary vaccination cicatrices was recorded in 182 of them, viz. 6 with 1 cicatrix, 42 with 2 cicatrices, 64 with 3 cicatrices, and 70 with 4 or more cicatrices.

The following tables show the distribution of the types of smallpox in relation to the number of cicatrices:—

Having one primary cicatrix:—

Confluent	1	16·6 per cent.
Coherent	1	16·6 ,,
Discrete	1	16·6 ,,
Mild	3	50·0 ,,

Grouping the severer and milder forms we have:—
Confluent and coherent, 33·2 per cent.
Discrete and mild, 66·6 per cent.

Having two primary cicatrices:—

Confluent	8	19·0 per cent.
Coherent	3	7·0 ,,
Discrete	11	26·2 ,,
Mild	20	47·6 ,,

Grouping the severer and milder forms together we have:—
Confluent and coherent, 26·0 per cent.
Discrete and mild, 73·8 per cent.

Having three primary cicatrices:—

Confluent	5	7·8 per cent.
Coherent	10	15·6 ,,
Discrete	19	29·7 ,,
Mild	30	46·9 ,,

Grouping the severer and milder cases we have:—
Confluent and coherent, 23·4 per cent.
Discrete and mild, 76·6 per cent.

[1] App. VI, page 46.

All the above tables relate to persons over ten years of age. There was no case of a person under ten years of age within either of the classes of which the tables are composed.

Having four or more primary cicatrices :—

Type of smallpox.	Under 10 years.	Over 10 years.	Proportion at all ages.
Confluent	—	2	2·8 per cent.
Coherent	—	6	8·5 ,,
Discrete	—	16	22·8 ,,
Mild	2	44	65·7 ,,

Grouping them again according to the severer and milder forms we have—

Confluent and coherent, 11·3 per cent.
Discrete and mild, 88·5 per cent.

281. It is interesting to compare these results with a similar analysis of the *unvaccinated* persons at Leicester who were attacked by smallpox.

Type of smallpox.	Under 10 years.	Over 10 years.	At all ages.
	P. cent.	P. cent.	P. cent.
Confluent and malignant .	54 or 51·9	25 or 50·0	79 or 51·3
Coherent	23 ,, 22·1	13 ,, 26·0	36 ,, 23·3
Discrete	19 ,, 18·2	8 ,, 16·0	27 ,, 17·5
Mild	8 ,, 7·7	4 ,, 8·0	12 ,, 7·7

282. Dr. Luff's report on the London outbreak[1] furnishes the following information. He obtained the number of vaccination scars, and also the condition as to foveation in 1580 cases. He ascertained the area of the vaccination scars in 1340 cases. The following table shows the relation between the number of scars and the type of the disease.

[1] App. IV, pp. 7-9, and 17-19.

	One scar.		Two scars.		Three scars.		Four scars.	
	Discrete.	Severe and confluent.	Discrete.	Severe and confluent	Discrete.	Severe and confluent.	Discrete.	Severe and confluent.
Under 10 years	10	0	13	0	25	2	35	0
Over 10 years .	249	35	310	27	346	28	486	14

The result may be summarised thus:

With 1 scar there were 7·4 cases of discrete to 1 case of severe or confluent.

„ 2 scars „ 11·9 cases of discrete to 1 case of severe or confluent.

„ 3 „ „ 12·3 cases of discrete to 1 of severe or confluent.

„ 4 „ „ 37·2 cases of discrete to 1 of severe or confluent.

It will be noticed that the only confluent cases under the age of 10 were in the class with three scars, and that the cases of discrete in the three-scar class under that age were in a proportion of 12·5 to one severe or confluent, or almost exactly the same proportion as in the same class at all ages.

Turning to the fatality we find that there were—

With 1 scar, 294, of whom 8 died, or 2·7 per cent.

„ 2 scars, 350 „ 12 „ 3·4 „

„ 3 „ 401 „ 5 „ 1·2 „

„ 4 „ 535 „ 6 „ 1·1 „

283. Discriminating now between the scars, according as they were foveated or unfoveated, we obtain the results which appear in the following table:

Number of scars.	Foveated.		Unfoveated.	
	Discrete.	Severe and confluent.	Discrete.	Severe and confluent.
One . . .	147	15	112	20
Two . . .	222	7	101	20
Three . .	261	17	110	13
Four . . .	341	8	180	6
	971	47	503	59

An examination of the total numbers shows that in the foveated class 95·3 cases were discrete, while 4·6 were severe or confluent; and that in the unfoveated class 89·5 were discrete, and 10·4 severe or confluent.

284. If the fatality in the two classes be examined, we find the following results:

Foveated.

One scar, 162 cases, with 5 deaths, or 3·0 per cent.
Two scars, 229 ,, 3 ,, 1·3 ,,
Three ,, 278 ,, 2 ,, 0·7 ,,
Four ,, 349 ,, 3 ,, 0·8 ,,

The total, amounting to 1018 cases with 13 deaths, shows a death-rate of 1·2.

Unfoveated.

One scar, 132 cases, with 3 deaths, or 2·2 per cent.
Two scars, 121 ,, 9 ,, 7·4 ,,
Three ,, 123 ,, 3 ,, 2·4 ,,
Four ,, 186 ,, 3 ,, 1·6 ,,

The total number in this class is 562, with 18 deaths, or a death-rate of 3·2 per cent.

285. With reference to the area of scars, Dr. Luff gives the following information. He divides the scars in respect to their area according as they are under ·25 of the square inch, or from ·25 to ·5 of the square inch, or over ·5 of the square inch.

An analysis of the cases, viewed in relation to their area, gives the following results :

	Percentage of severe and confluent attacks.
Area under ·25	12·6
Area from ·25 to ·5 . . .	4·6
Area over ·5	3·9

Or, to put the case in another way :

Area under ·25 there were 6·9 discrete cases to 1 confluent.
Area for ·25 to ·5 „ 20·3 „ 1 „
Area over ·5 „ 24·0 „ 1 „

286. Examining the fatality in the classes thus divided according to the area of the scars, we have the following results :

Area under ·25 there were 253 cases, with 6 deaths, or 2·3 per ct.
Area from ·25 to ·5 „ 385 „ 7 „ or 1·8 „
Area over .5 „ 702 „ 10 „ or 1·4 „

287. In his report on the Warrington epidemic[1] Dr. Savill divides the vaccinated persons, who bore marks of vaccination, into two classes, which he terms "well vaccinated" and "indifferently vaccinated." In the well vaccinated class he includes "all persons whose primary vaccination scars are fairly well marked in their foveation (or pitting), and of an aggregate area (irrespective of number) of half a square inch and upwards." In the indifferently vaccinated class he includes "(*a*) persons whose primary scars, though foveate, are in the aggregate (irrespective of number) under half a square inch area, and (*b*) other persons whose primary marks irrespective of number or size, are entirely non-foveate, and therefore generally indistinct (plain, or flat, or faint)."

The well vaccinated class consisted of 350. The type of disease was distributed as follows :

Of the 350 well vaccinated cases—
58·6 per cent. were mild.
23·7 „ „ discrete.
17·8 „ „ confluent.
2·9 per cent. died.

[1] App. V, pp. 22 and 28.

Of the 208 indifferently vaccinated cases—

50·0 per cent. were mild.
24·0 ,, ,, discrete.
26·0 ,, ,, confluent.
8·2 per cent. died.

288. Dr. Gayton, in his analysis of the cases of the Homerton Hospital already referred to,[1] furnishes the following particulars:

Of 529 persons with 1 good mark, 22 died, or 4·1 per cent.
Of 649 ,, ,, 2 ,, marks, 22 ,, 3·3 ,,
Of 518 ,, ,, 3 ,, ,, 12 ,, 2·3 ,,
Of 389 ,, ,, 4 or more good marks, 6 died, or 1·5 per cent.

289. The following table gives the results derived from Mr. Sweeting's observations at the Fulham Hospital,[2] divided according to the age periods 0 to 10, and over ten years of age:

	One mark.			Two marks.			Three marks.			Four and over four marks.		
	Cases.	Deaths.	Death rate.	Cases.	Deaths.	Death rate.	Cases.	Deaths.	Death rate.	Cases.	Deaths.	Death rate.
0–10 . . .	21	1	4·76	29	1	3·45	37	0	0	53	0	0
Over 10 years of age	384	41	10·68	509	46	9·04	459	37	8·06	396	19	4·80
At all ages . .	405	42	10·37	538	47	8·73	496	37	7·45	449	19	4·23

290. With regard to the area of the marks, Mr. Sweeting gives the following information:[3]

	More than ½ square inch total area.			Less than ½ square inch total area.		
	Cases.	Deaths.	Death rate.	Cases.	Deaths.	Death rate.
0—10 . . .	0	0	—	11	0	0
Over 10 years of age	60	3	5 per cent.	240	40	16 6 per cent.

[1] 2, App. 243–4. [2] Q. 3717. [3] Q. 3722.

291. Dr. Thorne Thorne handed us a table [1] founded (*a*) on information given in the 36th volume of the Medico-Chirurgical Society's *Transactions* by Mr. Marson, as the result of his observations made during the years 1836 to 1851 on 3094 cases of post-vaccinal smallpox, and (*b*) on data derived from Mr. Marson's evidence before the Vaccination Committee of 1871, based on a further experience of 10,661 such cases, and covering the years 1852 to 1867.

Cases of smallpox classified according to the vaccination marks borne by each patient respectively.	Percentage of deaths in each class respectively; uncorrected.[2]		Percentage of deaths in each class respectively; corrected.[2]	
	1836-51.	1852-67.	1836-51.	1852-67.
1. Stated to have been vaccinated, but having no cicatrix.	25·5	40·3	21·7	39·4
2. Having one vaccine cicatrix . . .	9·2	14·8	7·6	13·8
3. Having two vaccine cicatrices . . .	6·0	8·7	4·3	7·7
4. Having three vaccine cicatrices . .	3·6	3·7	1·8	3·0
5. Having four or more vaccine cicatrices .	1·1	1·9	0·7	0·9
Unvaccinated	37·5	35·7	35·5	34·9

292. Reviewing now the evidence on this subject, we observe that at Sheffield there was a distinct diminution in both the fatality and the severity of the disease in proportion to the number of the marks. At Leicester the proportion of severe cases were less as the marks increased in number. The same is true of the experience of the fatality in London hospitals supplied by Dr. Gayton's and Mr. Sweeting's analysis; and the table founded on Mr. Marson's cases affords evidence to the same effect.

Dr. Coupland's experience at Dewsbury differed somewhat. Whilst none of those with one mark died, the deaths were 5·7 in the class with two marks; and whilst none of those with three marks died, the fatality in the four-mark class

[1] I, App. 116.

[2] The terms *uncorrected* and *corrected* are used to signify the inclusion or exclusion of those fatal cases of smallpox in which the patient suffered from some other disease superadded to the smallpox.

was 2·3 per cent. It is to be observed, however, that there were only 34 with one mark. The two-mark class was more than four times as numerous, viz. 175. In the three-mark class there were 210, and the fatality in the four-mark class is founded on one death only, the total number of that class being 42.

On examining Dr. Luff's returns with regard to the London epidemic, it will be seen that the fatality in the class with two scars is slightly in excess of the fatality in the class with one scar, being 3·4 as against 2·7. There is, however, a very marked contrast between these two classes and those with three and four scars, the percentages in which are 1·2 and 1·1 respectively.

293. Taken together, the number of cases, classified according to the marks found on the patients, is very considerable; it exceeds 20,000. Apart from Mr. Marson's cases the number is 6839. Dealing with this number, they being all cases in which the observations were made in very recent years, and dividing into classes according to the number of marks, we obtain the following result:

1 mark,	1357	cases,	with	85	deaths,	or 6·2	per cent.
2 marks,	1971	,,		115	,,	5·8	,,
3 ,,	1997	,,		75	,,	3·7	,,
4 ,,	1514	,,		34	,,	2·2	,,

Dr. Gayton, in his evidence,[1] stated that, in the analyses which he gave of the cases at the Homerton hospital, when he found one good mark and some imperfect marks, he ignored the imperfect marks and only recorded the good one. As the basis of his calculations was not precisely the same as that adopted in the other cases, it may be well to see how the figures would stand if Dr. Gayton's cases be eliminated. We should then have 4754 cases, distributed as follows:—

1 mark,	828	cases,	with	63	deaths,	or 7·6	per cent.
2 marks,	1322	,,		93	,,	7·0	,,
3 ,,	1479	,,		63	,,	4·2	,,
4 ,,	1125	,,		28	,,	2·4	,,

[1] Q. 1697–1706.

We think it is of importance to ascertain the effect of combining in this way the information obtained from different observers. The greater the number of cases in which the comparison can be made, the less opportunity is there for the undue influence of any accidental circumstance, and consequently the higher is the value of the result.

There is no doubt some room for error. It may be that the number of scars was by accident incorrectly recorded, or even that some which had existed had ceased to be apparent. But it is not probable that either of these causes of error can have much influenced the result. Moreover, if there be no connection between the degree of protection and the number of vaccination marks, there is no reason why chance errors of classification should have led to the appearance of a higher fatality in those with fewer vaccination marks rather than to the opposite result.

294. Upon the whole, then, the evidence appears to point to the conclusion that the greater the number of marks the greater is the protection in relation to small-pox enjoyed by the vaccinated person. This further indication also seems to be afforded, that whilst the distinction in this respect between those with one and those with two marks is not very great, there is a very marked contrast between those with four or even with three marks as compared with those with either one or two.

295. The view which attributes a different protective effect to vaccination according to the number of marks receives confirmation from an examination of the type of the disease from which those with one, two, three, or four marks suffered. The particulars given in the Sheffield, Leicester, and London reports afford an indication that the disease varies in its severity inversely as the number of the vaccination marks.

296. There does not appear to be evidence of the same importance to show that foveation of the vaccination marks indicates a condition of better protection in the vaccinated person, though the facts we have detailed may be said, on

the whole, to tend in that direction. The only reports which deal directly with this point are those relating to Dewsbury and London. In the former case the numbers are small and the result shown is by no means conclusive. In the latter, both as regards fatality and mildness of the disease, the foveated class show a distinct advantage over the unfoveated.

At Warrington, Dr. Savill based his discrimination into two classes of well and indifferently vaccinated, upon a consideration of the condition of the persons as regards area and foveation combined. There was a very marked distinction in the fatality of the two classes and a distinction, though less marked, in the type of disease from which they suffered.

297. As regards the area of the vaccination marks, though the classification adopted was not quite the same, Dr. Coupland in Dewsbury, Dr. Luff in London, and Mr. Sweeting at the Fulham Hospital, all found some evidence of superior protection according as the area of the vaccination marks was larger. This will be seen by a reference to the statistics quoted above.

298. The investigation of this matter and of the relation between foveation and the protective power of vaccination has, however, been of a range so much more limited than the inquiry into the connection between the number of marks and its protective power that the results furnish material of less value, and any conclusions drawn from them must necessarily be of less weight.

299. The subject of re-vaccination, to which we have already alluded, is obviously one of great importance. If vaccination exercises a protective influence which diminishes in its effect after the lapse of some years, it is of moment to ascertain whether that influence can be restored by a repetition of the vaccine operation. Moreover, if it should be found that re-vaccinated persons are more favourably situated with reference to an attack of smallpox than unvaccinated persons or than persons vaccinated only in infancy, this would obviously have a direct bearing on the

disputed question whether vaccination has a protective influence.

300. Unfortunately it is not possible to obtain any statistics showing the amount of re-vaccination in this country generally. It is certain that it varies greatly in different towns, and the amount is probably not anywhere large, in proportion to the number of the population who have passed the age of childhood. The proportion of re-vaccinated persons to the population almost certainly increases in any town immediately after it has been visited by an epidemic of smallpox. A panic then arises which leads many people to resort to vaccination.

301. In the towns where the epidemic outbreaks of smallpox were investigated, an endeavour was made, amongst other particulars, to ascertain the facts with regard to re-vaccination.

In the borough of Sheffield, during the epidemic of 1887 to 1888,[1] Dr. Barry appealed through the public press and to medical men practising in Sheffield for information as to any cases in which persons had been attacked by smallpox after re-vaccination. It was reported to him from all sources that 352 persons had been so attacked from the beginning of the epidemic to March 31, 1888. Dr. Barry personally inquired into all these cases. Twenty-three of them had removed and could not be traced. Of the 329 who were inspected, it was ascertained that some had not been attacked by smallpox, that others had never been vaccinated at all, or had been vaccinated or re-vaccinated during the incubative stage of smallpox, while some had been re-vaccinated during recovery from smallpox.

Forty-eight, or 4·6 per cent., had been re-vaccinated unsuccessfully, whilst 26 only had been re-vaccinated successfully prior to the incidence of smallpox. In addition to those inspected, one person, who had been successfully re-vaccinated, was fatally attacked by smallpox in 1887. The number of persons found to have been attacked by smallpox after successful re-vaccination was thus 27 in all.

[1] Q. 1904, 2035–7.

Of the 27 cases of smallpox after re-vaccination at Sheffield, one ended fatally. He had been re-vaccinated in 1869. In 19 of the 27 re-vaccinated persons the disease was of an extremely mild character; in two there was a copious eruption, but no pitting ensued; in three others the attack was severe, and was followed in two of them by slight pitting, and in the third by bad pitting; in two others it was doubtful whether they were genuine cases of smallpox. The fatal case has just been referred to.

302. In speaking of re-vaccination it is necessary to distinguish between cases in which the operation has been performed without result and cases of successful re-vaccination. It is only when the vaccine virus had induced vaccinia that a person can properly be called re-vaccinated. The term is, however, often applied where the attempt to re-vaccinate has failed. In that case the subject of the operation has acquired no more protection by the process than if re-vaccination had never been attempted. No doubt the want of success shows, if the operation has been thoroughly performed, that the person is at the time insusceptible to the virus, and, it may be, to the virus of smallpox also. But this condition of insusceptibility is not necessarily permanent, and it is impossible to predicate how long it may last. Moreover, experience shows that where re-vaccination has led to no result, a repetition of the process after the lapse of a few days only may produce the normal features of successful re-vaccination. A single unsuccessful attempt at re-vaccination cannot therefore be regarded as an indication of insusceptibility unless of the most transient nature. Where re-vaccination is not successful, this may be due, on the one hand, to insusceptibility produced by the previous vaccination, or, on the other hand, to impotency of the operation caused by the imperfection of the lymph used or by want of skill on the part of the operator. Where re-vaccination, unsuccessful at the first attempt, is successful when the operation is repeated after a short interval, there is strong reason for thinking that the want of success was due to the latter and not to the former cause.

If a re-vaccination is unsuccessful it ought not from that

fact to be taken for granted that immunity is certain, but the operation should be repeated once or even twice, as in the case of failure of primary vaccination in infants.

303. In the census, to which we have already alluded,[1] taken at the time of the epidemic in Sheffield, the number of persons re-vaccinated was enumerated. They amounted to 64,431. Estimating the attack-rate amongst this class, of whom 27 were attacked by smallpox, we find it to be 0·04 per cent.

The attack-rate of vaccinated persons over the age of 10 years enumerated in the Sheffield census was 1·9, and of unvaccinated persons of a similar age was 9·4.

The fatality per cent. of vaccinated persons attacked above the age of 10 years was 5·1, of unvaccinated persons 54·2. The one death among the 27 re-vaccinated gives a fatality of 3·7.

304. It is important in connection with the subject we are considering to state the result of the inquiries into the cases of second attacks of smallpox which were made in the course of the investigations of the circumstances relating to the local smallpox epidemics at Sheffield and elsewhere. We have already pointed out that an attack of smallpox, though in general protecting against a subsequent attack, does not confer an absolute immunity. The view that it did practically confer such an immunity was very prevalent at the beginning of the present century. It was not, however, universally held. Jenner gives the details of a case, as one among many others, showing that a second attack may occur, though he admits that it is so rare as to be regarded as a phenomenon. Other writers, such as Monro (*Observations on the different kinds of Smallpox*, 1818), Thomson (*An Account of the Varioloid Epidemic in Edinburgh*, 1820), and Cross (*On Variolous Epidemics*, 1820), describe it as not uncommon. Indeed the evidence that second attacks do occur is beyond dispute. With regard to the frequency of such attacks, the only exact evidence available is that relating to the Sheffield epidemic, furnished by Dr. Barry, to which we are about to refer.

[1] Q. 2037–9.

305. In the Sheffield census, 18,292 persons were reported as having suffered from smallpox prior to 1887.[1] Of these, 23 were attacked during the epidemic of 1887–88. It will be seen, therefore, that the attack-rate was 0·13 per cent. Five of the persons attacked died. Both the attack-rate and the fatality were higher in the class which had previously suffered from smallpox than in the re-vaccinated class.

With respect to the fatality of a second attack of smallpox, it may be noted that in many of the individual cases recorded, as in the special case quoted by Jenner, the second attack was fatal. Thomson, in the work already referred to, speaks of the fatality of attacks of smallpox after smallpox as being comparatively greater than that of smallpox after vaccination. It will be observed that in Sheffield the fatality, shown by the figures, was very high, being 5 out of 23, or 21·7 per cent. In Dewsbury, Warrington, and Leicester, however, there were 12 cases of a second attack of smallpox without a single fatal result.[2] If these be added to the Sheffield figures it gives 35 cases with 5 deaths, or a percentage of 14·2.

It has been pointed out that the immunity in relation to smallpox acquired by a previous attack of that disease thus differs from that derived from cow-pox in that while the incidence or attack-rate in the former case is much lower than in the latter, the fatality is much higher, and it has been suggested that this want of correspondence raises a doubt as to whether in the latter case there is a real immunity. Such a purely theoretic objection, even if valid, could not have great weight. In our want of knowledge as to the exact chain of events within the body which bring about immunity, differences, such as the above, in certain characteristics of the immunity are negligable in comparison with the facts indicating that the immunity does exist. But it is not a valid objection, since the figures relating to smallpox after smallpox, as compared with those of smallpox after cow-pox, are far too small to allow of any confidence in a comparision between the two. Again, the figures are so small as to justify an examination of the individual cases.

[1] Q. 2040.

[2] App. III, p. 125; App. V, pp. 48 and 28; App. VI, p. 22.

Now, in two of the five deaths recorded by Dr. Barry,[1] the cause of death was, so to speak, accidental; the patients in delirium exposed themselves to cold, and presumably would not otherwise have died. In a third case death was from apoplexy, which is not a natural part of the smallpox disease. Of course, where large numbers are dealt with, all such accidental circumstances may be neglected; their effects are neutralised by the numbers; but in such small numbers they may justly be taken into account. If this is done, the five deaths really due to smallpox are reduced to two, and the fatality becomes quite low. It may be added that only one of these five deaths is a clear example of death by a second attack of smallpox uninfluenced by other circumstances, the individual having certainly had smallpox, and never having been vaccinated, for the other death was a case in which the evidence of the first attack was inadequate, and which had been vaccinated.

It would appear, then, that such statistics as we possess do not corroborate the impression which is apt to be made by the scattered records of the individual cases of second attacks, owing to so many of these having a fatal issue. Indeed, many at least of these fatal second attacks may perhaps be regarded as instances of exceptional susceptibility.

On the whole, we think the evidence tends to show that there is no such want of analogy in the immunity secured by a previous attack of smallpox or by cow-pox as to constitute a valid objection to the reality of the immunity conferred by cow-pox.

306. Turning now to Dewsbury, we obtain the following information from Dr. Coupland's report:[2]—

There were 14 individuals attacked by smallpox during the epidemic who were said to have been re-vaccinated. In four, at least, of the 14 cases the re-vaccination appears to have been unsuccessful. We have already pointed out that these cannot be regarded as cases of re-vaccination. In five of the other cases there was no definite evidence

[1] Report on an epidemic of smallpox at Sheffield during 1887–88, pp. 46, 87, and 157.

[2] App. III, p. 119–20.

shown of re-vaccination; in another case the re-vaccination was not performed until one day after the appearance of the rash of smallpox; whilst in three other cases the re-vaccination was only from twelve to eight days prior to the attack, when, therefore, the smallpox virus was already at work.

In the remaining case, where the vaccination had preceded the attack by three weeks, the disease was of a mild character. There were only two confluent cases (one of them being a fatal case) amongst those said to have been re-vaccinated, in neither of which was there definite evidence of re-vaccination having been successfully performed.

307. In Leicester,[1] during the epidemic, in a group of 133 houses with 842 inmates, of whom 141 were attacked, there were 84 re-vaccinated persons, of whom one was attacked by smallpox. In another group of 60 houses with 392 inmates, of whom 179 were attacked, there were 31 re-vaccinated persons, of whom 5 were attacked.

We notice that in the first group of houses the attack-rate in the vaccinated class was 14·6 per cent.; amongst the re-vaccinated it was 1·1.

Dealing in a similar way with the second group of houses, which were more intensely infected than the other group, and where the attack-rate was consequently higher, we find that out of 31 re-vaccinated persons 5 were attacked, or a rate of 16·1 per cent., whilst amongst the vaccinated it was 35·3, and amongst the unvaccinated 59·6.

308. In London Dr. Luff reported[2] the number of attacks of re-vaccinated persons to have been 108, with four deaths, showing a fatality of 3·7. The fatality shown amongst vaccinated persons above the age of 10 in the same epidemic was 4·2. The fatality amongst the unvaccinated of a similar age was 20·9.

The character of the disease in the re-vaccinated class was reported to be mild in 101 cases, and severe in 7.

[1] App. VI, 60–2.

[2] App. IV, pp. 6 and 17.

309. At Warrington[1] in the invaded houses there were 64 re-vaccinated persons. Of these 8, or 12·5, were attacked. The percentage of unvaccinated persons attacked in the same houses was 56·0 per cent., and of vaccinated persons over 10 years of age 29·9 per cent. There were in those houses 41 persons who had previously had smallpox. Of these 5 were attacked, or 12·1 per cent. There was no death either in the re-vaccinated class or amongst those who had previously suffered from smallpox.

310. The reports from which we have just quoted throw light in other ways upon the effect of re-vaccination.[2]

The average strength of the troops stationed at Sheffield during 1887–8 was about 830 of all ranks. The whole of these were, or should, in accordance with the army regulalations, have been at one time re-vaccinated or vaccinated in the exceptional cases where they had not been previously vaccinated. Twelve men, or 1·4 per cent. of the total strength, contracted smallpox, and of these one died. Not one of the soldiers who contracted smallpox had been *successfully* re-vaccinated. During the period of the epidemic the men mingled freely with their friends in the town, and although the neighbourhood of the barracks was one of the first localities invaded by the disease, no successfully re-vaccinated soldier quartered in Sheffield suffered from smallpox.

311. Turning now to the incidence of the disease upon the police force of the borough of Sheffield, it appears that there were 372 men of all ranks.[3] Of these 10 constables contracted smallpox. These men, though vaccinated in infancy, had not been re-vaccinated. On 10th February, 1888, the Chief Constable issued an order directing the re-vaccination of every man in the force. After that date, down to the time when Dr. Barry made his report, no constable contracted smallpox. It should be observed, however, that the epidemic ceased in the following August, and that rather more than 70 per cent. of the cases occurred before the 25th February. The police, in carrying out their

[1] App. V, pp. 27 and 43. [2] Q. 2027.
[3] Q. 2027–8.

ordinary duties, were of necessity frequently brought into close relation with infected persons and things.

312. There were at the time of the epidemic 290 men and boys employed on the permanent staff of the Sheffield Post Office.[1] The Post Office regulations require re-vaccination before engagement. Dr. Barry truly points out that the duties of letter carriers, telegraph boys, &c., continually bring them into personal contact with infected persons and things, yet no member of the permanent staff of the Post Office contracted smallpox.

313. The facts relating to the attendants in smallpox hospitals deserve close attention. Many of them spend their time in what may be termed a hot-bed of contagion. They are in constant personal contact with persons suffering from the disease. There are others who, though not themselves necessarily in actual contact with the sick, are in constant communication with attendants on smallpox cases.

314. During the year ending 31st March, 1888, four hospitals were used in Sheffield for the treatment of acute cases of smallpox.[2] The bed accommodation in these four hospitals was 315, and 1798 patients were treated in them in the course of that year. Some of these patients when convalescent were transferred to a fifth hospital, with 60 beds, which was used during part of the year for convalescent smallpox patients only. In these hospitals the total number of attendants in personal contact with the sick was 140. There were 21 other persons in constant communication with these attendants. Of these 161 persons 18 had suffered from smallpox prior to the epidemic, and none of the 18 contracted the disease again. One other had been vaccinated in infancy, and was re-vaccinated unsuccessfully on entering the hospital for convalescents, but successfully some days later; 14 days after entering the hospital she had a very mild attack of smallpox, which did not necessitate her going to bed. Sixty-two others had been vaccinated in infancy only,

[1] Q. 2029.

[2] Q. 2029–30; 19,905–7; 28,799–804.

of whom six contracted smallpox, and one died. Of the remaining 80, all of whom had been successfully re-vaccinated, not one contracted smallpox.

315. At Warrington a force of 300 regular troops and 200 militiamen resided in the barracks in the north-east corner of the town.[1] In addition to these, 80 women and about 213 children resided in barracks. The only case of smallpox among the inhabitants of the barracks, numbering some 800 persons, occurred in the case of a militiaman. Although all recruits to the regular troops are re-vaccinated on joining, Dr. Savill was informed that this was not the rule with militia recruits, who are not re-vaccinated unless their marks are imperfect. The practice is the same as regards the women and children residing in barracks. At the time of the epidemic an inspection was made by the surgeon in charge, and re-vaccination performed wherever the original marks were reported not good.

316. No cases of smallpox were reported as occurring either in the police force or the postal service, in both of which re-vaccination was extensively practised either before or during the panic.

317. Only two members of the Staff of the Aikin Street Hospital, where smallpox patients were treated, were attacked by smallpox.[2] They were the only two members of the staff who were not re-vaccinated at the commencement of the outbreak. Dr. Savill adds in a note, that one of these subsequently stated she was re-vaccinated a few days before the eruption, but if, as would appear, this was after the smallpox virus had begun its work the circumstance is not material.

318. The largest number of cases of smallpox in any place of employment in the town arose at the Dallam and Bewsey Ironworks, which were situate near the temporary smallpox hospital.[3] The disease first attacked persons

[1] App. V, p. 44.
[2] App. V, pp. 44 and 11.
[3] App. V, pp. 20, 44, and 75.

employed at these works during the last week in August, 1892. Dr. Savill states that there was at first some apathy and opposition on the part of the workmen to the practice of vaccination; they could not be persuaded of the necessity. However, the sick fund committee of the works, *i. e.* a committee of the men's representatives, acting on the suggestion of the manager and the medical officer of the works, passed the following resolution on November 12th, 1892: "That any member who remains unre-vaccinated after Monday, November 21st, 1892, shall not be entitled to any sick benefit should he be afflicted with smallpox." The expense of re-vaccination was borne by the sick fund.

The medical officer states that, as a consequence of this, between 1400 and 1500 hands were re-vaccinated during the last two weeks of November, and a good many others were vaccinated by their private doctors.

After the second week in December, when the vaccination would have become effectual, there were down to the end of the epidemic only 12 cases of smallpox. Dr. Savill states that he was informed by the Medical Officer of Health that these were in the case of men who had either refused re-vaccination or joined subsequently.

319. At Leicester, at the end of the year 1892, the staff at the hospital consisted of 28 persons.[1] Fourteen of these had either previously had smallpox or had been re-vaccinated before the outbreak. Eight others were vaccinated at the time of the outbreak. The remaining six, although they had not previously been re-vaccinated, refused to submit to the operation. During the outbreak there was an addition of 12 to the staff dealing with smallpox cases. These were all re-vaccinated, and none of them contracted smallpox. Out of the 28, six were attacked by the disease, of whom one died. Five of the persons thus attacked, including the one fatal case,[2] were amongst the six persons who had refused to be re-vaccinated, though in the case of one of the five consent was afterwards given to the operation, but it was only per-

[1] App. VI, p. 33.

[2] The person in whose case the disease was fatal was said to be of intemperate habits.

formed on the day that she showed premonitory symptoms of smallpox. The sixth case, a mild one, was that of a nurse who had been re-vaccinated ten years before.

320. Dr. Gayton gives the following facts as regards smallpox among the hospital staff at the Homerton Smallpox Hospital.[1] From 1st February, 1871, the date when the hospital opened for the reception of patients, to the end of 1877, 366 persons had been employed in the hospital. All of these were re-vaccinated on commencing duty with the exception of an assistant nurse who was not brought under Dr. Gayton's notice for some reason until after she had been in the wards. This woman in a fortnight was down with smallpox, and passed through a severe attack, but recovered. Dr. Gayton was unable to give the exact number employed in the years subsequent to 1877, but he thought it might be fairly estimated that an equal number were engaged in the work. There was only one person attacked among these, she had not been re-vaccinated. A third case occurred, in which a nurse engaged in the hospital was attacked. She was sent into a ward on 27th February, 1880, after being re-vaccinated. On 3rd March the operation, being evidently a failure, was repeated. On 7th March, however, she presented symptoms of smallpox.

In the smallpox ship-hospitals of the Asylums Board during the 12 years 1884–95, among the attendants (doctors, nurses, and servants), varying in numbers from below 50 during the year to a little over 300, cases of smallpox have occurred in three years only, in 1884, in 1892, and in 1893; in all the other years there were no cases at all. In 1884, with 283 attendants employed, there were four cases; in 1892, two cases among 138 attendants; in 1893, six cases among 320 attendants. It is a striking fact that in all these years there should have been so few attacks of the disease amongst so many persons who were in a remarkable way exposed to contagion, for the exposure to contagion in a ship-hospital is very great. It is to be observed that in one of these cases the disease appeared within three days of her entering the hospital; in another nine days, in four

[1] Q. 1719–26, 1795–6.

others ten days, and in four others twelve to fifteen days after they joined the staff. None of the recorded cases appear to have been re-vaccinated successfully prior to the period of incubation of the smallpox, though the operation was in all cases attempted shortly after joining.

321. Mr. Sweeting gives the following statistics on the same point with reference to the Western Hospital,[1] formerly the Fulham Hospital :—The total staff, during the time the hospital has been in use, is stated by him to have been 362, of whom one half, roughly speaking, were habitually employed in the wards. Of the 362, 48 had had smallpox before they came into the hospital. Of 314 persons who had never had smallpox, seven contracted the disease. Two of these seven had not been re-vaccinated on entering the hospital, owing to some oversight. Two were unsuccessfully re-vaccinated, one of these being a case of second smallpox; another was not re-vaccinated early enough, as the operation was not performed until the fifth day; and in the other two cases there is no record of any result. These occurred in his predecessor's time. The total staff employed in ambulance duty was 42. Of this number only one took the smallpox. He was not re-vaccinated, his arrival not having been reported. He contracted the disease 13 days after he arrived on duty.

322. Mr. Marson, surgeon to the Highgate Smallpox Hospital, giving evidence in 1871 before the Select Committee, stated that during the preceding 35 years no nurse or servant at the hospital had been attacked with smallpox. Since then, up to the present time, one case only, that of a gardener, has occurred, so that there is now a record of nearly 60 years with one case only. Of the 137 nurses and attendants who have been taken on since May, 1883, 30 had had smallpox previous to their entering the service. (Some of these were patients in the hospital, engaged as nurses or ward maids after their recovery.) All the others were re-vaccinated upon entering the service, with the exception of the one case, the gardener, who took the disease.

[1] Q. 3733, 3775–92, 3799.

323. Some stress has been laid upon a statement made by Mr. Porter, who was for a short time medical officer at the South Dublin Union Hospital in 1871, that "the experiment of not re-vaccinating the nurses was tried at the smallpox hospital at the South Dublin Union in 1871–2; 29 out of the 36 attendants had not been re-vaccinated, and these all escaped smallpox as well as the other 7."[1] It appears that Mr. Porter's employment at the hospital lasted only about a week, and although he states that he made some inquiry or examination as to whether these 29 persons had previously suffered from smallpox, he admits that he knew nothing on this point except "in a general way." He "did not make a very minute inquiry." It had been usual, he thinks, before he went to the hospital to re-vaccinate the nurses, though he does not think it was compulsory. He could give no information as to why these nurses, who were at the hospital before he came there, had not been re-vaccinated. He seems to have made no inquiry on the point. The statement was originally made in a paper read by Mr. Porter before a medical society in the year 1872. There was no reference in this paper to the question whether the nurses not re-vaccinated had previously suffered from smallpox. Upon the whole, then, it cannot be regarded as certain that none of the 29 nurses referred to had suffered from smallpox, even if it is to be taken as a fact that they were none of them re-vaccinated.

324. It is not easy to understand why so much stress has been laid on the fact, if fact it be, that at a particular hospital 29 attendants who had neither been re-vaccinated nor suffered from a previous attack of smallpox escaped the disease. It cannot be treated as an isolated experience, it must be considered in conjunction with the facts relating to other hospitals and to smallpox generally. If the inference suggested be that in the other instances it was a mere chance that the re-vaccinated showed immunity from the disease, and that they would have displayed the same immunity if they had not been a second time vaccinated, the facts seem to render such an inference impossible. At the Sheffield

[1] Q. 22,190, 22,207–29, 22,239–326.

hospitals out of 62 attendants who had only been vaccinated in infancy, six contracted smallpox, as did another attendant who had been vaccinated in infancy and was not successfully re-vaccinated until incubating smallpox, whilst of the 80 others who had been re-vaccinated not one suffered. At Warrington two members of the hospital staff were attacked, being the only members who had not been re-vaccinated at the commencement of the outbreak. At Leicester, of the six attendants who refused to be re-vaccinated, five contracted smallpox and one died; whilst there was only one case of the disease, a mild one, amongst the larger number who had submitted to the operation, that of a nurse re-vaccinated ten years before. At Homerton almost all the hospital attendants were re-vaccinated, but three, on whom the operation had not been successfully performed, suffered from the disease. In Fulham Hospital seven of the attendants were attacked. None of them appear to have been successfully re-vaccinated. Dr. Grimshaw,[1] the Registrar-General for Ireland, states that in the Cork Street Hospital, Dublin, with which he was at one time connected, all the officers and servants in the institution were re-vaccinated with the exception of one resident pupil, who refused to be re-vaccinated; he died of smallpox.

325. It will be seen, therefore, that if the hospital experience be regarded as a whole, there is clear evidence that whilst the re-vaccinated attendants escaped smallpox, many of those who had neither passed through an attack of smallpox nor been re-vaccinated were attacked by the disease. It is true that it cannot be asserted that persons employed in hospitals as medical men or attendants, even if re-vaccinated, enjoy an absolute immunity from the disease. There are instances of such persons having been attacked, but they have been so rare and exceptional as not substantially to modify the conclusion otherwise arrived at.

326. If the inference proposed be that attendants in a smallpox hospital enjoy, quite apart from vaccination, an immunity from the disease which is not shared by those who

[1] Q. 3000.

under other circumstances come within the reach of contagion, any such hypothesis seems to be equally inadmissible when the facts just alluded to are properly weighed. It is indeed not easy to understand why attendants in a hospital coming into constant contact with smallpox patients should be subject to less risk of contagion than those who nurse a member of their own family, or who are in communication with persons so engaged. Yet there is abundant evidence that contagion is constantly conveyed under these circumstances. The invasion of a house by a single case frequently leads to other attacks in the same house. There have been frequent attacks of smallpox among patients suffering from other diseases who have been inmates of a hospital a part of which has been used for smallpox patients. And there is strong evidence that smallpox hospitals have been the cause of a spread of the disease in houses in their proximity. These considerations must surely create a doubt whether what has been stated with regard to the South Dublin Union Hospital can be relied on as accurate, the more so when we find that the circumstances were not made the subject of careful and complete inquiry.

327. Our attention has been called to the experience at the Bicêtre Smallpox Hospital at Paris, recorded by M. Colin. It has been said that this shows that whilst out of 200 attendants, nearly all of whom were re-vaccinated under his eyes, 15 were attacked by smallpox with a fatal result in one case, there was not a single case of smallpox among 40 doctors and chemists and 40 nurses, nearly all of whom refused to be re-vaccinated. M. Colin's book does not enable us to arrive at a precise knowledge of the facts. The statements with reference to these incidents are found at different parts of it. It is stated that out of nearly 200 attendants on the hospital staff, almost all of whom were vaccinated under M. Colin's eyes, only some 15 were attacked by smallpox. It is to be observed that we are not told what was the number of those who were not re-vaccinated; for aught that appears, all or many of the 15 cases may have been amongst these. Moreover, unless M. Colin followed up the matter and ascertained that in the case of all the persons

re-vaccinated under his eyes the operation had been successful, it is not certain that this was always the case. The experience gained by a study of the subject of re-vaccination elsewhere suggests caution on this head. On another page of M. Colin's book we find the statement that there was not a single attack of smallpox amongst the 40 doctors and chemists attached to the establishment, in spite of the neglect of the majority of them to be re-vaccinated, and not a single attack amongst the 40 nurses who attended the smallpox patients. It will be noticed that this statement with reference to the neglect of re-vaccination is confined to the 40 doctors and chemists. Further, it is not certain whether it is intended to state that they had never been re-vaccinated, or merely that they had not submitted to the operation though advised to do so when they commenced their work at the hospital. In a subsequent passage where the fact that the doctors and chemists, and the nurses referred to, escaped smallpox is mentioned, it is added, "a large number of these persons, however, were not willing to yield to the advice I gave them to be re-vaccinated."

328. We do not think that the statements of M. Colin materially affect the weight of the evidence derived from hospital experience in this country. It will, of course, be noticed that both the Dublin and Paris cases only bear on the question of the value of re-vaccination as compared with primary vaccination; there is nothing to show that any of the persons who escaped the disease were unvaccinated.

It should be added that Dr. Ogle and others have called attention to the immunity enjoyed by medical men, who are largely a re-vaccinated class, from attacks of smallpox as compared with other contagious or infectious diseases.

329. It has been suggested that the true reason why those engaged in constant attendance in smallpox hospitals enjoy so exceptional an immunity from the disease, when the probabilities seem in favour of a risk much graver than the ordinary one, is this, that by a long and gradual exposure to the influence of the poison, the human frame becomes torpid in its action. But the facts do not support this explanation.

In the first place the exposure to the poison is not gradual, and further, this theory does not explain the phenomenon that the re-vaccinated so largely escape the disease as compared with those who have not been re-vaccinated.

Moreover, the experience of almost certain immunity from the disease in the case of successfully re-vaccinated attendants in smallpox hospitals has no parallel in the case of other contagious or infectious diseases.

Typhus fever is in many respects comparable with smallpox, especially in its contagiousness and in its attacking adults. Now at the London Fever Hospital during the period 1862–71, when large numbers of typhus patients were treated, the average number of attendants (including laundry-women) employed either temporarily or otherwise in the course of a single year was about 100, and the average number of cases of typhus occurring in a year amongst that staff was 19·2. It must be remembered that all these attendants were not employed in the typhus-wards; were it possible to obtain the separate figures of the number employed in those wards, the attack-rate would doubtless be higher. We are unable to state the exact proportion of the persons forming from time to time during the period 1862–71 the medical staff of the Hospital, who were attacked with typhus, but the following may be given as an instance of what at times happened. In 1862, the resident medical officer and a gentleman who temporarily discharged his duties both caught typhus; in the following year, the resident medical officer and three gentlemen who successively acted as his assistant all caught typhus; in the following year, the assistant resident medical officer, and in the year following that, another medical officer contracted the disease, while in the next year (1866) a resident medical officer took it and died. So great was the risk at that time of a new medical officer taking typhus, that each candidate was warned by the authorities of the danger to which he was exposing himself.

Neither scarlet fever nor measles can now, in respect to the question at issue, be compared with smallpox; since, as regards these two diseases, the proportion of adults protected by a former attack (in infancy) is one by the side of

which the proportion in recent years of adults protected by a former attack of smallpox sinks into insignificance.

At the London Fever Hospital, since the time that typhus has almost disappeared, the cases of fever have been principally those of scarlet fever, and hence now among the medical staff and nurses the attacks of fever are comparatively few in number. In fact, the behaviour of scarlet fever towards a hospital staff becomes comparable with that of smallpox, only on the hypothesis that a thoroughly good vaccination places a person towards smallpox in a position very similar to that which the having already had the disease places a person towards scarlet fever.

Typhoid fever cannot fairly be compared with smallpox, since the mode of contagion is different. Nor are there records available as to the hospital staffs specially in care of typhoid fever or of diphtheria patients as there are in the case of smallpox. But if the cases of ordinary contagious diseases, such as scarlet fever and diphtheria, be taken together, and even if typhoid fever be included, a striking contrast is afforded by the returns of the Metropolitan Asylums Board between the attendants in the hospitals treating these diseases, and those in the smallpox ship-hospitals mentioned above. This is shown in the following table (page 185) :—

Making every allowance on the one hand for the mixed character of the cases in the Fever Hospitals, and on the other hand for doubts about the re-vaccination of some of the staff at the ship-hospitals, it is clear that smallpox stands apart from all the other contagious diseases in relation to attacks among the staff.

330. We have already in our discussion of the subject of re-vaccination alluded to its apparent effect in relation both to the military forces stationed at Sheffield and Warrington, and to public officials such as those employed by the Post Office, who by the regulations of the service are required to be vaccinated before entering it. It is needless to say that these are for the most part cases of re-vaccination. It will be expedient now to examine the evidence with regard to the Army and Navy generally.

Year.	Metropolitan Asylums Board's Fever Hospitals.[1]			Metropolitan Asylums Board's Smallpox Hospital-ships.		
	Number of attendants employed either temporarily or otherwise in the course of the year.	Of whom, there contracted scarlet-fever, diphtheria,[2] or typhoid during the year.		Number of attendants employed either temporarily or otherwise in the course of the year.	Of whom, there contracted smallpox during the year.	
		Number.	Proportion.		Number.	Proportion.
1884	Figures not available			283	4	1·4 per cent.
1885				240	0	0 „
1886				110	0	0 „
1887	1,103	37[2]	3·4[2] per cent.	55	0	0 „
1888	Figures not	35	—	46	0	0 „
1889	available	42	—	53	0	0 „
1890	1,312	53	4·0 per cent.	64	0	0 „
1891	1,160	68	5·9 „	64	0	0 „
1892	1,652	121	7·3 „	138	2	1·4 „
1893	2,175	121	5·6 „	320	6	1·9 „
1894	2,182	111	5·1 „	289	0	0 „
1895	2,514	116	4·6 „	274	0	0 „

[1] Excluding the Gore Farm Hospital, opened in 1890. In the years 1893, 1894, and 1895, both scarlet fever and smallpox convalescent patients were admitted into that hospital, and the only available figures as to the staff do not enable us to distinguish between those employed in or about the fever, and those in or about the smallpox wards.

[2] Cases of diphtheria, as such, were not admitted into the Metropolitan Asylums Board's hospitals prior to October, 1888; though a few cases of that disease, sent in as fever cases, had been admitted in the earlier part of that year and in the previous year. Three attendants who contracted diphtheria in 1887 have not, therefore, been included in the number (37) and proportion (3·4 per cent.) given in the second and third columns of the above table against the year 1887.

331. The following table shows the attack-rate of and mortality from smallpox amongst the troops in the United Kingdom during each of the years 1847–1894 :[1]—

Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.	Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.
1847	18	1·0	1871	23	2·3
1848	26	1·6	1872	14	1·4
1849	25	3·2	1873	1	·1
1850	14	·7	1874	1	0
			1875	·6	·1
1851	14	·8	1876	3	·2
1852	30	2·1	1877	3	·4
1853	20	2·2	1878	2	·1
1854	41	4·5	1879	1	0
1855	47	3·8	1880	·4	0
1856	12	·4			
1857	12	1·0	1881	3	·2
1858	32	1·8	1882	2	·1
1859	24	1·0	1883	1	0
1860	14	·7	1884	1	0
			1885	2	·3
1861	6	·4	1886	1	0
1862	8	·4	1887	1	·1
1863	16	·8	1888	1	·1
1864	15	1·4	1889	·2	0
1865	12	·8	1890	0	0
1866	5	·1			
1867	5	·1	1891	·1	0
1868	9	·3	1892	6	0
1869	1	0	1893	·8	0
1870	3	·1	1894	1	0

332. Since the year 1858 it has been the practice in the army to vaccinate every recruit on joining the service, whether previously vaccinated or not, except those bearing distinct marks of smallpox.[2] During the years following 1858, therefore, as men previously recruited passed from the army, the proportion of the strength who had been vaccinated since enlistment increased ; until, in somewhere about ten years' time, the earlier recruits had, with comparatively few exceptions, left the army.[3]

[1] 2, App. 278–9 ; and reports of Army Medical Department for the years 1889–94.

[2] Q. 3450–8 ; 3489–99.

[3] Q. 3500–7.

333. During the period 1847–1858 the death-rate from smallpox amongst the troops in the United Kingdom, though varying from year to year, does not appear to us to have given evidence of decline. Speaking generally of the period 1859–1894, the growth of the proportion of the strength who had been vaccinated since enlistment was accompanied by a decline in the death-rate from smallpox, and the lessened death-rate has on the whole continued during those later years of the period in which that proportion has presumably been maintained at its highest.

334. The following table shows the attack-rate of, and mortality from, smallpox among the British troops in the Colonies from the year 1860 onwards:[1]—

Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.	Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.
1860	8	1·0	1878	1	·4
			1879	·3	0
1861	12	·9	1880	2	·4
1862	15	2·3			
1863	5	0	1881	0	0
1864	16	1·5	1882	1	0
1865	12	1·1	1883	3	0
1866	7	0	1884	·5	0
1867	8	0	1885	1	0
1868	10	·3	1886	0	0
1869	4	0	1887	1	0
1870	8	1·3	1888	3	0
			1889	2	0
1871	51	7·0	1890	0	0
1872	·5	0			
1873	3	·5	1891	2	0
1874	2	0	1892	0	0
1875	5	0	1893	2	0
1876	0	0	1894	1	0
1877	·4	0			

335. The following table shows the attack-rate of, and mortality from, smallpox amongst the British troops in India during the same period:[1]—

[1] 2, App. 278; and reports of Army Medical Department for the years 1889–1894.

Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.	Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.
1860	25	2·9	1878	12	2·3
			1879	6	·6
1861	40	6·1	1880	1	·2
1862	6	·8			
1863	8	1·8	1881	3	·2
1864	21	2·9	1882	8	·7
1865	21	2·6	1883	19	1·6
1866	6	1·0	1884	14	1·4
1867	8	·9	1885	2	0
1868	8	0	1886	4	·2
1869	28	3·2	1887	6	·3
1870	4	·9	1888	15	1·5
			1889	22	2·5
1871	2	·2	1890	5	·6
1872	9	1·9			
1873	14	1·9	1891	2	·2
1874	8	1·3	1892	3	·4
1875	2	·3	1893	5	·6
1876	3	0	1894	2	·4
1877	7	·3			

336. The following table shows the attack-rate of, and mortality from, smallpox amongst the British troops in Egypt during the years from 1882 onwards :—[1]

Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.	Year.	Attacks of smallpox to every 10,000 of the strength.	Deaths from smallpox to every 10,000 of the strength.
1882	5	0	1889	122	17·5
1883	10	3·8	1890	0	0
1884	39	1·5			
1885	54	4·2	1891	3	0
1886	46	2·7	1892	6	0
1887	49	7·6	1893	8	0
1888	42	12·0	1894	0	0

In order to maintain the same basis, the rates are stated as in the other tables in relation to every 10,000 of the strength, but except in the year 1886 the force in Egypt

[1] 2, App. 278; and reports of Army Medical Department for the years 1889–1894.

has never amounted to 10,000 men. It will be well, therefore, to give the actual figures, since a false impression as to the extent of the disease might otherwise be created. The actual figures are as follows :—

Year.	Strength.	Attacks of smallpox (*actual number*).	Deaths from smallpox (*actual number*).
1882	6,198	3	0
1883	7,897	8	3
1884	6,468	25	1
1885	9,593	52	4
1886	11,062	51	3
1887	5,272	26	4
1888	3,346	14	4
1889	3,431	42	6
1890	3,209	0	0
1891	3,172	1	0
1892	3,102	2	0
1893	5,073	4	0
1894	5,226	0	0

It will be seen that in the years 1887–89, and especially in the year 1888, the fatality was very high. We are not aware what is the explanation of this. It may be that smallpox prevailed in Egypt in a specially virulent form in those years.

There is a point connected with the returns of smallpox in the army which must be borne in mind, not only in relation to the attacks of smallpox amongst the troops in Egypt, but with respect to the disease in the army generally. It has been stated that the percentage of unsuccessful re-vaccinations is often as high as 20 to 30 per cent. It is certain that soldiers are often disposed to withdraw if possible the vaccine matter and thus to prevent vaccinia ensuing on the operation. Efforts are no doubt made to provide against this, but they are not likely to be always effectual. It may well have been the case, therefore, that a sensible percentage of the men were not protected by successful re-vaccination.

337. The following table shows the attack-rate of, and

mortality from, smallpox in the navy, wherever stationed, during each of the years 1860–1894 :[1]—

Year.	Attacks of smallpox to every 10,000 of the force.	Deaths from smallpox to every 10,000 of the force.	Year.	Attacks of smallpox to every 10,000 of the force.	Deaths from smallpox to every 10,000 of the force.
1860	51	3·9	1878	2	0
			1879	12	3·1
1861	50	3·8	1880	2	·2
1862	17	3·1			
1863	22	2·8	1881	6	·7
1864	87	6·2	1882	2	·5
1865	32	2·9	1883	2	0
1866	48	1·6	1884	1	0
1867	49	2·7	1885	1	0
1868	16	·4	1886	2	·6
1869	17	1·0	1887	·2	0
1870	9	·2	1888	4	·2
			1889	1	·2
1871	31	2·5	1890	1	·4
1872	19	2·3			
1873	3	·2	1891	3	0
1874	2	·2	1892	2	·3
1875	4	·2	1893	1	0
1876	5	1·3	1894	3	0
1877	4	0			

338. Since April, 1864, it has been the practice in the navy to vaccinate every person entering the service, other than natives joining abroad.[2] Before that date, though medical officers had been required to advise the men under their care to be vaccinated, there was no regulation enforcing vaccination. During the latter part of the year 1864 and during the following years, as men who had previously joined left the service, the proportion of the force who had been vaccinated since enlistment increased; until in March, 1871, before this can have attained its maximum an order was issued for the vaccination of the whole force, whether the men had been previously vaccinated or not and even in cases where they had had smallpox.[3] For some time, however, after the issue of this order there existed no

[1] 2, App. 254.

[2] 2, App. 255. Q. 2645–6; 3210–2. Q. 2651–7; 3212–9.

[3] Q. 2654; 2659; 3220–32; 3243–4; 3443.

regulation enforcing the vaccination of "foreigners," natives engaged abroad and discharged before their ship returns from her station; but in 1873 an order was issued for their vaccination on enlistment. Since the year 1873 the force should, under the regulations, consist only of persons who had been vaccinated since enlistment.[1]

339. During the period 1860–1864 the death-rate from smallpox in the navy gave no evidence of decline. Speaking generally of the period 1864–1894, the growth of the proportion of the force who had been vaccinated since enlistment was accompanied by a decline in the death-rate from smallpox, and the lessened death-rate has on the whole continued during those later years of the period in which that proportion has presumably been maintained at its highest. In the year 1879 the death-rate was, indeed, higher than it had been in any year since 1864;[2] but ten out of the fourteen deaths from smallpox which occurred during that year (representing 2·2 of the death-rate of 3·1 shown in the table in § 337) were those of certain "foreigners," shipped on one particular vessel, whom the medical officer of the ship had, contrary to the Admiralty regulations, neglected to vaccinate. The vessel referred to is the "Boadicea." When at Sierra Leone, 37 Kroomen were shipped on board her. Sixteen of them showed evidence of having had smallpox in their youth, and two had vaccine marks on their arms. Twelve Kroomen were attacked in all, of whom 10 died. None of them had suffered from smallpox previously, and only one, who had the discrete form and recovered, showed vaccine marks. Twenty-four white men were attacked, of whom one only died. Of the remainder, four suffered from the confluent form, eight from the discrete, six from the varicelloid variety, and five from fever without any eruption. With one exception, faintly marked, all the white men had good cicatrices, some of them being due to re-vaccination.

340. We have further evidence also with regard to the

[1] Q. 2670; 3172–3; 3226–34.

[2] 6, App. 688.

postal service. Sir Charles Dilke, speaking in June, 1883, made the following statement about those employed in that service in London:—"In the case of persons permanently employed in the postal service in London, averaging 10,504, who are required to undergo vaccination on admission, unless it has been performed within seven years, there has not been a single death from smallpox between 1870 and 1880, which period included the smallpox epidemic, and there have been only 10 slight cases of the disease. In the telegraphic department where there is not so complete an enforcement of vaccination there have been only 12 cases in a staff averaging 1,500 men." When it is remembered how many of the persons so employed become subject in a degree exceeding that of the population at large to the risk of contagion, and that the period referred to included that of the epidemic in London of 1870–2, when there were so many attacks of and deaths from smallpox, the statement is certainly noteworthy.

We have not been able to obtain information bringing the statistics given above down to the present date. We have been furnished, however, with the following particulars:—

Year.	General Post Office.		
	Number of established officers employed.	Number of cases of smallpox.	Number of deaths from smallpox.
1891	47,264	*None*	*None*
1892	54,198	2	*None*
1893	58,311	4	*None*
1894	60,490	11	1

It is noteworthy that, in the year 1892, 12 officers were absent from duty on account of the presence of smallpox in their houses; in 1893, 44; and in 1894 as many as 53.

341. It should be mentioned that a study of the facts observed by the medical men who have investigated recent epidemics tends to the conclusion that the re-vaccination induced by the existence of an epidemic of smallpox has played no small part in checking the spread of the disease

and narrowing its limits. It seems to have been a very important factor in controlling the epidemic.

342. Summing up, then, the evidence on the subject of re-vaccination so far as regards this country, we find that particular classes within the community amongst whom re-vaccination has prevailed to an exceptional degree have exhibited a position of quite exceptional advantage in relation to smallpox, although these classes have in many cases been subject to exceptional risk of contagion. We find, further, taking the evidence as a whole, that in the population at large, re-vaccinated persons seem to be in a position much more advantageous not only than the unvaccinated, but than adults who have only been vaccinated in infancy.

There is another conclusion suggested by the evidence to which we ought to advert, for it is of importance. Where re-vaccinated persons were attacked by or died from smallpox, the re-vaccination had for the most part been performed a considerable number of years before the attack. There were very few cases where a short period only had elapsed between the re-vaccination and the attack of smallpox. This seems to show that it is of importance in the case of any person specially exposed to the risk of contagion that they should be re-vaccinated, and that in the case even of those who have been twice vaccinated with success, if a long interval since the last operation has elapsed, the operation should be repeated for a third, and even for a fourth time.

343. A comparison has been instituted between the annual mortality from smallpox of males and females per million living at different ages for the three decennia between 1851–1880, and it has been suggested that an inference unfavourable to vaccination is to be drawn from this comparison, inasmuch as the mortality of males exceeds that of females, whilst the former were presumably the better vaccinated class. It is to be observed, however, that if the age below 15 be separately regarded, when infantile vaccination would be most protective, and when the conditions of exposure would probably be much the same, there is no substantial difference between the mortality of males and

females. Above the age of 15, when the male population would be likely to be exposed to the risk of contagion more than the female, the deaths amongst the male population were considerably more than among the female. There is no reason to believe that this increased risk was counterbalanced to any material extent owing to a much larger proportion of the male population having been re-vaccinated than of the female. There is every reason to think that only a small proportion of either class had submitted to the operation of re-vaccination. The number of those who pass through the army is not large in proportion to the total population. And, on the other hand, the number of females employed as domestic servants, whose re-vaccination would be likely to be attended to, exceeds that of men so employed.

344. In discussing the effect of vaccination upon the fatality of smallpox, and the attack-rate and type of the disease, we have referred exclusively to materials derived from experience acquired in England. We have done so because we possess the records of a careful examination into the circumstances of epidemics which occurred in that part of the United Kingdom. We have already insisted upon the importance of the reports which embody the results of those investigations. We do not possess any information of the same character with reference to the incidence of smallpox epidemics in other parts of the United Kingdom. We have not referred to the reports we received with regard to the other epidemics because they were of a more limited scope, and the information was derived more from other persons and less from a systematic investigation by the medical man appointed by ourselves.[1] Nevertheless they contain much information with regard to the incidence of smallpox upon the vaccinated and unvaccinated, which is in conformity with the results derived from the more complete investigation of the epidemics in the other towns. The records of the smallpox hospitals in London, which we have quoted, furnish the particulars of a very large number of cases. We have no similar records relating to anything like the same number of cases either in Scotland or Ireland.

[1] App. VIII.

We have pointed out the superior value of statistical results when derived from a large number of cases. For these reasons we do not propose to refer specifically to the evidence drawn from experience in Scotland or Ireland, bearing upon the question whether vaccination diminishes the fatality of smallpox or renders persons less liable to be attacked by, or to suffer severely from it. This much, however, we may say, that the evidence relating to those parts of the United Kingdom does not in any way tend to modify the conclusions to which a study of the evidence relating to England leads. On the contrary, its tendency is to confirm and strengthen them.

345. We have hitherto made no reference in this part of the case to what is to be learned by an inquiry into the practice of vaccination and the records of the disease of smallpox in foreign countries. We do not propose to include in our report an exhaustive examination of the experience gained in other countries than our own; it would obviously carry us beyond all reasonable limits of space. We may, however, refer to some important facts which have been prominently brought to our notice.

346. It is worth noting, for example, that a change of the same nature as regards age incidence, which has distinguished the mortality from the disease in the present day from that prevailing in the last century, has been observed in Germany also. There are records of epidemics in that country during that century where the deaths were exclusively among those under twenty and almost exclusively among those under ten years of age.[1]

347. A comparison of the mode in which the very general smallpox epidemic of 1870–71 affected the German and French armies in those years is especially worthy of attention. In the year 1834 vaccination was made compulsory for soldiers in the Prussian army.[2] Although it may not have been enforced with complete thoroughness, there seems

[1] 2, App. 232–3.

[2] Q. 1496; 6, App. 728.

to be no doubt that the German army was, on the whole, a well-vaccinated class at the time of the campaign of 1870–71.[1] We do not think there can be any real doubt that the French army was, during the same period, in a condition in that respect less satisfactory. According to the official returns, the number of smallpox deaths in the German forces during the years in question was only 316.[2] It was stated by Monsieur de Freycinet, when Minister of War, that 23,400 French soldiers died of smallpox during the years 1870–71. We have not been able clearly to ascertain how these last figures were procured. They were not derived directly from any official return. It would seem that the average derived from a limited number of returns relating to particular portions of the army was applied to the army as a whole. It is quite possible, therefore, that the figures given may not be accurate, and that the number stated is in excess of the real number of deaths; but we do not think it is possible to doubt that the ravages of smallpox in the French army were very great, and that the mortality was enormously in excess of that suffered by the force which was opposed to them.[3] Various facts which have been deposed to, as, for example, the smallpox deaths in the ranks of the French soldiers imprisoned in Germany, confirm this view, which receives further confirmation from a comparison of the smallpox deaths in the French and Prussian armies in the time of peace which immediately preceded the war. In 1869 there were 63 deaths from smallpox in the various French garrisons. In the four years from 1866 to 1869 there were 380 deaths from smallpox, 323 of them being in the active army. On the other hand, the total number of deaths from smallpox in the Prussian army from 1835 to 1869 was but 77.

348. Information of great importance is derived from an observation of the apparent effect of the law which was passed in Prussia in the year 1874 making re-vaccination compulsory. Since that period smallpox mortality in that country has been reduced to proportions quite insignificant

[1] 6, App. 727; Q. 1545–7.
[2] Q. 1543; 6, App. 728; 6, App. 727.
[3] 6, App. 725; Q. 1543–4; 2, App. 241.

as compared with any previous epoch. It is instructive in this connection to compare the deaths from smallpox per 100,000 of the population in Prussia and Austria. The deaths do not of course correspond year by year ; sometimes they are higher in one country than in the other, and upon the whole the mortality shown is greater in the case of Austria than of Prussia, but in the period prior to 1874 there is no contrast to be found such as is observable since that year. The figures for 1874 and for some years prior and subsequent to that date are worth placing side by side.[1]

—	Prussia.	Austria.	—	Prussia.	Austria.
1862	21·06	31·14	1872	262·37	189·93
1863	33·80	53·10	1873	35·65	323·36
1864	46·25	84·78	1874	9·52	178·19
1865	43·78	45·53	1875	3·60	57·73
1866	62·00	36·85	1876	3·14	39·28
1867	43·17	74·08	1877	0·34	53·18
1868	18·81	33·27	1878	0·71	60·59
1869	19·42	35·18	1879	1·26	50·83
1870	17·52	30·30	1880	2·60	64·31
1871	243·21	39·28	1881	3·62	82·67

349. In the year 1884 a Commission which had been appointed by the German Government to inquire into the subject of vaccination made their report, which, besides the comparison of Prussian and Austrian mortality just referred to, contains much valuable matter bearing upon the protective effect of vaccination.[2]

350. Upon a review of all the information derived from other countries which we have had an opportunity of considering, it appears to us not to contradict, but, on the contrary, to confirm the experience acquired in this country. The same may be said, too, of the evidence which has been placed before us relating to India and the British colonies.

[1] 6, App. 728.
[2] Ibid.

351. Much criticism has been applied to the writings of Jenner, and of other early advocates of the practice of vaccination, and strenuous efforts have been made to show that their observations cannot always be relied on, and that their reasoning was at times unsound. This appears to us, even if it were established, to be of little importance as a guide to the conclusion which ought to be arrived at on the question whether vaccination affords any protection against smallpox. We have now in our possession the experience of more than half a century, during which facts relating to the effect of vaccination upon smallpox have been carefully recorded. If a study of this experience taught us that vaccination had not exercised any beneficial influence as a protection against smallpox, that the ravages of the disease were as great in the case of the vaccinated as of the unvaccinated, and that no difference could be observed in the manner in which it treated the two classes, we could have no faith in vaccination as a prophylactic, however apparently accurate the observations of Jenner and his associates, or however apparently conclusive their reasoning. If, on the other hand, the reasonable conclusion, from an experience of more than half a century of the practice of vaccination, be that the vaccinated show less liability to attack by the disease of smallpox, or when attacked, suffer less fatally or severely, these facts cannot be displaced by showing that Jenner and his associates erred in some respects both in their observations and in the conclusions they founded upon them. It would, in our opinion, in that case have been proved that, however mistaken they may have been in other respects, they were right at least on this cardinal point, that the vaccinated enjoyed a position in relation to smallpox superior to that of unvaccinated persons. We think it would be as little reasonable to reject the conclusion to which the experience of vaccination led us, because Jenner and other early advocates of the practice made mistakes, as it would be to believe in its protective influence on account of the credit which seemed due to their judgment or observations, in spite of the lessons to the contrary taught by a lengthened experience of the practice. In saying this we must not be supposed to admit that all the criticisms to which Jenner and his asso-

ciates have been subjected are sound, or to give our adhesion to them; we have desired only to point out why it seems to us of comparatively little importance whether they be so or not, and to assign to them their true place among the considerations which ought to guide us in determining the question whether or no vaccination has a protective influence.

352. When an attack of disease secures immunity or protection against another attack of disease, the two attacks are, as a rule, attacks of the same disease. Some pathologists have, it is true, of late years been led to suppose that one disease may confer some degree of immunity or protection against another different disease; but instances of this are few, and, moreover, cannot be regarded as thoroughly established. The ordinary instances of immunity are so clearly those in which the attack, natural or artificial, which confers the immunity is of the same disease as that towards which immunity is conferred, that identity of disease has been considered as essential to the conferring of immunity. And it has been argued that it is *a priori* improbable that cow-pox should confer immunity from smallpox, seeing that the two are different diseases. Such a purely theoretical argument can have little weight against positive evidence of vaccination having actually conferred immunity. If this be definitely proved to be the fact, proof is thereby at the same time afforded that the theory is unsound, either because a particular disease may confer immunity against a different disease, or because smallpox and cow-pox are not different diseases. For the practical object with which alone we are concerned, it is not material that we should reach any conclusion upon the question, what is the real source of error in the theory alluded to, supposing it to be eroneous? We shall content ourselves, therefore, with a very brief notice of the subject.

353. Jenner himself, in his first paper, advanced the view that the cow-pox and smallpox were identical with each other; and since his time numerous observers have attempted to prove the identity of the two diseases experi-

mentally, namely, by giving rise to cow-pox in the cow through the inoculation of smallpox matter or by the introduction of contagion in other ways. It may at once be stated that while cow-pox is readily transferred from the cow to man and back again from man to the cow, the disease in man being identical with that in the cow, smallpox cannot be transferred from man to the cow so as to give rise to a disease in the latter identical in its features with the smallpox of man. Nor can cow-pox be so transferred to man as to give rise in him to smallpox. The two diseases are not in this sense convertible.

354. In most cases the attempt to transfer smallpox from man to the cow[1] has had simply a negative result; no obvious effect of any kind has been observed. This has been the case in the attempts to introduce the contagion through absorption by the respiratory or digestive organs, and in most of the attempts to introduce the contagion by inoculation. In certain instances these latter attempts have produced results which may be briefly described in three categories. (We may pass over the isolated experience of Thiele, who in 1838 asserted that by keeping smallpox matter sealed between glass plates for ten days before using it, and by diluting it with milk when using it for inoculation, the matter thus treated through ten removes through the human body [the cow not intervening at all] was converted into something which gave results identical with those of ordinary vaccine matter. We are not aware of any attempt to corroborate this experiment.)

355. The first category includes the experiments in which the inoculation of smallpox matter into the udder or adjoining parts of the cow gave rise at or near the seat of inoculation to a vesicle, either identical in visible characters with the ordinary vaccine vesicle produced by inoculation with the matter of cow-pox, or to a vesicle the features of which, while not corresponding wholly with those of a perfect

[1] Note.—"Cow" is here and in the following pages used, for brevity's sake, for the species irrespective of age and sex.

vaccine vesicle, so closely resembled them as to justify the vesicle being called a vaccine vesicle. Further, the matter from a vesicle which at the first inoculation had not the characters of a perfect vaccine vesicle, when carried through a second or third remove in the cow, fully acquired those characters, and when transferred to man gave results indistinguishable from the ordinary vaccine vesicle. Indeed, lymph of such an origin has come into general use for vaccination purposes. Of the experiments, the best known or most quoted are those of Thiele (1838), Ceely (1840), Badcock (between 1840 and 1860), Voigt (1881), Haccius and Eternod (1890), King (1891), Simpson (1892), and Hime (1892);[1] but there are several others. The details of the experiment are very scanty in the cases of Thiele and Badcock, but more full in the others, especially, perhaps, those of Ceely and Haccius.

356. In the second category may be placed the experiments of Klein and Copeman.[2] Klein, who had in 1879 obtained in 31 trials what then appeared simply negative results, found in a renewed research in 1892 that the result of the first inoculation in the cow of smallpox matter was not a distinct vesicle, but merely a thickening and redness of the wound. Lymph pressed from the thickened wound produced, when inoculated into a second cow, a like result, but rather more marked; the thickening and reddening still further increased with a third and a fourth cow. Lymph squeezed from the wounds of the fourth cow produced in a child typical vaccine, and crusts from the child produced typical vaccine in a cow. Copeman obtained somewhat similar results; the appearances increasing in three removes and approaching those of typical vaccine, but not reaching them.

357. The third category consists of the results obtained in an elaborate inquiry conducted by a Commission of the Society of Medical Sciences at Lyons, with Chauveau at its head. Those results, reported in 1865, were briefly as follows:

[1] 6, App. 661–86; Q. 24,023, *et seq.*

[2] Q. 26,940–27,061; 28,978–29,020, 29,037–42, 29,089–95.

Inoculation of the cow with smallpox matter in any one of the 30 animals used did not give rise to a vaccine vesicle. Nevertheless a definite result was obtained, in the form, however, not of a vesicle, but of a thickening and inflammation of the wound; when a puncture was employed this became a papule. Lymph squeezed from such a papule and inserted into a second animal gave rise to a like papule; and this, again, might be used for a third animal, but often failed; and the effect could in no case be carried on through more than three or four removes.

When the inoculation was repeated on an animal in which a previous inoculation had produced such a papule, no distinct papule was formed, and, moreover, lymph squeezed from the seat of inoculation produced no effect at all when used for the subsequent inoculation of another animal. This shows that the development of the papule was the result of the specific action of the virus. The same is shown by the fact that no such papule was produced when the smallpox matter was inserted into an animal which had previously had cow-pox naturally or artificially, as well as by the fact that when an attempt was made to vaccinate with vaccine matter of proved efficacy, an animal on which a papule had been so developed by inoculation with smallpox the vaccination failed, though the animal had never had natural cow-pox or had never been vaccinated. The specific nature of the lymph of the papule is further shown by the fact that such lymph when used on the human subject gave rise to veritable smallpox. It has been urged that in this case the virus producing the effect was simply the old virus used in the inoculation, producing the papule and still clinging to the wound. This is disproved by the experience that lymph *from a papule of the second remove* also gave rise in the human subject to veritable smallpox.

Thus Chauveau and his Commission found that smallpox implanted in the cow gave rise to a specific effect which was not cow-pox, but was of the nature of smallpox, though its manifestations in the cow were different from those of smallpox in man. They also obtained similar results in attempting to transfer smallpox to the horse.

358. It must be admitted that the results finally obtained in some of the successful cases were indistinguishable from those of vaccination; the characters of the local vesicle, the absence of eruptive pustules and of contagiousness, show that the lymph thus apparently originating from smallpox in the hands of Ceely, Badcock, and others was vaccine lymph. It has been urged that a vaccine vesicle making its appearance in the wound of inoculation with smallpox was due to the accidental introduction of cow-pox matter into the wound: the smallpox matter in the wound produced no effect, and the cow-pox matter its usual effect. Several considerations support this view. The cow is peculiarly susceptible to cow-pox. In some cases (Ceely, Voigt) the animal was vaccinated as well as inoculated with smallpox; thus in Ceely's first case the animal was inoculated with smallpox on one side of the body, and a few days after vaccinated on the other side. In many cases the experiments were conducted in an animal vaccine establishment, the stalls, the operating tables, and the assistants being those used or engaged in vaccination. It is true that in some cases at least special precautions, sterilisation of instruments, and the like, were taken to avoid the accidental introduction of cow-pox; but in observations of this kind the difficulties of avoiding all such sources of error are notorious. Still the successful cases are now so numerous that it is difficult to resist the conclusion that the same accident could not have occurred in all, and that a transformation of smallpox into cow-pox—that is to say, into the artificially inoculated cow-pox which we call vaccine—really took place.

359. Accepting this view provisionally, it may be remarked that in most cases the transformation was sudden and complete; the smallpox virus, under the influence of the tissues of the cow, became immediately converted into vaccine virus, and this produced a typical vaccine vesicle. In some cases, *ex. gr.* that of Hime, the transformed virus produced its effect not in the wound of inoculation, or not chiefly so, but at some little distance from it. In some cases the characters of the vesicle first formed, though sufficiently distinct to justify the vesicle being called a vaccine vesicle, were not

those of a perfect vaccine vesicle, but the lymph from such a vesicle, at least after one or two removes, gave rise to most typical vaccine vesicles.

In Klein's experiments the transformation was gradual. In his fourth cow the virus was as yet not typical vaccine, since it did not produce a typical vesicle ; yet it was so far already vaccine that, transferred to the child, it produced typical vaccine (unless we suppose some accidental introduction of vaccine to have taken place). That the vesicle on the child was vaccine, and not smallpox unaccompanied by eruptive pustules, was shown not only by its characters, but also by the fact that lymph from it produced typical vaccine in the cow.

In Chauveau's experiments no transformation at all took place.

As has been urged in another place (discussion on Woodville's cases, pages 145—153), there are no adequate reasons leading us to believe that in the human subject the smallpox virus and the cow-pox virus can so act on each other as to form a hybrid disease. But this does not preclude the view that, accepting the conclusion that the body of the cow has the power to convert smallpox into vaccine, the virus may exist for a while in a phase in which, while ceasing to be typical smallpox, it has not yet fully acquired the characters of vaccine, and we may regard Klein's results as illustrating this. In some of the experiments—for instance, those of Ceely and Voigt—the results obtained with the lymph of the vesicle produced by the inoculation of smallpox give rise to the suspicion that the lymph had smallpox qualities, as seen, for example, in the case of Ceely's assistant, Taylor ; but the facts cannot be said to be more than suspicious, they are not decisive. Moreover, admitting that the vesicle itself in such cases was the result of the transformed virus, some not transformed old virus might still remain dormant in the wound, and might be present in the lymph of the vesicle, mixed with the transformed and generating virus ; this old virus might have happened to be in excess on the point of the lancet which wounded Taylor.

360. Taking all the various facts into consideration, we

seem led to the provisional conclusion that under certain conditions the tissues of the cow are able to transform smallpox into vaccine, that these conditions may be such as to lead to the transformation being sudden and complete, that under certain other conditions the transformation may be gradual and incomplete, and that under certain other conditions, and these seem most commonly to obtain, the transformation into vaccine does not take place at all. But what the above conditions are has not as yet been clearly made out. It has been suggested that one condition favourable to the transformation is extreme youth of the subject; to effect the change the animal used should be a calf of not more than 3 or 4 months old, but this is not definitely proved.

Until these favourable conditions have been clearly recognised, so that, the conditions being fulfilled, the transformation will always be secured, the conclusion cannot be regarded as indisputable. Moreover it must be borne in mind that effects more or less closely resembling a vaccine vesicle have been at various times obtained by various observers through inoculating man or the cow or another animal with material other than that obtained from the pustules of the smallpox of man. Much discussion has taken place concerning the "grease" of the horse, which Jenner believed to be the origin of the cow-pox of the cow. Without entering into any discussion of the matter, it may be said that investigation has shown that horses do suffer from a malady which, transferred to the cow, gives rise to a vaccine identical apparently with that produced by the inoculation of the natural cow-pox. Hence this malady is spoken of as the "horse-pox," and some cases at least of so-called "grease" appear to be cases of this horse-pox. But it is at least not proved that all the cases of "grease" which by inoculation were found to give rise to vaccine vesicles in man, were cases of true horse-pox. And this at least must be said, that no investigations as complete and varied as those which have been carried out with regard to the development of vaccine vesicles through the inoculation of smallpox matter, have been carried out with regard to the alleged development of vaccine vesicles by the inoculation

of other material, such as the matter from the eruption of the sheep-pox, the cattle plague, and the like. Nor have there been like extended inquiries as to the production of vesicles resembling those of vaccine by the inoculation of smallpox matter into animals other than the cow or the horse; such results as have been obtained by observers are conflicting. There is still room for much inquiry; meanwhile it may be said that, in any case, the evidence in favour of a possible transformation of smallpox into vaccine is sufficiently strong to remove the force of the theoretical objection to the power of vaccination to secure immunity towards smallpox, on the ground that the two diseases are absolutely distinct.

361. It may be well to advert to the fact that the protective effect, in relation to smallpox, of the much milder disease of cow-pox, is not an isolated phenomenon. It has been illustrated of late years in the investigations of Pasteur and others, showing in other communicable diseases of animals the means of so mitigating the virus, whether by transmission from one species to another, or by various methods of cultivating or attenuating it, that a very slight disease produced by the milder form is yet protective against the more severe.

362. It appears to us that we may dismiss for practical purposes the theoretical questions which were discussed before us so fully. If the fact be established that the introduction of vaccine matter and the consequent vaccinia produce some effect upon the human body which renders it less susceptible to smallpox, or which modifies that disease when the smallpox virus enters the system, it will not be a strange or unwonted experience that we should be unable to explain how this comes about. Science has not yet succeeded in freeing therapeutics or kindred subjects from obscurity, or in solving all the problems which they present. The precise *modus operandi* by which a previous attack of a disease furnishes security against a subsequent attack by the same disease, has not yet been elucidated. There can be no cause for astonishment, then, if we are unable to trace the

steps by which vaccination exerts a protective influence, supposing the fact that it does so be established, nor is it essential that we should succeed in tracing them. Our inability to accomplish this does not seem to us to be the slightest reason for regarding with doubt the conclusions to which the facts lead us.

363. Professor Crookshank, than whom no one has more strongly insisted on the theoretical arguments against the protective influence of vaccination in relation to smallpox, gives it as his opinion that vaccination creates a transient antagonism to that disease. We understand his view to be that an attack of disease can only afford protection against the same disease, and that smallpox and cow-pox are not the same but different diseases. We gather, however, that in his opinion so long as the state of antagonism lasts, the person in whose system it exists is less likely to suffer from smallpox than he would be if the state of antagonism were wanting. This seems to us to amount in effect to the same thing as saying that during that period vaccination has conferred some protection. Whether the effect be to create antagonism or to confer protection, and whatever difference there be between the *modus operandi* in the one case and in the other, we know equally little about it. If a condition of transient antagonism to smallpox is induced by vaccination, theoretical considerations will not afford a guide of the slightest value to the conclusion how long this transient antagonism will last, or how soon it will pass away. Experience, and experience alone, can answer that question. *A priori* we do not see that there is any better reason for supposing that it would last for two or three years than that its duration would extend to 10 years.

364. If an impartial study of the facts led to the conclusion that smallpox treats the vaccinated and unvaccinated alike, this would throw, no doubt, an interesting light on the theories which have been advanced. If it leads to the contrary conclusion, then any theory inconsistent with it, especially any theory based upon hypotheses drawn from those

obscure regions which science has not yet completely illuminated, may safely and wisely be disregarded.

365. We proceed, then, to sum up the evidence bearing upon the question whether vaccination has any, and if so what, protective influence in relation to smallpox, and to state the conclusions at which we have arrived.

366. We find that the period which immediately followed the introduction of the practice of vaccination was characterised in all countries in which the practice prevailed by a marked though irregular diminution of smallpox mortality, and that this diminution of mortality, when compared with the century preceding vaccination, has continued in those countries down to the present time. We think this statement of the case is accurate, notwithstanding that the present century has witnessed epidemics of considerable severity even in countries where vaccination has largely prevailed. There has always been in those countries a class, more or less numerous, of unvaccinated persons who would, of course, be no less subject to the disease than if their neighbours, like themselves, had remained unvaccinated. Moreover, if it be true that experience has taught that the protective effect of vaccination diminishes in force, or for some purposes may even disappear, after the lapse of, say, ten years from the date of the operation, there will be many of the vaccinated class liable to be attacked, and to suffer more or less from the disease, even conceding the protective effect of vaccination. We cannot think, therefore, that the fact that epidemics have from time to time occurred, and that deaths from smallpox continue, ought reasonably to be accepted as a proof that smallpox is uninfluenced by vaccination. In referring to the experience of the period which followed the introduction of vaccination, we are of course speaking generally. We have already considered the extent to which causes other than vaccination may have contributed to the diminished mortality from smallpox.

367. We observe next that there has been in the United Kingdom a remarkable change in the age-incidence of small-

pox. The change does not appear to have been confined to this country, but we limit our remarks to it because we have not as precise information on the point in the case of other countries. This change in the age-incidence appears, on the whole, to have become increasingly marked as the infantile population came to be more completely vaccinated. On the other hand, we have seen that where vaccination has been neglected or practically abandoned, a smallpox epidemic has been characterised by a very large mortality among children when compared with the mortality exhibited in a well-vaccinated place visited by an epidemic of the same disease. This affords support to the view that vaccination is of protective value against a fatal result in the case of persons attacked by smallpox, and that its protective power is greatest during the early years after vaccination has been performed. We are unable to see that any satisfactory explanation has been given of the phenomenon now under consideration except that just indicated. We are indeed quite unable to appreciate the bearing of some of the circumstances which have been put forward as explaining it. As to others, such as improved sanitation, we have already pointed out that they do not really afford any explanation of the phenomenon when viewed, as it must be, in connection with the age-incidence and mortality found to prevail in the case of other diseases.

368. There is further strong evidence that where attacks of smallpox occur the fatality is far less in the case of the vaccinated than of the unvaccinated, and that this difference is much more marked in the first ten years of life than at a later period. We have given full effect to all the considerations which have been urged with the view of showing that the division into vaccinated and unvaccinated cannot be relied on as accurate. We quite admit that absolute accuracy may not have been obtained in any of the instances in which this discrimination has taken place, but looking at the matter fairly as a whole, we cannot but believe that the division may for all practical purposes be regarded as substantially accurate. Indeed, for the most part, it would seem to err, if at all, in representing the vaccinated class as

comparing less favourably than it really ought with the unvaccinated, for all cases of doubtful or alleged vaccination have been included in the vaccinated class, and whatever errors there may have been in erroneously placing vaccinated cases in the unvaccinated class, we think that they are counterbalanced by errors in the opposite direction. We think the improbability extreme, indeed it seems to us to reach the point of incredibility, that the fatality in classes of persons discriminated on different occasions by so many different observers, only on the ground that vaccination was believed to be present in the one and absent in the other, should always show so very wide a divergence, unless there were some real difference in the liability to a fatal attack of those included in the one class as compared with those comprised in the other.

We can see nothing to differentiate them in this respect save that the one class possessed, while the other did not, the protection of vaccination, unless it be the circumstance suggested that the unvaccinated were drawn from a more neglected, and therefore from a less robust, portion of the population. We have already given our reasons for thinking this explanation quite insufficient to account for the phenomenon.

369. We notice further that the same classes of vaccinated and unvaccinated persons, which display when attacked by smallpox so marked a contrast in the fatality of the disease manifest a contrast no less marked in the type of the disease from which they suffer, viewed in relation to its severity or mildness. Here again, unless vaccination be regarded as the determining cause of the difference, it would remain to us, after considering all the explanations which have been vouchsafed, an unsolved mystery.

370. The next point forced on our attention is the greater liability to attack which the evidence shows to exist in the case of the unvaccinated than of the vaccinated. We are of course again confronted by the possibility of error in the classification, but the same test was applied in dividing into the two classes those who inhabited the invaded houses as

in making a similar division in the case of the individuals attacked. It is possible, too, that the inhabitants of the invaded houses included in the two classes were not all equally within the reach of contagion, but any error in this respect is just as likely to have affected the vaccinated as the unvaccinated class. When the numbers dealt with are considered, and it is remembered that the classification was made in different towns and always with the same result, we do not think this source of possible error can be regarded as serious.

371. When we find again that, both as regards the type of the disease and the attack-rate, the contrast is specially noticeable in those under ten years of age, and that the explanations proposed are even less deserving of weight when applied to these phenomena than when regarded as a reason for the difference in the fatality of the disease in the two classes, the conclusion that vaccination exercises an influence in relation to smallpox, specially potent during the early years after the operation, to which, as we have already indicated, other considerations point, receives strong confirmation.

372. We see no reason for hesitating to adopt the conclusions to which we should otherwise be led, or to doubt the accuracy of the facts to which we have been adverting, on account of the objection, even if it be well founded in fact, that the fatality among the unvaccinated at the present day exceeds that experienced before the era of vaccination. We have already pointed out that in the statistics of modern times, with which we have been dealing, the fatality among the unvaccinated varied greatly, and it is by no means established that there were not as great variations in the pre-vaccination days.

373. It has been suggested that a comparison in the case of certain towns for the years 1892–93, of the attack-rate and mortality from smallpox, with the average annual default of vaccination for the previous ten years, shows that there is no connection between the amount of vaccination

and the attack-rate of or mortality from smallpox. It is a sufficient comment upon this to point out that Gloucester stands very high in that comparison as a place where there had been much default of vaccination and very little small-pox.

374. We have still to notice two other groups of facts bearing upon the question. We have shown that there is evidence that where vaccination has been most thorough the protection appears to have been greatest. It may be that on this point the force of the evidence is less than on some of those just alluded to; nevertheless it cannot be left out of sight, or regarded as of no importance, when we are seeking an answer to the question whether vaccination has a protective influence, or is altogether ineffectual.

375. The fact that the re-vaccination of adults appears to place them in so favourable a condition, as compared with the unvaccinated—and that, too, even when they are subjected to specially grave risk of contagion, and we take this to be established as a fact—affords further confirmation of the conclusions suggested by the evidence which we have already passed under review.

376. We have hitherto, save for a cursory reference to the bearing of some of the facts upon one another, treated the various tests which have been applied to ascertain whether vaccination has a protective effect separately and independently. We have found that in each case the result of the test has been to suggest an affirmative answer to the question. In order to estimate the value of the evidence aright, it is necessary to consider in conjunction all the tests which have been adopted, and the results which they exhibit. They are, it is true, independent of one another, and have been separately applied in a number of cases. But the greater the number of tests employed, and the greater the number of cases to which they are applied, the more certain is it that the play of chance, or the influence of other causes, will be excluded, and the more safely may the conclusions to which they lead be acted upon. The cumulative force of a number

of independent pieces of evidence, all pointing in the same direction, is very great indeed. Even if a more or less plausible answer could be suggested in the case of each one of them standing alone, the cumulative force of the testimony might still be irresistible. We think those who have denied the efficacy of vaccination have often lost sight of the circumstance that investigations, which have followed so many different roads, have all led to the same end.

377. We have not disregarded the arguments adduced for the purpose of showing that a belief in vaccination is unsupported by a just view of the facts. We have endeavoured to give full weight to them. Having done so, it has appeared to us impossible to resist the conclusion that vaccination has a protective effect in relation to smallpox.

We think—

1. That it diminishes the liability to be attacked by the disease.

2. That it modifies the character of the disease, and renders it (*a*) less fatal, and (*b*) of a milder or less severe type.

3. That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years.

4. That after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and possibly never altogether ceases.

5. That its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that

its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable.

6. That re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the operation should be at intervals repeated.

7. That the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places, it is more effectual than when introduced into one or two places only; and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this.

(*B*) *As to the objections made to vaccination on the ground of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result.*

378. We proceed to address ourselves now to another subject submitted to us, viz. "the objections made to vaccination on the ground of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result."

379. This is obviously a matter of great importance. Not only has the utility of vaccination been denied, but it has been asserted that mischievous effects have been due to it, resulting in personal injury and in the loss of life. If the practice has been productive of substantial benefit in limiting the ravages of smallpox, and mitigating the severity of the

disease, the fact that vaccination may lead in certain cases to personal injury or death, would of course not be a conclusive argument against its use. Danger of personal injury, and even of death, attends many of the most common incidents of life, but experience has shown the risk to be so small that it is every day disregarded. A railway journey or a walk in the streets of any large town certainly involves such risks, but they are not deemed serious enough to induce anyone to refrain from that mode of travelling or from frequenting the public streets. And to come within the region of therapeutics, it cannot be denied that a risk attaches in every case where chloroform is administered; it is nevertheless constantly resorted to, where the only object is to escape temporary pain. The admission, therefore, that some risk attaches to the operation of vaccination, an admission which must without hesitation be made, does not necessarily afford an argument of any cogency against the practice, if its consequences be on the whole beneficial and important, the risk may be so small that it is reasonable to disregard it. Everything depends, then, upon the extent and character of the risk.

380. Those who have assailed vaccination on the ground of the evil consequences which are said to flow from it, have adopted two lines of attack. They have asserted that evidence of its mischievous influence is to be traced in an increase in the number of deaths from certain specified diseases, corresponding with a spread of the practice of vaccination, of which increase vaccination was, they alleged, really the cause. They have further insisted that evidence of the evil effects it produces is furnished by an examination of particular cases in which it has been found that injury or death has resulted from the operation.

381. We shall examine in the first place the contention that the records of mortality show an increase in the deaths from certain diseases during periods of extensive vaccination when compared with those when the practice was less in use, and that it may be fairly inferred, from this comparison, that vaccination was the cause of that increase.

382. It is to be observed that the diseases selected for such a comparison by the opponents of vaccination have not always been the same. In 1877 a return was obtained by an Order of the House of Commons, showing the deaths from 14 diseases at three periods, viz. 1847—1853, 1864—1867, 1868 to 1875; these periods having been regarded as distinguished from one another by a progressive advance in the number of vaccinated persons, especially children. The diseases were tabes mesenterica, diarrhœa, bronchitis, pyæmia, skin disease, syphilis, convulsions, cholera, diphtheria, pneumonia, atrophy and debility, whooping-cough, erysipelas, scrofula.

383. The first six of these diseases showed an increasing, the next four a decreasing, mortality, whilst the remaining four exhibited an irregular mortality, there being in three cases an increase in the second period and a decrease in the third, and in another case a decrease in the second, but a slight increase in the third, when, however, the mortality was not so high as in the first period. When all the diseases were taken together, there appeared to be in the aggregate an increasing mortality. Some found in this circumstance evidence of the malign influence of vaccination. Such a conclusion is manifestly untenable. There was no more reason for attributing to vaccination the increase of mortality in the case of those diseases where the mortality had grown, than there was for asserting that to its beneficent influence was due the decrease of mortality in those cases in which the mortality had become less. The hypothesis that it caused the mortality in some instances to grow, and in other instances to decrease, and that it was responsible for the balance of increase shown on an aggregation of the two, does not merit serious attention. It is not as if all the diseases in the class showing an increasing mortality were such as could be deemed capable of being affected by vaccination, whilst those included in the class with a decreasing mortality were in a different category. Two of the diseases included in this latter class, viz. convulsions and pneumonia, have been regarded in particular cases, even on recent occasions, as having had their origin in vaccination.

384. Dr. Ogle,[1] in statistics drawn from the Reports of the Registrar-General for England and Wales, points out that the line of reasoning which had been considered by some sufficient to show that vaccination has produced in those who have been subjected to it, serious diseases, would equally serve to show that it has rendered them largely exempt from other diseases no less serious. He gives, as an example, the mortality from phthisis, pneumonia, convulsions, and from causes not ascertained or stated too vaguely for classification, and shows that, in each case, there has been a large decrease of mortality during the period from 1874 to 1891.[2] He does not, of course, suggest that vaccination has been the cause of this decrease, but he asks, and we think the question a pertinent one, why it should be credited with the increase of diseases which have increased, and not equally be credited with the decrease where the mortality has diminished.

385. We will refer now specifically to the principal diseases, an increase in the mortality from which is at the present day charged against vaccination. Before doing so it will be well to inquire whether infant mortality has shown an increase during the period into which we are inquiring. Vaccination is, in the vast majority of cases, coincident in point of time with this stage of life. If, then, it is the parent of other diseases, and has substantially augmented the number of deaths due to them, we should expect to see some effect produced on infant mortality as a whole, yet it is clear that the mortality of infants in the first year of life, as measured by the proportion of their deaths to births, has not increased at all during the times when infant vaccination has been increasing. The figures show that from 1838 to 1842 the annual infantile death-rate to one thousand births was 152;[3] from 1847 to 1850 it was 154; in the next decennium, 1851 to 1860, it was again 154;[1] in the next decennium, 1861 to 1870, it was 154 for the third time. From 1871 to 1880 it fell to 149, and from 1881 to 1890 it further fell to 142.

[1] Q. 27,187.
[2] 6, App. 646.
[3] 6, App. 645.

386. Turning now to specific diseases, we will begin with syphilis. We shall confine ourselves for the present as regards this and other diseases exclusively to the question whether there is evidence that according as vaccination has more extensively prevailed the mortality from them has been greater, and whether where such an increase is established there is evidence to justify its being attributed to vaccination.

387. It is the fact that deaths from syphilis have increased in the last twenty years among infants under one year of age. But the records of the mortality from the disease show that it is most largely fatal in the first three months of life. Such statistics as we have on the point indicate, too, that in England and Wales the increase has been greatest in that portion of the first year of life which would be practically unaffected by vaccination. There is certainly not the slightest sign of a cause operating, in the later portion of that age period, to increase the mortality from syphilis, which is absent in the first three months of it.

It may, indeed, be suggested that as three months is the age of compulsory vaccination in England and Wales, that age period rather than a later one would exhibit the effect of syphilis resulting from vaccination. There is, however, no doubt that the number of vaccinations taking place much before the age of three months is small; and if syphilis or any other disease supervened upon it, there would be an interval between the vaccination and the death caused by that disease. The matter is, we think, put beyond doubt by an examination of the particulars of the 205 cases in which deaths occurring between the 1st November, 1888, and the 30th November, 1891, were attributed to, or said to be connected with, vaccination, and which were investigated by the Local Government Board.[1] In the case of 158 of these deaths the age exceeded three months, in the majority it was over four months. Only 20 were recorded as below the age of three months. In the remaining cases the age was not stated.

[1] App. IX.

388. When we apply ourselves to the case of Scotland the supposed influence of vaccination in generating syphilis has to be tested in a somewhat different manner. The age of compulsory vaccination is there six months instead of three, so that a comparison has to be made between the mortality from syphilis in the first half and in the second half of the first year of life. There is nothing in such a comparison to lead to the belief that vaccination has increased the prevalence of syphilis. Taking the period of 1855–1863, immediately preceding that of compulsory vaccination, the proportion of deaths from syphilis in every 1000 deaths in Scotland from that disease was at the age 0–6 months, 575.[1] In the period 1864–1875 the corresponding proportion was 612, and in the period 1875–1887 it was 647. In the same periods the similar proportions of deaths at the age 6–12 months were 109, 118, and 109 respectively. It will be seen that while the proportion of deaths at the age 0–6 months had considerably increased between the periods 1853–1863 and 1876–1887 the proportion at the age 6–12 months had remained stationary. The proportionate increase in the number of deaths between the two periods was also greater in the case of the former than in the case of the latter age period.

The observation we have just made with regard to England, that deaths due to an illness produced by and supervening on vaccination would chiefly show themselves in the age period succeeding the time fixed for compulsory vaccination, applies equally to Scotland.

389. A statistical statement[2] which has been placed before us shows that the number of deaths of infants from syphilis in Ireland has largely diminished during recent years. During the two years 1864 and 1865 it averaged 124, while during the two years 1887 and 1888 (the last for which we have the particulars) the average was only 40. Without suggesting any explanation of this remarkable reduction, it certainly affords strong proof that in Ireland vaccination has not been influential in increasing the prevalence of the disease in question.

[1] 6, App. 641. [2] 2, App. 275.

390. Further evidence on the same point, of great importance, is afforded by a consideration of the statistics showing the deaths from syphilis under one year of age per million births in Leicester on the one hand and in England and Wales on the other. The Registrar-General has supplied us with the means of comparing the deaths in the period 1863—1867 with those in the period 1883—1887.[1] We have already seen that the latter years were marked by a great decrease in the practice of vaccination amounting at last to a practical disuse of it. If vaccination were, to any serious extent, a cause of syphilis we should have expected to see some evidence of it in these comparative records of the mortality of infants under one year of age. Yet we find that whereas in England and Wales there was as between the former period and the latter an increase in the infant mortality from syphilis in England and Wales of 24·7 per cent. only, the increase between the same periods in Leicester was no less than 69·3 per cent. This does not, of course, imply any connection between the disuse of vaccination and the increase of infantile syphilis. It does, however, conclusively rebut the argument of those who seek to connect the increase of mortality from syphilis with the practice of vaccination.

It has been observed that the comparison is made between Leicester, which is an urban population, and the whole of England and Wales, which would comprise a large rural population. This is no doubt true, but it is true for both periods alike. It does not appear to us materially to vitiate the comparison for the purpose of disproving the allegation that the great increase of syphilis during the last twenty years is due to vaccination.

Even if it can be shown that in some instances syphilis has been inoculated by vaccination, the conclusion would still remain that this cannot have been so to any substantial extent.

391. We take next, cancer. There can be no doubt that the mortality from cancer shown by the registered causes of deaths has considerably increased in recent years. This

[1] 6, App. 646.

disease is, it must be remembered, one to which persons of advanced years are specially subject. The young are seldom its victims. And the increase of mortality from it has, for the most part, affected adults and principally old people. There has been an actual decrease in the mortality from the disease of those under five years of age. In the second and third quinquenniads of life there has also been a decrease—it is only in later age periods that the mortality begins to rise, and the rise becomes more and more pronounced as the age increases. The increase is, therefore, greatest in the age period furthest removed from the time of vaccination, whilst in the age period nearest to it there is an actual decrease. This of itself would seem enough to acquit vaccination of the charge of having caused an increased mortality from cancer, even if the origin of that increase remained in complete obscurity. This, however, is not the case. The Registrar-General points out that there can be very little doubt that the increase is to a considerable extent apparent only, and is simply due to improved diagnosis, and more careful statement of the cause of death on the part of medical men. He calls attention in connection with this to the fact, that year by year the number of deaths ascribed to tumours, abdominal disease, or other similar imperfectly stated causes, has been undergoing diminution. This explanation of the increase of mortality shown by the registered causes of deaths receives support from the fact that the increase of mortality from cancer has been much greater among males than females, the rate for males having risen 62 per cent. in 20 years, while the rate for females rose only 43 per cent. As the Registrar-General observes: "The cancerous affections of males are in much larger proportion internal, or inaccessible, than are those of females, and consequently are more difficult of recognition, so that any improvement in medical diagnosis would add more to the male than the female reckoning." It may be that, in addition to the apparent increase, there has been some real increase in the mortality from cancer, but there is not a shadow of evidence to connect this with the practice of vaccination, whilst there is, as we have shown, evidence pointing the other way.

392. It is clear that whatever diminishes mortality in early periods, and favours the survival to middle age and beyond it, must necessarily tend to increase both the actual and relative mortality from any disease, such as cancer, which is a disease almost exclusively of middle and senile periods of life. It was to be expected, therefore, that vaccination, in conjunction with improved isolation methods and other precautions, having reduced the deaths from small-pox in the earlier periods of life, and the general mortality being less, there would be some increase in the number of deaths from cancer.

393. Next in order let us consider the case of erysipelas.[1] This is a disease largely affecting children, and, as Dr. Ogle showed in his evidence, chiefly in the first three months of life, *i. e.* before the time when, as a rule, a disease supervening on vaccination would end in death. The annual death-rates of infants from this disease, taken over a long series of years, per million living at each age period was, under three months, 1905; aged three months but under six months, 774; six months but under one year, 268.[2] He also drew attention to the fact that the mortality from erysipelas rose and fell in correspondence with the mortality from puerperal fever, which suggested an explanation of some part at least of the large mortality under the age of three months.[3]

394. The last parliamentary returns, obtained with a view of ascertaining the relation of vaccination to certain diseases, do not afford any evidence of an increase in the mortality from erysipelas. They show on the whole a diminishing mortality from that disease among the infant population.

An examination of the percentage during the first and second six months of life of the total mortality from erysipelas during the years 1855 to 1863, as compared with the years 1864 to 1887, has been obtained from the Registrar-General for Scotland.[4] In that part of the United Kingdom vaccination seldom takes place much before the age of six

[1] Q. 27,210–27.
[2] 6, App. 647.
[3] Q. 27,222.
[4] 6, App. 641.

months. The period first selected is that preceding the Act making vaccination compulsory in Scotland. An examination of this return certainly does not lend any countenance to the view that vaccination exercises a serious influence on the mortality from erysipelas. In the earlier period the percentage of deaths within the first six months to the total deaths was 28·36; in the second period it was 28·88. In the earlier period the similar percentage relating to the second six months of life was 5·02; in the later period it was 5·35. The changes, it will be seen, are very slight. There is certainly nothing to show that a new cause for gravely increased mortality had come into existence during the later period. It is worth turning again to the Leicester statistics.[1] Comparing the years 1883 to 1887 with the years 1863 to 1867 we find that whereas in England and Wales there had been a decrease in the 20 years of 16·7 per cent. in the infant mortality from erysipelas, there had been at Leicester an increase of 41·5 per cent. As before observed, the comparison is made between Leicester and the whole of England and Wales, but this does not appear to us materially to vitiate the comparison for the purpose of disproving the allegation that there has been a substantial increase in mortality from erysipelas due to vaccination.

395. It may well be that in some cases vaccinated children have suffered fatally from erysipelas who, but for the operation of vaccination, would not have been attacked by the disease. This is a point we shall have to consider presently. But the evidence is, in our opinion, conclusive to show that there has not been during the last 40 years any material increase of deaths from erysipelas owing to vaccination.

396. Passing on to tabes mesenterica and scrofula, we find that the mortality from these diseases, as returned to the Registrar-General, shows an increase during the last 40 years. On the other hand, the mortality from allied diseases, such as hydrocephalus and phthisis, shows a decrease. Some part, and it is impossible to say how much, of this increased mortality in the case of the two first-named diseases, and of the

[1] 6, App. 646.

decrease in the two last named, is apparent only and not real, and results no doubt from better diagnosis leading to a transfer of cases from one class to another. On this point again it is useful to resort to the experience of Leicester. The increase of deaths under one year from tabes mesenterica and scrofula per million births in Leicester during the years 1883–87, as compared with the years 1863–67, was 25·8 per cent.[1] A similar comparison for England and Wales shows a percentage of 26·8.

We do not find any facts to warrant the assertion that the increased mortality from tabes mesenterica and scrofula, or any part of it, was due to vaccination.

397. Without encumbering our report with the details relating to pyæmia, bronchitis, diarrhœa, and skin diseases, which are all said to have increased owing to the mischievous influence of vaccination, we may confidently say that there is no evidence to justify the statement. It is, however, worth while pointing out that comparing, as before, the period of 1883–87 with the period of 1863–67, the increase of deaths under one year of age from diarrhœa and dysentery in Leicester was 4·2 per cent.,[1] whereas in England and Wales it was 0·5 per cent. A similar comparison in respect of bronchitis shows the increase in Leicester to be 112·8 per cent., in England and Wales 73·3 per cent. It seems clear that as regards general infantile mortality Leicester has not gained by its avoidance of vaccination. Whilst in England and Wales the mortality of children under one year of age had between the periods selected for comparison decreased 7·5 per cent., in Leicester the decrease was only 2·8 per cent.

398. Upon the whole, then, we think that the evidence is overwhelming to show that, in the case of some of the diseases referred to, vaccination cannot have produced any effect upon the mortality from them, and that it has not in the case of any one of them increased the mortality to a substantial, we might even say an appreciable, extent.

[1] 6, App. 646.

399. When we pass to a consideration of the evidence that personal injury or death has resulted from vaccination, the questions which present themselves do not admit of the same simple solution as those with which we have just been dealing. The cause of death, or the nature of an illness, is sometimes obscure, and even if its nature be known, it may be difficult to ascertain with certainty what has been its origin. We shall have to make further reference presently to the difficulties which must needs be encountered in the investigation upon which we are engaged. As we have already stated, it is not open to doubt that there have been cases in which injury and death have resulted from vaccination.

400. In the years 1859–67 the deaths returned as due to erysipelas after vaccination varied from 2 to 13, the annual average being 6·8. From 1868–71 inclusive they varied from 9 to 24; the annual average being 18·0. From 1859–71 the population of England and Wales had increased from 19 to 22 millions. In addition to this there can be no doubt that the number of children vaccinated increased very much between 1868 and 1871, as compared with the previous period, owing to the legislation of 1867. Of course the greater the number of the vaccinated amongst the children born in any given period, the greater, *cæteris paribus*, would be the number of cases of erysipelas after vaccination, without any necessary connection between the two. The same remark applies to the period between 1872 and 1880, when the cases returned as erysipelas after vaccination varied from 16 to 39, the annual average being 28·5. The Act of 1871 undoubtedly increased largely the number of infantile vaccinations in this period as compared with that which preceded it. In subsequent years erysipelas after vaccination was not separately recorded, being included under the heading "cow-pox and other effects of vaccination." There were 283 such cases in the years 1881–85.

401. During the years 1886 to 1891 the cause of death was in 279 cases certified as connected with vaccination. Many of these cases were the subject of special inquiry by the

Local Government Board. We have had before us a summary of the reports [1] made to the Board of the result of such inquiries, prepared for us by Dr. Acland and Dr. Coupland. The reports referred to cover the period from the 1st of November, 1888, to the 30th of November, 1891. We have ourselves, in many instances instituted independent inquiry.

402. The cases in which the death has been certified as connected with vaccination cannot all be regarded as cases in which there was the link of causation between them. Indeed, the medical men whose certificates associated the two did not always intend to indicate that the disease which ended in death had its origin in vaccination. There have, no doubt, been other cases in which, although the illness which ended fatally was engendered by vaccination, there has been no mention of it in the certificate of death. Whether these are sufficient in number to counterbalance, or more than counterbalance those in the other category, the evidence does not enable us to say.

403. Taking for the moment the 279 deaths during the years 1886 to 1891, certified as connected with vaccination,[2] to have been really so connected, how does this figure compare with the number of vaccinations effected during the same period? The number of primary vaccinations during the years 1890 and 1891 were not put before us by Dr. Ogle, they had not then been published. He stated, however, that in the years 1881 to 1889, inclusive, the number of deaths certified as connected with vaccination was 476. During those same years there were 6,739,902 primary vaccinations showing the proportion of one death to 14,159 primary vaccinations. There is no doubt that for the years 1886–91 it was not substantially different. For the reasons stated in the preceding paragraph it is not possible to fix with absolute certainty the number of deaths connected with vaccination.

404. In the case of Scotland[3] during the years 1883 to

[1] App. IX.
[2] 6, App. 647.
[3] 6, App. 631.

1890 inclusive, the deaths registered from cow-pox and other effects of vaccination were 22. During the same years the number of persons successfully vaccinated was 855,185. This shows the number of cases in which the death was stated to have been due to vaccination to be one to every 38,872. It is not easy to say what is the cause of the difference in this respect between England and Scotland. It may be that it is the practice in the latter country to require more evidence of the connection between the death and vaccination before associating the two in the certificate, though it does not seem likely that this can be the explanation of the whole of the difference. It is worth noting that the proportion of deaths to vaccinated cases is much the smaller in the country where vaccination is postponed to a period three months later. The only other known distinctions between the two countries is that in Scotland only a minority of the cases are vaccinated by a public vaccinator, and that almost all the children are vaccinated at their own homes.

405. Since the 1st of June, 1889, we have, from time to time, been informed from various sources of cases in which death or non-fatal injury has been alleged or suggested to have been caused by, or otherwise connected with vaccination with a view to their investigation, and since the 14th of February, 1891, the Local Government Board have immediately informed us of all such cases brought to their notice. In March, 1892, the Home Office addressed a circular letter to coroners throughout England and Wales, requesting that in all cases where they received information that the death of any person, on whose body they proposed to hold an inquest, had been alleged to have been caused by, or to have had any connection with, vaccination they would communicate immediately with the Commission.

406. From all sources 421 cases in which death or non-fatal injury has been alleged or suggested to have been connected with vaccination, have been brought to our notice, from 1st June, 1889, to 1st July, 1896. These 421 cases, however, include 19 groups of connected cases, each of which has only been counted as one in arriving at that number. The

individual cases included in these groups amount to about 150. Some of these 421 cases were investigated and made the subject of reports by medical inspectors of the Local Government Board.[1] We received reports with reference to a large number of them from medical men appointed by ourselves. In a few cases the nature of the allegation or suggestion rendered it unnecessary in our opinion to make any inquiry into the case. In a considerable number we sought for further information, and after we had considered the further facts thus acquired there appeared to be no necessity for an investigation by the medical men who assisted us by personally inquiring into cases of alleged injury from vaccination.

407. We have not any means of ascertaining in what number of cases some other disease has supervened on vaccination as a consequence of it, without producing a fatal result. We are able, however, to form some judgment upon this point by observing the number of non-fatal cases to which our attention has been called. We do not mean to suggest that we have been informed of all cases of this nature which have occurred during the last six years. There have very likely been many cases which have not come to our knowledge, where the inflammation set up has been more than usual, and some where a slight attack of erysipelas has resulted. But when we consider that the fact that we were engaged upon this inquiry has been thoroughly well known, and that active organisations and zealous individuals were at work, searching out cases in which the results of vaccination had been abnormal, with a view to bring them under our notice, and that some of those which we were asked to investigate turned out to be of a trifling or unsubstantial nature, we think we are able to form a fairly accurate estimate of the amount of injury which can be plausibly attributed to vaccination. A consideration of all the circumstances has led us to the conclusion that, as regards the non-fatal cases with which we are now dealing, serious injury cannot have resulted in any considerable number of cases.

[1] App. IX.

408. An examination of the analysis of the fatal maladies connected with vaccination during the period 1886 to 1891,[1] made by Dr. Ogle, shows that erysipelas is credited with almost one-half of the total number of deaths. To these a considerable number is to be added, where inflamed arms occurred, but in which the disease did not receive the name of erysipelas, though it was probably allied to it. Next in number comes the class which includes pyæmia, septicæmia, and blood-poisoning. If this class be added to cases of erysipelas and maladies allied to it, they account altogether for two-thirds of the cases in which the cause of death has been connected with vaccination. An examination of the particulars of the cases of alleged deaths and injury from vaccination, to which our attention has been called during the last six years, shows that the death or injury has been attributed in the great majority of cases to one or other of these diseases, and chiefly to erysipelas.

409. It must not be forgotten that the introduction into the system of even a mild virus, however carefully performed, is necessarily attended by the production of local inflammation and of febrile illness. If these results did not in some measure follow, the practice would probably fail in its protective influence. As a rule, the inflammation and illness are of a trifling character; in exceptional cases, however, they may exhibit more severity, and, as certain facts submitted to us in evidence have shown, there are cases, though these are rare, where a general eruption may follow vaccination.

410. In order to determine how far the risk of erysipelas is a necessary incident of vaccination, what is the extent of that risk, and how it may best be avoided, it is necessary to consider the various circumstances which may occasion erysipelas and allied diseases in the case of vaccinated children. It is established that lymph contains organisms, and may contain those which under certain circumstances would be productive of erysipelas. It is, therefore, possible that some contagious material (the specific virus of erysipelas, for instance,) may be conveyed at the time of vaccination,

[1] 6, App. 647.

owing either to its presence in the lymph employed, or to its being conveyed by the vaccinator himself, or by those with whom the child comes in contact at the time of vaccination. We believe that the cases in which the virus is conveyed at the time of vaccination are rare. It has, however, in some instances been clearly established, the immediate occurrence of erysipelas in several co-vaccinees making it practically certain that some virus was conveyed at the time of the operation. In some instances where this has been the case, and there is every reason for believing that the contagion was conveyed through the medium of the lymph, it is, nevertheless, in evidence that the vaccinifer did not display anything more than a slightly inflamed arm. The scrupulous avoidance of inflamed arms in vaccinifers will do much to reduce the risk of conveying erysipelas, in the act of vaccination (a risk which, as we have seen, has been proved to be a very slight one), but it is possible it would not wholly remove it.

411. Where the contagious matter which produces erysipelas or blood-poisoning has not been conveyed at the time of vaccination the disease must have resulted, when it afterwards displays itself, from a subsequent introduction or development of the poison. It is not always easy to determine whether vaccination has been the cause of, or has contributed to, subsequent erysipelas or blood-poisoning. Erysipelas is a common disease in infancy, and not unfrequently leads to death. The evidence of Dr. Ogle[1] shows that nearly two thousand per million die of erysipelas during the first three months of life, and that the mortality rapidly declines as the age advances. Quite apart, then, from vaccination there is nothing remarkable in the occurrence of erysipelas in the case of an infant. The disease is obviously contracted in the majority of cases from some other source. Where a child has been in good health prior to vaccination and is seized with any malady after it, it is not unnatural that the two occurrences should be connected together as cause and effect by those who have not a wide experience of the liability to be attacked by the disease independently of vaccination.

[1] 6, App. 647.

It is a common fault too readily to connect together, as cause and effect, occurrences which follow one another in point of time. There can be no doubt that this tendency has sometimes been the reason why, without any real connection between the two, subsequent illness has been believed to have had its origin in vaccination. The apparent connection of the two may be a mere chance coincidence.

Illustrations of this have not been wanting. It has sometimes happened that circumstances have led to the vaccination being, on the day appointed for the operation, postponed to a later date. A troublesome skin disease has shortly afterwards manifested itself, which would certainly have been believed to have been caused by the vaccination if it had taken place at the appointed time.

412. In many of the cases which we have had to investigate, where vaccination has been followed by erysipelas, the disease has been present in the immediate vicinity, it cannot therefore be asserted with certainty that in such cases the child would have escaped erysipelas if it had not been vaccinated. Erysipelas may be acquired without any lesion. We do not intend to represent that the wound made in vaccination may not cause an attack of erysipelas where if there were no lesion there would be no such attack, but only to suggest that caution is necessary, and that it would be an error to refer all cases of erysipelas, or allied diseases, occurring after vaccination to that operation as their cause.

There can be no doubt that even very slight wounds may lead to erysipelas. It has been induced by scratches from pins, abrasions from the dress and other injuries, in themselves most trivial.

413. We propose to call attention to some of the features which have been observed in the cases we have investigated where erysipelas has ensued upon, and in all probability been connected with, the act of vaccination. We have already said that in some of these cases, erysipelas was prevailing in the neighbourhood, and sometimes even in the immediate vicinity of the vaccinated child. In a considerable number it was reported that the condition of the

premises in which the child was living was extremely insanitary. In some it was manifest that there had been a lack of care and attention on the part of the mother or other person in charge of the child. Not unfrequently the wound was in contact with and rubbed by articles of dress very likely to cause inflammation, and cream and other substances were applied to the wounds under circumstances which made the process a source of danger. There were instances in which persons in the habit of nursing a vaccinated child were suffering themselves at the time from running sores, which were very likely the source of contagion. In some cases, too, where the vaccinated vesicles had been opened on the eighth day, erysipelas manifested itself at a time which suggested that it had been acquired at a date subsequent to this opening of the vesicles. *A priori* this would appear to be a source of danger by rendering an attack of erysipelas more probable if the child came within the reach of contagion. The evidence, however, is not conclusive that erysipelas has, owing to this cause, appeared more often than it would have done if the vesicles had remained unopened. There is an opinion abroad that the taking away of lymph on the eighth day of itself causes some risk of inflammation of the arm. This, however, has not been confirmed by any evidence before us, and it is probable that it is almost wholly an imaginary danger.

414. We have dwelt upon features presented by the cases of erysipelas and various forms of septic disease which have followed vaccination, because they suggest precautions which may be adopted to lessen, if not to prevent, such evils in the future. If, for example, vaccination were performed at the patient's home instead of at a public vaccination place, the chance of disease being contracted at the time of vaccination would be to some extent diminished, and the same may be said of the inspection of the vaccinated person which takes place eight days after the operation. On these points we shall have some remarks and recommendations to make at a later stage of our report.

415. A study of the cases which have been made the

subject of careful examination and report points to the conclusion that an exercise of greater care would largely diminish the risk, already small, of erysipelas-contagion and blood-poisoning.

Although it may be confidently hoped that by additional care on the part both of vaccinators and parents, the number of inflamed arms and of cases of erysipelas may be reduced to very few, yet it is not to be expected that such occurrences will be wholly prevented. A vaccination wound is like one from any other cause, so long as it exists, a source of some risk.

416. The use of calf-lymph, though it may be supposed to be more free from the risk of conveying erysipelas, does not appear to prevent inflamed arms. Some witnesses have indeed supposed that it is attended with more risk of inflammation than the employment of that taken from the human subject. This opinion has not, however, been corroborated by some of those of widest experience.

417. The evidence given in reference to cases in which one or other of the maladies classed as scrofula has been supposed to have had its origin in vaccination, has usually been of a very vague and inconclusive character. Scrofula is a disease chiefly of childhood, and, being very common, there is nothing to cause surprise in the fact that occasionally children may show its presence in a manner likely to excite suspicion that it was due to vaccination. It may, indeed, easily be the fact that vaccination, in common with chicken-pox, measles, smallpox, and other specific fevers, does occasionally serve as an exciting cause of a scrofulous outbreak. It may, however, not unreasonably be suspected that in all such cases a latent predisposition was already present. The chain of causation is so complicated that it is impossible in isolated cases to arrive at any satisfactory conclusions. To attempt any analysis of the evidence on this subject comprised in Appendix IX, and the various Reports which we have already issued, would serve no useful purpose. It must be sufficient to say that after careful consideration of the whole evidence there appears

to be no reason whatever to believe that the practice of vaccination tends in any material degree to increase the prevalence of this class of disorders.

418. Precisely the same arguments as those just used are applicable to the chronic skin diseases, chiefly of the type of eczema, which are so often, by the public, attributed to vaccination. Of these numerous supposed instances have been brought before us and the medical men whose assistance we have had. It is to be freely admitted that vaccinia, like varicella, does occasionally cause an irritable condition of the skin which may last long, but it is exceedingly improbable that it is responsible for any substantial increase in the number of chronic skin diseases in children. No sufficient evidence whatever in support of such a conclusion has been brought before us.

Amongst the inconveniences connected with vaccination is the production of contagious forms of eruption, such as have been classed under the names of porrigo and impetigo contagiosa. These eruptions are not attended with any risk to life, nor by any permanent injury to health, and they are usually curable by simple measures. References to these eruptions have been made by many witnesses. Their occurrence has no doubt not unfrequently caused prejudice to the practice of vaccination.

419. As has been already stated, the occurrence of a febrile illness is the desired result of vaccination. To that illness the term vaccinia is applicable, and it may sometimes be attended by an eruption. It is in evidence that vaccinators in the early years after the introduction of the practice, were familiar, not only with severely inflamed arms, but with the frequent occurrence of general eruptions. Familiar as they were with the horrors of smallpox itself, they thought very lightly of events which in the present day would cause much complaint and excite opposition. The greater care now exercised in vaccination, and possibly, above all, the much diminished risk of variolation at the same time, have reduced to a very small number indeed the occurrences referred to. Still it has not been found possible wholly to

prevent them, and not only do vaccinators still meet occasionally with inflamed arms and erysipelas, but now and then a case occurs of severe eruption attended by fever, which may end in death. These cases occur exclusively in primary vaccinations and in young infants. They are so infrequent that no well-characterised examples have been brought under the notice of the medical men who have assisted us. A few which had occurred in former years have, however, been the subjects of evidence. These cases may be placed in two groups, one in which the vaccination sores proceed normally, but a general eruption, possibly gangrenous, occurs, and a second in which the pocks inflame, and are attended by satellites, and a more limited eruption, possibly due only to external contagion, is produced. Of the first, only a single example is to be found in the reports (Case 31 : not fatal) before us, but of the second there have been several. One of the most definite of these latter is the case ably and fully reported in the evidence of Dr. Fyson and Dr. Frederick Taylor.[1] In that instance a child previously in good health, and vaccinated with calf-lymph by means of a needle which had never been used before, died about six weeks afterwards with severely ulcerated arms, and ulcers in several parts of the body and limbs. No precaution had been neglected, and the event could only, as in other similar cases, be attributed to what is known as idiosyncrasy on the part of the child, a peculiarity of health attended by exceptional susceptibility to the specific virus of vaccinia.

Cases more or less closely parallel with this one are the Leeds case and one mentioned in the evidence given by Dr. W. G. Little.[2]

420. Nothing has produced so deep an impression hostile to vaccination as the apprehension that syphilis may be communicated by it. It was at one time doubted whether syphilis could result, and it was even confidently asserted that it could not. The fact that this was possible had been fully established, and was generally acknowledged by the medical profession before we commenced our inquiries. Our

[1] Q. 23,019–61 ; 23,062–83.

[2] Q. 20,894, *et seq.*

work has therefore chiefly been to ascertain the extent and character of the risk and the means of its prevention. As a general summary of the evidence on this matter, it may be stated that nothing in the least novel has been elicited, and that no hint has been given of the occurrence of any recent *series* of vaccination-syphilis cases in British practice.

421. In 1856, an extensive investigation undertaken by the Board of Health, under the direction of its Medical Adviser, resulted in the expression of an opinion that there was no proof that syphilis could be communicated in the practice of vaccination. Mr. Simon had issued circular letters of inquiry very widely, and although a few of his respondents had answered cautiously, none had been able to produce convincing facts, and a large majority had expressed entire incredulity. Amongst the latter were Sir Thomas Watson, Sir Charles Locock, Sir Benjamin Brodie, Mr. Acton, Mr. Marson, Mr. Ceely, and Sir William Jenner. Facts which were, not long after the issue of Mr. Simon's report, brought before the profession, and which were carefully investigated, made it certain that the negative conclusion which had been arrived at was a mistaken one, and from that time no doubt can have been entertained by any that it is possible to convey syphilis in the act of vaccination. In reference to the frequency of this, the report just referred to is still, however, of high importance. It is impossible to believe that an event concerning the possibility of which almost all the leaders of the profession were in 1856 incredulous can be otherwise than extremely rare.

422. Before proceeding to speak of the facts, or supposed facts, as to syphilis due to vaccination, which have been brought before the Commission, it is necessary to advert to the difficulties of the inquiry. The phenomena of syphilis may be closely approached by those of other disorders, and even when the nature of the malady is evident beyond doubt, there remain numerous sources of fallacy which have to be cleared away before the conclusion can be accepted that the disease has been caused by vaccination.

423. The very close resemblance in certain very rare cases of the results of vaccination, whether with calf-lymph or humanized lymph, to those attributed to syphilis (a resemblance so close that it has caused in a few cases a difference of opinion whether the disease was syphilis or vaccinia) has led to the expression by Dr. Creighton of the opinion that there is some essential relationship between the two diseases. This, however, is a point of speculative, almost it might be said of transcendental pathology, upon which for practical purposes it is useless to enter. It must be sufficient to remark that, whatever may be the relationship alluded to, it exists, if it exists at all, equally between smallpox and syphilis as between vaccination and syphilis. For all practical purposes variola and vaccinia are both wholly distinct from syphilis, and their differences are, with the rarest exceptions, easily recognised. They are alike in being attended by affections of the skin and mucous membranes, and exceptionally by disease of the bones, eyes, and other parts, but in all these it is a question of resemblance and not of identity with which we have to deal.

424. The knowledge of the sources of fallacy just alluded to has compelled the Commission to investigate with much caution the items of evidence which have been offered by the various witnesses whom it has examined. Some of these have manifested a tendency to recognise syphilis after vaccination upon very imperfect and insufficient data.

It is very desirable that every narrative of supposed infection with syphilis in the course of vaccination should be given in full detail. The dates should be accurately fixed, there should be an account of the vaccinifer and of those, if any, who were vaccinated at the same time. It is important, too, that the statements made should be based upon notes recorded at the time. Narratives which are defective on these points, although they must be taken for what they are worth, cannot ever be accepted as proven. When a witness admits that in so important a matter he took no care to ascertain such facts as those referred to, that his diagnosis was made without consultation with others, and that his statements rest only on his unassisted memory, it becomes

impossible to allow them much weight. Yet such is the character of much of the evidence which has been offered to the Commission on this question.

The cases mentioned by Mr. Ward, of Leeds, in the course of his evidence as recorded at page 218 of the Sixth Report, are the most serious ones as regards this matter which have been brought before the Commission. There can be no doubt that in the case observed by Mr. Ward himself, the disease was syphilis, and the chief defect in the narrative is as to proof that it was acquired in vaccination. No information was obtained as to the vaccinifer or the co-vaccinees, and the patient being an adult woman other modes of infection were obviously possible. At the same time it is right to add that the points of vaccination became indurated, and that Mr. Ward was convinced that it was a case of invaccinated syphilis. In the cases referred to by Mr. Ward as having occurred (in 1871) in the practice of Mr. Holmes of Leeds, inquiries subsequently instituted by the Commission have left no doubt that syphilis was conveyed to two (out of six) individuals by vaccination, one of whom died in 1886, it is believed, of syphilis. The vaccinifer was at the time the subject of latent taint, and this was revealed very shortly after the vaccination. These cases, it will be seen, occurred 25 years ago, and before the attention of the profession had been directed to this risk so prominently as has since been done.

425. Among the 279 deaths referred to vaccination as a cause during the period 1886—1891, five were attributed to syphilis. Except in cases where an inquest was held, these records are based simply on the certificate given by the medical attendant who certified the cause of death, but who had not necessarily attended the patient during the course of the illness which terminated fatally. Practically all the deaths referred to vaccination as a cause during the years 1889, 1890, and 1891, and some of those so referred during the last two months of the year 1888,[1] have been investigated and reported upon by Medical Inspectors of the Local Government Board.[2] It appears that all the five cases attri-

[1] App. IX. [2] Q. 27,254-62.

buted to syphilis after vaccination, during the longer period 1886—1891, were among the cases so reported upon. We have studied these reports, and we are satisfied that in none of the five [1] cases is there sufficient evidence to show that the death resulted from syphilis caused by vaccination. One of them was the Leeds case,[2] to which we shall refer immediately. As regards the others, with perhaps one exception,[3] there is abundant reason for believing that they were not cases of syphilis at all.

But besides these five deaths, there were amongst those alleged or suggested to have been connected with vaccination which were investigated and reported upon by Medical Inspectors of the Local Government Board, eight[4] cases in which in the course of the investigation some suspicion of syphilis was raised in connection with the illness which terminated fatally. In none of these eight cases, however, is there evidence of any value to show that syphilis was communicated by vaccination.

426. Two or three other isolated cases have been brought to our notice which witnesses believed to be examples of this occurrence, but in none of them were the facts such as in our opinion to justify us in concluding with any degree of confidence that the belief expressed had been sustained. On the other hand, a large amount of negative evidence has been offered. Witnesses who had been engaged through long series of years in the very extensive practice of vaccination, bore testimony to their never in their own sphere of observation having witnessed or heard of any case in which the suspicion of vaccination-syphilis had occurred.

At the same time it is not to be forgotten that a natural reluctance to register deaths as due to syphilis may have prevented some cases where recently vaccinated persons have died from that disease from being made public.

[1] *I. e.* Cases XLVI, XLVIII, XLIX, XC, and CXLVII of the Local Government Board series.

[2] Case XC.

[3] Case XLVI.

[4] *I. e.* Cases XLV, XLVII, LXXII, CXXVII, CXXIX, CLXXI, CLXXXI, and CXCVI.

427. Only a few items of the evidence produced before us appear to require special notice: among these, the most prominent is what has been known as the "Leeds case,"[1] upon which we have heard the evidence of Mr. Ward, Mr. Littlewood, and Dr. Barrs. The witnesses named regarded it as a case of syphilis, conveyed by vaccination, but all of them admitted that the course of events was most unusual. We have carefully investigated this case, and notwithstanding the opinion formed by the witnesses, there appears good reason to doubt whether it was one of syphilis.[2] The case was made the subject of careful inquiry by Dr. Barlow on our behalf, who shared the doubt we have expressed. The view taken by the Medical Inspector of the Local Government Board who in the first instance investigated the case was that it was a case of hereditary syphilis. It seems certain, however, that the parents of the child whose death was in question were not in any way affected with syphilis. The vaccinifer also appeared to be free from any taint of that disease, and its family history confirmed this view. The co-vaccinees from the same lymph also exhibited no trace of syphilis. These facts of themselves make out a strong case against that having been the nature of the disease. Coupled with the fact that it could not have been communicated by the vaccinator himself, they seem to render it practically impossible that syphilis was the cause of death. If the symptoms exhibited had in all respects corresponded with those which are known to characterise syphilis, the proper inference might have been that there was some error in ascertaining the facts of the case. But it is beyond question that the course of events was very different in some respects from that experienced in undoubted cases of syphilis, and we think the true conclusion is that it was not a case of that disease. It may probably be classed with a few others as examples of gangrene and blood-poisoning, the direct result of vaccination, which are not to be explained by supposing the introduction of any syphilitic or other poison. Fortunately, such cases are extremely rare, so much so that the witnesses concerned knew of no case precisely parallel.

[1] Q. 23,574–746; 23,747–858; 23,859–912.

[2] App. IX, reports on Case 1.

428. The evidence given by Dr. Robert Lee and Dr. Coutts,[1] the former, Physician of the Ormond Street Hospital for Children, and the latter, formerly a resident medical officer to the same institution, may be taken as relating to one and the same case. Both these witnesses testify to the abundant occurrence of the ordinary forms of congenital syphilis in the practice of that institution. Each of them mentions one single case in which it was believed that syphilis was communicated in vaccination, and that the vaccination sore became a chancre. Although it is not established in evidence that these witnesses were speaking of the same case, it is almost certain that they were, as Dr. Coutts expressly states that the child was Dr. Lee's patient. Neither of the witnesses knew more of the case than its earliest stages, and both were subjected to questions the answers to which left much doubt as to the correctness of the diagnosis. Whilst, however, syphilis cannot by any means be said to have been proved, the case must stand as one of reasonable suspicion, and Dr. Coutts's statement that another infant (not seen) vaccinated from the same source was said to have suffered in a similar way gives some support to Dr. Lee's opinion. It is of much importance to note that out of an experience of 30,000 children, at an institution beyond all others likely to attract cases of this kind, this was the only example of supposed transmission of syphilis in vaccination which Dr. Lee had ever known.

429. In considering those cases specially investigated by medical men on our behalf, we have as a rule the advantage of definite and adequate information. We have already mentioned that in the Leeds case,[2] upon which we heard evidence, we had the benefit of Dr. Barlow's assistance ; and we need not further discuss that case. Amongst the others investigated by medical men on our behalf were two[3] cases in which death was apparently certified as from vaccino-syphilis. The first[4] of these two deaths was registered, in

[1] Q. 30,238–560; 30,632–731.

[2] Case 1 of the Commission's series and Case XC of the Local Government Board's series.

[3] *I. e.* Cases 109 and 416 of the Commission's series.

[4] Case 109.

1892, as due to "vaccinia syphilitica : marasmus," but it subsequently appeared that the medical man who certified the death had not intended to state that it resulted from syphilis caused by vaccination. In explanation of his certificate, he said: " . . . . the meaning I intended to convey was 'vaccinia,' *i. e.* a general eruption over the body exactly like the vaccination pocks occurring in an infant the subject of congenital syphilis;" and a careful inquiry by Dr. Acland elicited overwhelming evidence in support of the view that the case was one of inherited syphilis. The second[1] of the two deaths was registered, in the present year, as due to "vaccination of syphilis." A thorough investigation showed that the case was certainly not one of syphilis caused by vaccination, and in all probability not one of syphilis at all.

Two[2] other cases, both fatal, were reported to us in which children whose vaccination had undoubtedly been followed by serious illness were believed to have been subjects of inherited syphilis. Both cases were very carefully investigated by Dr. Acland on our behalf. In neither of them is there any evidence that syphilis was communicated by vaccination. Probably both children were, as at first surmised, subjects of inherited syphilis.

Besides these deaths, there were amongst those alleged or suggested to have been connected with vaccination, which were investigated and reported upon by medical men on our behalf, ten[3] cases in which in the course of the investigation some suspicion of syphilis was raised in connection with the illness which terminated fatally. In none of these ten cases, however, is there evidence of any value to show that syphilis was communicated by vaccination; possibly five[4] of them were cases of inherited syphilis. The other five[5] were certainly not cases of syphilis at all.

Turning now to the *non-fatal* cases investigated by medical men on our behalf, we have had brought to our knowledge

[1] Case 416.

[2] *I. e.* Cases 207 and 326.

[3] *I. e.* Cases 52, 94, 113, 192, 195, 202, 215, 216, 309, and L. E. J. in Case 227 [series].

[4] Cases 195, 202, 215, 309, and L. E. J. in Case 227 [series].

[5] Cases 52, 94, 113, 192, and 216.

with a view to such investigation 26[1] non-fatal cases where syphilis was alleged to have been, or as to some few of the cases *possibly* to have been, communicated by vaccination. One[2] of these 26 cases could not be traced by the medica men whom we asked to investigate it. It had been reported to us, with 21 of the other 25 cases, by a gentleman whose only information as to the case, obtained from a relative of the child's, was that "the child had a frightful arm, and broke out badly everywhere, and was a very long time of getting better." The remaining 25 cases were, however, carefully investigated on our behalf, some by Dr. Barlow, some by Dr. Acland, and 15 of them by those gentlemen jointly. In 24 of the 25 there is no evidence that syphilis was communicated by vaccination; indeed, none of the 24 were cases of syphilis at all. In the remaining case[3] it appears that there was some ground for the allegation, though it is by no means proved that syphilis was communicated by vaccination, or even that the case was one of syphilis at all. The case, brought to our notice in 1892, was that of a boy born in 1880 and vaccinated in the following year. When examined on our behalf in September, 1892, he presented no unmistakable signs of having suffered from syphilis, either inoculated or inherited. The length of time which had elapsed, and the absence of any record, made it impossible to trace the source of lymph. The history of the boy's illness is extremely uncertain, but upon the whole, if it can be relied upon at all, it tends to render some support to the view that syphilis was communicated by vaccination or by contamination of the vaccination wounds.

Besides the non-fatal cases to which we have just referred, there were amongst those investigated by medical men on our behalf, in which non-fatal injury had been alleged or

[1] *I. e.* Cases 12 and 13; E. M. S. in Case 21 [series]; the following in Case 139 [series], A. E. L. (No. 426 in the vaccination register), A. L. C. (No. 406), J. E. (No. 409), W. E. W. (No. 424), J. P. F. (No. 429), F. M. D. (No. 440), N. G. S. (No. 449), A. F. (No. 451), F. J. (No. 453), H. L. (No. 455), E. J. S. (No. 456), F. R. (No. 458), E. J. (No. 459), A. J. L. C. (No. 467), M. M. (No. 469), and L. H. (No. 484); Cases 141, 142, 143, 144, 145, 146, and 180.

[2] In Case 139 [series], namely, A. F., No. 451 in the vaccination register.

[3] Case 141.

suggested to have been caused by vaccination, 13[1] cases in which in the course of the investigation some suspicion of syphilis was raised in connection with the illness which followed vaccination. In none of these 13 cases, however, is there evidence of any value to show that syphilis was communicated by vaccination; one[2] was a case of inherited syphilis, and the other 12 were not cases of syphilis at all.

430. The evidence offered to us would lead to the belief that whilst with ordinary care the risk of communication of syphilis in the practice of arm-to-arm vaccination can for the most part be avoided, no degree of caution can confer an absolute security. The rejection as vaccinifers of young infants, say below four months of age (in whom congenital syphilis may be as yet undeclared), and of adults (in whom the disease may possibly have been recently acquired) are precautions which would probably shut out almost the whole of the risk. The outbreaks of syphilis in connection with vaccination which have been mentioned to the Commission (all of which had been previously published) have occurred chiefly in arm-to-arm vaccination amongst soldiers, or from the use as vaccinifers of young infants the offspring of parents whose history was not known to the vaccinator. It must, however, be admitted that neither the examination of the vaccinifer if taken alone, and without a knowledge also of the parents, nor the most scrupulous avoidance of any visible admixture of blood with the lymph, are in themselves, however valuable, sufficient absolutely to exclude risk. The evidence given by Dr. Husband, of the Vaccine Institution of Edinburgh, established the fact that all lymph, however pellucid, does really contain blood-cells. Absolute freedom from risk of syphilis can be had only when calf-lymph is used, though where the antecedents of the vaccinifer are fully ascertained, and due care is used, the risk may for practical purposes be regarded as absent.

[1] *I. e.* Cases 11, 102, 128, and 129; the following in Case 140 [series], M. W. (No. 6 of series), C. C. (No. 23), J. H. (No. 24), A. N. (No. 25), A. J. A. (No. 64), and W. B. (No. 69); Cases 175 and 187; and C. M. J. in Case 227 [series].

[2] C. M. J. in Case 227 [series].

[3] Q. 27,327–9.

431. As regards the possible effect of vaccination in increasing the prevalence of leprosy, no affirmative evidence has been brought before the Commission which in their opinion establishes that this effect has resulted from the practice. On the other hand, much of a strongly negative character has been produced. The evidence which has been supposed to give support to the suspicion that leprosy has been caused by vaccination is of two kinds. First, the recent increase of leprosy in certain districts simultaneously with an increase of vaccination; and secondly, the assertion that in isolated cases leprosy has really followed the practice of vaccination. In regard to the former of these supposed arguments, it has been shown in evidence that there has been no general relationship between the increase of vaccination and the increase of leprosy. Whilst in a few places, of which the Sandwich Islands offer by far the most definite example, leprosy has very largely increased during vaccination periods; in others, New Zealand, for instance, it has died out, and in others, such as Norway, Iceland, and India, it has probably undergone decline. The evidence of Dr. Beaven Rake, a gentleman of great experience of leprosy as it occurs in the West Indian islands, and a member of the Commission recently sent out to report on the causes of leprosy in India, was definitely opposed to the belief that vaccination had any share in its spread. As regards the allegation that in certain individual cases vaccination had produced leprosy, there is no conclusive evidence.

The supposed risk of conveying leprosy in vaccination may be wholly got rid of by using English lymph or that from the calf.

432. As regards the almost infinitesimal risk of syphilis, it must be admitted that re-vaccination cases stand in the same position as primary ones. In reference to other dangers, however, the risk is even less in the case of adults than we have indicated it to be in the case of infants. This is a fact of great importance when the necessity for re-vaccination to which we have already directed attention is remembered.

433. It is obvious that the employment of calf-lymph only

would wholly exclude the risks as regards both syphilis and leprosy. Respecting the latter disease, however, there appears to be reason to doubt whether any risk exists, and at any rate it does not concern the British population. Even in leprosy districts the employment of English human lymph would be, so far as leprosy is concerned, as safe as that from the calf. The risk of syphilis, although real, is an exceedingly small one, even when humanised lymph is employed, and may probably be wholly avoided by care in the selection of the vaccinifer. As regards all the other dangers, whether of severe illness or temporary inconvenience, the two forms of lymph appear to stand on the same level. The instances of inflamed arms, of erysipelas, of vaccinia maligna, and eczematous eruptions are not more common after the use of human lymph than after that from the calf. Some of the best qualified witnesses who have afforded us their assistance have expressed a deliberate preference for arm-to-arm vaccination, believing that the advantages of calf-lymph are more imaginary than real.

434. A careful examination of the facts which have been brought under our notice has enabled us to arrive at the consion that, although some of the dangers said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done they are insignificant. There is reason further to believe that they are diminishing under the better precautions of the present day, and with the addition of the further precautions which experience suggests will do so still more in the future.

(*C.*) *As to whether any, and, if so, what means should be adopted for preventing or lessening the ill-effects, if any, resulting from vaccination; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination.*

435. We are asked further to inquire and report whether any, and, if so, what means should be adopted for preventing or lessening the ill-effects, if any, resulting from vacci-

nation, and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination.

436. We have already, in connection with a discussion of the nature and extent of any injurious effects which result from vaccination, indicated some means which might be adopted for preventing or lessening those ill-effects. It will be well, however, even though it may involve some repetition, to deal with them all together in this section of our Report.

437. We put the use of calf-lymph in the forefront because, as we have said, this would afford an absolute security against the communication of syphilis. Though we believe the risk of such communication to be extremely small where humanised lymph is employed, we cannot but recognise the fact that however slight the risk, the idea of encountering even such a risk is naturally regarded by a parent with abhorrence. We think, therefore, that parents should not be required to submit their children to vaccination by means of any but calf-lymph, but this should not preclude the use of humanised lymph in case they so desire.

So long as the State, with a view to the public interest, compels the vaccination of children, so long even as it employs public money in promoting and encouraging the practice, we think it is under an obligation to provide that the means of obtaining calf-lymph for the purpose of vaccination should be within the reach of all. We have no hesitation, therefore, in recommending that steps should be taken to secure this result. Whether the duty of providing calf-lymph should be undertaken by the Local Government Boards in the several parts of the United Kingdom, or whether some other method would be more advantageous, can be better determined by those who have had practical acquaintance with the working of the vaccination laws.

438. We have already noticed that whilst in Scotland the age within which vaccination is obligatory is six months from the date of births, in England and Wales and in Ireland it is three months from that date. There is obviously

no good reason for this want of uniformity. We have come to the conclusion that it would be well, at all events, to extend the age period in England and Wales and in Ireland to six months from the date of birth.

It is difficult to judge how far untoward incidents of vaccination would be likely to be lessened if the operation were postponed to a later age than three months. Looking at the circumstance that the tenure of life in children of a very early age is frail, and that where a disease supervenes upon vaccination the ability to battle against it may determine whether the result is fatal or not, or to what degree injurious, we should *a priori* think that the chances of death or injury from such a cause would be less, looking at the matter as a whole, when the age of the child was more advanced.

The evidence in our possession bearing upon the point is very slight. It consists only of the fact, to which we have called attention, that the return of deaths connected with vaccination in Scotland shows a much smaller proportion in comparison with the number of children vaccinated than in England. We have pointed out that there may be other explanations of this phenomenon, but so far as it goes it lends some support to the *a priori* view we have indicated.

We are aware that one consideration which led to the reduction of the period in Ireland to three months was that it would lessen the difficulty of tracing defaulters due to removals. But the experience of Scotland seems to show that the difference in this respect, whether the longer or shorter period be adopted, is not very grave.

439. We are quite alive to the objections which may be urged against a prolongation of the period within which vaccination must be performed. It will naturally be said that a number of children, who otherwise would be protected against smallpox, would be left without that protection, and would thus be liable to suffer from the disease themselves, and be a source of danger to others. It must be remembered, however, that so long as children cannot walk, the risk of their contracting contagion is less than if they were able to move freely about and mix with other people,

and that, for the same reason, the risk of their communicating contagion to others is less. We cannot trace in the statistics relating to Scotland any grounds for believing that the later compulsory vaccination age which prevails in that country as compared with England has affected, to any substantial extent, the general smallpox mortality of Scotland, though no doubt it may have led to some deaths among children under six months of age which otherwise would not have taken place.

We have already shown how satisfactory a position Germany has occupied in relation to smallpox since the year 1874. The age of compulsion in that country is the end of the next calendar year after birth. It is true that re-vaccination has been there made compulsory as well as primary vaccination, but we think the experience of Germany is not without its bearing on the question we are now considering. Wherever the line is drawn, whether at three months or six months, it will always leave a class of unvaccinated persons. The age to be fixed is a question of policy into which many considerations must enter. If an extension of the age within which vaccination was required rendered its untoward incidents fewer in number, and diminished hostility to the operation, it may be that, on the whole, it would promote the cause of vaccination, and secure, as its result, that the number of vaccinated persons would be greater than at present.

440. The truth is that it is only when an epidemic breaks out in any place that the vaccination of very young children becomes a question of grave importance. An epidemic is not likely to originate, nor in its early days to grow, owing to the non-vaccination of that class.

If, then, security could be obtained that whenever a case of smallpox occurred in a sanitary district, children within the range of the present compulsory law should be vaccinated, we think the protection against smallpox would not be substantially less that it is at present. Without some such provision as this, we should not be prepared to recommend an extension of the age beyond the period allowed in Scotland. With such a provision, we think that the age

might be advantageously extended to one year from the date of birth, and that the number of cases in which death was, whether correctly or not, attributed to vaccination would then much diminish. A provision of this kind would, however, no doubt involve some practical difficulties.

441. Our attention has been called to the fact that in some workhouse infirmaries and lying-in hospitals it has been the practice to vaccinate children within a few days of their birth. Although under favourable conditions vaccination may be successfully carried out at that early age, we think the practice is to be deprecated unless there be at the time obvious danger of smallpox contagion. In the exceptional cases in which vaccination becomes on that account necessary, the infant should, it possible, be kept under observation until the arm is healed. And we think that, in these cases, it is very undesirable to vaccinate in four or five places ; the operation should be limited to a single insertion of the vaccine matter.

442. A study of the reports in our possession relating to cases in which erysipelas or septic disease has followed vaccination teaches no lessons more forcibly than these,—that any abrasion of the vaccination vesicles by clothing of a nature likely to irritate them should be avoided, and that foreign substances should not be rubbed into the wounds under circumstances calculated to set up inflammation. It is most important, too, that any rags or other materials applied to the place of vaccination should be scrupulously clean. The want of care in these respects on the part of the parent or person in charge of the child has frequently been a source of mischief. If more care were exercised much good would result. Parents and others in charge of children are frequently unaware of the importance of these matters, and of the evil which may follow from a disregard of them. We think it would be well that a warning on the subject should be addressed to such persons. It has been the practice of some public vaccinators to take this course. It is desirable that the practice should be universal, and that the Local Government Board should settle a suitable form containing clear and simple rules for guidance in the care of the vacci-

nated arm, and for the avoidance of any likely source of injury or irritation of that part. If this were done untoward incidents might, we think, be largely diminished.

443. We have already drawn attention to the fact that some cases of disease contracted through vaccination might be avoided if the operation were performed at the child's home instead of at a public vaccination station. At present the child has not unfrequently to be taken twice to a considerable distance, first for the operation itself, and then for the subsequent inspection. This sometimes involves exposure to inclement weather, which is of itself hazardous. Besides this a considerable number of children are often collected both on the occasion of the vaccination and of the inspection, and the risk of contagion is thereby increased. If children were vaccinated and inspected, as a rule, at their own homes, instead of being brought to a public station, we believe the risk of injury would be sensibly lessened.

444. A medical man attending at the child's residence would be better able than the public vaccinator ordinarily can be to judge whether circumstances made it expedient to postpone vaccination for a time.

The insanitary conditions in which a child was living have often afforded an explanation of septic diseases which have supervened on vaccination. These conditions would be better known by a medical man visiting the home than by a public vaccinator to whose station a child is brought.

445. There can be no doubt that vaccination ought to be postponed when erysipelas, scarlet fever, measles, or chicken-pox are prevalent in the neighbourhood of the child's residence, or, if the child is not to be vaccinated at home, either there or near the place of vaccination. Here, again, there would be a gain if the home was more often the place of vaccination.

446. It would, in our opinion, be an advantage if the postponement of vaccination were expressly permitted, not only on account of the state of the child, but of its surroundings and any other conditions rendering the operation

at the time undesirable. If more discretion in this respect were possessed and exercised, we think untoward results would become even rarer than they are.

If provision could be made, in cases in which insanitary conditions would cause risk to a child if it remained at home whilst the vaccination wound was unhealed, for its removal elsewhere during that period, we think it would be desirable.

447. We think that the vaccination vesicles should not be opened unless for some adequate reason. We have already said that in our opinion the importance of this has been exaggerated, but the precaution is nevertheless a wise one, and may be of use.

448. We think that safety would be increased by preserving the lymph in tubes instead of on "dry points." There is some difference of opinion on this matter amongst those with whose opinions we have been furnished. On the whole, however, we think the weight of experience as well as reason is in the direction we have indicated.

In connection with this subject, our attention has been drawn to the experiments recently made by Dr. Copeman as to the effect of the storage of vaccine lymph in glycerine. The conclusions at which he arrives are that the addition of glycerine, whilst it leaves the efficacy of the lymph undiminished, or even increases it, tends to destroy other organisms. If it be the fact that the efficacy of the lymph remains unimpaired, its storage in glycerine would largely diminish the difficulties connected with the use of calf lymph, which are inseparable from calf to arm vaccination. The investigation has not yet reached a point at which it is possible to pronounce with certainty whether the anticipated results would be obtained. And it was at one time suggested that the introduction of glycerine was likely to be mischievous. The question is one a further investigation of which is obviously desirable.

If lymph is to be preserved in glycerine, due care would be requisite to ensure its purity and the absence of contamination in its introduction. We think that, whether mixed with glycerine or not, each tube should contain only sufficient lymph for the vaccination of one person.

449. Another precaution which ought to be insisted on is that no instrument should be used for the operation which has not been boiled or otherwise sterilised for the purpose; and the simpler the instrument employed the better.

Care should be exercised, too, not to place the insertions too near together, so as to injure the vitality of the tissues between them.

450. We think the time at present fixed for inspection of the vaccinated arm is somewhat too early, and that some time during the second week after vaccination should be substituted for the eighth day; and, moreover, that another inspection should be obligatory in the third week after vaccination. If summoned by the parent on account of any unfavourable symptoms prior to the time fixed for inspection the vaccinator should be bound to attend, and notice should be given to parents of their right thus to summon the public vaccinator.

The amount of the fee to be received by the vaccinator would, of course, require to be determined with reference to the duties which it is proposed to impose upon him. We think the fee should be adequate to cover all these duties.

In any case where a child requires medical attendance owing to illness supervening on vaccination, we think it should be the duty of the vaccinator to render such attendance if required by the parent, and that he should receive a fee in respect thereof.

In our opinion, if the precautions we have suggested were adopted, untoward incidents of vaccination, already rare, would become much rarer.

(*D.*) *As to what means, other than vaccination, can be used for diminishing the prevalence of smallpox; and how far such means could be relied on in place of vaccination.*

451. Another question upon which we are asked to report is, what means, other than vaccination, can be used for diminishing the prevalence of smallpox; and how far such means could be relied on in place of vaccination.

452. The means other than the inoculation of smallpox or cow-pox, which have been referred to by witnesses as being

capable of diminishing the prevalence of smallpox, are such means as have been employed against infectious diseases generally; they may be summarised as—1. Measures directed against infection, *e. g.* prompt notification, isolation of the infected, disinfection, &c. 2. Measures calculated to promote the public health, the prevention of overcrowding in dwellings or on areas, cleanliness, the removal of definite insanitary conditions, &c.

The principle underlying the practice of isolation with its accompanying machinery is obviously the very opposite of that which recommended the practice of inoculation; it aims at exclusion of the disease, whereas inoculation aimed at universal acceptance by artificially "sowing" or "buying" the disease. Except in regard to the plague, our knowledge and practice of measures of isolation and quarantine against epidemics is of relatively recent growth. As the result of increased knowledge of the mode of propagation of infectious diseases, of greater sanitary activity, and under the stimulus of legislation, organised effort, more or less thorough, is now, in this as in other countries, directed against the spread of dangerous infectious diseases. Side by side with a vaccination system, means of isolation, &c., have been successfully employed to check the spread of smallpox. They have also been sometimes so employed in recent years in places where vaccination has fallen into disuse.

453. It will be well to commence with a brief statement of the growth of our knowledge on the subject of isolation as a means of dealing with infectious or contagious diseases. We have already adverted to the fact that smallpox is highly contagious, and that contagion from those suffering from it is the means by which the disease is propagated.

454. Although reference to infection appears in some of the Arabian writers, the contagiousness of smallpox attracted little attention in this country and in Western Europe until the 18th century. Sydenham (1624–1689), though he refers to the contagiousness of smallpox, did not dwell upon the matter, and did not regard it as so important an element in the spread of the disease as some peculiar constitution of

the atmosphere to which he attributed epidemics. Boerhaave was the first at the commencement of the 18th century distinctly to formulate the now generally accepted doctrine that smallpox arises only from contagion.

455. In 1720, Mead drew up an elaborate system of notification, isolation, disinfection, &c., in view of a threatened invasion of the plague, but no attempt to deal with smallpox in a similar fashion appears to have been made until the last quarter of the 18th century. This was in all probability largely due to the adoption of inoculation as the recognised defence against smallpox, and the acceptance of Sydenham's doctrine of epidemic causation may have exercised an influence in the same direction.

456. No writer appears to have suggested methods of isolation, disinfection, &c., against smallpox prior to 1763. In that year Rast of Lyons published his 'Reflections on Inoculation and Smallpox,' and upon the means which might be taken to deliver Europe from that malady. He maintained—1. That smallpox was not a necessary and inevitable malady. 2. That it arose only from contagion. 3. That it resembled plague in most of its features. His conclusion was expressed in these terms: "I say, that to deliver Europe from smallpox we must act upon principles directly opposed to inoculation; far from multiplying the contagion, we must keep it away by taking the same precautions and employing the same measures against that malady as have proved so successful against leprosy and the plague."

The earliest account of the practical employment of such means is from Rhode Island, U.S.A. Haygarth, on the authority of Drs. Moffat and Waterhouse, states that for many years prior to 1778 smallpox had been successfully prevented from becoming epidemic there by regulations for isolation of the infected on a neighbouring small island specially used for that purpose, and for quarantining infected vessels, destruction of infected clothing, &c. Moreover inoculation was discouraged at Rhode Island, and those who wished to be inoculated had to go to some place away from the island,

and were not to return until there was no danger of their infecting others.

457. A passage in Dimsdale's work on Inoculation, published in 1781, shows that in some towns of England pest-houses were beginning to be used for smallpox. In 1784 Haygarth, of Chester, published his "Inquiry how to prevent the Smallpox," and in 1793 "A Sketch of a Plan to exterminate the Smallpox from Great Britain."

The great epidemic of smallpox at Chester in 1774, to which allusion has already been made, was the occasion of Haygarth's first attempts at organised dealing with epidemics of smallpox with a view to prevention. In his Inquiry he combated Sydenham's doctrine that epidemics are due to some occult condition of the atmosphere, and argued that smallpox was always spread by infection only. He further maintained that the variolous poison could be carried as an infection for a little distance only through the air, and "consequently that the smallpox may be prevented by keeping persons liable to the distemper from approaching within the infectious distance of the variolous poison till it can be destroyed." These views led him, upon the return of an epidemic in 1777, to propose a plan for the prevention of the natural smallpox, and in 1778 a society was formed to carry out the plan in Chester. The plan consisted on the one hand of a general inoculation at people's homes at stated intervals, on the ground that the inoculated smallpox was far less fatal or injurious than the natural smallpox, and on the other hand of "Rules of Prevention" based on Haygarth's views of infection. In the report of the society, called shortly "The Smallpox Society," dated September, 1782, it is stated that in the four and a half years of its existence two general inoculations had been held, and that the deaths from smallpox had been greatly lessened. Great difficulties, however, were met with. "A large proportion of the inhabitants" refused inoculation, and a large proportion also, "being fearless, or rather desirous, that their children should be infected with the natural smallpox," refused to obey the rules of prevention. Hence, though the same report states that the example of Chester had been followed by Liverpool,

where "a general inoculation was successfully executed in the autumn of 1781 and another in the spring of 1782," and in Leeds, where a general inoculation was held in 1781, and another proposed in 1782, with such success that the Royal College of Physicians in Edinburgh appointed a committee to inquire into "the modes of conducting the general inoculations of the poor" thus adopted in these places, the plan met with such difficulties that it was ultimately abandoned. It will be observed that a general inoculation was an essential part of the plan proposed and carried out in 1778–82; but, writing in 1784, Haygarth looked forward to being able ultimately to dispense with inoculation, and in the preface to his later edition, published in 1793, he states more definitely that the adoption of his Rules of Prevention without any general inoculation might exterminate smallpox in some country other than Great Britain. It must be remembered, however, that Haygarth entertained the opinion that the infection of smallpox could not be carried through the air above about half a yard, and that no one could be infected by the clothes of a person visiting a smallpox patient provided that he kept beyond this distance from the patient. It is obvious that if this had been established the control of the disease by isolation would be a much simpler matter than it really is.

458. In the 'Medico-Chirurgical Review' for 1796 there appeared an account of a work by Dr. Faust of Leipsic, entitled "An essay on the duty of man to separate persons infected with the smallpox from those in health, thereby to effect the extirpation of that disease equally from the towns and countries of Europe," in which it was argued that the first person ill in a place is the only source from which all the rest, perhaps hundreds and thousands, become affected, and that if he were put immediately into a situation where he could not injure by contact those who had not had the disorder, the spread of the disease would be prevented.

In the same Review for 1799 appeared an account of establishments for the extirpation of smallpox. The failure of inoculation to attain the desired end is referred to, and legislation is urged to facilitate isolation. It is further stated

that in 1796 the Prussian College of Physicians reported favourably to the King on the project, and that at Halberstadt it had been resolved to establish a house for the purpose. At Côte d'Or, in France, a similar plan had been tried with success.

459. In 1798 Jenner's Inquiry was published, and in the early years of this century inoculation began to be discouraged; for a while the prospects of annihilating smallpox by vaccination appear to have superseded, in the minds of many, the plans of Haygarth and others. Some vaccinators, however, like Willan and Ring, still looked to methods of quarantine and to national and municipal regulations promoting isolation to exterminate the smallpox.

It is worthy of notice, too, that Haygarth himself, in a letter quoted by Dr. Cappe of York in a communication to the 'London Medical and Physical Journal' (vol. iv, p. 429), dated October 13th, 1800, remarked, "An introduction of the vaccine still more than of the variolous inoculation would effectually promote the great object of my publications."

460. Prior to the year 1866 there was no provision made by law for enabling sanitary authorities to establish hospitals for infectious diseases, and thus to promote the isolation of such cases. The only institutions of that description then existing were the result of private effort. So far as regards smallpox, there was, practically speaking, no provision for its treatment by means of isolation.

461. The Sanitary Act of 1866 empowered, though it did not compel, local authorities throughout England and Wales, Scotland, and Ireland, to provide or to join in providing isolation hospitals for the use of the inhabitants of their districts. There was further legislation on the subject by the Public Health Act, 1875; the Public Health (London) Act, 1891; the Public Health (Scotland) Act, 1867; and the Public Health (Ireland) Act, 1878, into the details of which it is not necessary to enter. The most recent Act relating to the matter is the Isolation Hospitals Act of 1893, which

applies to the small towns and rural districts of England and Wales.

462. In London the local authorities to whom the power to provide isolation hospitals was given by the Sanitary Act of 1866 were in the City the Commissioners of Sewers, and in other metropolitan districts the Vestries or District Boards. With few exceptions these authorities did not exercise the powers conferred on them, and, speaking generally, it may be said that the Sanitary Act of 1866 had practically no effect in London as regards the provision of hospital accommodation for smallpox. Some few of the metropolitan workhouses, however, had infectious wards attached in which cases of smallpox were treated, and the guardians of some of the unions sent cases by arrangement to the smallpox hospital at Highgate. This institution, which had been established in 1746, was extended in 1850 so as to provide accommodation for about 100 smallpox patients. It remained down to the year 1870 the only smallpox hospital in London.

463. The obvious difficulty and danger attending the treatment of persons suffering from smallpox in the same institutions in which other destitute persons are practically forced to reside led to the enactment of certain provisions of the Metropolitan Poor Act of 1867, and to the issue under that Act of an order of the Poor Law Board virtually uniting the whole metropolis into one district for the purpose, amongst others, of providing hospital accommodation for paupers suffering from smallpox.

464. Although the Metropolitan Asylums Board had power to provide hospital accommodation for paupers only, they found it practically impossible to confine the inmates of their hospital to this class owing to the epidemic which prevailed at and after the time when their first hospital was opened in December, 1870.

465. In 1879, by the Poor Law Act of that year, power was given to the Metropolitan Asylums Board to contract

with the Local authorities for the reception into the Board's hospitals of any persons suffering from smallpox or other dangerous infectious disorder within their districts, but it was not until 1889 that express power was given to the Asylums Board by the Poor Law Act of that year to admit persons reasonably believed to be suffering from smallpox who were not paupers.

It will thus be seen that the hospitals of the Asylums Board have been practically the only isolation hospitals available for London, though to some extent the Highgate hospital has served the same purpose.

466. A return made in 1879 showed that at that time 296 out of 1593 (or about 18 per cent.) of the sanitary authorities of England and Wales, other than the metropolitan or port sanitary authorities, had made some provision for the isolation of cases of infectious disease. A similar return relating to the conditions existing in December, 1892, shows that by that time 36·6 per cent. of the same sanitary authorities (representing districts together containing 62·1 per cent. of the total inhabitants) had some provision for the isolation of infectious diseases, either in hospitals of their own or by arrangement with neighbouring authorities, and that 20·4 per cent. of these authorities (representing districts containing together 44·6 per cent. of the total inhabitants) had special accommodation for smallpox patients. In addition, it appears that 45 of the 57 port sanitary authorities then existing (exclusive of the Port of London) in England and Wales had arrangements of some kind for the isolation of infectious diseases, 12 of these 45 then having special accommodation for smallpox patients.

467. The value of isolation in restricting the spread of smallpox has been long acknowledged by the Medical Officers of the Local Government Board.

Dr. (afterwards Sir George) Buchanan, in a report made in 1874, expressed the opinion that "smallpox, as well as other infections, is capable of being wonderfully limited by isolation in hospital, and the amount of provision made for such isolation may be expected to affect materially the rate at which an epidemic of smallpox becomes extinguished." In proof of this he adduces a striking comparison of the

behaviour of the epidemic of 1870–71 in Birmingham, London, and Coventry. Again, the 1871 epidemic was prolonged in Plymouth, but quickly extinguished in adjacent Devonport, the only difference between the two being the more rapid and copious hospital provision in the case of the latter.

468. Evidence bearing on the same point was given by Dr. Thorne before the Royal Commission which in 1881–2 inquired into the subject of smallpox and fever hospitals in London.

Speaking of hospitals for infectious diseases generally, he said, "The evidence is so abundant that I could occupy you for hours in telling you of instances in which epidemics have evidently been prevented by the isolation of first cases of infectious disease."

As regards smallpox in particular, he cites two striking examples. "Before the erection of the Delancey Hospital at Cheltenham, smallpox had frequently led to some considerable mortality; in 1858 it caused 52 deaths, in 1861 12 deaths, in 1865 32 deaths, but during the six years which had elapsed between the provision of the hospital and my inquiry, smallpox had been imported into Cheltenham on twelve different occasions; the imported cases were in every instance removed to the hospital, and in no single instance has the disease spread beyond the house first attacked!" Again, he says: "At Birkdale, in Lancashire, the spread of smallpox was, in 1876, successfully checked by the isolation of a few first attacks. At Wigan, the isolation of a first imported case, both in 1877 and 1878, prevented any further attack. At Maidstone I found that there had never been any spread of smallpox in any house from which the medical officer of health succeeded in removing to hospital the first patient attacked. Indeed, it was everywhere found that where a hospital for the reception of infectious diseases was kept in actual readiness for the admission of patients, and where removal could be effected at the outset of the disease, the isolation of cases of smallpox had prevented any extension of infection."

Dr. Thorne says, "It is really more striking as regards smallpox than any other disease, because smallpox can be

more easily isolated, the friends of the patient, and they themselves being so much more willing to submit to isolation, than when suffering from any of the other specific fevers." He adds, however, that "efficient vaccination must be considered as a probable influence in contributing to the results."

It is to be observed, too, that Dr. Thorne expressed the opinion that after an outbreak of smallpox had proceeded a certain way, the influence of a hospital for good upon the population would be very small indeed; that it would be good so far as concerned the individual house from which the patient was removed, but that it often had but little influence upon the general body of the epidemic.

469. After the hospitals established by the Metropolitan Asylums Board had been employed for some time for the reception of persons suffering from smallpox, attention was called to the fact that the number of cases of the disease in the neighbourhood of the hospitals was apparently in excess of the number found in streets further removed from them, and a suspicion was aroused that the hospitals were themselves causing a spread of the disease. There had appeared, according to Dr. Thorne, to be ground for believing that in the case of two provincial hospitals, one at Maidstone and the other at Stockton, the inhabitants of dwelling-houses in their neighbourhood had suffered owing to proximity to these institutions. In consequence of the suspicion which existed as to the influence of London hospitals in spreading the disease, a careful investigation was made for the Local Government Board by Mr. Power of the circumstances relating to the Fulham smallpox hospital. In the result, he came to the conclusion that the Fulham hospital, with all its advantages of site and construction, and with the many excellences of its administration, had, by dissemination of smallpox material through the atmosphere, given rise to an exceptional prevalence of smallpox in its neighbourhood.

470. The matter was felt to be of so much importance that a Royal Commission was appointed to consider the prevention and control of epidemic infectious diseases in London and its neighbourhood.

The Commission arrived at the conclusion that it "appeared clearly established," by the experience of the five hospitals maintained by the Asylums Board for smallpox patients, that "by some means or other the asylums hospitals in their present shape "cause an increase of smallpox in their neighbourhoods." They accordingly recommended that these hospitals, which, in their judgment, should be no longer used to anything like the extent they then were for cases of smallpox, should become, in the main, fever hospitals, and that mild and convalescent cases of smallpox should be provided for in two or three more country hospitals, it being apparently thought impracticable to remove acute cases to such hospitals.

471. Towards the end of the year 1883 the Metropolitan Asylums Board, who had already made some use of a hospital camp at Darenth, and a hospital ship, the "Atlas," moored at Greenwich, for the treatment of smallpox patients, decided to make important changes in its method of dealing with London smallpox.

The "Atlas" hospital ship was moved to Long Reach, about twenty miles below London Bridge, and well without the metropolitan area, and reopened in February, 1884; the hospital camp at Darenth was reopened early in the following month; in June of the same year a second hospital ship, the "Castalia," was opened alongside the "Atlas," and a second hospital camp opened at Darenth; and from February to October, 1884, the cases of smallpox received by the Board were dealt with in the following manner:— Cases of smallpox were received at first at three, and afterwards at six, intra-urban hospitals and there treated—(in May the hospitals at Hampstead and Fulham had been reopened for this purpose, and a sixth hospital hired at Plaistow, just beyond the metropolitan boundary, but in a populous district) —but the number of cases under treatment in each intra-urban hospital at any one time was not allowed to exceed 50, mild and convalescent cases being thence transferred from time to time to the hospital ships and camps, where their treatment was continued; after the middle of June mild cases of smallpox were also received on the hospital ships directly

from their homes. Complaints, however, again arose that some of the six intra-urban hospitals, and even that the hospital camps at Darenth, were spreading smallpox in their vicinity, legal proceedings being instituted with reference to the use of the latter; and from October, 1884, though the Board continued for a time to follow the same method of dealing with cases of smallpox, the number of cases under treatment in each intra-urban hospital at any one time was not allowed, as a rule, to exceed 25.

472. Finally, in July, 1885, the Metropolitan Asylums Board decided thenceforward to treat, in the first instance, on the hospital ships, all cases of smallpox received by the Board, unless the condition of the patients made their removal to the ships dangerous; and the Board's arrangements, well designed and well carried out, for the conveyance of patients thereto, have since been found to admit of practically the whole of the cases being taken to the ships. As a relief to the hospital ships in times of smallpox epidemics, the Board erected in 1888–9, and extended in 1893–4, at Darenth, on a site near that before used for the hospital camps, a hospital primarily intended for cases convalescent after smallpox, which was so used during the later part of the smallpox outbreak of 1892–94. The Metropolitan Asylums Board have also provided, since 1881 a partial, and since 1889 a complete, ambulance service for London smallpox; and so well has the service, which formerly was often an undoubted means of infection, been carried on by the Board that it may, in this connection at least, be taken that no spread of infection has occurred from the Board's ambulances.

473. In many of the large towns of England the notification of infectious diseases, including smallpox, has been at different times adopted, and steps have been taken to provide hospital accommodation where patients suffering from smallpox could be received, and endeavours made with more or less vigour to isolate cases of the disease by removing them to a hospital. We shall advert presently to the effect of these measures in the metropolis and some

provincial towns. We may mention here, however, that the experience in London, that the collection of a considerable number of smallpox cases in hospitals situate in or near populous districts tends to a spread of the disease, has had its counterpart in provincial towns, though the greater numbers collected in one place have, we believe, made the evil more felt in London than elsewhere.

474. The reports upon recent provincial epidemics to which we have so often referred contain evidence bearing upon the danger of spreading the disease if considerable numbers of smallpox patients are aggregated in hospitals situate in populous neighbourhoods. Thus in Sheffield the Winter Street Hospital appears to have led in the epidemic of 1887–88 to a dissemination of the disease in the vicinity. The site of the hospital has been since changed. Again, at Leicester it was observed during the epidemic of 1892–93 that the amount of smallpox round the hospital was abnormally great when compared with the other parts of the town. And there was a similar experience at Warrington and other places.

475. As regards Scotland, the yearly abstracts of public health expenditure, given in the more recent reports of the Board of Supervision, enable us in some degree to judge of the extent to which local authorities have exercised the power to provide, or to join in providing, isolation hospitals for the use of the inhabitants of their districts, given to them by the Sanitary Act of 1866, and again by the Public Health (Scotland) Act of the following year. The earlier of those Acts, not having been framed with special reference to the local institutions of Scotland, was practically inoperative in that part of the United Kingdom, but some few local authorities may have from the first exercised their powers in this respect under the Act of 1867. The abstracts of expenditure given by the Board of Supervision do not enable us, however, specially to distinguish expenditure in connection with the provision or maintenance of hospital accommodation incurred prior to the year ending the 14th May, 1873. From that year onwards the proportion,

year by year, of local authorities making any such expenditure, however small, is shown by the following table:

Year.	Proportion in each year of Local Authorities making any expenditure at all in connection with the provision or maintenance of hospital accommodation.
Ending 14th May, 1873 . .	5 per cent.
,, ,, 1874 . .	6 ,,
,, ,, 1875 . .	7 ,,
,, ,, 1876 . .	7 ,,
,, ,, 1877 . .	8 ,,
,, ,, 1878 . .	9 ,,
,, ,, 1879 . .	10 ,,
,, ,, 1880 . .	10 ,,
,, ,, 1881 . .	11 ,,
,, ,, 1882 . .	12 ,,
,, ,, 1883 . .	12 ,,
,, ,, 1884 . .	13 ,,
,, ,, 1885 . .	13 ,,
,, ,, 1886 . .	13 ,,
,, ,, 1887 . .	13 ,,
,, ,, 1888 . .	15 ,,
,, ,, 1889 . .	16 ,,
,, ,, 1890 . .	17 ,,
,, ,, 1891 . .	34 ,,
,, ,, 1892 . .	39 ,,
,, ,, 1893 . .	44 ,,
,, ,, 1894 . .	49 ,,

476. The largely increased proportion of local authorities making some expenditure in connection with the provision or maintenance of hospital accommodation during the year ending the 14th May, 1891, as compared with the proportion in the previous year, probably does not indicate any material increase in the amount of hospital accommodation provided. At the beginning of that year (*i. e.* in May, 1890), under the provisions of the Local Government (Scotland) Act of 1889, there were substituted for certain of the local authorities under the Public Health (Scotland) Act of 1867 a very much smaller body of authorities, representing larger areas in which the districts of the former authorities were merged. Apart, therefore, from any increase which may

have followed in the amount of hospital accommodation provided, the effect was naturally to increase the proportion of local authorities making some expenditure in connection with the maintenance of hospital accommodation.

At the same time the success, in this respect, at all events, of the policy of this substitution, is strikingly shown by the increased proportion of local authorities making some expenditure in connection with the provision or maintenance of hospital accommodation during the year ending the 14th May, 1892, and during each of the two following years, as compared with the proportion during the year ending the 14th May, 1891.

477. In the case of Ireland, we are able to judge to some extent of the proportion of cases of smallpox which, prior to the enactment of the Sanitary Act of 1866, was treated in hospitals or infirmaries of some sort. The inquiries to which we have already referred, made on the taking of the census in 1841, in 1851, in 1861, and in 1871, gave the following results:—[Census reports of Ireland: in 1841, pp. xii, xiii, lix, and lx, and pp. 182 and 194–204 of Surgeon Wilde's Report; in 1851, part v, vol. i, pp. 364–5 and 423, and vol. ii, pp. 70, 110, and 122; in 1861, part iii, vol. ii, p. 20, and (in the tables) pp. 66, 106, and 118; and in 1871, part ii, vol. ii, pp. xxxvii, 122, 154, 168, and 265.]

58,006 persons were returned as having died of smallpox during the inter-censal period 1831–41. Of these 58,006 deaths, 19 occurred in the few Poor Law institutions which had been opened towards the close of the period; 16 occurred in county hospitals; 5 in prison hospitals; 38 in other general hospitals; and 49 in fever hospitals. So that altogether 127 out of the 58,006 deaths (or 0·2 per cent.) occurred in these institutions.

38,275 persons were returned as having died of smallpox during the inter-censal period 1841—1851. Of these 38,275 deaths, 5016 (or 13·1 per cent.) occurred in Poor Law institutions; 8 occurred in county hospitals; 4 in prison hospitals; 26 in other general hospitals; and 593 in fever hospitals. So that altogether 5647 out of the 38,275 deaths (or 14·7 per cent.) occurred in these institutions.

12,727 persons were returned as having died of smallpox during the inter-censal period of 1851–61. Of these 12,727 deaths, 1118 (or 8·8 per cent.) occurred in Poor Law institutions; 4 occurred in county hospitals; 9 in prison hospitals; 57 in other general hospitals; and 187 in fever hospitals. So that altogether 1375 out of the 12,727 deaths (or 10·8 per cent.) occurred in these institutions.

4113 persons were returned as having died of smallpox during the inter-censal period 1861–71. Of these 4113 deaths, 435 (or 10·6 per cent.) occurred in Poor Law institutions; 2 occurred in county hospitals; none in prison hospitals; 22 in other general hospitals; and 107 in fever hospitals. So that altogether 566 out of the 4113 deaths (or 13·8 per cent.) occurred in these institutions.

478. The figures just given relate to deaths from smallpox only, and not to all cases of that disease however terminating. But unless the rate of fatality during the periods to which they relate was considerably lower amongst cases of smallpox treated in the institutions mentioned than amongst cases treated outside, which is unlikely to have been the case, we may infer from the figures that in Ireland the proportion of cases of smallpox which were treated in hospitals or infirmaries of some sort did not materially exceed 0·2 per cent. during the inter-censal period 1831–41, 14·7 per cent. during the inter-censal period 1841–51, 10·8 per cent. during the inter-censal period 1851–61, and 13·8 per cent. during the inter-censal period 1861–71. It must not, of course, be assumed that the cases so treated were effectually isolated during their treatment.

479. We have not the same means of estimating the proportion of cases of smallpox in Ireland which have been treated in hospitals or infirmaries of some sort since the close of the inter-censal period 1861–71. The power given to local authorities by the Sanitary Act of 1866, and again by the Public Health (Ireland) Act of 1878, to provide, or to join in providing, isolation hospitals for the use of the inhabitants of their districts, has been exercised in Ireland to a far less extent than the similar power in England and Scotland;

indeed, except in the case of some few towns in quite recent years, it can scarcely be said to have been exercised at all. On the other hand, such isolation of cases of smallpox as may have been effected by their treatment in Poor Law institutions was carried out more generally in Ireland during the decennial period 1871–80 than during any of the intercensal periods to which we have referred, and still more generally, and indeed to a very large extent during the next decennium 1881–90. The returns of deaths in workhouses from smallpox, given in the annual reports of the Local Government Board for Ireland, show that the proportion of the deaths from smallpox in Ireland which occurred in those institutions was about 25 per cent. during the period 1871–80, and about 65 per cent. during the period 1881–90. Unless, therefore, the rate of fatality during these periods amongst cases of smallpox treated in those institutions was materially different from the rate of fatality amongst cases treated outside, it would appear that about one case of smallpox out of every four during the period 1871–80, and about two cases out of every three during the period 1881–90, were treated in Poor Law institutions.

480. Passing now to a consideration of the effect produced by a notification of cases of smallpox and the steps taken to isolate them, we naturally begin with Leicester. The method there employed in dealing with smallpox has attracted much attention, and is often spoken of as the "Leicester system."

As some discussion has arisen as to the exact procedure under the Leicester system, it will be well to briefly state in what it consists. On the receipt of a notification at the Health Office, a telephonic message is sent to the hospital to prepare for the reception of a patient, and to despatch the ambulance; the sanitary inspector at once proceeds to the house notified, and urges the removal of the patient to hospital, and also the removal of those who have been in contact with him to the quarantine wards near the hospital. There is rarely any difficulty in securing the removal of the patient; in the case of the other inmates of the infected house, there is no power of compulsory removal, but per-

suasion has generally been successful. If a person liable to infection is not quarantined, he is visited daily by the inspector; he is warned against going to work, or undue exposure, but is not confined to the house. Compensation has been given in some cases. The history of the smallpox patient is then inquired into, especially his whereabouts, and the persons he has been in contact with during the preceding fortnight, and any clue of infection is vigilantly followed up. Meanwhile the house is thoroughly disinfected, and clothing is either burnt or sent to the steam disinfector on the hospital grounds. There are 28 beds ordinarily set aside for smallpox in a separate pavilion at the hospital; in another building fenced off from this, but very near it, cases of scarlet fever are received, and the quarantine wards are separated from the fever wards by a corridor only.

If no smallpox appears among those quarantined, they are allowed to return after 14 days: vaccination or revaccination is offered them, but it has not been largely accepted. From 1877 to 1891 inclusive it appears that 183 persons were thus quarantined, and 103 patients were treated in the smallpox hospital. Of 14 persons quarantined in 1887 two developed smallpox, and of 39 quarantined in 1888, three developed smallpox.

481. Leicester suffered severely from smallpox in 1872, 346 deaths having been registered as caused by it. Two deaths from that disease occurred in 1873, but no other until 1877, when there were six, and one in the following year. The next year in which smallpox deaths were registered was 1881. There were two in that year, and five and three in the following years. No other death took place until 1892 and 1893, in which years the fatal cases numbered 21.

Prior to 1875 the vaccination laws were well observed in Leicester. In that year the number of children born who were unaccounted for was only some 4 per cent. Since then there has been, as we have seen, a marked and progressive decline in the number of vaccinations, especially since 1883, until at the present time 80 per cent. of the children born remain unvaccinated.

482. The borough hospital for infectious diseases was erected in 1871–2 outside the town; though within the last few years houses have been built in proximity to it. It appears to have been with Dr. Crane, the Medical Officer of Health in 1875, that the quarantining the inmates of an infected house, in addition to isolating the patient, originated. His successor, Dr. Johnston, established it in 1877 as a regular system. He was aided in this, after 1879, by the notification of infectious diseases then rendered compulsory by a private Act which Leicester, anticipating most other towns, obtained in that year. Dr. Johnston reported that up to 1884 the spread of smallpox from imported cases had been arrested in twenty instances by the means he adopted.

His successor, Dr. Tomkins, though, like his predecessors, regretting the increasing disuse of vaccination, bore testimony in his annual reports to the efficacy of the measures adopted in Leicester, and expressed his opinion that had such a system been in force at Sheffield in 1887 it would not have suffered in the way it did.

483. In 1892 smallpox became prevalent in different parts of England, especially in Lancashire and Yorkshire. Many of the large provincial towns suffered, and Leicester amongst them. There were in 1892–3, 357 cases of smallpox in Leicester, of whom 21, or 5·8 per cent., died. 193 households were invaded, containing 1234 persons. The first importation was by a tramp, whose disease, passing unrecognised, caused infection at a common lodging-house and at the workhouse. 11 other importations of the disease by tramps occurred in the course of 1892–3. When the first cases were removed to the hospital the fever wards were full of children suffering from scarlatina, and others, convalescent from that disease, were lodged in a neighbouring pavilion. It is not surprising that a number, amounting in all to 13, of the scarlatinal children caught smallpox, some of these apparently from contact with a child who, during quarantine, developed a scarlatinal rash, and later an eruption, which was at first erroneously thought to be chicken-pox. The children from the fever wards were sent home in October, 1892, but six of them were re-admitted to hospital

with smallpox within a fortnight. From this time onward the whole of the hospital was devoted to smallpox cases, and to quarantined persons. It was, however, soon found impossible, for lack of accommodation, to remove all the inmates of the infected houses to the quarantine wards at the hospital; and from May, 1893, onwards, quarantine was superseded by a system of daily visitation and inquiry.

484. An analytical study of the incidence of smallpox on 193 households, containing 1234 inhabitants, shows that in the 170 instances in which the first or only case of smallpox was removed to hospital, 85 cases occurred among the 915 other inmates, or 9·2 per cent. In the 23 instances in which the first or only case of smallpox remained at home, 42 cases occurred among the 126 other inmates, or 33·3 per cent. Both in the vaccinated and the unvaccinated a far greater proportion of the inmates were attacked when the first case remained at home than when removed to hospital.

The influence of promptitude in removal upon the development of secondary cases is shown by the following facts. In 120 of the 170 houses from which the first or only case of smallpox was removed, there were no further cases. Removal had been effected on or before the fifth day of attack in 60 per cent. of the cases so removed. In the remaining 50 houses out of the 170, one or more further cases of smallpox occurred. Removal had been effected on or before the fifth day in only 38 per cent. of the first cases occurring in these houses.

485. The evidence derived from the complex conditions which obtained at Leicester during the outbreak of 1892–3, is inconclusive as to the relative merits of quarantine in hospital or supervision of the exposed at their homes. The influence of prompt isolation of the patient appears to overshadow any superior efficacy the one method may have had over the other.

486. Leicester suffered less than many of the other large towns which have been invaded by smallpox during recent

years, both in the number of cases and in the number of deaths. In connection with this, however, a point to which we have already called attention must be borne in mind. The disease was remarkably slight there in its fatality, even as regards those who, by reason of their age, could not be affected by the change of practice in relation to vaccination. Dr. Priestley, the Medical Officer of Health, claims, in his report to the Sanitary Committee for 1893, that it was by reason of the energetic methods adopted that the disease had been prevented running riot through the town. His claim may be well founded. At all events, the experience of Leicester affords cogent evidence that the vigilant and prompt application of isolation, &c., even with the defects which were brought to light during the recent epidemic, is a most powerful agent in limiting the spread of smallpox. It is true that the system and appliances which appeared adequate for some years failed to prevent a serious outbreak of smallpox in 1892–3. We think its value was none the less real. We shall consider the matter further when we come to review the whole of the evidence on the subject of isolation and notification.

487. The system of isolation has been adopted more or less completely in many provincial towns, and has there proved of value.

At Sheffield, during the epidemic of 1887–8, there was no compulsory notification, though a voluntary system of notification by medical men had been in vogue since 1885. Only one-fourth of the 32 cases of smallpox known to have occurred during the first three months of the epidemic were thus notified. Though the proportion of notified cases increased as the epidemic progressed, it is evident that during the most important period the system must be regarded as having failed. The borough hospital in Winter Street, which for a considerable period was the only hospital in use, did not provide adequate accommodation for patients, and became overcrowded ; moreover, being in proximity to a densely populated area, it became the means of spreading the disease. Cases of smallpox were accordingly treated in buildings or huts in connection with the Sheffield and Eccles-

hall Unions' Workhouses, and the disease spread to inmates of the workhouses. Nevertheless, evidence is forthcoming from Sheffield of the great advantage to individual households of early removal of first cases. Dr. Barry says :

"The advantages arising to individual households from the early removal of smallpox cases to hospitals were clearly seen in the earlier months of the epidemic. From its commencement to the middle of July, during which period, with comparatively few exceptions, all cases of smallpox which came to the knowledge of the Health Department were at once removed to hospital, it was exceptional to have a recurrence of the disease in the same household. After the middle of July, in consequence of the insufficiency of hospital accommodation, a large and increasing proportion of smallpox cases had to be treated in their own homes, and multiple cases in families became of frequent occurrence.

"The beneficial effect upon groups of households and districts of the early removal of cases to hospital is evident from the following notes with regard to the sub-districts of South Sheffield, Attercliffe, and Upper Hallam, all districts at a considerable distance from the hospital.

"Smallpox was introduced into South Sheffield in July, during which month two persons living in different houses contracted the disease. Both cases were at once removed to hospital. During August two more houses were invaded, and the cases were similarly dealt with. No fresh cases occurred in this district till October, when the disease was again introduced, and in consequence of the want of accommodation in the hospitals, cases had to be treated at home. During this month 25 households were attacked, and from this time onwards the number of fresh households affected rapidly increased.

"Smallpox was introduced into Attercliffe in the third week in July, and the person who had contracted the disease was at once removed to hospital. No further case occurred in this district until in the fourth week in August a house situated in a different part of the district to that last mentioned became affected. In consequence of the want of accommodation in the hospital, it was two or three days after the development of the disease before this case

could be removed, and in the following fortnight six new cases occurred, of which three were in the same house as the person above referred to. Of the three cases in fresh houses, two were removed to hospital and one was treated at home. In the following fortnight two fresh houses in the same neighbourhood were invaded, and from this time cases occurred more frequently. In October there were 11 new cases, in November 24, in December 67, in January, 1888, 140, in February 150, and in March 170, only a small proportion of these later cases being removed to hospital.

"In Upper Hallam the first case of smallpox was reported to have occurred on June 18th. This was at once removed to hospital, as was also a second case which occurred on July 1st. No further cases were reported to have occurred in this district till September 20th, when there was a case which was also at once removed to hospital. From that date till December 29th, when the disease was re-introduced, no more were reported to have occurred in the district."

The experience gained in 1887–8 has borne fruit; in 1889 Sheffield adopted the Compulsory Notification Act, and when smallpox broke out there in 1892–3, all cases were promptly removed to the new hospital at Lodge Moor, four miles from the centre of the town and in an isolated position. So convinced is the medical officer of the need for isolating those attacked that he is in favour of insisting on removal in any case. Moreover, provision has been made at Lodge Moor for isolating members of infected families or others who have been exposed to infection, and quarantining them for 15 days. 18 persons were thus quarantined in the outbreak of 1892–3. To these measures and to the influence of the epidemic of 1887–8, when 6088 persons suffered from smallpox, of whom 589 died, as well as to the numerous cases of re-vaccination, is ascribed the non-extension of the disease in 1892–3. Sheffield had obeyed the vaccination laws better even than the average of large towns. Had there been prompt removal of first cases to adequate and suitable hospital accommodation in 1887, it is in the highest degree improbable that the disease would have run riot as it did. It is important to notice that the rapid spread of the disease at the commencement of the

epidemic of 1887–8 seems to have been due to the fact that some of the early cases were of so mild a character that they passed unobserved.

488. At Halifax in 1893, owing to inadequacy of accommodation, an attempted quarantine of infected households at the hospital broke down, the disease was spread from common lodging-houses, and invaded the poorer portions of the town, and was especially prevalent in the neighbourhood of the smallpox hospital.

489. At Bradford the fever hospital has on many occasions since 1874 afforded isolation for smallpox cases, and effectually prevented its spread in the borough. It was formerly in an isolated situation, but houses have now been built close to the walls of the hospital grounds, and in these there was a special incidence of the disease in 1893. Owing to the prevalence of scarlet fever, the accommodation for smallpox proved inadequate, and a temporary hospital was erected at Scholemore. Unfortunately a fire broke out here in October, 1893, necessitating the removal of the patients, and causing a further extension of the disease as well as seriously dislocating hospital isolation. Quarantining was only attempted on a small scale at Bradford, in a house accommodating four persons.

490. Without entering into further details, we may state that the advantage of hospital isolation has been felt in Glasgow, Leeds, and other towns.

491. We have already directed attention to the fact that it was, practically speaking, not until 1871 that hospital accommodation was provided in London, which rendered possible the removal from their homes of persons suffering from smallpox, and we have detailed the measures adopted from time to time for that purpose.

As these facilities were augmented, the proportion of cases treated in the Metropolitan Asylums Board's hospitals steadily increased :

Years.	Number of deaths from smallpox registered in London, or (of London residents) in the Metropolitan Asylums Board's hospitals situated outside London.	Number of deaths from smallpox in the Metropolitan Asylums Board's hospitals.	Deaths in Metropolitan Asylums Board's hospitals—per cent. of total deaths.
1871–2	9,643	3,020	31
1881	2,373	1,431	60
1893	206	180	87

The deaths shown by the table in the last of these years are not those which occurred in the hospitals during that year, but the deaths of patients who during that year were admitted to the hospitals. This does not, however, detract from the importance of the figures as evidence of the great increase in the proportion of smallpox cases treated in the hospitals.

492. The Royal Commission to which we have referred, in their Report made in July, 1882, contrasted the amount of smallpox in London with that which had occurred in England generally. It will be well to bring such a comparison down to the present time, and to notice the features which it presents.

The following table affords a comparison between the mortality in London and that in England and Wales with the metropolis excluded, the deaths being those from smallpox to every 100,000 living. The figures are taken for the five years 1838–42, and from 1847 onwards in decennial periods, the figures for the years 1843–6 not being procurable.

—	Mean annual deaths from smallpox to every 100,000 living.	
	England and Wales, excluding London.	London.
1838–42	54·5	77·1
1847–56	23·6	34·6
1857–66	20·0	26·8
1867–76	22·5	41·9
1877–86	3·3	27·4

493. It will be seen that during the second and third periods there was a great reduction of mortality both in England, excluding the metropolis, and in London; though it must be remembered that 1838–42 includes 1838, in which there was a considerable epidemic. The great epidemic wave of smallpox which swept over the country in 1870–71, and which made itself felt in almost every part of Europe, naturally produced a sensible effect on the mortality of the next decennium, but it is to be noted that its effect was much more serious in London than outside the metropolis. The mortality there, though raised higher than in the previous decennium, did not reach the point at which it stood in the decennium before that. In London, on the other hand, the mortality largely exceeded that of the two previous decennia. Again, it is to be observed that though in the next decennium the mortality fell, both in England generally and in the metropolis, the fall was very different in its extent; outside the metropolis it was vastly greater than within it. It is only since the year 1885 that the condition of London has been at all comparable as regards the amount of smallpox mortality with the rest of the country. The corresponding figures for the years 1887–94 to those given above are as follows:

—	England and Wales, excluding London.	London.
1887–94	2·0	1·0

494. In the Report of the Royal Commission of 1881, already alluded to, suggestions were made with regard to notification and isolation which have since been largely carried into effect. As we have said, it was considered proved that the existing smallpox hospitals had caused a spread of the disease in their neighbourhood. We cannot but think that this may in some measure account for the greatly increased mortality from smallpox in London during the 1871–2 epidemic as compared with the rest of the country. It is true that the statistics relating to England and Wales

outside the metropolis include those of other large towns where the same evil was present, but it probably did not exist then in so aggravated a form, and the effect may be neutralised by the statistics relating to smaller towns and rural districts with which they are combined. This idea has been suggested to us, as the result of the inquiry, how it has come about that whilst the metropolis, in the decennium 1867–76 and again down to 1885, compared so unfavourably with the rest of the country, the condition has since that date become so entirely changed? We think it is impossible to attribute this change to vaccination. There is no reason to suppose that the position of the metropolis in respect to vaccination has, since the year 1885, become superior to the rest of England and Wales; rather the other way, as the decrease in infantile vaccination has been greater during the last few years than in the rest of England and Wales. The change, therefore, must be due to some other cause.

495. The hospitals which, in the opinion of the Commissioners, were propagating the disease in their neighbourhood, were in operation down to July, 1882, when their report was made. In 1877 and 1878, and again in 1881, smallpox was epidemic in London to a considerable extent.

We have stated in detail in paragraph 471 the steps which were taken by the Metropolitan Asylums Board in consequence of the recommendations of the Royal Commission. It will be seen that the intra-urban hospitals still continued in use, and that complaints were made in 1884 that they were spreading smallpox in their vicinity, although the number in each of them was not allowed to exceed 50. In October, 1884, this number was reduced to 25. It was not, however, until 1885 that the system now in operation was inaugurated, and all cases of smallpox were treated in hospital ships. It is impossible not to be struck with the fact that it is since the year 1885 that the metropolis has presented so satisfactory an aspect as regards smallpox mortality. The facts to which we have been calling attention certainly seem to point to the conclusion that this has been due to a system of isolation, well organised and ad-

ministered, the beneficial effect of which is no longer neutralised by a spread of the disease from the hospitals in which the isolation is carried out.

Upon the whole, we think the experience of London affords cogent evidence of the value of a sound system of isolation in checking the spread of smallpox.

496. The experience of isolation systems in Australia is interesting and worthy of special notice, because whilst in this country the quarantining of persons who have come in immediate contact with those suffering from smallpox has only been possible with the consent of the persons whom it was proposed to subject to quarantine, in Australia their removal to a place of isolation has been made compulsory.

497. Australia, by virtue of its geographical position, and the consequent separation by long sea voyage from infected ports, enjoyed for a long time a sort of natural isolation. Thus Hirsch, in his 'Historical and Geographical Pathology,' vol. i, pp. 133–4 (1881), remarks :

"The continent of Australia up to 1838 had enjoyed an absolute immunity from smallpox ; towards the end of that year the disease appeared at Sydney, having been imported probably from China ; it lasted, however, only a short time, and remained absent from the continent until 1868. In that year it was introduced into Melbourne by a ship, and again it spread only to a slight extent, and quickly died out. By a rigorous inspection of ships on their arrival, it has been found possible to prevent subsequent importations, a notable instance of prevention having occurred in 1872. Tasmania has hitherto quite escaped the disease ; so also has New Zealand, where an importation of it in 1872 was prevented by strictly isolating a vessel that had arrived with smallpox on board."

In New South Wales, Dr. MacLaurin, who has been President of the Board of Health since 1889, informed us that the Government act on the assumption that smallpox is an exotic disease, and that every case must have come from outside the colony, and it is therefore dealt with under a quarantine Act of William IV, originally instituted for

dealing with cholera. By an Act passed in 1882, notification of smallpox was made compulsory on medical men and householders under heavy penalties. At Sydney notification of smallpox is followed up by the compulsory removal of the patient, and all persons who have been in the house with the patient to the quarantine station at North Head. This station is 670 acres in extent, and situated on the peninsula at the mouth of Sydney Harbour, and is seven miles from the Health Office, with which there is telephonic and telegraphic communication. The persons are conveyed to the station by a steamboat comfortably fitted expressly for the purpose, and no difficulty has been experienced in effecting their removal. It was, in Dr. MacLaurin's opinion, by carrying out this practice of isolation and quarantine that "the epidemic of 1881–82 was suppressed," and smallpox "has never become epidemic since this plan has been adopted." The persons who have been in the house with the patient are detained 21 days in quarantine from the date of the last possible contagion. Should a case of smallpox arise among them, those who had been in contact with such infected person would be detained for a further period of 21 days, and so on. To facilitate this the exposed persons are distributed in separate groups within the station. They are allowed to receive letters or parcels, &c., and a telegraph operator is employed, "whose special business it is to work the telegraph at their request." "Reasonable compensation is given by the Government for loss;" and there are heavy penalties under the original Act whereby the quarantine is secured. The station is, according to Dr. MacLaurin, "a pleasant place to stay in, and everything is done that can be done to make the people comfortable; they have nothing whatever to do, and are free from all care, and they can spend the day pleasantly enough; but they do not like it." No one, however, raises any objection to the Sydney system; "the people are all very sensible about it." In all Australian towns the same system is carried out as strictly, with the result that there was not a case of smallpox in Australia on the 5th February, 1890; and Dr. MacLaurin is of opinion that the risk of dying of smallpox in Australia is smaller

than in any other part of the world. As regards vaccination :—In New South Wales it is very little practised ; there is no compulsory Act, and though medical opinion is in favour of it, an opinion shared by Dr. MacLaurin, it is not likely that a compulsory Vaccination Act could be passed or would be tolerated. The proportion of young persons in New South Wales who are not vaccinated is accordingly very large ; probably much more than half of those under ten years of age are unvaccinated. Although Dr. MacLaurin favours vaccination and respects it highly, he is satisfied that the system of isolation as supervised by him is perfectly successful. As President of the Board of Health he considered it his business to produce extinction of the disease ; he does not consider vaccination a sufficiently absolute protection for such purpose ; and he is "fully of opinion that the only way in which you can bring to an end an outbreak of smallpox, that is to say, to bring it under control, and not leave it to work itself out, is by notification and isolation. Of course in any small community, if you let the disease in it will work itself out in time, because all the susceptible people will have had it ; but the only way in which you can absolutely control an epidemic of smallpox is by a system of notification and isolation."

498. Smallpox has never been epidemic in Western Australia. Only one case has occurred within the last 31 years, and that was an imported one ; quarantine was carried out, and no infection occurred ; the immunity from the disease is mainly at least due to isolation. Before 1879 vaccination was not generally practised, a great majority of those born in the colony were unvaccinated ; in that year a compulsory Vaccination Act was passed in consequence of Sir H. Ord and Dr. Waylen's representations, and in consequence of reports of smallpox in other colonies, and not on account of the existence of smallpox in Western Australia.

In Tasmania there was a compulsory vaccination law, but it was found to be inoperative because no one was appointed to conduct the prosecutions, and it has now fallen into desuetude. The same system of isolation and quarantine

is exercised as in the other Australian colonies. Smallpox was for the first time introduced into Tasmania in 1887, and although preparations for isolation were inadequate, the disease was soon stamped out. Communication between Launceston and Melbourne was temporarily suspended, and to this precoution the non-invasion of Victoria was attributed. The particulars of this, the first introduction of smallpox into Tasmania during the history of that colony, are to be found in a report to the Central Board of Health by Mr. A. Mault, dated November 17th, 1887. The origin of the outbreak is not clear, but it was presumed to have been imported, probably by a ship from China, into Launceston. The earliest case reported to the Local Board of Health was on September 23rd, though it appears that earlier cases had passed unnoticed, or had been notified as measles. 33 cases in all occurred, every one of which was traced to direct infection to the first case. By September 27th a temporary hospital had been erected, and thither patients and suspects to the number of 72 were removed. The last case appeared on October 13th. Other persons who had been to the infected houses were isolated in their houses and watched. Only four of the 47 persons quarantined at the station were attacked. The clothing was burnt, and very thorough disinfection of the infected houses was carried out, and the dead were interred in a special cemetery. The other colonies were communicated with, and quarantine, at first unduly rigid and afterwards relaxed, was practised against ships proceeding from Tasmania. Although vaccination had been nominally compulsory in Tasmania, it was estimated that two-fifths of the population were unvaccinated.

499. We have no difficulty in answering the question, what means other than vaccination can be used for diminishing the prevalence of smallpox? We think that a complete system of notification of the disease, accompanied by an immediate hospital isolation of the persons attacked, together with careful supervision, or, if possible, isolation for sixteen days of those who had been in immediate contact with them, could not be of very high value in diminishing the prevalence of smallpox. It would be necessary, however, to bear

constantly in mind as two conditions of success, first, that no considerable number of smallpox patients should ever be kept together in a hospital situate in a populous neighbourhood; and secondly, that the ambulance arrangement should be organised with scrupulous care. If these conditions were not fulfilled, the effect might be to neutralise or even do more than counteract the benefits otherwise flowing from a scheme of isolation.

500. When we turn to the other branch of the inquiry, how far such means could be relied on in the place of vaccination, we find ourselves involved in questions of a much more complicated nature. We have little or no experience to fall back upon. The experiment has never been tried. The nearest approach to a trial of it has probably been in Australia. But even in the parts of that country to which we have alluded the population has not been entirely unvaccinated, though there has been a large unvaccinated class amongst it. Moreover, in applying the experience of Australia to this country two things must be borne in mind. In the first place, smallpox has only appeared from time to time, introduced from without at one or other of the ports of the country, and the several colonies of which Australia is composed are of great territorial extent, with few large centres of population. In this country smallpox is always present in some part of it. There has not been a single year without several deaths from the disease. Large centres of population are numerous, and the intercourse between them constant. In the several colonies of Australia the number of ports is not great, the vessels which enter them are comparatively speaking not numerous, and the ports from which they arrive are many days' voyage distant; and there are careful arrangements for quarantining vessels to exclude disease. The shipping which enters English ports is of vast quantity, and passengers are brought in large numbers from the continent of Europe, not only daily, but it may almost be said hourly; the voyage, too, is but brief. The other matter to be remembered, is that part of the Australian system is the *compulsory* removal to quarantine for 21 days of those who have been in the house with the patient, in

addition to the transfer of the patient himself to a hospital. There can be no doubt that such a system, if completely carried out, would be of the highest efficacy. But it is obvious that in this country the practical difficulties of working such a scheme in the large towns would be really insuperable, to say nothing of the difficulty of procuring legislative sanction for it.

501. In order to maintain in efficiency the primary essential condition of a system of isolation, viz. the immediate isolation of a person attacked by the disease, it is requisite to have a hospital always ready with sufficient accommodation for the reception of all such cases, and there are no means of estimating what extent of accommodation will suffice to meet at all times the necessities of a particular town. It is certain that the disease spreads more rapidly, its contagion seems to operate more actively, at one time than at another. If an epidemic affects a locality, the preparations made for the isolation of smallpox cases, which have proved to be fully adequate in ordinary years, may turn out to be quite inadequate. It is impossible at once to provide the needed hospital accommodation. If the cases are to be removed to a hospital at all, the massing of large numbers together, in itself a means of spreading the disease, might prove inevitable. We have only to look at what happened at Leicester to see how suddenly the necessities of the case may outrun the preparations made for isolation. Moreover, although the vaccination of children had been neglected in Leicester for many years, it would be quite a mistake to regard it as an unvaccinated town. The population over 20 years of age were probably well vaccinated, and a large proportion of those between 10 and 20 years of age were vaccinated persons. More than half even of those between 7 and 10 years of age at the commencement of the epidemic must be placed in the same category.

502. The question we are now discussing must, of course, be argued on the hypothesis that vaccination affords protection against smallpox. Who can possibly say that if

the disease once entered a town, the population of which was entirely or almost entirely unprotected, it would not spread with a rapidity of which we have in recent times had no experience, or who can foretell what call might then be made on hospital accommodation if all those attacked by the disease were to be isolated? *A priori* reasoning on such a question is of little or no value.

503. We can see nothing, then, to warrant the conclusion that in this country vaccination might safely be abandoned, and replaced by a system of isolation. If such a change were made in our method of dealing with smallpox, and that which had been substituted for vaccination proved ineffectual to prevent the spread of the disease (it is not suggested that it could diminish its severity in those attacked), it is impossible to contemplate the consequences without dismay.

To avoid misunderstanding, it may be well to repeat that we are very far from underrating the value of a system of isolation. We have already dwelt upon its importance. But what it can accomplish as an auxiliary to vaccination is one thing; whether it can be relied on in its stead is quite another thing.

504. Even admitting fully the protective effect of vaccination, it does not, in our opinion, diminish the importance of measures of isolation or dispense with their necessity. We think that steps should be taken to secure a more general provision for the isolation of smallpox patients than exists at present. We have already called attention to the fact that mischievous results are likely to follow the use as a smallpox hospital of a building situate in a populous place. We think that wherever it is placed, it should have sufficient space around it to enable the Sanitary Authority to add rapidly to the accommodation by the erection of temporary buildings.

505. Sanitary Authorities are now sometimes reluctant to provide isolation hospitals. We think that, on a petition by a prescribed number of the ratepayers in a sanitary district, the Local Government Board, if satisfied that hospital accommodation ought to be provided, should have power to make an Order for such provision.

506. Power should, in our opinion, be conferred on Sanitary Authorities to give compensation for loss of wages, and generally for any expenses occasioned either by the isolation of patients, or persons who have come in contact with them, or such supervision of them as is necessary, whether in hospital or elsewhere.

507. Our attention has been drawn to the circumstance that outbreaks of smallpox have not unfrequently had their origin in the introduction of the disease to common lodging-houses by tramps wandering from place to place. In view of this we make the following recommendations:

(i) That common shelters which are not now subject to the law relating to common lodging-houses should be made subject to such law.

(ii) That there should be power to the local authority to require medical examination of all persons entering common lodging-houses and casual wards to see if they are suffering from smallpox, and to offer a reward for prompt information of the presence of the disease.

(iii) That the local authority should have power to order the keeper of a common lodging-house in which there has been smallpox to refuse fresh admissions for such time as may be required by the authority.

(iv) That the local authority should be empowered to require the temporary closing of any common lodging-house in which smallpox has occurred.

(v) That the local authority should have power to offer free lodgings to any inmate of a common lodging-house or casual ward who may reasonably be suspected of being liable to convey smallpox.

(vi) That the Sanitary Authority should give notice to all adjoining Sanitary Authorities of the occurrence of smallpox in common lodging-houses or casual wards.

(vii) That where the disease occurs the Public Vaccinator or the Medical Officer of Health should attend

and vaccinate the inmates of such lodging-houses or wards, except such as should be unwilling to submit themselves to the operation.

508. In connection with the subject with which we have been dealing we may advert to the suggestion that the vaccination and the sanitary authority should in all cases be identical. It has been pointed out that whilst the isolation of patients in hospitals and otherwise is provided for by the sanitary authority, the extent of the provision requisite to deal with the outbreak of an epidemic of small-pox may depend upon the degree in which the vaccination laws have been enforced. More hospital accommodation may be required where vaccination has been neglected than where the vaccination laws have been complied with. It is contended that sanitation and vaccination, concerning as they both do the health of the people, should be under the jurisdiction of a single authority, and that the sanitary authority is the appropriate one for that purpose. Indeed, the advantage of placing in the same hands the supervision of vaccination and of the other measures designed to prevent the spread of disease are so great and so obvious that the proposal to do so deserves most serious consideration. Under present arrangements, however, such a proposal raises very great difficulties. Whilst in England and Wales there are only 648 vaccination authorities, the sanitary authorities exceed 1700 in number. Moreover, whereas in some cases a borough (the council of which is the sanitary authority) comprises parts of several unions, in other cases a single union contains within it many sanitary authorities. For example, the borough of Bristol includes the whole of one union and parts of two other unions. On the other hand, the Huddersfield and Halifax unions contain no less than 25 and 19 urban sanitary districts respectively. Many other instances might be cited to show that it would be impracticable to vest the sanitary and vaccination duties in all cases in a single local authority without a complete recasting of our present areas of local administration. We are not in a position to devise a scheme which would accomplish either wholly or partially the desired result. At the same time we

fully recognise the importance of achieving it as far as possible, and we should regard with favour such changes as would render the amalgamation of the vaccination and sanitary authorities feasible, or indeed any steps taken in that direction, even although they should only partially effect the object in view.

(*E.*) *As to whether any alterations should be made in the arrangements and proceedings for securing the performance of vaccinations, and, in particular, in those provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the Law.*

509. From the views which we have expressed on the subject of vaccination, and on the absence of proof that any practical alternative exists which could be relied on to accomplish the same results if vaccination fell into disuse, it follows that we are of opinion that the State ought to continue to promote the vaccination of the people. Nor are we prepared to recommend that the State should cease to require vaccination, and trust entirely to a voluntary adoption of the practice.

510. It will be well at the outset of our discussion of this subject to advert to the nature of the compulsion at present employed, to secure compliance with the law requiring that children should be vaccinated within a limited time after their birth.

When vaccination is spoken of as "compulsory," it is only meant that in case a child is not vaccinated as prescribed by law, a pecuniary penalty is imposed which may be followed by distress and imprisonment. The liability to this penalty no doubt in many cases leads to vaccination, where it would otherwise be neglected; but whether the penalty be enforced once or repeatedly, it does not compel vaccination in all cases. If a parent is content to pay the penalty his child remains unvaccinated; there have been not a few cases in which repeated penalties have been thus paid. Vaccination could be made really compulsory only by

taking the child from the parent and vaccinating it against his will, if he would not himself procure or consent to its vaccination. It is necessary to bear this distinctly in mind in considering the modifications of the present law which have been proposed. There may be some who would consider it both justifiable and expedient for the State thus to take the matter into its own hands, and effectually ensure the vaccination of the entire population. We do not stop to inquire whether it would be justified in adopting such a method, for we are satisfied that no such measure, if proposed, would have any chance of acceptance; indeed, few even of the most ardent advocates of vaccination have hitherto made such a proposal. Nor, again, do we think that a proposal to substitute for the pecuniary penalty now imposed a more stringent form of punishment, such as imprisonment, would have any greater chance of acceptance.

511. If, then, the only kind of compulsion available is to attach some pecuniary penalty to the neglect of vaccination, the question to be determined is what form of law, based on penal provisions of this description, will secure the largest number of vaccinated persons. That this is the question to be solved has, we think, sometimes been lost sight of. In our Fifth Report we recommended that repeated penalties should no longer be enforced. Our proposal has been subjected to criticism on the ground that it would enable a person to break the law, and to purchase immunity by the payment of a single penalty. But there is no difference in principle whether immunity can be purchased by the payment of one or of several penalties. If the cases in which vaccination was omitted would be less in number, supposing one penalty only were enforced instead of many, the end which the Legislature sought to accomplish in enacting the compulsory vaccination law would be better attained. To secure that vaccination should be as wide-spread as possible is, we think, the object to be kept primarily in view. When an answer has been found to the question, what scheme which is within practicable limits would best conduce to that end, the form which legislation should take will, in our opinion, have been ascertained.

512. We have alluded to the mode in which pressure is at present exerted to secure vaccination; we must now direct attention to the machinery by which the law is enforced.

It is for the local authorities to put the law in motion. In England and Wales the guardians have been in the main an elected body, necessarily reflecting the views of those by whose votes they obtain their office. In some districts guardians have been elected from time to time solely because they have pledged themselves not to prosecute those who fail to have their children vaccinated. The enactments under which the guardians are the authority to enforce the vaccination laws contain no provision dealing with the case in which they neglect or refuse to do so. By a statutory Order made by the Local Government Board, the duty of enforcing these laws has been cast upon the guardians, and in the case of the guardians of the Keighley Union a *mandamus* was issued by the Court of Queen's Bench commanding them to perform this duty. In default of obedience they were committed to prison. After a short incarceration they were let out on bail. When subsequently brought before the Court to answer for their contempt, they were released on entering into their own recognisances to come up for judgment when called upon. By the terms of the recognisance they were bound while guardians to do nothing in disobedience to the Vaccination Acts, or to cause their operation to be in any way disturbed. The proceeding proved, however, quite ineffectual so far as vaccination was concerned. The same course was pursued afterwards as before. There is no process open for constraining guardians to enforce the vaccination law except a *mandamus* resulting in their committal to prison in case they refuse to obey the command of the Court. Experience has shown that when the guardians represent a local community opposed to vaccination this method of putting pressure upon them is inoperative to promote it.

513. We were anxious to learn to what extent the guardians in England and Wales had ceased to put the law requiring the vaccination of children in force. We accord-

ingly made inquiry of the guardians throughout the country. Answers were received from 620 out of the 648 unions. We found that the law was not being enforced in 122 out of these 620 districts; in 46 of the 122, however, the guardians based their action upon the fact that a Royal Commission had been appointed to inquire into the subject of vaccination, and had not yet reported.

514. The question then naturally arises whether the institution of proceedings against those who do not procure the vaccination of their children as required by law should be transferred from the guardians to some other authority, either universally or where the guardians refuse to prosecute. If such a change were made, the only alternatives would seem to be either to transfer the duty to some local authority having jurisdiction over a wider area, such as the County Council, or to vest it in the Local Government Board. We do not think it would be feasible to impose on the county councils the duty of enforcing the vaccination laws in cases where the local authorities neglected to do so. Such an arrangement would have the effect of bringing these councils at once into acute conflict with other local authorities exercising jurisdiction in different districts within the ambit of the several counties, and the practical difficulties involved in the scheme would obviously be great. If, then, any transfer to the county councils of the duty now incumbent on the guardians or other local bodies were deemed expedient, we think it would be found requisite to transfer the duty altogether. It is not certain that a change of the nature we are considering would lead on the whole to a more complete enforcement of the law relating to vaccination. In some cases it might do so; but, on the other hand, it might happen that the majority of a county council would be elected to support an anti-vaccination policy, in which case the area within which the vaccination laws were not enforced might be extended. It is to be anticipated, too, that any proposal to cast the duty of enforcing vaccination upon county councils would encounter serious opposition.

515. The other alternative would be to vest the duty of prosecuting in the Local Government Board. It may be

that it is already empowered to cause prosecutions to be instituted against defaulters. Article 17 of the Local Government Board Order of October, 1874, provides that the vaccination officer of any district shall take any such proceedings as may be necessary under the Vaccination Acts in any case in which the Local Government Board may direct him to do so. But if this article confers the power to direct a vaccination officer to prosecute, notwithstanding that the guardians, whose officer he is, have resolved not to enforce vaccination penalties, no such power has ever been exercised in spite of the fact that for years past the guardians in many districts have allowed the compulsory vaccination laws to fall into abeyance. Under these circumstances it is, to say the least, very doubtful whether the Local Government Board would without direct parliamentary sanction, even if they have the power to do so, adopt the new departure of overriding the action of the local authorities, to say nothing of the practical difficulties which such a course would present. It would not, in our opinion, be practicable altogether to withdraw the duty of proceeding against defaulters from local authorities and to vest it in the Local Government Board. If that Board is to discharge the duty at all, its intervention would have to be confined to cases in which the local authority failed to enforce the law. Even if the duty of the Local Government Board were thus limited, the proposal might not improbably have to encounter the resistance not only of those who were opposed to compulsory vaccination, but of some who, though having no leaning in that direction, were keenly sensitive to any interference by a Government department with local authorities. The situation is by no means the same as if from the outset the law had been enforced by the Local Government Board. Moreover it does not seem certain that, if the scheme we have been discussing were embodied in an Act of Parliament, it would achieve the desired end. In some parts of the country the action of the central body would most certainly be obstinately and even violently resisted, and that resistance would probably obtain the aid and sympathy of many who regarded the question of vaccination with indifference. The result might well be not more but less vaccination than at present.

516. Before proceeding to state the conclusions which we draw from the considerations to which we have been adverting, it is desirable to point out that it is only within a limited area in England and Wales that vaccination has fallen into more or less disuse. The vaccination of the great majority of children is secured, where the practice is not voluntarily adopted, by the penalty to which the law subjects those who neglect to have their children vaccinated. It is not found necessary, in a large number of cases, to put the law in motion or to enforce the penalty; the mere liability to it is in general sufficient. It is worth giving the figures from a return presented to the House of Commons in 1890. It shows that since July, 1879, to the date up to which the return was made, the number of persons fined in England and Wales for breach of the vaccination laws was 11,408. Of these 115 were imprisoned. The date up to which the return extends is not stated, but it covers a period of at least ten years; so that the average number of fines per annum was about 1100.

517. The necessity of proceeding to enforce a penalty, or at all events repeated penalties, arises for the most part in cases where the parent objects to have his child vaccinated, and not in cases of mere neglect or indifference. It is important to consider how it has come about that whereas in many parts of the country there is no serious objection to vaccination, in other places the objection is so acute and wide-spread that the opponents of the practice are enabled to elect guardians pledged to abstain from enforcing it. We believe that it has largely arisen from the attempt to compel parents to vaccinate their children who conscientiously believe that vaccination is of little or no advantage as a protection against smallpox, and that it involves a serious risk of injury to the health of the vaccinated child. Symptoms of injury following vaccination, and really or apparently connected with it, have occurred in the case, it may be, of an elder child of the same parent, or in the case of a neighbour's child; this immediately arouses hostility to vaccination, and induces the parent to resolve that his child shall remain unvaccinated. If the attempt be made

to compel a parent, in this attitude of mind, to have his child vaccinated, it meets with determined opposition, and, where the penalty is repeated, the hostility is often intensified without any progress being made towards the vaccination of the child. Such a parent has often become a focus of hostility to the vaccination laws; his neighbours and friends take his side; he is regarded as a martyr; and he and they frequently become active agitators against the vaccination laws. There are, indeed, a central association and local associations which advocate the abolition of compulsory vaccination, and denounce the practice altogether; but it is local circumstances, such as we have described, which stimulate the creation of these local associations and give them their vitality, and which add to the force of the central association. It is often said that the opposition to vaccination is the work of agitators. This may be true; but the agitation, though it may be afterwards intensified from without, in our belief has its origin almost invariably in a particular locality. It is this, we think, which accounts for the phenomena to which we have called attention, that the acute opposition to vaccination is confined to a limited number of localities, and that it seems usually to spread from a local centre.

518. In Scotland the vaccination laws have encountered little opposition, the great majority of the children born are vaccinated. The enforcement of the law is there in the hands of the parochial boards. Some of these boards would seem to have exercised a discretion in subjecting defaulters to prosecution, though the exercise of this discretion does not appear to have been in strict accordance with the law. They have been in the habit of omitting from the list sent to the vaccination officer those whose names appeared on the registrar's list, but who had been already prosecuted, so that no further proceedings were taken against them. The practice of the parochial boards in this respect has not been uniform. We have no means of judging to what extent this discretion has been exercised, but we gather that it has been so to a considerable extent. The Scotch vaccination law and its methods of procedure,

no doubt, tend to discriminate in a manner unknown in this country between the cases in which the failure to procure vaccination was due to hostility to the practice on the part of the parent, and those which resulted from mere neglect or indifference. In England and Wales, where a parent does not procure the vaccination of a child by a private medical practitioner, or take it to a vaccination station for the performance of the operation by a public vaccinator, this may equally arise from objection to vaccination or from neglect or indifference. There is nothing tending to show what influence has led to the failure to procure vaccination. In Scotland the case is different. If a child is not vaccinated within the time specified in the notice received from the parochial board, the official vaccinator attends at the abode of the parent prepared then and there to vaccinate the child unless consent to do so is refused. Its vaccination is therefore at once secured, unless the parent interposes a refusal, or the official vaccinator sees grounds, either on account of the condition of the child or of local circumstances, to postpone the operation. The reason given by the parent for a refusal to permit vaccination is embodied in a certificate, and is thus in all cases recorded.

The statements we have made refer to the condition of things existing until 1894, when the Local Government Act was passed. The duties and powers of the parochial boards were by that Act transferred to the district councils, and the duties and powers of the Board of Supervision to the Local Government Board.

519. The details relating to defaulters in one half-year which were furnished us by Mr. Skelton are worth giving with some particularity. The half-year in question is that ending the 31st of December, 1892. The number of persons returned as defaulters is 6613. Of these there were returned as defaulters for the first time 4327, so that the balance of upwards of 2000 was brought forward from previous years. The number of children who had been vaccinated by the official vaccinator since the date of the list (prior to April, 1893, when Mr. Skelton's evidence was

given) was 1006. The number of children since the date of the list vaccinated by other medical practitioners was 1604. The number not vaccinated because they had died or left the parish or could not be found was 1833, and because of postponement certificates, 1178. The balance of 992 was made up as follows:—(*a*) children vaccinated but the certificates not transmitted, 207; (*b*) previous successful vaccination, 44; (*c*) insusceptible, 18; (*d*) undisposed of, cases being attended to (these had not been completed, the vaccinator not being in a position to state whether vaccination had been successful or not), 125; (*e*) isolated position of houses in severe weather making it difficult for the vaccinator to carry it out, 161; (*f*) illness or omission on the part of the inspector of the poor, 66; (*g*) postponed on account of epidemics in the locality, 46; (*h*) delay pending the report of the Royal Commission on Vaccination, 10; (*i*) refusal of parents, 50; (*k*) delay of parents, 35; (*l*) on account of ill-health, 39; (*m*) unaccounted for entirely, no reason given, 194.

520. The number of prosecutions during the half-year was 22 only. Of these 7 were for failure to transmit the certificate within the specified period, and 15 for refusal to allow the child to be vaccinated. Of those 15 there were 10 who were prosecuted for the first time, 4 who were prosecuted for the second time, and 1 who was prosecuted for the fifth time. These figures are instructive. In view of those quoted in the preceding paragraph, the number of prosecutions appears remarkably small, and it does not seem possible to doubt that the practice of the different parochial boards must have varied greatly.

The figures above given relate to the same half-year as that to which the figures in the preceding paragraph relate, and would have reference to some cases which had occurred in the previous half-year. The figures for the subsequent half-year, when some of the cases of default referred to in that paragraph would be dealt with, are as follows:—the number of prosecutions during the half-year was 11 only; of these 4 were for failure to transmit the certificate, and 7 for refusal to allow the child to be vaccinated.

521. We are now in a position to state the reasons which led us to recommend that repeated penalties should no longer be enforced; indeed, they will be apparent from what we have already said.

We do not doubt that the fact that penalties may be repeated secures in some cases the vaccination of children who would otherwise remain unvaccinated; but we believe that the irritation which these repeated prosecutions create, when applied in the case of those who honestly object to have their children vaccinated, and the agitation and active propaganda of anti-vaccination views which they foster in such cases, tend so greatly to a disuse of the practice, in the district where such occurrences take place, that in the result the number of children vaccinated is less than it would have been had the power of repeated prosecution never existed or been exercised. This seems to us to be the crucial question. A law severe in its terms, and enforced with great stringency, may be less effectual for its purpose than one of less severity and which is put in force less uncompromisingly. When this is the case it cannot be doubted that the law which appears less severe is really the more effective. The ultimate object of the law must be kept in view. The penalty was not designed to punish a parent who may be considered misguided in his views and unwise in his action, but to secure the vaccination of the people. If a law less severe, or administered with less stringency, would better secure this end, that seems to us conclusive in its favour.

522. If, then, we cannot look with any certainty to a change of the authority whose duty it is to enforce the law as a means of securing vaccination in those districts where it has already fallen into disuse, it obviously follows that every endeavour should be made so to frame and to administer the law that opposition to vaccination should not spread to other districts, and that it should cease or diminish in those parts of the country where it at present prevails.

It is to be hoped that our Report will stimulate belief in the efficacy of vaccination, that it will remove some misapprehensions, and reassure some who take an exaggerated

view of the risks connected with the operation, as well as lead to a more ready enforcement of the law by local authorities.

523. Why, it is asked, should not vaccination cease to be compulsory altogether, and be left to the free choice of parents? If no penalty were attached to the failure to vaccinate, it is, we think, certain that a large number of children would remain unvaccinated from mere neglect on the part of their parents, or indisposition to incur the trouble involved, and not because they thought it better in the interest of their children. This appears to us to be a complete answer to the question. If we be right in the conclusions which we have expressed on the subject of vaccination, it is better for the child, and better for the community, that it should be vaccinated than that it should remain unvaccinated. A parent can have no inherent right, under the circumstances to which we have alluded, to prevent or neglect its vaccination. The difficulty arises where the parent abstains from procuring the vaccination of the child because he believes it will be detrimental to its interests. We do not intend to discuss the abstract question whether the State is entitled in such circumstances to compel the parent, in spite of this conviction, to see that his child is vaccinated; we will assume for the purpose of our argument that it is so entitled. This leaves untouched the question whether, on the whole, such a course conduces to a better vaccinated condition of the people. We think that ardent advocates of vaccination have not always borne in mind the practical consequences of an attempt to enforce the law in such cases. They have maintained that no one has a right to set up his judgment against that of the community embodied in the statute law, and to refuse in consequence to render that law his obedience; they have therefore opposed any relaxation of the laws relating to vaccination, assuming that because in particular instances it might lead to children remaining unvaccinated who would otherwise be vaccinated, it must necessarily result in a diminished number of vaccinations. We believe that this assumption is not well founded. It has been apparently forgotten that under the

existing law a penalty, or even repeated penalties, can be paid without difficulty by a man only moderately well-to-do, and that a poorer man will constantly pay, or suffer a distress of his goods, or go to prison, rather than allow his child to be vaccinated. We think these ardent advocates have not always been the wisest friends of vaccination, and that there would have been more vaccinated persons if the law had been enforced with more discretion.

524. After careful consideration and much study of the subject, we have arrived at the conclusion that it would conduce to increased vaccination if a scheme could be devised which would preclude the attempt (so often a vain one) to compel those who are honestly opposed to the practice to submit their children to vaccination, and, at the same time, leave the law to operate, as at present, to prevent children remaining unvaccinated owing to the neglect or indifference of the parent. When we speak of an honest opposition to the practice, we intend to confine our remarks to cases in which the objection is to the operation itself, and to exclude cases in which the objection arises merely from an indisposition to incur the trouble involved. We do not think such a scheme impossible.

525. It must of course be a necessary condition of a scheme of this description that it should be such as would prevent an objection to the practice being alleged merely as an excuse to save the trouble connected with the vaccination of the child. We may give the following as examples of the methods which might be adopted. It might be provided that if a parent attended before the local authority and satisfied them that he entertained such an objection, no proceedings should be taken against him. Or, again, a statutory declaration to that effect before any one now authorised to take such declaration, or some other specified official or officials, might be made a bar to proceedings. We do not think it would be any real gain to parents who had no conviction that the vaccination of their children was calculated to do mischief, to take either of these steps rather than submit them to the operation.

526. It is in England that the point we have been recently discussing is of most practical importance, but if our suggestion were adopted the change should, of course, be made in all parts of the United Kingdom.

527. We are quite conscious that the proposal we have made will be regarded by some as a retrograde step in the cause of vaccination. We do not believe that it would prove to be so in practice. Too blind a confidence is sometimes reposed in the power of an Act of Parliament. It is thought that if the law be only sufficiently stringent and inflexibly enforced the desired end is sure to be attained. There is, however, abundant experience to the contrary. When that which the law enjoins runs counter to the convictions or prejudices of many members of the community it is not easy to secure obedience to it. And when it imposes a duty on parents the performance of which they honestly, however erroneously, regard as seriously prejudicial to their children, the very attempt to compel obedience may defeat the object of the legislation.

At the same time we think it would be well to make the change a temporary one in the first instance, say, for a period of five years, and that in the meantime its effects should be carefully watched.

528. Whatever diversity of opinion there may be on the point just discussed, there can be no doubt that every effort should be made to remove the causes which now render vaccination burdensome and tend to its discouragement, and that such changes in our vaccination system should be made as would be calculated to promote vaccination and diminish the number of cases in which the practice is neglected.

529. We have no hesitation in expressing the opinion that the Scotch system is in some respects, to which we have called attention, superior to that prevailing in the other parts of the United Kingdom. Its great merit lies in this, that the defaulters are sought out at their own homes by the official vaccinator and then and there vaccinated, by

him, unless the parent objects or circumstances render postponement desirable. There is obviously a great difference between this system, and one in which the vaccinator does not present himself at the child's home, but the child must be taken by the parent to a vaccination station, and when the next step after default is a prosecution. We cannot doubt that the former is far better calculated than the latter to secure the vaccination of the people. On the other hand, it appears to us a defect in the Scotch plan that gratuitous vaccination can only be procured for those who are not pauper children by making default,—in other words, by failing to obey the law. For this reason we think it would not be wise to adopt that plan in England and Wales without modification. We think that where a certificate of successful vaccination is not received within the prescribed time a notice should be served upon the parent that a public vaccinator will attend on a day named for the purpose of vaccinating the child, unless the operation has been already performed, and that the only offence rendering the parent liable to prosecution should be the refusal to permit the child to be vaccinated by the public vaccinator when he attends for that purpose. The adoption of such a scheme would render the burden much less than it is where the child has to be taken to a public station, not only for the purpose of vaccination, but again at the end of a week for inspection. The vaccination and inspection would both take place at home. It is not only by rendering vaccination less burdensome that this would be an improvement, it would also, as we have already pointed out, tend to diminish risks of injury which arise when a child is conveyed twice to a public station, and which would be absent if the vaccination and inspection always took place at home. Moreover, the vaccination would be more certain to be postponed when the condition of the child or local or family circumstances make this course desirable. This again would diminish the risk attending vaccination. Further, the proposed change would render it easier to introduce the requirement, already alluded to, that the progress of the vaccination should be more carefully watched than it is at present, and any mistakes made in the treatment of the

vaccination vesicles would be likely to be more early discovered and more readily remedied.

530. We think it would tend to promote vaccination if every duly qualified medical man who vaccinated a child successfully were entitled to the fee which is now paid only to the public vaccinator. We are aware that there is evidence tending to show that in England and Wales vaccination has been, speaking generally, more efficiently performed by public vaccinators than by other medical men. But the experience of Scotland, where only a minority of the vaccinated are dealt with by official vaccinators, shows that such a system may be a satisfactory one. Safeguards might be provided against inefficient vaccination. The fee should only be allowed in cases where the certificate showed that the child had been vaccinated in accordance with the rules prescribed by the Local Government Board. And if every duly qualified practitioner who vaccinated a child successfully could claim the appointed fee, it could properly, and ought, we think, to be made a condition that all children so vaccinated should be liable to inspection, and that the fee should not be allowed when the examination did not appear to have been performed in accordance with the prescribed rules. It would not, of course, be necessary to make such an inspection in every case; a limited number of test cases would suffice. The liability to inspection would prevent abuse, and under proper regulations we think the system might be an improvement on any at present existing.

531. We have already said that in our opinion the State is bound to see that a supply of calf lymph is within the reach of every vaccinator. Though this recommendation has been dictated by other reasons, its importance in connection with the alteration in our vaccination system which we are now considering is apparent. It would, at all events, go far to secure that any defect in vaccination should not result from imperfection in the lymph employed.

532. The change which we propose in our vaccination

system would no doubt render it somewhat more costly,[1] but the difference would not be very great, and, in our judgment, no

[1] In connection with this it may be well to indicate the approximate annual cost at the present time in England and Wales of the practice of vaccination, so far as that cost is borne by the public funds.

Out of the sums received from poor rates and in aid of poor rates, the expenditure for vaccination fees and expenses during the last ten years for which the figures are available was as follows:

Year ending Lady-day.	Expenditure.	Year ending Lady-day.	Expenditure.
	£		£
1886	93,475	1891	84,295
1887	92,116	1892	83,146
1888	90,487	1893	83,709
1889	91,254	1894	87,981
1890	85,606	1895	82,961

Out of sums voted by Parliament or, more recently, out of county funds and charged to the Exchequer Contribution Account, there has been the following expenditure in respect of awards to public vaccinators:

Year.	Amount of awards to Public Vaccinators in Unions inspected during the years specified in the last column.	Year.	Amount of awards to Public Vaccinators in Unions inspected during the years specified in the last column.
	£		£
1885	17,687	1890	15,638
1886	18,964	1891	13,625
1887	17,313	1892	15,289
1888	17,974	1893	14,286
1889	15,042	1894	12,171

The cost of the National Vaccine Establishment, which is a department of the Local Government Board, has been as follows:

Year.	Cost.	Year.	Cost.
	£		£
1885–6	3,635	1890–1	3,263
1886–7	3,537	1891–2	3,193
1887–8	3,385	1892–3	3,081
1888–9	3,453	1893–4	3,019
1889–90	3,188	1894–5	3,205

And there has also been, of course, the cost of the administration of the

consideration of cost ought to be allowed to stand in the way of any improvement which would render the operation less burdensome or diminish its risk. It is only fair to demand this if vaccination is to remain compulsory. In this connection we may observe that the public vaccinator ought, in our opinion, to be under an obligation to afford medical attendance without cost to the parent in all cases in which the vaccination does not run an ordinary course, and owing to supervening illness such attendance becomes necessary. Whether the fee paid in respect of vaccination should be fixed at such an amount as to cover this extra attendance in the exceptional cases in which it would be requisite, or whether it should be the subject of special compensation, is a matter of detail on which the Local Government Board is in a better position to form an opinion than we can be. Inasmuch as compulsory vaccination is justified on the ground that it is not a matter which concerns alone either the parent or the vaccinated child, we think a provision such as we have indicated would be both just and reasonable.

533. We have already adverted to the importance which we attach to re-vaccination. It has been suggested that the operation should be made compulsory by law. We are quite alive to the protective value of general re-vaccination. At the same time we are not insensible of the difficulties necessarily involved in rendering it compulsory. It is, comparatively speaking, easy in the case of infants to ascertain whether the law requiring vaccination has been complied with. The constant movement of the population would render it much more difficult to ascertain whether, at the more advanced age at which it would become applicable, a law providing for compulsory re-vaccination had been observed. Again, it is impossible to leave out of sight the effect that such an extension of the present compulsory law might have in intensifying hostility, where it at present exists, and even in extending its area; though if our recommendations, especially that which exempts from penalty those who honestly object to the practice, were adopted, this objection

Vaccination Acts by the Local Government Board, the amount of which cannot be accurately stated.

would be much diminished. After full consideration of the question we are, however, deterred by the considerations to which we have adverted from proposing that re-vaccination should be made compulsory. At the same time, in view of the great importance of re-vaccination, we think it should be in every way encouraged. If an adequate fee were allowed in every case of successful re-vaccination, by whatever medical man it was performed, we think there would probably be a large extension of the practice. We think steps should be taken to impress on parents the importance of having their children re-vaccinated not later than at the age of twelve years. We recommend further that when smallpox shows signs of becoming epidemic special facilities should be afforded both for vaccination and re-vaccination.

534. We think that notification of smallpox should everywhere be compulsory, and whenever the disease showed a tendency to become epidemic, a notice should be served by the sanitary authority upon all persons in the neighbourhood who would be likely to come within the reach of contagion, urging them to submit to vaccination or re-vaccination, as the case might be, if they had not been recently successfully vaccinated or re-vaccinated; and attention should be called to the facilities afforded for their doing so. Attention should also be called to the importance of avoiding contact with persons suffering from the disease, or coming into proximity to them, and of avoiding contact with any person or thing which may have become infected. It is important to notice that, even where vaccination has been neglected, there is great readiness to submit to it in the presence of a threatened epidemic; a large number of vaccinations are then obtained willingly and without opposition. Whenever a sanitary authority has received notification of a case of smallpox, we think the fact should be at once communicated to the vaccination authority of the district in which the case of the disease has occurred.

535. We desire to call attention again to the recommendation, which we made in our fifth interim report, that persons committed to prison by reason of the non-payment

of penalties imposed under the vaccination laws should no longer be treated as criminals. We stated in that report our reasons for this recommendation, to which we still adhere. If, however, the changes in the compulsory provisions of the vaccination laws which we have suggested were adopted, the matter would lose much of its importance.

536. We have had the misfortune to lose by death several of our colleagues. Mr. Bradlaugh died at an early stage in the inquiry, and was replaced as a member of the Commission by Mr. Bright. Sir William Savory and Dr. Bristowe died at a later period, and their places have not been filled. We are deeply sensible of the valuable assistance in the preparation of this Report of which death has thus deprived us.

537. We cannot conclude our labours without expressing our sense of the great assistance we have derived from the zeal and ability with which our Secretary, Mr. Ince, has discharged his duties.

All which we humbly submit for Your Majesty's gracious consideration.

(Signed) HERSCHELL.
JAMES PAGET.
CHARLES DALRYMPLE.
W. GUYER HUNTER.
EDWIN H. GALSWORTHY.
JOHN S. DUGDALE.
M. FOSTER.
JONATHAN HUTCHINSON.
FREDERICK MEADOWS WHITE.
SAM. WHITBREAD.
JOHN A. BRIGHT.

BRET INCE,
Secretary.

August, 1896.

NOTE APPENDED BY SIR W. GUYER HUNTER AND MR. HUTCHINSON, DISSENTING FROM THE TERMS OF THE CONSCIENCE CLAUSES, AND ALSO RECOMMENDING COMPULSORY RE-VACCINATION.

The undersigned do not find themselves able to go so far in recommending relaxation of the law as is implied in paragraphs 524, 525, 526, and 527. We think that in all cases in which a parent or guardian refuses to allow vaccination, the person so refusing should be summoned before a magistrate as at present, and that the only change made should be to permit the magistrate to accept a sworn deposition of conscientious objection, and to abstain from the infliction of a fine.

We are also of opinion that, in spite of the difficulties as set forth in paragraph 533, a second vaccination at the age of twelve ought to be made compulsory.

W. GUYER HUNTER.
JONATHAN HUTCHINSON.

NOTE APPENDED BY MR. WHITBREAD, MR. BRIGHT, DR. COLLINS, AND MR. PICTON, OBJECTING TO ALL FORMS OF COMPULSION.

We the undersigned desire to express our dissent from the proposal to retain in any form compulsory vaccination. (Paragraphs 509, 511, 522, 523, 524, 525, 529.)

We cordially concur in the recommendation that conscientious objection to vaccination should be respected. The objection that mere negligence or unwillingness on the part of parents to take trouble might keep many children from being vaccinated would be largely, if not wholly, removed by the adoption of the Scotch system of offering vaccination at the home of the child, and by providing for medical treatment of any untoward results which may arise.

We therefore think that the modified form of compulsion recommended by our colleagues is unnecessary, and that in practice it could not be carried out.

The hostility which compulsion has evoked in the past toward the practice of vaccination is fully acknowledged in the Report. In our opinion the retention of compulsion in any form will in the future cause irritation and hostility of the same kind.

The right of the parent on grounds of conscience to refuse vaccination for his child being conceded, and the offer of vaccination under improved conditions being made at the home of the child, it would in our opinion be best to leave the parent free to accept or reject this offer.

SAM. WHITBREAD.
JOHN A. BRIGHT.
W. J. COLLINS.[1]
J. ALLANSON PICTON.[1]

[1] NOTE.—Dr. Collins and Mr. Picton sign the above note of reservation, though they have not signed the Report.

APPENDIX I.

Detailed discussion by the Commission of—

(*A*) *The "Variolous Test;" and*

(*B*) *Woodville's cases.*

(*A*) *The "Variolous Test."* (*See* §§ 13—17 *of Report.*)

In the practice of inoculation for the smallpox it was observed in successful and normal cases that on the second and third day the part of the skin into which the smallpox matter had been inserted became red and hard, that is to say, inflamed. On the fourth day the beginning of a vesicle might be detected. On the following days the vesicle became more distinct, and surrounded by an area of redness, the so-called efflorescence.

On the sixth day some pain in the axilla was usually felt, and on the seventh or the eighth day general disturbances constituting the "eruptive fever" or "fever of invasion" made their appearance. This lasted some two or three days, subsiding soon after the appearance, towards the end of the tenth or on the eleventh day, of pustules on the surface of the body other than the seat of inoculation. This eruption of pustules usually lasted about three days. When these pustules began to suppurate, as they usually did on the thirteenth or fourteenth day, a secondary fever, whose intensity was greater or less according as the pustules were many or few, was observed.

The eruptive fever was regarded as an indication, the

axillary pain being a premonitory symptom, that the virus had "affected the system." The changes taking place previous to the eruptive fever were held to be purely local; the matter inserted produced in the inoculated spot a series of events, but these were limited to seat of inoculation, and did not spread beyond. So soon as the local changes caused by the virus began to produce effects in the body at large, those effects were revealed first by the eruptive fever, and later on by the eruption of pustules. And it was held that immunity towards smallpox was only secured when the "system," the body at large, had thus been "affected;" the mere local changes were not sufficient to produce immunity.

When the pustules made their appearance in parts of the body distant from the inoculated spot, even though they might be few, no doubt was entertained but that the system had been affected and immunity secured. But at times no eruptive pustules at all made their appearance, and the evidence of the system being affected was less conclusive.

So far as can be judged from the writings of Sutton and Dimsdale, these inoculators (in cases rendered doubtful by the absence of eruptive pustules) trusted to the eruptive fever as the sign that the system had been affected. And the same may be said of Gatti, for though he has been accused (Bromfield, *Thoughts*, &c., p. 44) of "giving the disorder" (*i. e.* inoculating) "without the sensible effect of either fever or eruption," his own writings do not bear this out; he says (*Nouvelles Réflexions*, 1767, p. 91), "The third period is marked by the fever;" and again (p. 94), that the fever "is the sole constant symptom of the action of the virus on the total of the animal economy;" and again, in treating of the fever attendant on the suppuration of the eruptive pustules, which he insists is not the special and immediate effect of the variolous virus, he points out that when the pustules are few the suppurative fever is slight, and that when there are no pustules it is absent, and "the malady is finished at the same instant that *the eruptive fever has ceased.*"

Of course the symptoms of the eruptive fever formed, even at the best, a far less definite sign of the system being

affected than did the eruption of pustules; and it is highly probable that inoculators in cases where eruptive pustules were absent may have at times mistaken a feverish disorder of intercalated origin for the specific eruptive fever. On the other hand, anomalous cases occurred in which the signs of the "system being affected" did not include a distinct fever,—that is to say, a rise of the temperature of the body. Dimsdale (*The Present Method of Inoculating*, 6th ed., 1772, p. 47, et seq.) dwells on and gives the details of several of such cases. He speaks of them as instances of "a short way of having the distemper," and insists on the variety and irregularity of the symptoms manifested by such cases. Briefly put, in such cases the local effects advance prematurely, the whole malady being sometimes over in a week; there is no eruption, or a slight and imperfect one, and the signs of "the system being affected" are limited to chilliness, slight pains, giddiness, and a slight headache, "sometimes attended with a feverish heat, but often without any." Elsewhere he speaks of a peculiar offensive smell of the breath as being specially diagnostic of the system being affected. When Dimsdale first met with these cases he doubted whether the disease had been really taken, but, in a manner which will presently be described, satisfied himself that it had. He goes on to say that his subsequent experience enabled him from the early appearances of the local effects "to foretell in two or three days after the operation when the disease will pass in this slight way."

Thus the inoculator was not satisfied that the disease had really been given unless the local effects were accompanied by an eruption of pustules, or, failing them, by an eruptive fever, or at least by certain symptoms which he accepted as signs that the system had been affected.

When an inoculator met with a case in which from an absence of eruptive pustules, or from the symptoms of the eruptive fever being ill defined, or from the presence of other anomalous features, it seemed to him, or indeed to the patient, doubtful whether the disease had really been given, it was not an uncommon practice to repeat the inoculation. If the second inoculation failed, the result

was taken as evidence that the first inoculation had really given the disease, and so conferred immunity; a conclusion sometimes further tested by a third inoculation, or even several in succession. If the second inoculation succeeded, that is produced a local pustule, with eruptive fever and an eruption of pustules (the latter, however, being possibly absent), or at least with symptoms indicating that the system had been affected, the result was taken to show that the first inoculation had not really produced the disease. In this way the "variolous test" came into use as applied to smallpox inoculation, and was subsequently applied to cow-pox inoculation.

The experience of those inoculating persons who had previously had the smallpox, either by inoculation or in the natural way, disclosed that the local changes induced at the seat of inoculation might be various. Sometimes the wound healed immediately without any further effects at all. Sometimes inflammation set in, in some cases slight, in other cases considerable, and lasted for a variable time. Sometimes such an inflammation even when considerable was not specific, being merely what we should now call septic; and this, perhaps, was especially likely when the method of inoculation was by an incision, and not as in the improved method by a puncture. Sometimes the inflammation was specific, and a vesicle passing on to a pustular condition, and then presenting the ordinary characters of a smallpox pustule, was formed. But in such cases, so long as there was no eruptive fever, or no special constitutional disturbances (it is needless to say so long as there was no eruption of pustules), it was concluded that, though the local changes might be regarded as specific, the existing immunity of the subject prevented the system being affected. All through the literature of inoculation a strong contrast is insisted on between the local changes, however specific, and the constitutional effects. On the one hand, local changes of so distinctly a specific character, that matter taken from the pustule produced "a perfect smallpox" when inoculated into other subjects, might go on in a subject suffering only from the local changes, and not having really the disease as shown by his afterwards "passing through the smallpox

either in the natural way or by inoculation" (Harrison, *Med. Phys. Jl.*, vol. v, p. 109). On the other hand, a subject rendered immune towards the disease by a previous attack might have, as the result of inoculation, specific local changes giving rise to a pustule of specific smallpox nature, the immunity being shown by the absence of constitutional effects; in this relation is quoted the common experience that variolous pustules (due to accidental or intentional inoculation) might appear on smallpox nurses, who had previously had smallpox, pustules distinctly variolous, but entirely local, and unaccompanied by any "affection of the system."

So far as can be judged from the literature of the subject, the ordinary experience of applying the variolous test to persons who had previously had smallpox, either by inoculation or in the natural way, was that the effects of the test inoculation were limited at most to a little inflammation, dying away in at longest a few days: the experience of a definite pustule being formed appears to have been rare. And in all cases the inoculators seem to have had little hesitation in deciding whether immunity was secured or not, being guided, in the instances in which the local changes were considerable, by the presence or absence of symptoms indicating that the system had become affected.

The following passage from Dimsdale illustrates how, amid the varying results presented by the "variolous test," the inoculator saw his way to conclude whether the test showed immunity or no. The cases of "the short way of having the distemper" were subjected by Dimsdale, in his early experience, while he was as yet in doubt whether such cases had really had the madady or no, to the test on the one hand of severe exposure to contagion, and on the other hand of a second inoculation. He describes the results of the second inoculation thus (op. cit., pp. 50, 51):

"Upon the second inoculation, however, the incised parts are commonly inflamed for a day or two, just in the same manner as I have, in numerous instances, found them to be as well in those who, though certain of having had the smallpox in the natural way, have submitted to be inoculated merely for the experiment's sake, that the result might

be observed, as in others who, being doubtful whether they have had it or not, have been inoculated in order to be satisfied. But in all such cases the parts soon became well; nor did any of those appearances which have been described as the constant attendants on inoculation, as pain in the head, giddiness, marks of infection on the arm, &c., ensue; nor can they ever be produced upon a person who has had the smallpox before, either in the natural way or by inoculation; and therefore it cannot with reason be suggested, that the patients, whom I suppose to get through the disease in the very slight manner above described, may possibly have had the smallpox unobserved in some former part of their lives."

That is to say, Dimsdale recognised a clear distinction between the maximum effects of inoculation applied to one who had had the smallpox before, the inoculation being then the variolous test, and the minimum obvious effects of inoculation consistent with its really giving the disease in one who had not had it before.

And the inoculators of cow-pox appear to have used the variolous test for immunity in the same way and under the same conceptions as did the old inoculators of smallpox.

(*B*) *Woodville's cases.* (*See* §§ 18—23 *of Report.*)

As we have stated in the body of our Report (§ 21), "Of the cases recorded by Woodville in his Reports, the larger number, about three-fifths, presented an important and, as compared with Jenner's cases, a new feature, in that, in addition to the changes taking place at the seat of inoculation, and constituting what Woodville called the 'cow-pox tumour,' which may here be spoken of as the 'vaccine vesicle,' an eruption over the body of a greater or less number of pustules was observed. These eruptive pustules occurred in the very first cases; of the seven cases inoculated from the cow, four, and of the five inoculated from the dairymaid, four had such pustules; and their appearance is recorded again and again in the series, down to the case which appears last but one in the tabular statement forming

part of the Reports. Moreover an eruption of pustules is described in certain of the cases of which accounts were published at about the same time by Pearson and many others. In some of these cases the lymph used was supplied from the Smallpox Hospital by Woodville or Pearson."

Those eruptive pustules (we may put on one side the cases in which an eruption of mere papules or pimples is recorded) possessed characters very different from those of the pustule, vesicle, tumour, or whatever it be called, which was produced at the seat of inoculation with the cow-pox matter. The latter presented certain features which distinguished it from the smallpox pustule, whether of inoculation or eruption. These distinctive features had of course to be learnt by the early vaccinators, since they were dealing with a new subject. Jenner in his first case described the local appearances of inoculation with cow-pox matter as being much the same as those resulting from inoculation with smallpox ; but he soon learnt to distinguish between the two, as did also Woodville, Pearson, and the rest. Woodville had certainly arrived at this knowledge by the time he wrote his Reports, for he there describes in detail the differences between the two, and probably had reached it in his early, if not in his very first cases. So sharply did he, at a later date, recognise the differences that he is able to speak of a smallpox pustule making its appearance within the margin of a cow-pox tumour.

The eruptive pustules, on the other hand, though they sometimes presented variations especially as regards suppuration, were, as a rule, identical in external characters with those of smallpox. And it may at once be admitted that they were actually the pustules of smallpox—were indications that the individual on whom they appeared was suffering from smallpox.

It is true that in the practice of vaccination, cases have from time to time occurred in which a general eruption of vesicles has been observed under circumstances which seem to preclude all possible coincident smallpox ; in such cases the eruption appears to be a manifestation of the vaccine virus itself, and the cases are spoken of as those of "generalised vaccinia." The evidence available is not sufficient to

show whether any of the eruptions recorded by Woodville and others were of this nature, and it may be taken for granted that at least the majority of cases were not, but were the eruptions of smallpox.

Woodville himself did not at first recognise that these eruptive pustules were those of smallpox; he for some time thought that, in spite of their likeness to those of smallpox and their unlikeness to the local cow-pox tumour, they were a natural part of the cow-pox disease; and under this idea he spoke of the cow-pox disease resulting from the inoculation of cow-pox matter, as being mild or severe according to the less or greater number of eruptive pustules, the mildest being those in which there were none at all; he used the terms commonly applied to the smallpox disease resulting from the inoculation of smallpox matter. Pearson also (*Med. Phys. Jl.*, vol. iii, pp. 97 and 399) held similar views; but later on Woodville certainly, and Pearson apparently as well as all the others arrived at the conclusion which Jenner had reached much earlier, that the pustules in question did not truly belong to cow-pox, but were really those of smallpox, and that the cases in which they occurred were cases of cow-pox and smallpox occurring together.

Woodville, during the period of his belief that the eruptive pustules were a natural part of the cow-pox, repeatedly made use for inoculation of matter taken from the eruptive pustules; even in the second series of cases recorded in his reports many instances of this occur. Such cases must be regarded as simply cases of inoculated smallpox, and they were apparently early recognised as such, for they were soon stopped; the cases by which the practice of vaccination was carried on and made its way were cases in which the matter used had been taken from the cow-pox tumour at the seat of inoculation.

It being granted that the cases in which eruptive pustules appeared were cases marked by the presence of smallpox, the question arises, How did the introduction of smallpox take place?

Before discussing this it will be useful to call to mind what is known concerning the behaviour of cow-pox and smallpox occurring at the same time on the same person.

The evidence, which subsequent to the date of the events now being treated of has accumulated in support of the view that vaccination confers immunity towards smallpox, shows, at the same time and by similar lines of argument, that the establishment of immunity is not brought about until some days after the act of vaccination, after the introduction into the skin of the vaccine virus; and further, that the effects of the nature of immunity towards smallpox, produced by vaccine, are dependent on the relations as to time of the introduction into the system of the two viruses. Thus it is admitted that if vaccination be performed during the period of incubation of smallpox, that is to say, the period elapsing between the introduction by contagion into the system of the virus and the occurrence of the first symptoms, or at least after the third day of that incubation, the vaccine is powerless to confer immunity.

Similarly the evidence which showed that at a certain date after vaccination the attempt to produce smallpox by inoculation failed, also showed inoculation could bring about smallpox if done in the early days of vaccination, not later than the eighth or ninth day.

Hence, as has been repeatedly seen, under certain conditions smallpox and cow-pox may occur together at the same time in the same person.

Further, the evidence shows that the coincident presence in the body of the one disease does not affect the characters of the other; that, for instance, the coincident presence of smallpox does not modify the cow-pox, does not "variolate" the cow-pox, to use the word then employed. Thus, as Woodville himself points out (*Reports*, Crookshank, p. 148), if "on the same day a person be inoculated in one arm with the matter of the cow-pox, and in the other with that of the smallpox, both tumours preserve their respective characteristic appearances throughout the whole course of the disease." Indeed, he (*Observations*, p. 12) quotes the observation that if cow-pox and smallpox be inoculated at the same time into the same arm "within an inch of each other, so that on the ninth day the same efflorescence becomes common to both the local affections," matter from the cow-pox tumour produces the genuine vaccine disease:—"I am con-

vinced the matter thus taken would not be more liable to produce pustules or a less favourable disease than matter procured directly from the cow."

Woodville, moreover, relates an experiment in which he inoculated a number of persons with matter consisting of equal parts of cow-pox and of smallpox matter well mixed together. "In more than half, the local affection distinctly assumed the characters of the cow-pox; in the others it more resembled the smallpox, but in none of them was there much indisposition or many pustules." It is doubtful whether any great stress ought to be laid on this experiment, but it may at least be taken to show that when the two kinds of matter are introduced into the same spot of the skin, they do not produce a hybrid local affection partaking of the characters of both, but give rise either to one or to the other. Whether the fact that in the greater number of cases the result was cow-pox shows that the cow-pox matter is prepotent, or "takes" more readily, need not be considered here; and the evidence just given precludes the view that the mild character of the smallpox was due to any action of the cow-pox. Nor has subsequent experience brought to light any evidence as to the possibility of any such hydrid disease; the presence in the body of the one virus modifies the effect of the other virus, but not the nature of the virus itself. It is true that, later on, in 1827, one Guillou (*Journal Général de Médecine*, xcviii, p. 239), using lymph taken from a case of variola which had previously been vaccinated, and in which the disease appeared in the modified form known as "varioloid," not only produced local vesicles resembling those of vaccine and unaccompanied by eruptive pustules, but also carried the lymph through two other removes with the same results, and therefore maintained that the virus of the variola had, through the influence of the previous vaccination, been so affected as to assume the characters of the virus of vaccine. But a second attempt was not so successful, and his conclusions did not find acceptance. And, indeed, while the details given of his cases by Guillou are insufficient to determine whether the local vesicles had truly vaccine characters, the absence of eruptive pustules may be regarded

as being simply accidental, such an absence being possible though unusual.

The introduction of smallpox into Woodville's cases may have taken place in one of three ways:

(i) The cases either lived in the hospital or at least were brought to the hospital to be vaccinated, and so were much exposed to the contagion of smallpox. They might thus have caught smallpox at the hospital, or might indeed have caught it at their homes, and thus have suffered from natural or casual smallpox at the same time that they were undergoing cow-pox.

(ii) In several cases the patient was inoculated for smallpox very early after vaccination, and thus, as has been shown above, may have had the two diseases together.

(iii) The lancet used for introducing the cow-pox matter might have had adherent to it some smallpox matter left from previous use. Woodville states expressly in speaking of the first cases with pustules that the lancets supplied to him were said to be freshly ground; but experience has shown how easily in like cases error creeps in; even in these first cases, and probably still more in other later cases, where no special care is recorded as being taken, this means of the introduction of smallpox must be considered as *a priori* possible.

When we come to consider, in respect to individual cases, such facts as are recorded of their history, these do not seem adequate to form a sure judgment of the mode of introduction of the smallpox. In this relation a special interest attaches to the case of Collingridge, one of the seven cases vaccinated from the Gray's Inn Lane cow, and the one whose local tumour at the seat of inoculation supplied matter which was passed in succession through many persons, and was the origin of much of the lymph used or distributed by Woodville. For if the smallpox from which Collingridge obviously suffered shortly after she

was inoculated from the cow was due either to her being inoculated with smallpox on the fifth day after inoculation from the cow or to natural contagion, there is no reason whatever to doubt that the local effects produced by the inoculation from the cow was, as Woodville considered it, a cow-pox tumour,—that is to say, a vaccine vesicle; that the matter—lymph—taken from this local tumour was veritable cow-pox matter, and that the series of cases through which it was propagated were cases of cow-pox. But, on the other hand, if Collingridge's smallpox were due to the lancet by means of which the cow-pox matter from the cow was inserted in her left arm, having, in spite of precautions, still attached to it some smallpox matter, which smallpox matter was effective, the cow-pox matter failing, then it may be maintained, and indeed has been maintained, that the local effects on that arm, in spite of its presenting characters which led Woodville to call it a cow-pox tumour, was in reality a smallpox pustule, the matter taken from it was smallpox matter and not cow-pox matter, and the series of cases through which it was propagated were cases of smallpox, and not at all of cow-pox.

When the details of the history of Collingridge's case as recorded by Woodville are examined, it is found that they do not of themselves justify a clear decision as to how the smallpox was introduced; these details are as follows:

Collingridge was inoculated on the left arm with cow-pox matter. On the fifth day she was inoculated with smallpox matter on the right arm. On the eleventh day (sixth day of variolous inoculation) she "complains of headache and pains about the loins," signs of 'eruptive fever.' On the thirteenth day (eighth day of the variolous inoculation) "several pustules appear;" on the fifteenth day (tenth day of variolous inoculation) "more pustules are scattered" over the body; on the seventeenth day (twelfth day of variolous inoculation) "the number of pustules is from one to two hundred." Now, in the ordinary practice of inoculation with smallpox, the 'eruptive fever' began on the seventh, or more usually the eighth day, while the pustules made their appearance at the end of the tenth or beginning of the eleventh day, and usually continued to appear for

three days. Hence the 'eruptive fever' (on the sixth day) and the appearance of pustules (on the eighth) are very early if we suppose them due to the variolous inoculation on the right arm. On the other hand, both the 'eruptive fever' (on the eleventh day) and the appearance of the pustules (on the thirteenth) are very late if we consider them as due to smallpox introduced by the supposed cow-pox inoculation on the left arm. But too much stress must not be laid on these dates, since though the times given above are those quoted as the ordinary ones, it was admitted that the eruption, and the fever precursory of it, might appear at an earlier or at a later date. Dimsdale (Haygarth; *Inquiry*, page 23) states, "In the improved method . . . . . the eruptive fever in every instance within my experience commenced on some day from the sixth to the fourteenth, both inclusive." This is consonant with either of the views in question. It sometimes happened (Sutton; *The Inoculator*, page 118) that a few pustules appeared prematurely, especially near the inoculated spot, before the general eruption. The record on the fifteenth (tenth) day runs: "There are small pustules round the edges of the variolous tumour; more pustules appear scattered over the face, body, and limbs." If we are allowed to regard the first half of this sentence as a fuller description of the pustules spoken of in the preceding paragraph of the record as appearing on the thirteenth (eighth day), then these pustules would appear to be such premature pustules belonging to the inoculation round which they occurred, and the real eruption of pustules must be considered as those spoken of in the latter half of the paragraph. If this be so, the whole eruption clearly belongs to the inoculation on the right arm, and occurs at its proper time.

Suspicion of the left arm inoculation being really one of smallpox, and not, as Woodville thought, of cow-pox, is raised by the margin of the tumour being described on the eleventh day as "beset with minute confluent pustules" (at this epoch the distinction now generally made between pustule [with pus] and vesicle [with lymph] was not as yet made), a character common in smallpox, but at least rare in cow-pox. But against this may be urged that the same

tumour is described on the eighth day in the words "its form is perfectly circular," whereas the margin of a small-pox tumour on the eighth day should be irregular or jagged. Further, even on the thirteenth day the left arm (cow-pox) tumour is beginning to scab, though it ought to be, as the left arm (smallpox) tumour actually was, still in the vesicular stage, and still surrounded by an efflorescence, an area of redness, if we consider that day as marking the eruption of pustules due to the left arm inoculation; the scabbing is all the more premature if, as suggested, the pustules appearing on the fifteenth day are to be regarded as the real eruption. Lastly, it was the experience of inoculators of the smallpox, that when a second inoculation was made some days after a first one, the progress of the second was accelerated, so that it overtook the first, and thus the two reached the same phase together; nothing of this is seen in Collingridge's two inoculations, the development of each is independent of that of the other, as was recognised to be the case when a cow-pox and a smallpox inoculation were performed at the same time, or nearly the same time, on the same person.

The child Buckland, inoculated at the same time as Collingridge and with the same matter, clearly suffered from smallpox. Further, the history of the eruption of pustules on the tenth and eleventh day, and the appearance on the seventh day of two pustules near the inoculated spot, "premature" pustules, strongly suggest that the smallpox was introduced by the inoculation. Indeed, this view presented itself to Woodville himself, but he rejected it on learning that his lancets had been newly ground. It is indeed possible that Buckland took smallpox in the natural way, and the eruption taking place on the tenth day of inoculation was a mere coincidence: but the former view is the more probable; and if Buckland was thus given smallpox by mistake, the same mistake might very well be made in Collingridge's case.

Thus while some of the facts of Collingridge's case point to the first inoculation, others point to the second inoculation as having served for the introduction of smallpox; and even if the latter be considered as on the whole outweighing the former, they at least do not afford a conclusive

proof. The exact nature of the effect on Collingridge's left arm, called by Woodville a cow-pox tumour, must be determined by help of general considerations touching the history of the whole of Woodville's cases.

The view that Collingridge's case was in reality one simply of smallpox has been developed somewhat as follows:—The local effect produced by the virus used to inoculate Collingridge took on for some reasons or other characters like, but not absolutely identical with, those of cow-pox; the virus in other words "sported" so as to simulate cow-pox. Matter from this local pustule used to inoculate others, and then others again in succession, the matter being always taken from the local pustule, the inoculation being "arm to arm" preserved or rather increased its likeness to cow-pox, the local effect being after a while at least quite indistinguishable from that produced by true cow-pox. It was found, moreover, in many cases still further to simulate cow-pox in that eruptive pustules were absent. And by selecting mild cases, that is cases in which the eruptive pustules were absent or scarce, this feature of the absence of pustules was fixed, so that eventually absence of pustules was the ordinary result, pustules appearing on rare occasions only. Thus by selection what started as smallpox became indistinguishable from cow-pox. We have further to suppose that the modifications in the nature of the virus put on by the sport was limited to the local tumour. Matter from the local tumour produced a like local tumour, with or without an eruption of pustules; matter from the pustules always or almost always gave rise to eruptive pustules: the local tumour in these latter cases is not accurately described in the record, but in one case (140th) is spoken of as "having an angulated border,"—that is, having smallpox characters.

Support to this view in the way of analogy is furnished by the experience of Adams, who, starting with a variety of smallpox known at the time as the "pearly sort," succeeded in obtaining a local effect, which he describes as "having a vaccine appearance," which he was able by arm-to-arm inoculation to propagate, with preservation of its characters,

through several generations, and which in some of the cases further simulated cow-pox in the absence of eruptive pustules. He also described a second series with similar results. So far as it goes Adams' experience is to the point. But Adams' recorded cases are very few; and as Adams himself remarks of the cases, "They are not entitled to the degree of confidence as to the probability of retaining a permanent character which the cow-pox may claim, nor is there any proof that these vesicles are not infectious" (*On the Cow-pox*, page 158.) Both series suddenly came to an end.

Against the support afforded by Adams may be placed the fact that the wide experience of the inoculators of smallpox by the improved method during the latter part of the eighteenth century, affords no support to the view which we are discussing. The object of the improved method was, as has been said, to produce a mild form of smallpox, that is one with as few pustules as possible, but one nevertheless conferring immunity; and had either Sutton or Gatti, or any other inoculator, come across a strain of smallpox matter, which while conferring immunity could be propagated from arm to arm without eruptive pustules, they would, we may be sure, have made much of it. But the literature of the subject records nothing of the kind. Indeed, there is no evidence even that the practice of arm-to-arm inoculation tended to secure paucity or absence of eruptive pustules. The practice has indeed by some writers been said to be part of the "improved method;" but neither Sutton nor Gatti, in the instructions which they give as to their mode of procedure, put this among them. That it was certainly not an essential part of Sutton's ordinary practice, may be inferred from an incidental remark of his (*The Inoculator*, page 60), that on one day he inoculated 700 persons *from the same subject*. Dimsdale, again (*On Inoculation*, 6th edition, page 26), says, "It seems to be of no consequence whether the infecting matter be taken from the natural or the inoculated smallpox: I have used both, and have never been able to discover the least difference, either in point of certainty of infection, the progress, or the event; and, therefore, I take the infection from either as opportunity offers, or at the option of my

patients or their friends." He adds, however, "In all cases when I take matter from an inoculated person, it is from the place where it was inserted; as I am always sure to find infection there if the disease succeeds, and always of sufficient energy." Further, as an argument against arm-to-arm inoculation at all ensuring a paucity of pustules, Bromfield recounts (*Thoughts, &c.*, 1767, page 10) how, with matter which had been propagated by arm-to-arm inoculation through 14 generations, 20 children who had all undergone the same kind of preparation were inoculated at the same time; of these "some had the disease very mild and others rather severe."

Sutton, moreover, so far from expecting mild cases to produce mild cases, appears to have thought the opposite; for his work contains a remarkable passage (pages 58–9) in which, after stating that people in general, and even the majority of inoculators, limited themselves in the choice of matter for inoculation to the "good natural state of health of the subject from whom the matter is to be collected, preferring a mild benign sort to a copious, malignant, ill-conditioned species," he says, "I have my objections to inoculate those whom upon examination I rank under the class of unfavourable subjects, from such as have a very benign smallpox, or from those whose arm indicates such benignity:" by the former meaning apparently matter taken from a case in which the eruptions had come out, and therefore probably from a natural case; by the latter, matter taken from the local pustule at a time when the eruption was not yet out, the character of the local pustule indicating that the eruption would probably be a mild one. He believes such an inoculation would give more of the disease than an inoculation "from a malignant sort, or from those whose arms indicated such malignity." He even says, "I usually employ matter from an untoward stock."

Moreover, the history of the use made of Collingridge's lymph, as recorded in Woodville's Reports, does not show any selection of non-eruptive cases leading to a gradual elimination of pustules; the appearance of the pustules was irregular and fitful. Woodville, it is true, remarks that while matter taken from a case without pustules may give

rise to pustules in others, "yet it has much more commonly had the effect of exciting a milder disease than the matter of the (eruptive) pustules, or than that which was obtained from a patient who had the disease in a severe manner, as may be seen by an examination of the table." But though the table shows this clearly as regards the cases in which matter was taken from the pustules, or from cases which had been inoculated from the pustules, it does not show clearly any elimination of pustules in the series originating in Collingridge.

This will be evident from the following table, in which the matter from Collingridge is traced out. There is no obvious progressive elimination of pustules. Of the 122 cases, 54 (about 44 per cent.) are non-pustular; while the last four groups give 23 cases with 15 non-pustular (*i. e.* about 65 per cent.), the four groups just earlier give 29 cases with 11 non-pustular (*i. e.* about 38 per cent.), and the three groups just earlier give 30 cases with 14 non-pustular (*i. e.* about 47 per cent.). One of the best groups (that is, most free from pustules) is that from Bumpus, the second remove; one of the worst is that from Spooner, the last remove but one recorded, though Spooner was a milder (with fewer pustules) than Bumpus; and S. Timms, with no pustules, gives worse results than Platford, with a thousand—both equally removed from Collingridge. Matter from Bumpus, used outside the Hospital (namely, by Jenner and Marshall), gave only one or two pustular cases in more than 300 cases; but on this we shall dwell later on. It is singular that Woodville allowed Bumpus's strain to drop, and it is worth while noting how many of the cases are derived from Jewel, who had no eruptive pustules; and whose case is insisted on by Woodville himself as a proof that the matter he was using was cow-pox, since Jewel had previously had smallpox, and had the matter with which she was inoculated been smallpox it ought not have taken.

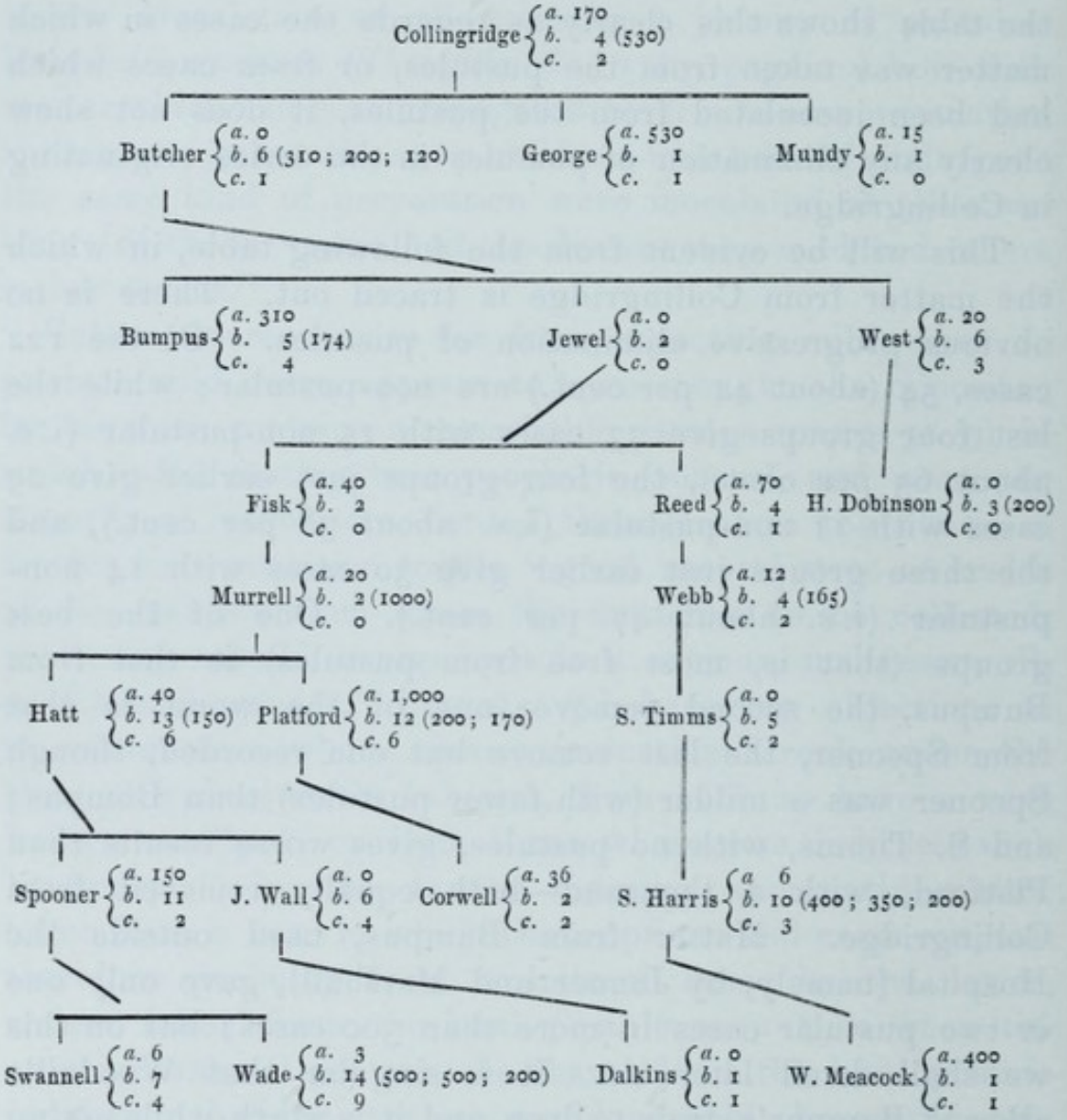
The figures against the names in the table below indicate—

a. The number of pustules appearing in the case itself.

b. The number of cases done from the tumour on the arm of the case. (The figures in brackets giving the number of

pustules, in the cases so done, in the instances where they exceeded one hundred.)

c. *The number of the above cases in which pustules were absent.*



Further, while Collingridge's local tumour was the source of much of the lymph used or distributed by Woodville, it was not the only source. From the source of the dairymaid at the Gray's Inn Lane "dairy" five cases were inoculated. One of these (Crouch) had no eruptive pustules, and matter taken from his arm produced cow-pox in a cow belonging to Mr. Coleman; we may conclude that Crouch's case was one of veritable cow-pox. But Harris and Bunker, done on the same day and with the same matter, had eruptive pustules,

the former 300, the latter only 3. These two cases, being inoculated for smallpox on the fifth day of the inoculation with cow-pox matter, are parallel to that of Collingridge. If their pustules were due to the second inoculation, they supply an argument of analogy in favour of Collingridge's pustules having a like origin. If we suppose, as the view concerning Collingridge which we are discussing supposes, these two cases were simply cases of smallpox, due to an unclean lancet being used, we are not only met with the difficulty of such an accident being repeated again twice so soon, but the far greater difficulty that the smallpox matter used (and if separate lancets were used for each, the smallpox matter in each case might have had different origin) "sported" again as it did in the case of Collingridge, and gave birth to a cow-pox-like local tumour.

Further, from Coleman's cow, which we may assume to be veritable cow-pox, three cases were inoculated. Each of these had an abundant crop of pustules. If these pustules were due to an unclean lancet, as has been supposed in the case of Collingridge, we must repeat afresh the hypothesis of the smallpox matter "sporting;" and this on the doctrine of chances presents enormous difficulties. If the pustules had some other origin (which in these three cases must have been natural contagion, since they were not, as was Collingridge, inoculated with smallpox early in the disease), we must conclude that the local effect was a veritable cow-pox tumour. But these three cases, especially one (Streeton), were the origin of much of the lymph used (and presumably distributed) by Woodville. The series of cases proceeding from Streeton's local tumour run closely parallel to the series proceeding from Collingridge, pustules appearing and disappearing in a like fitful irregular way. If Streeton's series was one of cow-pox, it is very difficult indeed to suppose that Collingridge's series was one of smallpox.

Lastly, it became early acknowledged in the practice of cow-pox inoculation that while cases with eruptive pustules were contagious, that is to say, produced a like disease by contact or proximity, cases without such pustules were not (Woodville, *Observ.*, p. 31; Fosbrooke, *Med. Phys.*, vol. iii, p. 247). Now it is true that some authors main-

tained that cases of inoculated smallpox showing the local pustule only were not contagious ; but these authors had an ulterior reason for their contention, namely, their desire to prove that the practice of inoculation did not increase the prevalence of smallpox ; and this lessens the value of their opinion. Even admitting that the contagion itself, the *materies morbi*, is produced or contained in the pustules, and distributed from them, and that, therefore, a case with many pustules is more contagious, emits more "particles of contagion" than a case with few, and *a fortiori*, than one with the local tumour only, the evidence goes to show that no true case of inoculated smallpox should be considered free from contagion : this was the opinion of the inoculators, and Dimsdale (*op. cit.*, p. 93 ; *see also* p. 39) quotes a case in point. The "sport" which the smallpox put on in the case of Collingridge must therefore, according to the view which we are considering, have further simulated cow-pox in the loss of contagiousness. It is, of course, not possible outside Woodville's report to disentangle the cases derived from Collingridge from the cases having other sources ; but unless all the other sources are, like that of Collingridge, to be regarded as sports of smallpox, this very fact increases the difficulty of regarding Collingridge's case as being of that nature.

The supposition, then, that the local effect on Collingridge, called by Woodville a cow-pox tumour, was in reality a smallpox tumour of a special kind, lands us in an accumulation of difficulties. On the other hand, all difficulties, except the minor ones which we have discussed as presented by the details of Collingridge's case, vanish if we suppose that Woodville was right in calling the local effect a cow-pox tumour, and that the lymph taken from the local tumour used and distributed by him was vaccine lymph, and that where pustules did appear they were (putting aside the possibility of generalised vaccinia) pustules of accompanying smallpox, introduced in some cases by premature inoculation, but in most cases by natural contagion.

This latter view explains why Woodville found no difference in his results at the Hospital between lymph of different sources, not only between that of Collingridge and the

others on which we have dwelt, but also between these and the virus "produced in different cows" procured by him "at various times;" he says (*Observations*, page 19) "The effects of all the matter I tried were perfectly similar, and pustules proved to be not less frequently the consequence of these trials than of those made with the matter formerly employed." This view also explains the contrast with which Woodville himself was struck, between the cases at the Hospital and cases away from the Hospital. At the beginning Woodville on several occasions used matter from the eruptive pustules, that is smallpox matter, and it is very probable, as has been said, that some of the matter distributed from the Hospital, for instance, by Pearson, was taken from the eruptive pustules, and that in some of the cases outside the Hospital, in which an eruption of pustules was recorded, this matter was used. But the cases outside the hospital in which eruptive pustules appeared were exceptional. Woodville himself states that not only in the cases inoculated with the matter from Bumpus sent to Jenner, but in nearly all other instances, the matter which in the Hospital continued to produce pustules, when sent abroad did not produce them. He mentions (*Observations*, 1800, page 21) as exceptions matter sent to a village where smallpox was raging, and where one in five had pustules, and matter sent to Mr. Evans of Ketley, who, like Woodville, was carrying on cow-pox and smallpox inoculations at the same time in the same house, more than half of whose patients had pustules: he argues that the pustules were due not to the nature of the lymph sent, but to the presence of smallpox in the localities.

Jenner, with what some might call rashness but others sagacity, maintained from the very first that the eruptive pustules were indications of smallpox. Woodville, as we have seen, at first believed that the eruptive pustules were a natural part of the malady, and spoke of the cases as being mild or severe according to the number of such pustules occurring. He held this view when he published his Reports in May, 1799, and, indeed, three fifths of the cases there recorded exhibited pustules (in many of them, however, the matter used for inoculation was itself derived from the eruptive pustules). Writing in June, 1799, that is a month

later (*Med.-Phys. Jl.*, vol. i, p. 417), he reports that out of 310 cases subsequent to the Reports only 39 had pustules, the last 110 of these having pustules in 7 cases only. He says this confirms the opinion expressed in the Reports that matter taken from mild cases tended to produce mild cases, or that the disease actually became milder in its progress from patient to patient,—that is to say, the very nature of the virus was affected by the mere transmission through a series of human beings. But he ends with a striking sentence that these cases lead "to a conclusion widely different from that published in the Reports." In his *Observations*, the preface of which is dated July 1st, 1800, in quoting 2000 cases he states that "in the Hospital, however, the disease still continues to occasionally produce pustules, though not more than in the proportion of three or four cases out of a hundred." Six months later, December, 1800 (*Med.-Phys. Jl.*, vol. v, p. 6), he speaks of the cases which had at the date of his last publication "received the vaccine infection" as exceeding 2500, and says that since that time upwards of 1500 have been inoculated for the cow-pox at the same place, and that "the number of pustular cases . . . . has been even less than three or four out of a hundred." He now states that he is convinced that an eruption of variolous-like pustules "will be found to be a very rare occurrence unless previously to the vaccine inoculation, or during its local progress the patient has been exposed to the action of variolous matter." This probably "is the conclusion widely different from that published in the Reports," foreshadowed in his writing of June, 1799; that is to say, he now abandons the view then expressed that the diminution of pustular cases is due to the selection of mild cases or to weakening by continued transmission.

Thus, though, as has been said, the occurrence of pustules was irregular in the cases recorded in the Reports, the absence of pustules occurring quite early in the series and being fitfully continued, so that they cannot be said to show a distinct progressive elimination of pustules, there was in the subsequent cases, especially in the later of these, a distinct progress towards an absence of pustules. This might have been in part due to Woodville's abstaining from

using the matter of the eruptive pustules, as well as from premature inoculation with smallpox, but could only in part have been so due. On the other hand, in the Hospital it was natural that pustules should be common so long as Woodville thought, as he did at first, that they formed a natural part of the disease, and that they should become less so soon as he became aware, as apparently he did so early as June, 1799, that they were due to the patient being exposed to the action of variolous matter; so soon as he had grasped this view he would take care that those inoculated with cow-pox should be exposed as little as possible to the action of variolous matter, no care at all having been taken previously. The marked diminution of pustular cases coincides with Woodville's change of views.

Reviewing, then, all the evidence, no conclusion seems justifiable other than the one that all Woodville's and Pearson's cases (excluding of course all those in which the matter used was taken from the eruptive pustules and not from the local cow-pox) were cases of cow-pox, however much some of them might have been mixed up with smallpox.

APPENDIX II.

Tables, furnished by the Registrar-General, showing for England and Wales—

(*A.*) *The deaths from smallpox at certain age-periods, to one thousand deaths from smallpox at all ages, in each year* 1848—1894; *and*

(*B.*) *The death-rates from smallpox, per millions living at certain age-periods, in each year* 1848—1894.

[*N.B.—In both tables deaths returned as from chicken-pox are unavoidably included as regards the years* 1848—1854 *inclusive.*]

(*A.*)—*Deaths from smallpox at certain age-periods, to one thousand deaths from smallpox at all ages, in each year* 1848—1894.

Year.	Under 1 year.	1–	5–	10–	15–	25–	45 and upwards.
1848	235	457	130	37	72	58	11
1849	250	427	145	35	65	60	18
1850	268	432	133	35	65	55	12
1851	258	439	131	33	68	59	12
1852	267	426	122	32	75	62	16
1853	273	413	123	31	71	70	19
1854	203	388	128	31	108	107	35
1855	194	321	135	31	135	143	41
1856	231	329	122	40	134	108	36
1857	243	345	164	31	94	98	25
1858	234	319	173	39	105	106	24
1859	252	327	126	44	116	104	31
1860	232	324	112	42	121	132	37

Chicken-pox unavoidably included in the years 1848—1854 inclusive.

Year.	Under 1 year.	1–	5–	10–	15–	25–	45 and upwards.
1861	242	295	108	47	125	126	57
1862	231	328	110	45	122	125	39
1863	236	308	105	37	129	140	45
1864	243	312	105	37	119	140	44
1865	233	272	102	41	134	163	55
1866	222	320	99	32	136	146	45
1867	239	298	86	31	133	160	53
1868	239	351	102	31	115	123	39
1869	221	327	126	30	111	136	49
1870	179	284	143	38	140	170	46
1871	135	199	149	56	181	221	59
1872	137	162	164	66	191	214	66
1873	132	99	138	62	224	258	87
1874	129	100	107	70	263	258	73
1875	106	101	108	80	261	254	90
1876	119	135	108	67	214	286	71
877	102	145	112	72	216	270	83
1878	119	135	117	77	213	255	84
1879	116	127	119	63	187	265	123
1880	120	142	117	76	196	267	82
1881	103	136	109	68	205	276	103
1882	98	111	77	61	226	325	102
1883	131	104	95	62	239	262	107
1884	114	116	92	71	214	302	91
1885	120	126	79	63	185	312	115
1886	113	80	65	40	189	313	200
1887	121	73	61	61	283	328	73
1888	119	81	63	49	230	329	129
1889	86	43	—	43	261	437	130
1890	188	63	—	—	188	373	188
1891	246	102	61	61	82	285	163
1892	117	148	77	9	132	359	158
1893	141	142	66	30	110	305	206
1894	140	133	45	28	143	367	144

(*B.*) *Death-rates from smallpox, per million living at certain age-periods, in each year* 1848—1894.

Year.	All ages.	Under 5 years.	5–10 years.	Total under 10 years.	10–15 years.	15–25 years.	25–45 years.	45 years and upwards.
1848	397	2090	439	1311	135	149	86	23
1849	264	1364	326	874	86	90	59	26
1850	262	1400	298	881	86	89	54	18

Chicken-pox unavoidably included in the years 1848—1854 inclusive.

Year.	All ages.	Under 5 years.	5–10 years.	Total under 10 years.	10–15 years.	15–25 years.	25–45 years.	45 years and upwards.
1851	389	2066	438	1299	121	139	86	25
1852	401	2117	420	1319	119	158	93	34
1853	171	892	180	558	50	64	45	17
1854	151	675	165	436	44	86	61	28
1855	131	512	151	343	39	93	70	28
1856	116	491	122	318	44	82	47	22
1857	202	891	283	607	59	100	75	27
1858	330	1364	489	956	121	185	132	42
1859	193	835	208	543	82	119	76	31
1860	136	564	130	362	54	87	67	27
1861	64	256	59	165	28	43	30	19
1862	78	322	73	206	33	50	37	16
1863	286	1153	255	735	101	198	151	67
1864	364	1500	325	953	126	232	193	83
1865	301	1127	260	723	117	217	187	86
1866	139	558	117	352	41	102	78	33
1867	114	453	82	280	33	82	69	31
1868	91	396	78	247	27	56	43	18
1869	67	271	71	177	19	40	35	17
1870	113	388	136	270	40	86	74	27
1871	1012	2502	1265	1922	529	994	860	306
1872	821	1815	1130	1494	503	851	676	279
1873	98	167	114	142	57	119	98	44
1874	88	148	79	116	57	125	87	34
1875	35	54	32	44	26	49	35	16
1876	99	185	89	140	62	113	108	37
1877	173	316	161	243	116	201	180	76
1878	74	139	72	108	53	85	73	33
1879	21	38	21	30	12	21	22	14
1880	25	49	24	37	18	26	26	11
1881	119	210	107	161	75	130	127	65
1882	50	78	32	56	28	60	63	27
1883	36	64	28	47	20	46	36	20
1884	83	145	63	106	54	93	96	40
1885	104	197	69	136	60	101	123	63
1886	10	15	5	10	4	10	12	11
1887	18	28	9	19	10	27	23	7
1888	36	58	19	39	16	44	45	25
1889	0·8	0·8	—	0·4	0·3	1·1	1·3	0·6
1890	0·6	1·1	—	0·6	—	0·5	0·8	0·5
1891	1·7	4·8	0·9	2·7	0·9	0·7	1·8	1·4
1892	15	32	10	21	1	10	20	12
1893	46	105	26	67	12	26	52	49
1894	27	61	11	36	7	20	38	21

Chicken-pox unavoidably included in the years 1848—1854 inclusive.

Statement by Dr. Collins and Mr. Picton of the Grounds of their Dissent from the Commission's Report.

1. We entirely agree with the Report of our colleagues in so far as it shows the great change of professional and scientific opinion since vaccination first engaged the attention of the Legislature, and since the passing of the first compulsory Act in 1853. We hold with them that the prophylactic power of vaccination has been at least exaggerated, and that dangers incidental to the practice, though at one time denied, "are undoubtedly real and not inconsiderable in gross amount." We gladly added our signatures to theirs in support of the Commission's interim report recommending the abolition of repeated prosecutions, and also that recalcitrants against the vaccination laws should no longer be subjected to the same treatment as criminals. We now desire also, if compulsion in any form is to be maintained, to support their final recommendations for the relief of conscientious nonconformity with the law. We also gladly endorse the precautions they recommend with the object of preventing avoidable dangers in connection with the operation. There is no difference among us on these points; so far as these recommendations go the Commission is absolutely unanimous. We feel, however, that the evidence not only justifies but requires a more complete reconsideration of the present state of the law, as well as of the methods adopted in dealing with smallpox. For this purpose it is necessary to review in some detail the history of smallpox and the various preventive measures which have at different times been in vogue, and to scrutinise the grounds on which one alone of these preventive measures has been relied upon to the exclusion of others. We desire also to give reasons for thinking that other more effective and practicable (as well as less objectionable) modes of stamping out small-

pox, or protecting communities from its introduction, are available. We venture to think that the report of our colleagues, in the preparation of many portions of which we have borne our part, has approached the consideration of the behaviour of smallpox, and the means of preventing it, too exclusively from the standpoint of vaccination, and that too little attention has consequently been accorded to sanitary organisation, prompt notification and isolation, measures of disinfection and cleanliness, and healthy conditions of living, which we believe to be of the first importance in preventing and controlling outbreaks of smallpox.

Reference I.—The effect of vaccination in reducing the prevalence of, and mortality from, smallpox.

2. The origin and antiquity of smallpox are involved in obscurity. No account of the disease appears in the writings of Hippocrates or Galen; it seems to have been unknown in ancient Greece and Rome. Unambiguous evidence of its presence on the continent of Europe is to be found in the fifteenth century, and scattered references of more debatable character may be found in the two previous centuries.

Smallpox, like the plague and some other infectious maladies, appears to have, as it were, its habitat in certain countries, and its diffusion thence results from importations under favourable circumstances of the morbid poison by infected persons or things. Such native foci of smallpox are said to be the countries of Central Africa and India.

3. The first extant work on smallpox is by an Arabian physician, Rhazes of Bagdad, written in the tenth century A.D. His account of the disease was so accurate and complete that it served as a model for many medical writers when the disease became common in Europe.

4. Various theories of the cause of smallpox were advanced in mediæval writings, but contagion, though referred to by some of the earlier Arabian authors, was not thought to be of importance. No doubt smallpox was often confounded with other eruptive diseases, such as measles, and even as

late as 1700 these were classed together in Bills of Mortality. Sydenham (1624–89) described fully the smallpox as it occurred in London in the seventeenth century. He emphasised the distinction between smallpox and measles, and introduced the "cool treatment" for these diseases. He describes smallpox as prevailing epidemically, attacking persons of all ages, varying greatly in its severity; the mortality being in his opinion largely augmented by mischievous treatment. Sydenham, like his contemporaries, did not attribute the propagation of smallpox to contagion, but to what he termed the "epidemic constitution of the atmosphere," due to "certain hidden and inexplicable changes within the bowels of the earth."

5. It was reserved for Boerhaave, of Leyden (1668–1738), to proclaim the view, now generally accepted, that smallpox arises only from contagion.

6. During the seventeenth century smallpox became more prevalent in Western Europe, especially in large towns and trading ports. It was introduced into Boston (U.S.A.) early in the century; and on numerous occasions epidemics in the West Indies and South America have been traced to slave importations from Africa. On the other hand, it appears that places and countries naturally isolated, or removed from the more populous centres of human intercourse, then, as now, enjoyed complete or comparative immunity from the disease. Thus the Faröe Islands were first infected by a ship from Denmark in 1651, Cape Colony in 1713 by a ship from India, while the continent of Australia, it is stated, enjoyed an absolute immunity until 1838, and the island of Tasmania continued to be exempt until 1887.

7. In view of the curious notions entertained by the most learned medical writers in the seventeenth century as to the propagation of smallpox, and the superstition with which an epidemic was regarded by the common folk, it is not surprising that the century closed without any effort being made to protect individuals or communities from this disease. In London the ravages of the Plague until

its extinction in 1680 appear to have eclipsed the lesser evils of the smallpox, and to have absorbed whatever of organised effort was available on the part of those responsible for the public health.

8. The London Bills of Mortality were first compiled by the parish clerks in 1629, and though the data they furnish in regard to the deaths from various diseases cannot be regarded as even approaching to scientific accuracy, they give some idea of the health, or rather of the unhealthiness, of seventeenth century London.

Annual death-rates in London per 100,000 *living.*[1]

Causes of death.	1629–35.	1660–79.
All causes	5000	8000
Plague	125	1225
Fever	636	785
Smallpox	180	417

There can be no doubt that the conditions which obtained in London "within the Bills" during the seventeenth century were in the highest degree favourable to the propagation of pestilential diseases. The general death-rate was enormously high, and though plague disappeared soon after the Great Fire, fevers and smallpox became more severe and fatal, and were perennially endemic.

9. Not only were the insanitary conditions which prevailed well calculated to foster and perpetuate any infection which happened to be introduced, but owing to the non-recognition of the part played by contagion in the dissemination of these diseases, the latter were accepted as well-nigh inevitable evils, and no effort was made to restrict their ravages.[2]

10. In 1710, for the first time since the Bills of Mortality had been compiled, more than 3000 deaths were

[1] Vol. i, App., p. 88.

[2] 11,004.

ascribed to smallpox in London, or 127 per 1000 deaths from all causes. The prevalence of the disease led to many speculations as to possible means of deliverance from it. The orthodox teaching of propagation by "epidemic constitution of the atmosphere" was not calculated to inspire sanitary precautions, or the separation of the sick from the whole. Mead's work on the prevention of contagions, primarily directed against a threatened invasion of plague, was not written until 1720.[1] On the other hand, there were reports from the Levant, where smallpox had been long endemic, that by a method of "engrafting" the disease artificially it might be robbed of its terrors. As far as the epidemiological history of smallpox can be followed back in Asia and Africa, we find records of the popular practice in some form or other, and often with religious associations, of the artificial induction of the disease.[2] Even in Wales and Scotland, and in Western Europe, some kind of popular tradition of a similar practice has been traced by some authorities.

11. Whatever credit may attach to the introduction of the practice of inoculation into this country is, however, due to Lady Mary Wortley Montagu. During her residence at Pera, while her husband was Ambassador to the Porte, Lady Mary learnt that it was there the fashion "to take smallpox by way of diversion, as they take the waters in other countries." In a letter, dated 1717, she announced her intention of submitting her son, aged five, to the operation, and added, "I am patriot enough to take pains to bring this useful invention into fashion in England." Her son was accordingly inoculated by a Greek woman, under the supervision of Mr. Charles Maitland, Surgeon to the Embassy, and he passed favourably through the disease. Lady Mary returned to London, and in the spring of 1721 had her younger child inoculated by Maitland. The operation, which was satisfactory, was witnessed by three physicians, as well as several ladies and persons of distinction. In August, 1721, inoculation was tried experimentally on

[1] Vol. iv, App. 1, p. 400.

[2] 10,332—10,335; 107—10,340.

six criminals at Newgate, and the practice was encouraged by the Court.

12. While the effects in most of the early cases appear to have been mild, a few terminated fatally, and the practice became for a while less popular. After 1740, however, inoculation was revived, and in the modified form of Dimsdale and Sutton, was widely adopted in many parts of the United Kingdom. In 1746 an inoculation hospital was started in London, and in most of the large provincial towns the new practice was encouraged by the clergy, as well as the leading medical practitioners; "and in 1754 the Royal College of Physicians of London pronounced its authoritative sanction of what was no longer a speculative novelty." The resolution of the College was—"The College, having been informed that false reports concerning the success of inoculation in England have been published in foreign countries, think proper to declare their sentiments in the following manner, viz.:—That the arguments which at the commencement of this practice were urged against it have been refuted by experience; that it is now held by the English in greater esteem, and practised among them more extensively than ever it was before; and that the College thinks it to be highly salutary to the human race." From this date to the end of the century inoculation was widely diffused, though to varying degrees, in different districts; the practice doubtless paved the way for the later acceptance of vaccination. The latter came to replace the former method, and by the Act of 1840, sec. 8, the practice of inoculation became a penal offence.

13. Now the practice of inoculation was based on the belief that one attack of smallpox protected from subsequent attack those who recovered. And it was argued that the artificially inoculated disease, though usually far less severe than the natural disease, yet afforded a similar immunity. It is neither necessary nor profitable to discuss at any length the various theories that have been advanced to account for such immunity; suffice it to say there exists,

[1] Vol. i, p. 66.

and has always existed, a belief, shared by medical writers, that in the case of many infectious diseases one survived attack affords a certain amount of protection against a second attack. We are not aware of any large body of statistical evidence which can be cited in support of the general statement; but the belief is held by those most conversant with the facts, and has been insisted on most strongly in the case of smallpox. It has been stated that second attacks of such diseases, when they do occur, are more severe than the first, and there is, so far as we know, no ground for asserting that second attacks of infectious diseases are in any way mitigated in severity by the abiding influence of the first attack.[1]

14. The earlier writers on smallpox appear to have held that second attacks of the disease undoubtedly occurred and not unfrequently.[2] The view that second attacks of smallpox occurred was held by Sydenham, also by Diemerbroek, who observed that the eruption was more severe in second attacks than the first. The case of Louis XV has been often quoted; he had a first attack at 14, and died of a second attack at 64. During the inoculation period the possibility of second smallpox was emphatically denied by several writers. After the introduction of vaccination the controversy which took place over its relative merits when compared with those of inoculation brought to light numerous instances of second smallpox in the same individual. Jenner collected more than a thousand cases of the kind. Moore says, "For some years the periodical and other medical publications teemed with cases of smallpox occurring twice."[3] At the present time cases of second attacks of the disease are usually met with in every outbreak of any extent,[4] and it would seem reasonable to conclude that the protection afforded by a previous attack, though considerable, is by no means absolute. Moreover experience, though of limited amount, appears to show that no mitigating influence is exerted by the first upon a second attack should it occur.[5]

[1] 4545; 26,127.
[2] 24,848.
[3] 24,850.
[4] 26,125.
[5] 4545; 24,937.

15. Notwithstanding the extensive practice of inoculation, or, as has been alleged, in consequence of it, smallpox continued throughout the eighteenth century to be endemic in London, and severely epidemic, often at frequent intervals in many towns and villages in this country and abroad. During the latter half of the century attention was called by many writers to the serious evil to society of partial and indiscriminate inoculation. It was shown that, whatever advantages might result to the inoculated by way of protection from attack, the practice had frequently been the means of introducing the disease into towns and villages that were previously free from it, and that it could only be worked at an intolerable cost of life.[1]

16. Attention was also about this time called to the restrictive influence which might be exerted upon outbreaks of smallpox by separating the sick from the healthy.[2] The part played by contagion in the propagation of epidemics had, since the adoption of inoculation, come to be clearly recognised, and measures were suggested for stamping out smallpox on the lines of methods employed against the plague.

Some, like Haygarth, suggested the combination of general and systematic inoculation at stated intervals with measures of isolation. Others, like Rast, Faust and Cappel, advocated hospital isolation of the infected, and regarded inoculation as not only superfluous but dangerous, and opposed in principle to the proper method of exterminating the infectious poison.[3]

17. It was at this juncture that the value of the cow-pox as a protection against smallpox attracted attention.[4] It could be inoculated like the smallpox, from one person to another, but unlike the latter it was stated to be not communicable by infection. If it afforded protection against smallpox without spreading the disease, opinion was evidently ripe for the substitution of the one practice for the other, for inoculation had come to be regarded about

[1] Vol. i, App., p. 66.
[2] 11,015; 1105.
[3] 10,796—10,969.
[4] 10,803.

this time, not merely as a troublesome affair to those who submitted to it, but as a serious evil to society.[1] Henceforth the controversy over the cow-pox absorbed almost exclusively the attention of those concerned for the prevention of smallpox, and for a long while little was heard of any means other than vaccination, such as isolation, &c., for the suppression or restriction of the disease.

18. From such records and statistics as are available it would appear that smallpox was more prevalent, and the mortality from it was greater, especially in large towns, during the eighteenth century than it had been in the seventeenth. It is also true that, speaking broadly, the present century compares favourably with the last; the disease has not been the scourge that it then was. Prior to 1838, when official registration of the causes of death in this country began, the longest series of figures, and those which have been most often quoted, are the London Bills of Mortality. The following figures are taken from a table put in by Sir J. Simon, which was compiled by Dr. Farr, with due regard to the many sources of error which these Bills admittedly contain :—

Annual death-rates in London per 100,000 *living at seven different periods during the years* 1629—1835, *from*—

—	All causes.	Smallpox.	Fever.
1629–35	5000	180	636
1660–79	8000	417	785
1728–57	5200	426	785
1771–80	5000	502	621
1801–10	2920	204	264
1831–35	3200	83	111

There was evidently a great improvement in the health of London, as measured by the fall of the death-rate from all causes, from its highest point in the Plague period to a rate of about one half or one third of what it had been. A

[1] Vol. i, App., p. 66.

great improvement took place between the middle of last century and the earlier years of the present. Dr. Farr, remarking on these figures, says :—

"The diseases of London in the sixteenth century still prevail in unhealthy climates; not only the diseases and the manner of death have changed in this metropolis, but the frequency and fatality of the principal diseases have diminished."

"Smallpox attained its maximum mortality after inoculation was introduced. The annual deaths of smallpox registered 1760–79 were 2323; in the next 20 years, 1780–99, they declined to 1740; this disease, therefore, began to grow less fatal before vaccination was discovered; indicating together with the diminution of fever, the general improvement of health then taking place. In 1771–80 not less than 5 in 1000 died annually of smallpox; in 1801–10 the mortality sank to 2, and in 1831–5 to 0·83."

"Fever, exclusively of the plague, has progressively subsided since 1771: *fever has declined nearly in the same ratio as smallpox.* In the three latter periods of the table the deaths from fever decreased as 621 : 264 : 111; from smallpox as 502 : 204 : 83."

19. We think these figures suggest that the fall of the death-rates from fever and smallpox was associated in cause as well as in time with the improvement in the public health which the fall in general mortality indicates. It is possible that inoculation, as practised in London in the latter part of last century, prevented an earlier or greater reduction in smallpox than actually took place.[1] Among the influences at work in the last quarter of the eighteenth century which would tend to counteract any injurious influence of inoculation, were the progressive rooting out of smallpox from our prisons, the sanitary improvements in our towns, the growth of what has been termed the "new humanity," which made the care of the sick and the protection of the public health against noxious agencies matters of public concern and active philanthropy, influences for

[1] 5491–3.

good with which the names of Howard and of Cook and of Haygarth are honourably and eternally associated.

Since Dr. Farr compiled the figures which we have quoted above, we have five completed decades of registration statistics, and extracting for London the death-rates to the same scale from all causes, from smallpox, and from fever, we obtain the following :—

Annual death-rates in London per 100,000 *living, from—*

—	All causes.	Smallpox.	Fever.
1841–50	2500	40	97
1851–60	2400	28	88
1861–70	2400	27	90
1871–80	2240	45	37
1881–90	2037	14	21

20. Objection has been taken to a comparison between fever and smallpox when endeavouring to decide what has been the influence of the various agencies collectively spoken of as " sanitation " upon either, on the ground that the term fever has varied in its signification, and that measles and whooping-cough should be therefore used instead for such comparison. We cannot agree with this view; our knowledge of the history,[1] epidemiology, and behaviour of measles and whooping-cough does not suggest to us that they have hitherto been very amenable to sanitary reforms, or that they present an analogy with smallpox, like the fevers, and especially typhus fever. As regards the objection that the nomenclature has varied, it appears that Dr. Greenhow and Dr. Farr, in the figures which Sir J. Simon quotes from them, paid particular attention to this source of fallacy. Thus the former writer,[2] " throwing into one group all those deaths of the present day which might have been included under the old application of the word 'fever' (counting scarlet fever, and inflammation of the brain, and inflammation of the lungs in

[1] 871.

[2] Simon, 1857. Papers, App., p. 29, and vol. i, App., p. 88.

this category), still finds that even with this large addition the so-called 'fever' of the present day occasions only a death-rate of 385 per 100,000, whereas a century ago its death-rate was close on 539."

21. But since 1869 the Registrar-General has separately distinguished deaths from typhus, typhoid, and simple fever, and we find that the decline has not been at the expense of one of these classes only, but has been shared by all.

The 42nd report of the Registrar-General, p. xxx, says: "Had the deaths from one or more of this group (fever) of causes fallen, while those from others in the same group had risen; or had the fall been trifling; or the totals dealt with insignificant in amount; it might have been suspected that the alteration was a mere alteration of name. But as the deaths under each heading have declined, as the fall in the death-rate from them has been enormous, 62·4 per cent. in the course of ten years; and as the totals are by no means small, it may be accepted as an indisputable fact that there has in truth been a notable decline in these pests, and it may be fairly assumed that the decline is due to improved sanitary organisation. The deaths from these causes per million persons living were 850 in 1869, and only 320 in 1879."

Annual death-rates per million living (England).

—	Typhus.	Typhoid.	Simple fever.
1871–75	81·4	373·8	140·2
1876–80	34·2	277·2	69·2
1881–85	22·8	216·0	34·2
1886–90	6·6	179·2	16·6

We are, therefore, led to the conclusion that the great fall in the fever death-rate since the middle of last century in London is a real and substantial one, that it is in all probability due to greater sanitary activity, and that a fall of about the same amount has during the same period taken

place in smallpox mortality, and we are unable to agree that it is not largely due to similar causes.[1]

22. The infectious nature of the inoculated smallpox came as a surprise to the first inoculators in England; but it was not long before the practice was accused of introducing and spreading the disease.[2] Thus Dr. Wagstaffe, writing in 1722, instanced an occurrence in the town of Hertford, where, in consequence of a few inoculations, the smallpox had spread and occasioned a considerable mortality. (Moore's 'History of Smallpox,' p. 242.) Moore, alluding to these occurrences, remarks (p. 233) that they should have "induced the profession to pause ere they proceeded, or at least to have prompted them never to inoculate without adequate measures being adopted to prevent the infection spreading to others. The neglect of this easy precaution has occasioned the loss of millions of lives." Statistics prepared by Dr. Jurin and others appeared to prove the advantages of inoculation to those who received it, but Moore, alluding to Jurin's calculations, said (p. 243, 'History of Smallpox.') —"These proved that an individual who resided in London, or in any large city where the smallpox prevailed, had a much better chance of surviving that disease by being inoculated; but they did not apply to the country, or to places where the smallpox was infrequent. And, as in the year 1723 a great increase of the mortality by smallpox took place in London, Dr. Jurin expressed his opinion that this ought not to be imputed to inoculation, as the numbers who had been inoculated in town that year did not exceed 60. This was a very inadequate answer; a single person may bring the Plague into a town, or into a nation, and be the cause of the destruction of an innumerable multitude. The smallpox is fully as infectious a disease as the Plague, and sixty inoculations were more than sufficient to account for the augmented mortality, and were probably the real cause of it." Without accepting this opinion we are nevertheless satisfied that inoculation did tend to establish and spread the disease, and introduce it into places which would probably have otherwise remained free, and that in places

[1] 352, 354, 382. [2] 10,551.

where it was restricted a less mortality resulted. It is also doubtless true that inoculation by opening up a new line of thought as to the preventability of disease, paved the way for the subsequent reception of vaccination, and at the same time the knowledge that disease could be thus propagated at pleasure must have suggested the possibility of its being controlled at will. To the continuance and universal acceptance of Sydenham's doctrine of "epidemic constitution of the "atmosphere," Haygarth attributed the persistence of smallpox.[1]

23. We also learn on the authority of Haygarth how great was the contrast, in respect of smallpox prevalence, between towns and country districts. Thus, in Kent, where inoculation was cautiously avoided, he quotes figures to show that last century the annual smallpox mortality did not exceed one in 20,000. From Sussex, too, he had evidence pointing to a similar experience, Writing in 1793,[2] he adds, "How far this wonderful exemption from the mortality of the distemper extends through the South of England I cannot determine. The facts here related in regard to both Kent and Sussex are taken by accident, and I have no reason to believe them extraordinary in these counties. But no fact in any degree similar to them can be produced in this neighbourhood [Chester], nor probably in any other where inoculation is freely allowed, and where, at the same time, the casual contagion is permitted to make its destructive progress without any kind of interruption. If the feeble, irregular, unconnected, and unauthorised efforts of individuals can prevent so much mischief, *how much more benefit might reasonably be expected from the united, systematic, and concerted regulations of the whole island, aided and strengthened by legal premiums and punishments*!" (Italics ours.)

In 1763 smallpox was unusually severe in Paris, and upon inquiry it was determined that this was owing to increased infection from inoculation, a decree was accordingly issued prohibiting the practice in that city. It is stated by Moore and others that in Spain inoculation never became a general

[1] 10,738.

[2] Vol. iv, App. 1, p. 398.

practice, and that no other country in Europe last century suffered so little from smallpox.

24. In estimating the influence of the practice of inoculation on the amount of and mortality from smallpox in a community, regard must be had to several factors. If we accept the common view that one attack of the disease, though artificially administered, affords a considerable amount of immunity against a future attack, though perhaps not influencing the severity should such attack occur, the universal practice would, in view of the usually greater mildness of the inoculated disease, determine a low smallpox death-rate. Inasmuch as such universality of the practice never was and never could be attained, the extent to which it failed ensured (except in the rare cases where special isolation of the inoculated was secured) the constant presence of infected persons who were centres of contagion to the susceptible. There is plenty of evidence, not only last century but of more recent dates, that inoculation has been the means of introducing and spreading smallpox in localities where the population was largely composed of susceptible persons.[1] The effect of inoculation would in any particular time or place depend not only on the proportion of the inoculated to the susceptible, but also on the condition of things obtaining as regards the diffusion of the contagion independently of this particular mode of its propagation. Thus, if through habitual disregard of contagion smallpox patients were suffered to mix freely with those liable to the disease, the effect of any such superadded source of contagion as inoculation might well be inconsiderable. In a town where the disease had been long naturalised, and no particular measures taken to prevent it, we should not expect to find a very marked augmentation of the disease by even the partial practice of inoculation. In the case of isolated towns or villages removed from the more populous centres of human intercourse, and in which accordingly smallpox came rarely and epidemically, the introduction of inoculation might be expected to establish and spread the disease. Moreover, the habitual and systematic

[1] 10,492; 2886–7; 3182–4; 8128.

carrying on of the practice, without precautions, in a large town, by ensuring the endemicity of the disease, and, as it were, making it indigenous, would in the case of smallpox tend to mask and obscure any influences at work of a countervailing character as regards the public health.

25. This is in fact what we find when we examine such figures as are available for determining the influence of inoculation on the prevalence of and mortality from smallpox, as for instance, the London Bills of Mortality.[1] Whether we consider the horribly insanitary conditions with the attendant overcrowding, or the disregard of precautions against contagion, it would probably be difficult to conceive conditions more favourable to the spread and fatality of smallpox than those which obtained in London in the first three quarters of last century. In this respect it is probable London was as bad as or even worse than other large European towns. Smallpox and other infectious fevers were allowed to run riot, and Bernouilli's calculation, derived from the experience of such places at such times, to the effect that 60 per cent. of those born took smallpox, was probably not far wrong. The introduction of even partial and indiscriminate inoculation was not likely to, and in fact did not, increase to the extent which might otherwise have been expected the heavy toll that smallpox already exacted. Thus the figures from the London Bills show that in the first quarter of the eighteenth century, when inoculation had scarcely begun to be practised in London, the deaths from smallpox were 44,306 out of 586,270 total deaths, or 7·6 per cent. In the following quarter, when a certain amount of inoculation was carried on, especially towards its close, smallpox was responsible for 49,941 deaths out of 660,800, or again 7·6 per cent. In the third quarter, when inoculation had become an established custom, 56,690 out of 549,891 deaths, or 10·3 per cent., were ascribed to smallpox. In the last quarter of the eighteenth century, although the total deaths had greatly fallen, under the influences to which we have already alluded, the deaths from smallpox still constituted 9·2 per cent. of the whole (45,428 out of 493,309). It cannot be

[1] 11,004.

denied that the proportion of smallpox deaths to deaths from all causes was greater last century in London after the introduction of inoculation than it was before, though it is also true that the death-rate in proportion to the estimated population from all causes and from smallpox showed signs of improvement during the last quarter of the eighteenth century.

26. The Committee of the House of Commons which reported on Jenner's petition stated:[1]—"As a comparison between this new practice and the inoculated smallpox forms a principal consideration in the present inquiry, some facts with regard to the latter engaged the attention of your Committee, and in the supplement are inserted statements of the mortality occasioned by the smallpox in 42 years before inoculation was practised in England, and of the 42 years from 1731 to 1772; the result of which appears to be an increase of deaths amounting to 17 in every 1000; the general average giving 72 in every 1000 during the first 42 years, and 89 in the 42 years ending with 1772, so as to make the whole excess of deaths in the latter period 1742. The increase of mortality is stated by another witness (No. 10) to be as 95 to 74, comparing the concluding 30 years with the first 30 of the last century, and the average annual mortality from smallpox to have been latterly about 2000; for though individual lives are certainly preserved, and it is true that a smaller loss happens in equal numbers who undergo the smallpox now than there was formerly, yet it must be admitted that the general prevalence of inoculation tends to spread and multiply the disease itself; of which, though the violence be much abated by the present mode of treatment, the contagious quality remains in full force."

27. Calculations made by de Haen, Rast, Heberden, and others[2] confirmed the belief that inoculation, as practised in London, kept going a constant source of contagion and in-

[1] Vol. i, App., p. 95.

[2] 10,515. Vol. i, App., p. 66.

creased the prevalence of smallpox. Dr. Heberden, writing in no controversial spirit, thus summed up the case in 1801 : —"The inoculation of the smallpox having been first used in England since the beginning of the eighteenth century, and having been now for many years generally adopted by all the middle and higher orders of society, it becomes an interesting inquiry to observe, from a review of the last hundred years, what have been the effects of so great an innovation upon the mortality occasioned by that disease. But, however beneficial inoculation prove to individuals, or indeed to the nation at large, the Bills of Mortality incontestably show that in London more persons have died of the smallpox since the introduction of that practice. The poor, who have little care of preserving their lives beyond the getting their daily bread, make a very large part of mankind. Their prejudices are strong, and not easily overcome by reason. Hence, while the inoculation of the wealthy keeps up a perpetual source of infection, many others who either cannot afford or do not choose to adopt the same method, are continually exposed to the distemper. And the danger is still increased by the inconsiderate manner in which it has lately been the custom to send into the open air persons in every stage of the disease, without any regard to the safety of their neighbours. It is by these means that, while inoculation may justly be esteemed one of the greatest improvements ever introduced into the medical art, it occasions many to fall a sacrifice to what has obtained the distinction of the natural disease. This must always be an objection against making any great city the place for inoculation until the practice is become universal amongst all ranks of people. Out of every thousand deaths in the Bills of Mortality, the number attributed to the smallpox during the first 30 years of the eighteenth century, before inoculation could yet have had any effect upon them, amounted to 74. During an equal number of years at the end of the century they amounted to 95. So that, as far as we are enabled to judge from hence, they would appear to have increased in a proportion of above five to four."

28. We agree with those witnesses[1] who are of opinion that inoculation as practised in this country and many parts of Europe last century did tend to increase the prevalence and mortality from smallpox, that it introduced the disease into places that in all probability would have remained exempt from it, and in some large towns like London it tended to keep the contagion alive and to make the disease endemic. It appears, however, from the Bills that its introduction did not at once or very materially increase the mortality from smallpox in London. This was doubless owing to the fact that it was scarcely possible to make matters much worse then than they were before in regard to the number of smallpox deaths.

29. We are led to believe that but for the disease being kept alive by inoculation, the improvement of the public health which set in towards the end of the eighteenth century, in obedience to the causes to which we have alluded, would have brought about an earlier and greater decline of smallpox mortality. The mere substitution of a non-contagious process like vaccination for the old inoculation in a population of whom some 80 per cent. or more had acquired naturally or artificially such protection as previous smallpox affords would have a striking effect upon the smallpox death-rate by reducing the liability to infection of the remaining susceptible.

30. We think there can be no doubt that, speaking generally, in London last century, whether from the indiscriminate practice of inoculation or from the habitual indifference which permitted smallpox to run riot with little, if any, restriction, the great bulk of persons suffered from smallpox in childhood and acquired such protection as an attack of smallpox affords. The deaths from smallpox each year were chiefly those of young children or new-comers who were exposed to the constant sources of infection always kept going, and to the effects of which they had not been rendered immune. It is clear that any changes which would have the effect of reducing the chances of infection would diminish for the susceptible the prospects of attack and

[1] 282.

death by smallpox; while those who had acquired natural or artificial immunity would constitute to that extent a protected class. In so far as vaccination (after the first mistakes of Woodville and Pearson) substituted a non-infectious procedure for the old inoculation, to that extent, and apart from any question of its affording any immunity, it should by checking a fertile cause of the diffusion of smallpox bring about indirectly a reduction of mortality from that disease. Great as such influence must have been, and great as were the efforts which were now for the first time made to restrict the spread of smallpox—by efforts directed against contagion—there were in addition those other influences at work during the last quarter of the eighteenth century to which we have already alluded, influences which have been continued and intensified during the present century, and which in our opinion must be credited with a considerable share in the reduction of smallpox.

31. Attention has also been directed to the influence of states of peace and war upon smallpox epidemics. Smallpox as well as typhus has not uncommonly been especially prevalent and fatal among armies and nations in a state of war. The privations, crowding, interruptions of regular sanitary organisation associated with sieges and the field of battle are calculated to propagate infectious disease,[1] and such disease under such circumstances is likely to spread far and wide, and regardless of national boundaries to extend to other nations besides those actually engaged in war. The experience of the last century as well as the present indicates a relationship between war and smallpox, and it is not improbable that the fall of smallpox in the earlier part of this century in Europe may have been due in some measure to transition from war to peace, and that certain recrudescences of smallpox during the latter part of the century may have been connected with wars, notably in the case of the Franco-German war of 1870–71.

32. The lull in smallpox which characterised the early years of this century was, then, probably largely due to the

[1] 7994—8021.

cessation of inoculation in a population whose sanitary condition was beginning to improve, as evidenced by the falling death-rate from all causes and from fevers, and who had for the most part received naturally or artificially such protection as previous smallpox is capable of affording. In the 80 or 90 years which separated the introduction and abandonment of inoculation there had been enormous improvements in the healthiness of large towns, the influence of which, upon smallpox in particular, had been interfered with and masked by the propagation of this disease artificially.

33. When inoculation of the smallpox became more general in accordance with the method adopted by the Suttons, failure of the operation was in some cases attributed to the patient having previously suffered from cow-pox. Jenner, who was practising at Berkeley in Gloucestershire, became impressed with this belief. He found, however, that some who had undergone the cow-pox on inoculation with the smallpox, felt its influence just the same as if no disease had been communicated to them by the cow. This experience was shared by the medical men in his district. Jenner then proceeded to draw distinctions between what he called the true cow-pox, and other varieties of "spontaneous eruptions" on the teats, which he classed together as spurious cow-pox. The true cow-pox, *i. e.* that which was protective, he traced in origin to the heel of a horse suffering from the grease.

34. Jenner's first writing on the cow-pox was a communication intended for the Royal Society in 1797, the original of which, it would appear, exists in manuscript in the library of the Royal College of Surgeons. The communication was not printed in the 'Philosophical Transactions,' but was returned to Jenner, and, with additions, was published in 1798 as "An inquiry into the causes and effects of the Variolæ Vaccinæ." The original paper asserted that "matter of various kinds when absorbed into the system may produce effects in some degree similar; but what renders the cow-pox virus so extremely singular is, that the person

who has been thus affected is for ever after secure from the infection of the smallpox ; neither exposure to the variolous effluvia nor the insertion of the matter into the skin producing this malady."

35. Jenner states that the observations which led to the publication of his inquiry extended over 25 years. The original paper for the Royal Society contained an account of only one case of vaccination (*i. e.* inoculated cow-pox) ; the other instances cited being three cases of casual infection from the grease of the horse, and 10 cases of casual infection from the cow.

Dealing with the 10 cases of "casual cow-pox" first, it must be premised that inasmuch as the disease conveyed by the cow had in nearly all the cases taken place many years before they came to Jenner for inoculation with smallpox, it would be impossible to decide what kind of "cow-pox" it was from which they had suffered. Again, it would appear that these 10 cases had been collected from an experience of inoculation extending over some years. One case was inoculated by Jenner in 1778, another in 1791, another in 1792, two in 1795, three in 1797, and in two the date is not given. The effect of the inoculation of smallpox as applied by Jenner in these cases is recorded as local inflammation, often described as an "efflorescence," in some amounting to "erysipelas," but without any constitutional variolous symptoms. In the three cases of casual horse-grease, the date of their infection is not given. Two of these were inoculated with smallpox, in one case six years later, in the other "some years after," with the result of a slight inflammation only in the first case, and in the second a few eruptions on the forehead which did not advance to maturation. The third horse-grease case on exposure to infection of smallpox caught the disease, the nature of which was verified by successful inoculations in others. Jenner quotes this last case in support of his contention that the virus from the horse could not be relied upon until it had been communicated to the nipple of the cow, and thence to the human subject.

36. We will return presently to the only case of vaccination mentioned in Jenner's original paper. The other cases may be thus summed up. In the course of several years' inoculation practice, Jenner collected 10 instances of insusceptibility to smallpox in persons who stated that many years or months previously they had suffered from a disease which they called the cow-pox. He added three cases of grease in the human subject, only one of which gave evidence of insusceptibility to smallpox.

37. Jenner's "Inquiry," published in 1798, reproduced the above cases, and added others. The additions were as follows :—

(1.) A case of casual cow-pox (Sarah Nelmes) from whom lymph was taken for the vaccination of Phipps, the only case of vaccination alluded to in the original paper. She does not appear to have been subjected to the variolous test. (2.) A case of insusceptibility to inoculation in 1792, who was reported to have had cow-pox 10 years previously. (3.) The paupers of Totworth, having been inoculated in 1795 by Henry Jenner, eight who proved insusceptible were reported to have had the cow-pox "at different periods of their lives;" one of them had been attended with the cow-pox in 1782 by Jenner himself. (4.) Three cases of casual horse-grease in servant men of a farm, two of whom had had smallpox previously; they do not appear to have been submitted to the variolous test. (5.) A child, John Baker, was inoculated with horse-grease from the hand of one of the foregoing. The pustule appears to have shown a disposition to run into an ulcer, and "the boy unfortunately died of a fever at a parish workhouse" soon after this experiment was made, and before he could be submitted to the variolous test. (6.) Several children and adults were vaccinated directly or indirectly from a cow which had been infected with horse-grease. Three of these were submitted to the variolous test (Summers, Barge, and Pead). The reason why the test was not applied to others is thus stated by Jenner :—"After the many fruitless attempts to give the smallpox to those who had had the cow-pox, it did not appear necessary, nor was it convenient

to me, to inoculate the whole of those who had been the subjects of these late trials."

38. The original paper and inquiry of Jenner taken together therefore furnish us with four cases in which the human subject had been intentionally cow-poxed, and to whom the "variolous test" had been subsequently applied, viz. Phipps, Summers, Barge, and Pead. The facts in regard to these four cases as given by Jenner, are summarised in the following table:

Name.	Age.	Date of vaccination.	Date of inoculation.	Result.
1. Phipps .	8 years	May 14, 1796	1. July 1, 1796 2. "Several months afterwards"	"1. The same appearances were observable on the arms as we commonly see when a patient has had variolous matter applied, after having either cow-pox or the smallpox." "2. No sensible effect was produced on the constitution."
2. Summers .	5 years	Mar. 16, 1798	(No date), but before June 21, 1798	"He was inoculated with variolous matter from a fresh pustule; but, as in the preceding cases, the system did not feel the effects of it in the smallest degree."
3. Pead. .	8 years	Mar. 28, 1798	(No date), but before June 21, 1798	Inoculated by Henry Jenner, who reported: "I have inoculated Pead and Barge, two of the boys whom you lately infected with the cow-pox. On the second day the incisions were inflamed, and there was a pale inflammatory stain around them. On the third day these appearances were still increasing, and their arms itched considerably. On the fourth day the inflammation was evidently subsiding, and on the sixth it was scarcely perceptible. No symptoms of indisposition followed."
4. Barge .	7 years	Apr. 19 (?), 1798		

In these four cases, therefore, subsequent inoculation within a few weeks or months gave results upon which Jenner based the claim that insusceptibility to smallpox was conferred by inoculation of cow-pox.

39. The value of this "variolous test," *i. e.* the failure of inoculation of smallpox to produce the disease in those who had had the cow-pox, as a test of acquired immunity has been disputed. To assess its value it is necessary to know what results were likely to occur when the test was similarly applied to those not cow-poxed.

40. It is difficult to arrive at any numerical estimate of the proportion of cases of inoculation, in the modified form in which it was practised at the end of last century, in which little or no eruption of pustules appeared upon the body.[1] There can be no doubt that such cases were more common in the practice of the Suttons and of Dimsdale than in the hands of the earlier inoculators. The cause of the mildness has been variously attributed to drugs, to open-air treatment, to taking the lymph early, to using lymph from the "mother pustule," &c.; but whatever the cause of the mildness, and even when there was only a local pustule, or merely local inflammation, and constitutional symptoms short of any general eruption, the operation was regarded as effective, and the patients were held by some inoculators to have gone through the smallpox, and acquired protection. Adams, in 1805, operating with a mild variety of smallpox, succeeded in carrying on inoculation, in some cases from arm to arm, in such a form that the results on the arm were described as of "legitimate vaccine appearance;"[2] and in half his cases there was no eruption. This and other attempts by Adams at the Smallpox Hospital in the early years of this century, to perpetuate a favourable smallpox,[3] were interrupted by the prejudices of parents in favour of secondary pustules; although it was urged that "before the discovery of cow-pox, the inoculation of smallpox was sometimes only followed by a pustule at the arm,

[1] 4895, 5008, 4850.
[2] 11,144. [3] 11,141. [4] 10,435.

with the attendant fever."[1] Adams' experiments of arm-to-arm variolation, giving "vaccine" results, received subsequent corroboration from those of Guillou and Thiele.[2] This mild variety of smallpox had been observed by Jenner, and in 1789 he appears to have used it under the name of swine-pox for the inoculation of his son;[3] and he held that by arm-to-arm inoculation under certain conditions a mild smallpox might be produced at will.

41. The fact that smallpox could be inoculated under certain conditions so as to produce minimum results has an important bearing—

1. Upon the interpretation to be placed upon the "variolous test" as applied to vaccinated persons; and
2. Upon the nature of a series of inoculations by Woodville at the Smallpox Hospital with what was called cow-pox, which undoubtedly did much to found the belief that vaccination secured immunity towards smallpox.

42. In regard to the first point it will be necessary to note in cases where cow-poxed persons were subjected to inoculation to test their immunity, what was the amount of the local and constitutional results to be expected from the method of inoculation adopted, and how far the actual results differed from those obtained in persons who had not previously had the cow-pox. Whether resistance to the "variolous test" implied protection against natural or epidemic smallpox must be reserved for consideration later on. In regard to Jenner's own cases we find in his "Inquiry," after alluding to the mild variety of smallpox, which Adams termed "pearl-pox," he goes on to speak of "the attention that was paid to the state of the variolous matter previous to the experiment of inserting it into the arms of those who had gone through the cow-pox. "This," he says, "I conceive to be of great importance in conducting these experiments, and were it always properly attended to

[1] 11,150. [2] Vol. i, App., p. 68, foot-note.
[3] 25,249.

by those who inoculate for the smallpox, it might prevent much subsequent mischief and confusion."

43. In one case in the "Inquiry" Jenner does make mention of the source of the variolous matter which he used for his test. In Case 3 (Phillips) he says, "It was taken from the arm of a boy just before the commencement of the eruptive fever, and instantly inserted." It was therefore arm-to-arm variolation from an early "mother-pustule." In regard to the two cases of vaccination by Jenner set out in the foregoing table, the following statements as to the variolation are made:—In Phipps's case "he was inoculated with variolous matter immediately taken from a pustule." In Summers's case "he was inoculated with variolous matter from a fresh pustule." It is not possible to say, therefore, that in these two cases the method employed differed from that adopted in Case 3 (Phillips).

Now the results obtained in these cases were hardly less than the results obtained[1] in some cases by Dimsdale and other inoculators in persons who had not previously been cow-poxed, but who were nevertheless regarded as having thereby received the infection to an extent sufficient to establish immunity.

44. It appears from Jenner's later publications and correspondence that he sometimes met with more definite results from the insertion of variolous matter in the arms of those who had been cow-poxed than in the cases mentioned in the Inquiry;[2] in some cases a pustule or vesicle resulted, capable of communicating smallpox, and often attended with extensive inflammation, and sometimes by a slight eruption[3] (Baron, vol. i, 445, *Med.-Chir. Trans.*, vol. i). It is also clear that cow-pox lymph from one of the same stocks used by Jenner[4] (the Stonehouse cow-pox), and in his hands stated to be protective, in the hands of neighbouring surgeons, when submitted to the variolous test, failed to prevent the development of inoculated small-

[1] Vol. iv, App. 1, p. 398.
[2] 11,780–1.
[3] 254.
[4] 11,966; 11,975.

pox in the usual way. Jenner's "Inquiry" was read with interest, by leading men in this country, and for the most part appears to have been favourably received. Haygarth, Percival of Manchester, Ingenhousz (who was on a visit to England), and others asked for more evidence of the alleged protection. Moseley, who led the opposition to the practice, doubted whether the vaccinated would stand proof against epidemic smallpox, and declared the protection to be non-specific and temporary. Dr. Beddoes, of Bristol, who was not unfriendly to Jenner, thus summed up the position of affairs at the beginning of 1799, in a letter to Professor Hüfeland, of Berlin:—"You know Dr. Jenner's experiments with the cow-pox. His idea of the origin of the virus appears to be quite indemonstrable, and the facts which I have collected are not favourable to his opinion that the cow-pox gives complete immunity from the natural infection of smallpox. Moreover, the cow-pox matter produces foul ulcers, and in that respect is a worse disease than the mildly inoculated smallpox (Hüfeland's *Medical Journal*, 1799). He adds that experiments were to be carried out at the London Smallpox Hospital.

45. Thus the matter stood when, in January, 1799, cow-pox was discovered in a dairy in the Gray's Inn Lane, London, and attracted the attention of the leading medical men in town, and became the subject of experiments on a large scale by Drs. Woodville and Pearson at the Smallpox Hospital.[1]

Woodville published the results of his experiments in May, 1799, and Pearson in March of the same year distributed the hospital lymph to some 200 practitioners at home and abroad.[2]

46. This was the starting-point of the practice of "vaccination;" for Jenner had lost his strain of lymph. Woodville's cases merit careful attention, as from their number and detail, and from the fact that he had submitted nearly all of them to the variolous test within three months of their "vaccination," and found they resisted it, they produced a

[1] 11,182. [2] 11,185.

profound impression on the mind of the public and the profession. In July, 1800, 33 of the most eminent physicians and 40 distinguished surgeons of the metropolis signed a declaration to the effect that "those person who have had the cow-pox are perfectly secure from the future infection of the smallpox, and that the inoculated cow-pox is a much milder and safer disease than the inoculated smallpox" (*Morning Herald*, July 19th, 1800).

47. We are unable to find in these early days of vaccination any other evidence on a scale at all comparable to that of Woodville in confirmation of the views advanced by Jenner; and it is clear that professional authority declared for vaccination mainly upon the experience of Woodville and Pearson.

48. We have received a great deal of evidence on the subject of the nature of the lymph used and distributed so widely at home and abroad by Woodville and Pearson. Its effects differed from those of inoculated cow-pox as described by Jenner, and as observed since, in that in the majority of the cases detailed in Woodville's Reports, pustules appeared on the body similar to smallpox pustules; indeed, Woodville spoke of the cow-pox as an eruptive disease, in one case even as confluent, and as sometimes contagious.[1] It is now not disputed that these pustular cases, three-fifths of the whole, were cases of smallpox, and that their resistance to the variolous test accordingly proved nothing as to the alleged protection conferred by cow-pox.[2] How was this source of error introduced, and what was the nature of the remaining two-fifths of the cases?

Some, at any rate, of the "vaccinations" appear to have been performed within the precincts of the Smallpox Hospital, and it has been suggested that the infection was aërially conveyed.[3]

In several of the first cases (Collingridge, R. Payne, Redding, Pink) smallpox matter was inoculated on the

[1] 4878; 25,234; 25,246. [2] 11,776; 11,239.
[3] 4874.

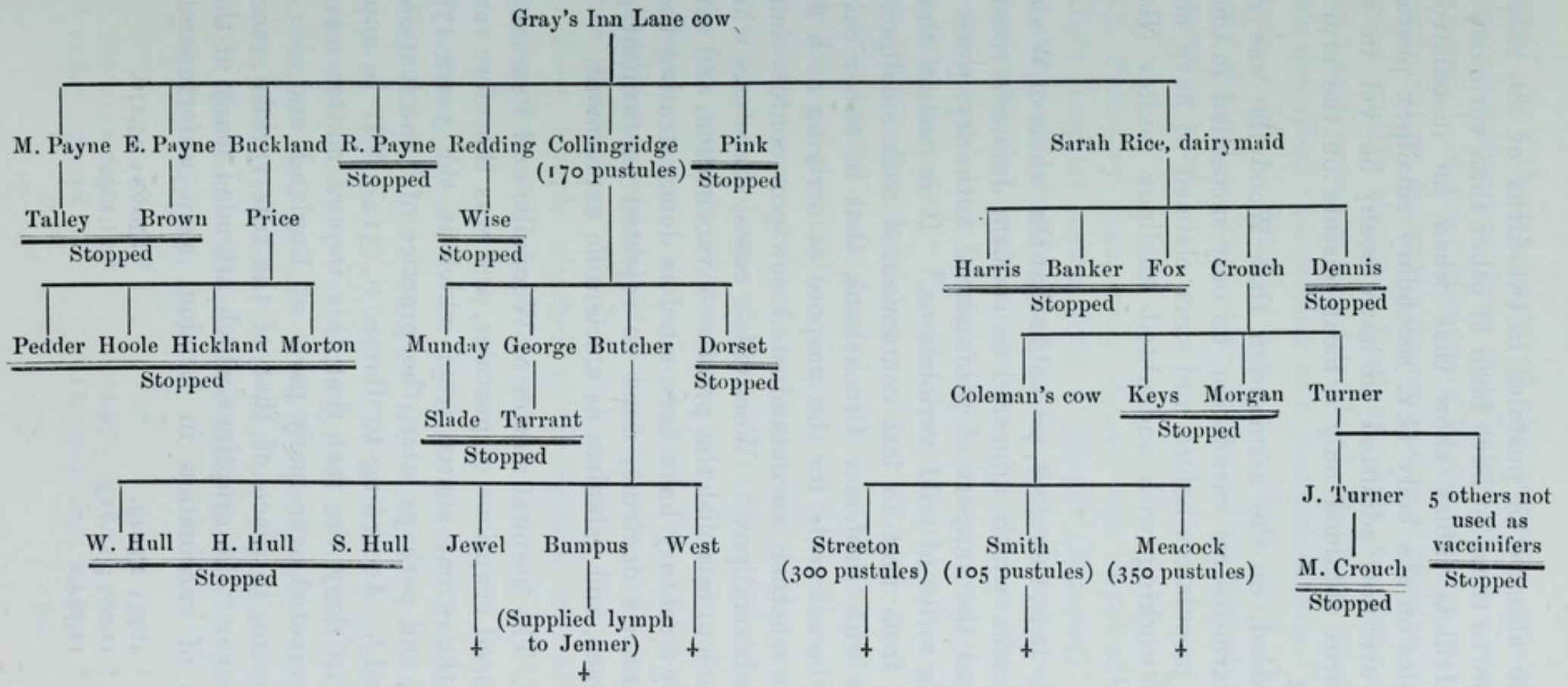
"vaccinated" patient a few days after the cow-pox, and this may have led to contamination.

49. But one of the very first cases (Buckland) which Woodville believed he had only inoculated with matter "in a purulent state" direct from the cow, exhibited all the symptoms (including a pustular eruption commencing on the inoculated arm),[1] which make it in the highest degree probable that this patient was in fact variolated when he was supposed to have been vaccinated.

50. The three persons (Streeton, Smith, and Meacock) inoculated from a cow (Coleman's) which had been inoculated at one remove from a pustule on the hand of a dairymaid at the Gray's Inn Lane Dairy, similarly at the proper time developed smallpox in a way highly suggestive of its having been inoculated at the place and time of what purported to be vaccination; from these three persons much of the lymph was taken for the subsequent inoculations. The only other case (Collingridge) inoculated direct from the cow, used to any extent for subsequent inoculations, was purposely variolated on the fifth day of her vaccination; it is impossible to establish that the first inoculation in her case was in fact that of cow-pox, and it may well have been, as in the first case mentioned above (Buckland), that what purported to be vaccination was in truth variolation. Her own subsequent symptoms, as well as the results on those inoculated from her arm, support such supposition. Indeed, Woodville's lymph passed exclusively through those suffering from smallpox, for he seems to have avoided carrying on matter from those who exhibited only the local pustule as the result of their inoculation from the Gray's Inn Lane cow, or dairymaid.

[1] 25,224.

Pedigree of Woodville's "Hospital Matter," showing how the strain continued only through subjects with smallpox pustules.[1]



[1] Vol. vi, App., pp. 619–623.

The absence of pustules in two-fifths of the cases does not prove these to have been of other than variolous origin. Woodville's tables show that when he inoculated from pustules on the body (*i. e.* secondary smallpox pustules, as they are now admitted to have been) he yet in several instances obtained only a local pustule on the arm as the result.

Indeed, on the assumption that Woodville was dealing with arm-to-arm variolation, he only succeeded in obtaining what inoculators before and since claimed to have obtained when working with undoubted smallpox matter (Baron, i, 245).[1]

51. It is, therefore, probable that the whole of Woodville's 500 cases which appeared to confirm Jenner's thesis, and secured the support of professional authority, were in fact only a series of mild variolations.[2] It is certain that they were from first to last contaminated with smallpox. We agree with Professor Crookshank that in either case they must be set aside for the purpose of arriving at a decision as to whether uncontaminated cow-pox confers immunity towards smallpox.[3] Woodville's cases, therefore, which did so much to establish the practice of vaccination, and which for nearly a century have been cited as demonstrating the truth of Jenner's doctrine, must be rejected as furnishing false evidence, and valueless as a scientific experiment.

52. The hospital matter of Woodville and Pearson, which produced eruptions of pustules, and was therefore variolous, was the great source from which in the years 1799 and 1800, and perhaps later, the practice of "vaccination" was started.[4] According to Baron (i, 312), "It is impossible now to deny the fact that this *impure* matter was really disseminated over many parts of England, and also on the Continent, in place of that of the true variolæ vaccinæ."[5] Moreover "the eruptions which attended many of the early cases of vaccination in London, were unfortunately also

[1] 4895; 25,249.
[2] 25,265; 25,270.
[3] 12,089; 11,813.
[4] 11,185.
[5] 11,764.

propagated in different parts of the country, where the *contaminated* matter had been distributed by Dr. Pearson" (Baron, i, 339).[1] Moore ('History of Vaccination,' p. 36) says, "Variolous matter, under the denomination of vaccine lymph, was spread widely through England, and transported to Germany, and even to the island of Madeira, where a physician described the vaccine as a pustular disease."

Jenner's original lymph had been lost, and though repeatedly applied to for matter in the latter part of 1798, he had none to send.[2]

53. On February 15th, 1799, Jenner was supplied with Woodville's Hospital matter from a patient (Bumpus)[3] who had 310 variolous pustules, and in the first case inoculated by Jenner with this matter pustules appeared on the face, and in the second case, though there was no eruption, the local pustules assumed "the variolous character," and the areola was studded with minute vesicles. Jenner kept up a stock of this matter from arm to arm, and when applied to by Ring for cow-pox matter, Jenner in September, 1799, sent him matter derived from the Woodville stock, explaining that "when I had the pleasure of receiving your letter there was no cow-pox matter here in a fit state to send you" (Baron, i, 358, and Crookshank, ii, 184–6). It would therefore appear that if at that time Jenner possessed any other strain than the hospital matter, such as the Kentish Town lymph alluded to in Section 27 of our colleagues' report, it was not fit for use.

54. Writing to Moore in 1812, Jenner accused Pearson of "spreading the smallpox through the land, and calling it the cow-pox" (Baron, ii, 383). The medical journals of the time furnish evidence[4] that the lymph of Woodville and Pearson, when used in the country, produced variolous eruptions, in some instances even proving contagious as it had done in London. Those thus inoculated also proved refractory to the variolous test.

[1] 11,192–11,204.
[2] 11,978.
[3] 11,847; 25,276.
[4] 11,192–11,204; 25,303.

55. It is true, as stated in Sections 20, 23, and 27 of the majority report, that Woodville speaks of having at various times procured lymph from different cows, and with it inoculated patients in the hospital ('Observations on the Cow-pox,' 1800); but he adds, "The effects of all the matter I tried were perfectly similar; and pustules proved to be not less frequently the consequence of these trials than with those made of the matter formerly employed."

56. In the report of the Vaccine-Pock Institution, 1803 (page 4), it is stated that it was from two sources *only*, viz. the Gray's Inn Lane lymph taken by Woodville and Pearson,[1] and the Marylebone lymph taken by Pearson, that the matter used in London and the provinces in or about 1799 to the extent of some four or five thousand inoculations was derived.

57. In the letter which Pearson sent on March 12th, 1799, enclosing a thread imbued with matter, to 200 practitioners, he stated that "in many of the cases eruptions on the body appeared, some of which could not be distinguished from the smallpox."[2]

This same "hospital matter" was also widely distributed abroad, to Paris, Berlin, Vienna, Geneva, Hanover, and to Portugal and America.[3]

58. We read of this matter producing variolous eruptions in distant places as it had done at home, and in some cases the variolous test showed a refractoriness had been acquired. The hospital matter of Woodville and Pearson would appear to have been the chief source of the first stocks of lymph used on the Continent and in America. It is true Stromeyer of Hanover also received matter from Jenner,[4] but as it produced tedious ulcerations he gave it up in favour of Pearson's stock, which he says "produces frequently an eruption of small pimples." We have been unable to trace the extensive use of any matter sent abroad from this country in these early years, which can be clearly shown to

[1] 25,219.
[2] 11,185.
[3] 11,190.
[4] 11,204.

have had other origin than the stock of Woodville and Pearson.

59. Fresh stocks of lymph were later on raised by Sacco and others from various sources, such as spontaneous cow-pox, horse-grease, and sheep-pox. Even if we accept Sacco's somewhat sensational accounts of his work we do not find in it corroboration of the thesis of Jenner that cow-pox derived from the grease of the horse is possessed of specific efficacy such as is not possessed by spontaneous cow-pox or the grease as taken from the horse. And as to the matter used by De Carro and sent by him to the East and used so extensively in India, which our colleagues suggest (sec. 27) establishes the use of cow-pox lymph abroad of other than British origin, we learn from De Carro, "The source of our cow-pox is partly British, and partly originating from the *grease* of a horse at Milan, without any intervention of a cow. The effect was so similar in every respect that they were soon mixed,—that is to say, that it was impossible to say, after several generations, and in the hands of innumerable practitioners, what was equine and what was vaccine. The whole British settlements in India have been *equinated;* for the first liquid drop which I sent 25 years ago to India was the second generation of Milanese equine transplanted at Vienna." (Letter from De Carro to Monro, 'Edinburgh Journal of Medical Science,' vol. i, 1826, pp. 284–5.)

60. Apart from the vague statements of Marshall,[1] which must be received with reserve, we are unable to find in the early days of vaccination any large body of definite evidence sufficient to establish the contention of Jenner that cow-pox, and especially that of equine origin, affords, when conveyed to man, security from the future infection of smallpox.

61. Whatever may have been the nature of the matter used and so widely distributed by Woodville and Pearson, and even if we must regard it all as derived from smallpox, it seems that after a time, whether from attenuation or

[1] 11,826; 11,680; 11,847; 12,002–12,018.

dilution of the original matter, or the selection of mild cases, or from other causes, the operation gradually ceased to be followed by pustular eruptions, was no longer infectious, and came to assume the local phenomena now observed in ordinary vaccination.[1]

62. It is clear, therefore, that the bulk of the cases of "vaccination," which in the first few years of the practice were shortly afterwards submitted to the variolous test, and of which record remains, had been inoculated with the hospital lymph of Woodville and Pearson.[2] It would have been satisfactory to find evidence on a similar scale, and recorded with equal detail, of cases inoculated with cow-pox matter pure and simple, and submitted at subsequent periods to the variolous test or epidemic exposure, and showing immunity towards smallpox. Though much research has been directed to this point, it appears to have been almost entirely barren of result.[3]

63. We shall adduce reasons later on for thinking that under the one name of "vaccination," matter derived from various sources, and of diverse origins, has been introduced at different times. It is now no longer possible to trace or distinguish these. We therefore, in using the term "vaccination," must be held to employ it colloquially, and not exclusively as an equivalent for cow-poxing.

64. In the early years of this century it was not unnaturally argued that the renunciation of inoculation was a necessary consequence of the approval of vaccination,[4] and the milder operation was authoritatively urged in substitution of the old practice. In 1808 Jenner contributed a paper to the 'Med.-Chir. Trans.' in which, after guarding those who thought fit to inoculate after vaccination from unnecessary alarm should a pustule, fever, and a slight eruption ensue therefrom, he concluded thus:—"At the commencement of vaccination I deemed this test of security necessary; but now feel confident that we have one of

[1] 11,204.
[2] 11,795.
[3] 12,087.
[4] 11,853.

equal efficacy, and infinitely less hazardous, in the re-insertion of the vaccine lymph." Bryce about the same time advocated the same practice, which was adopted by many, and came to be spoken of as "Bryce's test" ('Practical Observations on the inoculation of the cow-pox,' 1809). The significance of this test of re-vaccination we shall discuss later on in connection with the modern development of that practice.

65. Though in his first essays Jenner merely suggested vaccination as a substitute in certain cases for inoculation, there can be no doubt that the claim he originally made for vaccination was one of complete and permanent protection against smallpox. Jenner in his "Inquiry" observed, "What renders the cow-pox virus so extremely singular is, that the person who has thus been affected is for ever after secure from the infection of the smallpox."[1]

66. Cases in which smallpox had occurred after cow-pox had frequently been pressed upon Jenner's attention (Gregory's '*Eruptive Fevers*,' p. 208), and in his third publication in 1801 Jenner thus alludes to these objectors:— "Some there are who suppose the security from smallpox obtained through the cow-pox will be of a temporary nature only. This supposition is refuted, not only by analogy with respect to the habits of diseases of a similar nature, but by incontrovertible facts, which appear in great number against it." He claimed that it had been uniformly found that "the human frame, when once it has felt the influence of the genuine cow-pox in the way that has been described, is never afterwards, at any period of its existence, assailable by the smallpox." In his evidence before a Committee of the House of Commons in 1802 he maintained that "it now becomes too manifest to admit of controversy, that the annihilation of the smallpox, the most dreadful scourge of the human species, must be the final result of this practice." In his petition to the House of Commons he states that he had discovered that "the cow-pox admits of being inoculated on the human frame with the most perfect

[1] 1st Report, App., p. 94.

ease and safety, and is attended with the singularly beneficial effect of rendering through life the persons so inoculated perfectly secure from the infection of the smallpox" (Baron, i, 490).

67. It was not long, however, before cases of smallpox in those who had been vaccinated began to crop up.[1] Goldson of Portsea published some cases in 1804; Moseley, Birch, and others called attention to failures in London, and in 1809 Brown of Musselburgh published a work containing a number of cases of post-vaccinal smallpox which raised doubts as to the efficacy of the practice, and suggested that its powers at best were only temporary. There were also reports from abroad of smallpox subsequent to vaccination, especially in Geneva (Baron, i, 338).

68. Further failures in London, and particularly one in the family of a nobleman in 1811, excited some opposition to the practice. In 1818 Dr. Monro of Edinburgh published a nnmber of cases observed by himself and others in which smallpox in its perfect form succeeded to vaccination in its perfect form. Smallpox continued to be epidemic in Scotland, attacking many hundreds of the vaccinated in various degrees, and Dr. Thomson wrote a book in 1820 on the varioloid type of the disease. In 1819, 19, and in 1825, 147 vaccinated persons were admitted with smallpox into the London Smallpox Hospital.

69. Other countries of Europe suffered severely from smallpox about this time,[2] and the theory that ascribed to vaccination the reduction of smallpox in the earlier years of the century, in some places to the point of extinction, received a rude shock. In 1828 a severe epidemic broke out at Marseilles, and 2000 vaccinated persons caught the disease.

70. In Copenhagen, where the absence of fatal smallpox from 1811 to 1823 had been confidently attributed to the introduction of vaccination, in 1824 there were 41 deaths

[1] 25,336; 25,472; 11,853.
[2] Vol. i, App., p. 74.

from smallpox, and in 1835, 434, or 11·2 per cent. of the total deaths. It appears from Dr. Gregory ('Lectures on Eruptive Fevers,' p. 214), who gives a "Table exhibiting the amount and mortality by smallpox in the well-vaccinated population of Copenhagen, from 1824 to 1835," that of 3839 persons attacked by smallpox no fewer than 3093 had been vaccinated. It was these figures that led Dr. Gregory, the physician to the Smallpox Hospital, in 1843 to declare "that some material error had crept into the views originally entertained regarding the power and capabilities of the vaccine inoculation. If smallpox can invade so large a proportion of a well-vaccinated population, it is obvious that all idea of banishing that disease from the earth is vain and illusory."

71. The fall in smallpox death-rate observed in many places[1] in the first vicennium of this century can hardly be ascribed to vaccination. If the limited and voluntary practice of the operation could be so influential upon smallpox mortality as such a theory demands, it is strange indeed that the more complete and compulsory adoption of it should have been so uninfluential against recurring epidemics as was especially exemplified in the pandemic of 1870–74, and against more recent outbreaks in this country and abroad, in which the vaccinated figured largely among the victims.

72. The vaccinated, nowadays, generally constitute the majority of the patients in smallpox hospitals,[2] and in certain limited outbreaks only vaccinated persons have been attacked.

Thus Mr. Marson[3] records 3094 cases of post-vaccinal smallpox treated by him at the Highgate Hospital between 1836 and 1851, and a further series of 10,661 such cases between the years 1852 and 1867.

Dr. Gayton during the years 1870 to 1883 treated 8234 cases of smallpox in vaccinated persons in the hospitals of

[1] App., vol. i, p. 74.
[2] 22,433.
[3] Vol. i, App., p. 116.

the Metropolitan Asylums Board. At Sheffield, in 1887–8, 5035 vaccinated persons were attacked by smallpox.[1]

It is, however, superfluous to cite further evidence at this stage to prove, what is no longer denied by anybody, that smallpox attacks the vaccinated.

No witness who has appeared before us has maintained the original contention of Jenner and the earlier vaccinators, and the protection now claimed by those who assert such protection is relative, not absolute; temporary, and not permanent.

73. It was at one time alleged that even if vaccination did not invariably prevent attack by smallpox, yet such attack was modified and never severe or fatal. There can, however, be no doubt that fatal smallpox and cases of the disease in all its various types of severity occur in persons who have been successfully vaccinated.

74. Dr. Gayton's tables include fatal cases, not only in those stated to be vaccinated but without visible marks, nor only in those whose marks were considered to be imperfect, but also amongst those who exhibited at the time of their attack one, two, three, and four good marks of vaccination.[2] We are not now concerned with the question of relative mortality in the various classes, to which we shall return, but these and numerous other examples suffice to prove, what we believe is no longer disputed by anyone, that severe and fatal smallpox occurs in those who have been successfully vaccinated. As affecting the kind of attack, as well as liability to attack, the influence now claimed for vaccination is a relative one; that is to say, the contention is, that admitting to the full the occurrence of smallpox, and even death from smallpox in the vaccinated, yet the vaccinated are relatively to the unvaccinated in a superior position both as regards the liability to be attacked and the chance of the disease assuming a severe or fatal form.

[1] 1683; 1809; Sheff. Rep., p. 191.
[2] 2nd Report, App. 3, Table A.

75. Restricting our attention in the first instance to the question of liability to attack, it is right to state that in the earlier part of this century, when cases of the failure of vaccination began to multiply, it was urged that inasmuch as smallpox itself did not invariably prevent a second attack it was unreasonable to expect that vaccination could accomplish more.[1] This view appeared to receive support when experiments seemed to show that the cow-pox was merely the smallpox of the cow, and it was said the vaccinated are protected against smallpox because they have in fact had it. Indeed, the Select Committee of the House of Commons which inquired into the operation of the Vaccination Act in 1871 reported that they had no doubt "that the almost universal opinion of medical science and authority, is in accordance with Dr. Gull, when he states that vaccination is as protective against smallpox as smallpox itself."

76. We have already shown that such protection is by no means absolute, but we cannot recall a single witness who has been examined by us on this question who has not admitted that whatever may be the amount of protection afforded by vaccination, it is at any rate less than that conferred by a previous attack of smallpox.

The Registrar-General, in his 43rd Annual Report, thus states the view of "the best authorities" on this point: he says, "It is pretty generally recognised, and this on good grounds, that the immunity derived from vaccination is both less perfect and less permanent than that conferred by smallpox itself; its efficacy diminishing with the lapse of time, while the protective influence of smallpox remains practically unaltered."

Dr. Ogle thinks there is no doubt that the protection by previous smallpox is greater than that of vaccination.[2]

Dr. Gayton, after quoting a later opinion of Jenner's to the effect that the protection by vaccination was tantamount to that of an attack of smallpox, says, "Proofs are abundant already, and will continue to accumulate, to disprove these statements."[3]

[1] 1st Rep., App., p. 69.
[2] 654–5. [3] 1801.

Mr. Marson, in the 16 years following 1836, and when he estimated the number of persons who had been inoculated or had smallpox to be probably about equal to the number of those who had been vaccinated, found that only 47 persons were admitted to the hospital suffering from smallpox after the natural or inoculated disease, whereas there were 3094 cases of smallpox after vaccination.

Mr. Sweeting is of opinion that vaccination is decidedly less protective than a previous attack of smallpox.[1]

At Sheffield, in the 1887–88 epidemic, Dr. Barry found, as the result of his census, that 18,292 persons, or 6·6 of the enumerated population of the borough of Sheffield, had had smallpox prior to 1887. Of these, 23 were attacked again in 1887–88, and 5 died.[2] This gives an attack-rate of 13 per 10,000 against an attack-rate of 155 per 10,000 in the vaccinated.

77. The evidence leads us to the conclusion recorded by Dr. Gregory, the physician to the Smallpox Hospital in 1843, viz. "that any attempt to institute a parallel between cases of smallpox after vaccination, and cases of secondary or recurrent smallpox, must fail."

78. The vaccinated, therefore, stand in a position very inferior to that of those who have previously undergone smallpox *quâ* liability to an attack of smallpox. We now proceed to inquire, do the vaccinated stand in a superior position to the unvaccinated?

In other words, is the attack-rate of smallpox amongst the vaccinated less in proportion to their numbers than it is amongst the unvaccinated?

79. Various methods of arriving at an answer to this question have been attempted. A comparison has been made between the ratio of the vaccinated to the unvaccinated of those admitted to hospital with smallpox, and what is estimated to be ratio of the vaccinated to the unvaccinated in the general population. If vaccination

[1] 3770. [2] Sheffield Rep., p. 202, p. 180.

were an absolute protection we should, of course, find only unvaccinated patients in smallpox hospitals. If the protection were, though not absolute, yet relatively great, we should expect to find the proportion of the vaccinated patients relatively small. And in proportion as the ratio of the vaccinated to the unvaccinated in the hospital approximates to that obtaining outside (assuming the admissions to be a fair sample of the whole cases), we must regard the protection against attack of smallpox as approximating to *nil*.

80. No hospital supplies so large an experience, extending over a long series of years, as the London Smallpox Hospital. We learn from the figures recorded by Mr. Marson and Dr. Munk, and the reports of the hospital,[1] that the percentage of cases of vaccinated smallpox patients to the total admissions has progressively increased with the increase of vaccination among the general population, if not in exact ratio, at any rate in a ratio approximating closely to it.

Years.[2]	Post-vaccinal smallpox per cent. of total.
1826 . . .	38
1835–45 . .	44
1845–55 . .	64
1855–65 . .	78
1863 . . .	83
1864 . . .	84[3]
1878–79 . .	93
1885 . . .	93
1888–91 . .	(14 cases only) 100

81. We are not aware of any grounds for thinking that at any time more than 90 per cent. of Londoners have been vaccinated. Judging from the vaccination returns the proportion would seem to be less than this, and the evidence derived from local investigations supports the latter view.

The percentage of children not finally accounted for as

[1] Munk, R. C. on S. P. Hosps., 4670.

[2] Marson, 1871 Rep., 4190. [3] 9090.

regards vaccination in London is given as follows by the Local Government Board [1] for the years since 1872 :

1872	8·8	1883	6·5
1873	8·7	1884	6·8
1874	8·8	1885	7·0
1875	9·3	1886	7·8
1876	6·5	1887	9·0
1877	7·1	1888	10·3
1878	7·1	1889	11·6
1879	7·8	1890	13·9
1880	7·0	1891	16·4
1881	5·7	1892	18·4
1882	6·6		

Similar figures are not obtainable prior to 1872, but there is no doubt that if they could be had they would not show less vaccinal default than do those of later years ; and this would be especially true of years prior to the first Compulsory Vaccination Act of 1853.

82. These figures lend no support to the supposition that the number of vaccinated persons[2] in London exceeds, if indeed it reaches 90 per cent. of the whole. We are unable, therefore, to infer from the statistics of the London Smallpox Hospital, that vaccination has any very marked effect in reducing the liability to attack by smallpox, seeing that the proportion of vaccinated cases to the total has increased with the increasing proportion of the vaccinated in the population.

83. Another method of arriving at the relative liability to attack in the vaccinated and unvaccinated respectively has been by censuses taken in connection with epidemics in particular towns. Such censuses have, as in the case of Sheffield, comprised the whole population, or as in the cases of Dewsbury, Leicester, and Warrington, been restricted to particular parts or to the infected houses.

[1] Rep. for 1894–5, p. 2.

[2] In Marylebone, one of the better vaccinated parishes of London, an examination of 2838 children attending various schools in 1894 showed 25·6 per cent. were unvaccinated ('Sanitary Chronicles of Marylebone,' August and September, 1894).

84. The figures derived from these reports have been set out in such detail in Sections 176 to 309 of our colleagues' report that it is needless to recapitulate them. We regret that owing to the reports from Dewsbury, Warrington, and Leicester having been made by medical men selected by the Commission, opportunity for examination upon them has been precluded. We shall, therefore, merely draw attention to certain points which we think require to be emphasised.

85. In the case of the Sheffield outbreak Dr. Barry has explained to us the manner in which his vaccination census was conducted. We are unable to agree that a census conducted after an epidemic has reached its height, and after endeavours have been made to get every one vaccinated who has not already had the disease, is of much value in determining the incidence of smallpox upon the vaccinated and unvaccinated classes respectively.[1] It is true that after Dr. Barry's attention had been called to this source of fallacy he made an attempt to correct the effect of it, and the figures so corrected are given in Sections 232 and 234 of our colleagues' report. We doubt whether, even in the corrected figures, anything like a sufficient allowance has been made for the transfer from the unvaccinated to the vaccinated class before the date of the census.[2] This transfer had been so great that in one district, that of Upper Hallam, only one person was found unvaccinated in the invaded houses at the time of the census, and he had had the smallpox during the epidemic. This would give an attack-rate of 100 per cent. of the unvaccinated in this particular case. This is, of course, an extreme instance, but it serves to exhibit the fallacy we are dealing with.[3] Not only were persons at ages above those of childhood vaccinated for the first time during the epidemic, but children were vaccinated at an earlier age. Indeed, the rush to be vaccinated, and the pressure brought to bear, tended to inflate the vaccinated population, and to reduce the unvaccinated population to zero, or at any rate to restrict it to those of them who had survived an attack of smallpox.

[1] 29,333–29,341. [2] Sheffield Rep., p. 161.
[3] 29,333; 2472; 2376–2432.

The result of a census thus obtained is such as one would naturally expect from assessing the cases of smallpox upon a greatly augmented population in the case of the vaccinated, and a greatly reduced population in the case of the unvaccinated. This criticism would apply even more strongly in the case of censuses of invaded households.

For these and other reasons we think that censuses thus obtained are of little or no value in determining the incidence of smallpox on the two classes.

86. Another method of arriving at the proportion of the vaccinated to the unvaccinated in the population would be by reference to the vaccination registers. It is, however, only since 1872 that these have been compiled in their present form.

In Sheffield, we learn from Table XCVII (p. 185 of Dr. Barry's[1] report) that for the years 1878–87, 84 per cent. of the children born during those years were successfully vaccinated, some 10 per cent. died unvaccinated, and 4·5 per cent. remained unaccounted for. But in arriving at a conclusion as to the proportion of the whole population vaccinated on the basis of the vaccination registers, it is necessary to bear in mind that the proportion of the vaccinated amongst those born before the Vaccination Acts of 1853, 1867, and 1871 was in all probability very much less;[1] thus in 1862, at an inspection of the borough school children by an inspector of the Privy Council, 13 or 14 per cent. were found unvaccinated. It would be hazardous to assert, in view of these facts, that the proportion of the vaccinated in the whole population of Sheffield at or about the beginning of the epidemic much exceeded 90 per cent. Now of the cases of smallpox investigated by Dr. Barry in the epidemic of 1887–8, 4151 out of 4703, or 88 per cent., were vaccinated.

At Warrington,[2] which like Sheffield had obeyed the vaccination laws perhaps somewhat better than the average of large towns, the percentage of the births unaccounted for as regards vaccination given for the years 1874–89, in

[1] Sheffield Rep., p. xv. [2] 2403.

Table VIII of Dr. Savill's report, varied from 1·7 in 1874 to 8·1 in 1883.[1] Having regard to the facts we have already alluded to in the case of Sheffield, we should doubt whether the proportion of the whole population at Warrington who were vaccinated before the commencement of the epidemic in May, 1892, greatly exceeded 90 per cent. Of the 667 cases of smallpox investigated by Dr. Savill,[2] 69 were unvaccinated and 598 were included in the various vaccinated classes, or 89·7 per cent.

In Leicester,[3] which in the beginning of 1893 was described by the medical officer of health as "practically an unvaccinated town," there had been in 1872 to 1875 only 2, 3, or 4 per cent. of the births unaccounted for as regards vaccination; but from 1885 onwards more than half the births were thus unaccounted for, and from 1888 to 1892 the vaccinal default amounted to from 77 to 80 per cent. of the births.

If we assume 50 or 60 per cent. of the population of Leicester[4] to have been vaccinated at the time of the outbreak, it is interesting to observe that of the 357 cases dealt with by Dr. Coupland, 158 were unvaccinated (including 4 "under vaccination"), and 199 (including 1 doubtful vaccination), or 55·7 per cent., were vaccinated.

87. Dr. Coupland[5] remarks, that "the natural liability to smallpox, unaffected by vaccination, was not so great as has been supposed." He found the attack-rate much the same at different ages, despite the great variations in the proportion vaccinated according to his census:

—	Vaccinated, per cent.	Attacked, per cent.[6]
Under 1 year . .	3·0	21·2
1 to 10 . . .	26·0	28·9
10 to 30 . . .	84·5	28·1
Above 30 . . .	97·3	20·5

[1] Warrington Rep., p. 25.
[2] P. 28. [3] Leicester Rep., p. 38.
[4] P. 45. [5] P. 3. [6] P. 3.

88. In Dewsbury[1] for twenty years vaccination has been greatly neglected; from 1873 to 1876 the vaccinal default was from 22·9 to 35·3 per cent. of the births, from 1877 to 1883 the default was less, varying between 12·6 and 19·8, but for the ten years prior to the outbreak, about a third of the children born remained unvaccinated. It would scarcely be safe to assume that of the whole population in 1891 more than two-thirds, or between 60 and 70 per cent., were vaccinated.[2] Of the 1019 cases of smallpox dealt with by Dr. Coupland 367, or 36 per cent., were unvaccinated (including 21 "under vaccination"), and 652, or 64 per cent., were vaccinated (including 25 alleged to have been vaccinated).

89. It would appear therefore that whether, as in the case of the London Smallpox Hospital, we have regard to the ratio of vaccinated to unvaccinated persons attacked compared with the varying ratio of the vaccinated to unvaccinated in the population at large, or whether we consider the similar ratios in different towns where vaccination has been practised to varying degrees, we find that for the population at all ages the proportion of smallpox attacks on the two classes of vaccinated and unvaccinated respectively approximates closely to the proportion which the two classes bear to each other in the population generally.

90. Whatever influence vaccination may exert against smallpox, then, would appear to lie somewhere between none at all on the one hand, and very considerably less than that of a previous attack of smallpox on the other.

91. We have not received as yet the report of Dr. Coupland from Gloucester, but from the figures contained in Section 243 of the report of our colleagues it would appear that from a census made of persons in infected houses 30 per cent. of the vaccinated were attacked, and 46 per cent. of the unvaccinated, nearly all of whom were children under ten years of age.

[1] Dewsbury Rep., p. 10. [2] P. 113.

92. The accompanying table serves to show the relative severity in regard to attack-rate, mortality, and case-mortality in the various towns from which we have received special reports.

Place.	Date.	Population.	Cases.	Case-incidence per 10,000 living.	Deaths.	Mortality per 10,000 living.	Fatality per cent. of cases.
Sheffield .	1887–88	316,288	6,088	*192·4*	589	*18·6*	9·7
Warrington.	1892–93	54,084	667	*123·3*	62	*11·4*	9·3
Dewsbury .	1891–92	162,596	1,029	*63·2*	110	*6·7*	10·7
Leicester .	1892–93	184,547	357	*19·3*	21	*1·1*	5·8

The above table shows that Leicester and Dewsbury, in which vaccination had been much neglected, came off better as regards both attack-rate and mortality than did Sheffield and Warrington, in which vaccination had been well carried out. And further, while in Leicester, where only 55 per cent. of the cases of smallpox were in vaccinated persons, the fatality was 5·8 per cent.; in Sheffield and Warrington, where more than 80 per cent. of the cases of smallpox were in vaccinated persons, the fatality was 9 per cent. The fact that only 22 or 25 per cent. of the deaths occurred in children under ten is but small compensation to Sheffield and Warrington for their high attack-rate and mortality-rate.

93. When we proceed to inquire whether vaccination exerts an influence upon the character of an attack of smallpox so as to render it milder or less fatal than it would otherwise have been, our investigation becomes more difficult. If the influence of vaccination on smallpox be only or chiefly that of mitigating the severity of an attack of that disease, rather than the prevention thereof, an important argument for insisting upon the practice on public grounds is neutralised. It is asserted that mild natural smallpox is or may be as infectious as the severer forms, and indeed it is often found that outbreaks of the disease have been traced to infection from unrecognised smallpox in vaccinated persons, the disease being, it is said, so modified in its features by vaccination. If this be so, vaccination may well be a matter

for personal choice, as an agency calculated to ameliorate individual cases of the disease, but, if it exert little or no influence against attack by smallpox, it cannot be insisted on as a means of reducing danger to the public by way of infection.

94. Analogy does not here render us much assistance; there is, so far as we are aware, no evidence to show that in the case of other infectious diseases, attacks of which are held to confer immunity towards subsequent attacks, such second attacks, should they occur, are milder than the first. Indeed, there is evidence pointing in the opposite direction.

95. Are we, then, to institute a comparison between the case-mortality or fatality of smallpox last century and the present? Or between times and places where vaccination has been neglected and those wherein it has been well carried out? Or shall we find an answer to the question in the comparison of the fatality in the vaccinated and unvaccinated respectively in recent outbreaks? If we make the last comparison, are we able to sort the two classes accurately, and is vaccination the only material point of distinction between the two classes?

96. We have received a great deal of evidence directed to all these points. Broadly speaking, while there has always been considerable variation in the fatality of the disease at different times and in different places, from about 1 in 3 (33 per cent.) to about 1 in 40 (2·5 per cent.), the fatality on a large number of cases averages about 1 in 7 or 8 (14·3 or 12·5 per cent.).[1] This was the average fatality of natural smallpox generally accepted last century, and used by Bernouilli for his calculations in 1760, as stated in Section 53 of our colleagues' report.

Jurin's figures, based upon a large number of cases collected by him during the first half of last century, give a fatality from natural smallpox of 16·5 per cent. of those attacked. We agree with our colleagues that the criticism made upon Jurin's figures, to the effect that deaths under

[1] 7057; 8336–7.

two years of age were excluded, fails to establish the alleged fact.[1]

97. The fatality observed on a total of 60,855 cases[1] of smallpox in the hospitals of the Metropolitan Asylums Board from 1870 to 1894 was 16·7 per cent.[2] This rate includes vaccinated and unvaccinated without distinction. It is important to point out that caution must be observed in comparing the fatality in hospital with cases treated at home, and also in comparing hospital fatality regard must be had to whether all cases are admitted to hospital or only the more severe. Thus in recent years in London, when the great majority of smallpox cases are at once removed to hospital, the fatality has been as low as 7 or 8 per cent.; while in earlier years, when the Asylums Board's hospitals were less generally resorted to and the accommodation limited, the fatality was as high as 20 or 21 per cent.

98. In order to obtain a large aggregate we may add together the London and the provincial figures:—

—	Cases.	Deaths.
London (1870-94) .	60,855	10,183
Sheffield . . .	6,088	589
Dewsbury . . .	1,029	110
Warrington . .	667	62
Leicester . . .	357	21

Here we have a total of 68,996 cases with 10,965 deaths, or a fatality of 15·8 per cent.

99. The broad result is that when large figures are taken the fatality of smallpox now, with a large majority of the cases protected by vaccination, is about the same as it was last century, when none of the cases had received any protective rite.

100. It is true that when the cases of smallpox in various

[1] Vol. iii, App. 3, p. 201. 24,802.

[2] Rep. for 1894.

epidemics in this country and abroad have been sorted into groups according to whether the patients have been vaccinated or not, the result is almost invariably to show a higher rate of fatality in the unvaccinated than in the vaccinated class.[1] The range of difference is considerable. Fatalities in the vaccinated from 1 per cent. to 18 per cent., but rarely higher, are recorded. Unvaccinated fatalities of 9, 13, 30, and 50 per cent., and even higher, are recorded. In some sets of figures the unvaccinated fatality rate is three, four, and five times that of the vaccinated;[2] in others, such as the Berlin and Duisburg figures for 1871–72, the rates at various ages are not very different in the two classes.

101. It has been argued that the difference of the case mortality in the two classes is not due, or not wholly due, to the presence or absence of vaccination, and further that the division into the two classes is not properly made.[3]

It is alleged that the unvaccinated differ qualitatively as well as quantitatively from the vaccinated. Thus this class, it is urged, includes (1) infants under the age of vaccination; (2) those whose vaccination is postponed on account of poor health, in obedience to the instruction to public vaccinators to vaccinate only those who are healthy; and (3) those of the lowest and most neglected social class.[4] Inasmuch as these, when they constitute a considerable proportion of the whole unvaccinated class, would, from reasons apart from vaccination, raise the case mortality, it is urged that the high fatality of the unvaccinated must not be ascribed merely to the fact of their non-vaccination.

Objection has also been made to the classification by marks on the skin of cases of a disease whose chief symptom is, and the chief cause of whose fatality is, the abundance of an eruption on the skin.[5] It is claimed that the fact of vaccination or non-vaccination of smallpox patients should be determined by reference to the vaccination registers, not by the visibility of marks on the arm.

[1] Table N., App., vol. ii, pp. 240 and 236.
[2] 6814.
[3] Vol. vi, App. 14, p. 720.
[4] 8713.
[5] 8709.

Reference has been made to some of these objections in our colleagues' report, but we hardly think sufficient weight has been attached to them. It is clear that if these objections are well founded, some part of the difference between the fatality of the vaccinated and the unvaccinated is explicable without reference to vaccination. It is difficult to say whether the whole difference can be thus explained.

102. There can be no doubt that in towns where vaccination has been well carried out, a considerable proportion of the unvaccinated population consists of young infants. Thus at Warrington it was found by Dr. Savill [1] that of 57 unvaccinated children living in the invaded houses, 22 were under one year; of these 13 were one month or under, and of these eight were attacked, and all of them died: these eight babies constituted one-third of the total unvaccinated deaths. The inclusion of such cases in the unvaccinated class raises the unvaccinated case mortality, while the vaccinated class is necessarily free from a similar contingent of young infants.

103. A certain number of children are every year reported as having had their vaccination postponed by medical certificate on account of ill-health; thus, in the year 1892, 13,278 were so reported in England and Wales. It is possible some of the ailments necessitating postponement may not have been very serious, but this again constitutes a sub-class of the unvaccinated class which has no counterpart among the vaccinated, and may have an influence on the case mortality. It is obvious that the importance of the presence of these two classes of the very young and the postponed among the unvaccinated becomes greater in proportion to the strictness with which the Vaccination Acts are enforced. In towns where the Acts are thoroughly carried out the unvaccinated class should consist almost exclusively of these two sub-classes, in whom it is urged a high fatality rate is to be naturally anticipated. It is certainly curious to note that while the unvaccinated fatality rate is given as 49·6 per cent. at Sheffield and 35·3

[1] Warrington Rep., pp. 35, 39, 49, 54.

per cent. at Warrington, at both of which vaccination has been thoroughly enforced; at Leicester, where the unvaccinated class was much larger and very differently composed, the unvaccinated fatality is recorded as 12·0 per cent. The mere fact of non-vaccination is evidently insufficient to explain this remarkable difference.

104. Dr. Gayton thinks[1] the unvaccinated patients he treated were drawn from a poorer class than the vaccinated, and that this circumstance would tend to make the fatality among them higher than in the vaccinated. It would appear that, except in towns where the Acts are not administered, a not inconsiderable proportion of the unvaccinated is contributed by waifs and strays and paupers. Dr. Stevens, in giving evidence before the Hospitals Commission of 1882 (Q. 3434), thus explained the prevalence of smallpox in London. He said there were three very distinct classes of people who helped to keep up smallpox in London. "First of all from a very large class, viz. immigrants; and those immigrants I calculate to the extent of two thirds are workhouse-born people. I estimate, of course very roughly, there are about 10,000 children born every year in workhouses and lying-in institutions, and hitherto they have universally escaped vaccination, because once out of the workhouse unvaccinated it is impossible to get at them, no one knows of them, and having lost their birth record they wander about, and to a large extent get up to London, and get smallpox. Then just imagine the numbers of years that these unvaccinated workhouse children have been accumulating." That among such persons, apart from vaccination, a high fatality rate should obtain is at least probable. We know that Dr. Murchison, from the figures he collected at the London Fever Hospital, found that social class as well as age had an influence on the case mortality of typhus fever. He found—

In paying patients a fatality of	.	.	14·89	per cent.
,, free non-pauper ,,	,,	.	18·58	,,
,, parish paupers ,,	,,	.	27·64	,,

The influence of social class upon case mortality of

[1] 1842–3.

infectious diseases is also brought out by comparing the statistics of the London Fever Hospital, which now only admits paying or non-pauper patients, with those of the Metropolitan Asylums Board hospitals, which admit pauper and non-paying patients.

Case-Mortality in 1889 *from—*

—	Scarlet fever.	Typhoid.	Diphtheria.[1]
London Fever Hospital . .	1·2	5·2	17·6
Metropolitan Asylums Board hospitals	8·85	15·15	40·74

We think it probable that social class has an influence upon smallpox fatality in the same direction.

105. Three main varieties of smallpox are recognised—the discrete, the confluent, and the malignant.[2] The first is rarely fatal even in the unvaccinated; the last is almost always fatal even in the vaccinated. It is the confluent variety that mainly dominates the case mortality of the whole.[3] Now it is in the confluent variety that question is most likely to arise as to whether marks of vaccination are present or not. If seen early, before the eruption is complete, no difficulty may be encountered; but in cases not seen until a later stage, in which the eruption is abundant and the liability to a fatal issue great, difficulty has undoubtedly occurred. It is in these worst cases that in the opinion of Dr. Birdwood there is risk of including vaccinated cases in the unvaccinated category. Indeed, so alive to the difficulty of classification by marks is Dr. Birdwood,[4] that after an experience of 12,000 cases of smallpox, he is of opinion that "the evidence of primary vaccination

[1] Hopwood, Lords' Com., 1891, 21,675–21,682; Ann. Rep., M.A.B., p. 18.
[2] 30,826–37.
[3] 1816–20; 30,832–47.
[4] 31,230; 31,061.

collected in smallpox hospitals should not be relied on. Because—

"(1) On the outbreak of an epidemic there is necessarily much administrative confusion, and many untrained observers. The early observations are incomplete and faulty.

"(2) In the worst instances the eruption may be sufficient to, and does, obscure the scars.[1]

"(3) The statement of parents as to primary vaccination and of adult patients as to re-vaccination, should be accepted even when scars are not seen.

"(4) Scars produced in infancy grow with the growth of the body, as was pointed out, I understand, by Sir James Paget.

"(5) In such statistics insufficient allowance is made for other circumstances, such as occupation, intemperance, and the existence of other diseases. An altogether different death-rate might be anticipated if smallpox broke out in a public school, or in the infirm and aged wards of a workhouse. A typhoid fever patient, or an ill-fed baby, catching discrete smallpox and dying, would be counted a death from smallpox, obviously neither vaccination nor its neglect having anything to do with it.

"(6) The accurate observation and record of clinical details is one of the most difficult duties required of medical men employed in hospitals for infectious disease."

106. We could have wished, in view of the doubt cast upon the classification of smallpox patients into vaccinated and unvaccinated, that resort had been oftener had to the vaccination registers for corrobation or correction.[2]

We note that Dr. Savill was alive to the difficulties to which we have alluded; in his report on the Warrington outbreak he says:—"In nearly all fatal cases the eruption is profuse, and tends to hide the vaccination scars if they exist. Hence the doctor's or nurse's evidence 'unvacci-

[1] 31,221.

[2] 28,461; 2330; 2359; 28,480; 28,744; 31,250; 28,468; 16,447; 16,621.

nated,' if based solely on their own observation, is less valuable than the doctor's statement 'vaccinated.' Such was probably the source of error which arose in Case 473. If the pocks are very plentiful, or are situated over the vaccination scars, or when the congestion and induration of the skin, so characteristic of severe smallpox, is present in large amount, then the plainest of scars, and certainly a faint one, is liable to be described as absent."[1]

He also cites an instance in which reference to the vaccination register sufficed to rectify an important error:— "Cases 79 and 75. The brothers Peter and James L—, æt. 20 and 8 respectively, are very good illustrations of the difficulties which often beset an inquiry as to vaccination in fatal cases. For a long while I was assured on good authority that they were both unvaccinated persons. I was told that no record could be traced of their vaccination, and no marks could be seen during life.[2] The death certificate, of which I procured a copy, contained the word 'unvaccinated' in both cases. Both mother and father of these lads were dead, and those members of the family available could give me no definite information. I therefore included them at first in the unvaccinated class. But some time later I succeeded in finding an older brother, who stated in general terms that he was sure all his brothers and sisters had been vaccinated except little Walter, another child who contracted the disease and recovered (Case 80). This statement was confirmed by his uncle Sam and an old friend of his mother's. Next I sought an old friend and servant of the family, who said she always 'thought Peter was vaccinated; but as to Jimmy, I used to see his marks thro' washin' 'im so often; he had two good 'uns.' Finally I determined to search the vaccination register myself, and found that against the name of Peter L—, who was born on May 26th, 1872, the vaccination entries were vacant; but against the name of James L—, who was born on April 12th, 1884, was an entry of successful vaccination on August 22nd, 1884."

107. Dr. Savill also calls attention to the fact that vac-

[1] Warrington Rep., p. 34. [2] Ibid.

cination scars tend to become obliterated with age, and to alter in character with time.

108. In earlier statistics, and in many of Dr. Luff's tables in regard to smallpox in London,[1] only two classes appear, viz. those vaccinated and those unvaccinated, apparently no evidence as to vaccination being accepted except the presence or absence of scars on the arms. Dr. Ricketts, of the Smallpox Hospital ships, calls especial attention to this class in his report for the year 1893, showing that "an absolute reliance ought not to be placed on this evidence. There is no doubt that cases occur in which vaccination has been successfully performed, although cicatrices are not present when the attack of smallpox supervenes. There is a small class, too, but naturally a very fatal class, in which the rash is too abundant over the upper part of the arm for an assertion to be made that scars are absent."[2] Dr. Ricketts truly observes that "in considering the vaccination statistics of smallpox cases, it is clear that in comparing the vaccinated with the unvaccinated class, it would never do to leave out of consideration these doubtful cases among which the fatality is so high, a class which includes nearly a quarter of the total deaths."[3]

109. Attempts have been made to classify cases of smallpox according to their severity as well as according to their fatality.[2] This classification is open to the obvious objection that "no two men could, independently, classify the same series of cases in the same way." When a further division of the severe and mild cases into vaccinated and unvaccinated is made, another source of error is introduced by reason of the inconclusiveness of the evidence as to vaccination.

110. When we consider all the sources of error to which we have alluded, we are led to conclude that the difference in fatality between the vaccinated and unvaccinated smallpox patients is not as great as is sometimes contended, and that so far as it exists it cannot be due merely to the effect

[1] M.A.B. Rep. for 1893. [2] P. 136. [3] P. 138.

of vaccination; while the fact that the fatality of all cases lumped together is practically the same now as it was in the unvaccinated of last century, when large numbers are taken for comparison, strongly suggests that the inclusion of a large contingent of vaccinated persons has not exerted a mitigating effect on the average fatality of the whole.

111. In view of the fact now recognised, that whatever protection vaccination affords against smallpox is temporary and relative, not permanent and absolute, various attempts have been made to determine what is the shortest period within which an attack of smallpox can occur after vaccination. We have shown that the variolous test, or the inoculation of the vaccinated, was largely given up after the first few years of this century, Jenner and Bryce advocating the re-insertion of vaccine lymph as a test of equal efficacy. The records of attempts at producing smallpox by inoculation at various periods after vaccination are, therefore, not very numerous. We shall allude to some of those which have been laid before us. Evidence is also available on the point in question as the result of inquiries which have been made as to the date of vaccination and the onset of subsequent smallpox in various epidemics. Lastly, we have the results of re-vaccination at different intervals of time from primary vaccination.

112. Goldson, of Portsea,[1] in 1804 published cases of the inoculated and the natural disease occurring within two or three years of vaccination. In 1809 Brown, of Musselburgh, published his 'Inquiry into the Anti-variolous Power of Vaccination,' in which he recorded 48 cases of children who had caught smallpox within three, four, five, six, seven, eight, nine, and ten years of their vaccination.[2] He relates also how he had abandoned inoculation since the year 1800, having been satisfied with the negative results he obtained in those whom he had tested a few weeks or months after their vaccination. The occurrence of smallpox in vaccinated children led Brown to apply the variolous test to some vaccinated children at a longer interval of time; he

[1] 95,472–8. [2] 11,852.

then found that after the lapse of from three to six years vaccination no longer rendered the variolous test ineffectual, and he was forced to the conviction "that vaccination even in the most perfect form is not only incapable of imparting permanent security against smallpox, but even of retaining the system in that state of impregnation capable of only allowing it to exercise its influence to a safe or trifling extent."[1] It is a matter of regret that the writings of Brown and Goldson were not received with the attention and courtesy from their contemporaries that they deserved. Had they been then fairly considered much misapprehension and misrepresentation might have been avoided.

113. A relatively low fatality rate in vaccinated children under ten is, as is shown in the report, a remarkable feature in recent epidemics, and this, if it were constant, might well be urged as a ground for encouraging the practice of infant vaccination when smallpox is prevalent, if no other means for controlling the disease were available. This, however, is not the case, and we believe that if the measures of prompt detection and isolation we advise were universally and energetically adopted, there would be no excuse for allowing smallpox to run riot or to invade the settled population, and least of all to attack young children.

114. We find that at Sheffield[2] in 1887–8 there were according to the census 353 cases of smallpox in vaccinated children under ten years of age, of whom 121 were under five, of whom 11 were under one.[3] In children vaccinated by public vaccinators we find cases of severe smallpox at six years, three years, two years, and under one year; the first two were fatal. There is a case of very slight smallpox at six months, and one 14 days after vaccination.[4]

It is usual to exclude cases at a less interval than a fortnight after vaccination from the vaccinated category,[5] on the ground that the vaccination had not at that period exercised its influence on the constitution although the "success" of vaccination is registered on the eighth day

[1] 11,855; 25,479; 25,517–21.
[2] Sheffield Rep., p. 178.
[3] 29,381–2; 29,388.
[4] 29,391–2; 29,415; 29,409.
[5] 29,411; 19,814–5; 28,708.

after the operation; there are plenty of instances in this and other outbreaks, of the two diseases running their courses together in the same person.

At Dewsbury[1] in 1891–2 there were 44 cases of smallpox in vaccinated children under ten years of age, of whom 17 were under five.

At Warrington[2] in 1892–3 there were 33 cases of smallpox in vaccinated children under ten years of age, of which two were confluent attacks and terminated fatally.

In London[3] in 1892–3 there were 110 cases of smallpox in vaccinated children under ten, 27 of which were under five, and of these 7 were under one.

Dr. Browning, medical officer of health for Rotherhithe, writing in 1892, called attention to the fact that children and adults recently vaccinated with humanised lymph, and some showing good marks, worthy of an extra grant from the Government inspector, yet took smallpox within a few days, months, or years of their vaccination. He cited 25 cases of smallpox in vaccinated children under ten, of whom three died.[4]

Dr. Gayton in London between 1870 and 1884 saw 1306 cases of smallpox in children under ten stated to have been vaccinated; of these 137 died: 303 of these cases were between the ages of two and five, with 56 deaths; 58 were under two, with 12 deaths.[5]

Dr. Gayton accordingly thinks that "primary vaccination is a very fleeting protection indeed," and that it is not absolutely protective up to any age whatever.[6]

115. It has been argued that, inasmuch as cow-pox is to be regarded as the smallpox of the cow, and as vaccination is to place the vaccinated in the same position as if they had been through an attack of smallpox, the repetition of the operation is to be held to be the equivalent of the old variolous test.[7] That consequently as long as re-vaccination is successful, it indicates that the person so successfully re-

[1] Dewsbury Rep., p. 114.
[2] Warrington Rep., pp. 51 and 54.
[3] London Rep., pp. 6 and 16.
[4] 8429; 12,386 (note).
[5] Vol. i, App., p. 245.
[6] 1755; 1768.
[7] 173; 177; 1837–9.

vaccinated had re-acquired susceptibility to smallpox. If this view be correct it would be strange indeed that, while vaccination was unable to protect an individual against the repeated operation of its own poison, it was yet capable of protecting against the operation of the more potent poison of smallpox.

116. The difficulty of this position was early realised by Dr. Pearson and the directors of the Vaccine Pock Institution; in their report for the year 1803 (p. 49) they declared that persons who had undergone vaccination could not undergo it a second time, and that persons who had undergone smallpox could not be infected with the cow-pox. These views are strangely out of harmony with the experience and practice of to-day.

117. If we accept, with Jenner and Bryce, the theory that re-vaccination is a test of susceptibility to smallpox "of equal efficacy" with variolous inoculation, we then have a means whereby we may gauge the duration of the temporary protection or antagonism conferred by vaccination.

118. The earliest experience of re-vaccination on an extensive scale is recorded by Heim in the Wirtemberg army in 1829.[1] Out of more than 14,000 soldiers who were re-vaccinated about 60 per cent. exhibited perfect or modified success. Another series gave a perfect success in more than 50 per cent. of the re-vaccinations. Moreover a perfect result was obtained not less frequently in those who presented normal cicatrices than in those in whom the scars of primary vaccination were defective; and again there was no marked difference in the success of vaccination on those soldiers who bore marks of smallpox from that which attended the re-vaccination of those who did not.

119. The experience derived in recent years from our own army is similar.[2] The table put in by Brigade-Surgeon

[1] Vol. i, App., p. 47.

[2] Vol. ii, App. 8, p. 277.

Nash shows that in nearly half of the re-vaccinations of soldiers and recruits perfect vaccinal pustules are obtained; in about a fourth of the whole a modified success occurs; while in the remainder the operation gives a negative result.

Higher percentages of success are recorded by Continental observers, 70, 80, and even 90 per cent. being mentioned in the case of military re-vaccinations.[1] In the case of school children in Germany at the age of 13 or 14 the success rate is 70 to 82 per cent.

120. M. Layet, of Bordeaux, has recorded the results of a large number of re-vaccinations of school children at different ages with calf lymph.[2] Putting aside the partial or modified results, described by him as *fausse vaccine*, he found that in 41 to 45 per cent. of the whole number at all ages he obtained perfect vaccine vesicles. Moreover his success rate was about the same in children of six years old as it was in those over 13.[3] The exclusion of the modified successes or "*fausse vaccine*" from Layet's figures makes his success rate appear lower than that of other observers, who included all degrees of success. The striking feature about Layet's figures is that vaccinated children of six show as great a susceptibility, or, as it is argued, as much unprotectedness against smallpox, as do those of 13.

121. Similar experience is afforded by the results of re-vaccination of the children of soldiers in this country. The success rate is greater and the failures fewer in the case of the re-vaccination of children than in that of soldiers or recruits.[4] Inasmuch as the latter are further removed from their primary vaccination, want of success of re-vaccination can hardly be ascribed to the abiding influence of the first operation. Indeed, the fact that the success rate in the re-vaccination of children approximates nearly to that of their primary vaccinations, while the *primary* vaccination of recruits and soldiers is less successful

[1] 11,606.
[2] 11,607–11,649; 11,619; 11,626.
[3] Vol. iv, App. 1, p. 407–8.
[4] Vol. ii, App. 8, p. 277.

than that of children, strongly suggests that the failure or modified success of re-vaccination in adults is due not to the abiding influence of a primary vaccination, but to other changes the result of age.

122. The results of vaccinations and re-vaccinations in the army formed the subject of an interesting paper by Professor F. Smith, of the Army Veterinary School, communicated to the Sanitary Institute in 1892, and entitled "For how long does vaccination confer immunity against smallpox?" [1] He noted that the percentage of successful vaccinations was 92·64 per cent. of successful re-vaccinations 88·37 per cent. Of the 79,491 re-vaccinations, 15,842 had a modified success, and 54,497 had perfect vesicles. In the latter "the vesicles are as perfectly defined as in a primary vaccination. It is important to bear this fact in mind, for no matter what view we take of the modified vesicle, I think there can be no doubt that a person who develops a perfect vesicle is one who would have contracted smallpox if exposed to the contagion. On examining the 5832 primary vaccinations it is found that 92·64 per cent. were successful; these vaccinations were only 4¼ per cent. better than the re-vaccinations. In what way are we to interpret these results? It is certain that of 79,591 persons only 11·63 per cent. (adopting vaccination as a test) were protected against smallpox; and this number may be further reduced when we consider that many of the failures were due to other causes than protection, for of the primary vaccinations 7·36 per cent. failed. If, therefore, we take these figures as representing the failures due to inert lymph, &c., it leaves only 4·27 per cent. of the adults as protected against smallpox by their previous vaccinations."

Professor Smith further states that within three years of a thorough re-vaccination it is possible for a person to be successfully re-vaccinated, the result produced being naturally of a modified character. He adds, "I can, however, go a step further than this, and affirm that, after a successful primary vaccination, it is possible to successfully re-vaccinate a person twelve months later, the only

[1] 'Trans. of Sanitary Institute,' vol. xiii, pp. 116–18.

difference between the first and second vaccinations being that the latter will run a more rapid course, though, excepting for this fact, the character of the vesicle produced is nearly indistinguishable from a primary inoculation."

123. If vaccine is to be regarded as attenuated variola, we are not aware of any ground for anticipating that after immunity towards the weaker virus has ceased, immunity towards the stronger virus should continue.[1]

124. That even severe smallpox does not prevent the success of subsequent vaccination is shown by the experience of Dr. Scroggie, of Aberdeen, quoted by Mr. Skelton:

"Although a second attack of smallpox is very uncommon, I re-vaccinated fifteen cases who had had the disease, some of them severely, as indicated by the deep and numerous pittings left, and in thirteen found them susceptible to the vaccine virus. The disease is usually fatal at the extremes of life, so I have vaccinated from the infant of a few weeks to the adults from 80 to 90 years of age. The re-vaccinations done were 356 in number, and of these 339 were successful." [2]

125. It would appear from the foregoing facts that while shortly after vaccination there may be a certain amount of immunity or antagonism to the influence of renewed vaccination, or inoculation with smallpox, and therefore, it may be argued, to the natural disease, this soon wears off, perhaps more rapidly in some than in others. It would seem that in the majority of cases susceptibility to re-vaccination is encountered in a few years, though tests at shorter intervals do not appear to have been extensively made. The evidence suggests that insusceptibility towards inoculation is not more lasting; while cases of natural smallpox are recorded at all possible intervals subsequent to vaccination.

126. Attention is called in Section 293 of our colleagues' report to the results of some 20,000 cases of smallpox when

[1] 4540–4552. [2] 28029–30.

classified according to the number of marks they exhibited. It must be borne in mind that these cases must be regarded as 20,000 failures of the protective properties of vaccination as originally proclaimed, and that it would not be very remarkable if, speaking generally, it were to be found that in classifying cases of a disease whose fatality is mainly due to the amount of eruption those cases would on the whole show a higher recovery rate in whom a greater number of scars could be clearly discerned on the skin of the arm.

127. In regard to the manner and degree in which the number and quality of the vaccination cicatrices exert an influence over the liability to or the severity of subsequent smallpox, we have received a good deal of conflicting evidence. It has been argued that if the virus of the vaccine disease be of a self-multiplying character, one insertion should, as was originally held, be as efficacious as many ; and that the nature of the cicatrix being due largely to local causes, or individual peculiarities, this can indicate nothing as to the constitutional effect which the virus has produced.[1] On the other hand, a large collection of statistics, such as those of Marson and others, has been adduced to prove that the mitigating effect of vaccination varies with the number of cicatrices, and that the area and foveation of the scars affect the fatality of subsequent smallpox.

128. There are some points in regard to the late Mr. Marson's statistics which it would have been well to have elucidated further, but it has not appeared possible to do so. We refer especially to his method of deducting deaths due to superadded disease, and to his mode of dealing with cases in which abundance of the eruption obscured the cicatrices, cases which occasioned considerable difficulty in classification to his predecessor, Dr. Gregory, and to many later observers.[2] There is a good deal of evidence,[3] especially from France, showing that neither the number nor the quality of primary cicatrices exerts any influence upon the success of re-vaccination ; indeed, it is noted by some

[1] 846; 11.893; 11,642. [2] 224,301.
[3] 841; 30,832–4; 31,221; 31,230; 31,235; 11,618; 11,642.

observers that re-vaccination is more likely to take in those in whom the scars of primary vaccination are large and well marked. Moreover it would appear that in the practice of the most experienced vaccinators,[1] and with the same lymph of the best quality, the cicatrices vary immensely; some are plain, some puckered, some foveated; indeed, one French observer[2] has figured some 70 varieties of scar resulting from vaccination. This would tend to show that differences of constitution, age, the mode of performing the operation, the extent of the local inflammation, &c., have an important bearing on the qualities of the resulting scars.[3]

129. We are also struck with the different methods adopted by different observers in classifying cases of smallpox according to the vaccination marks. Thus Dr. Gayton,[4] who collected 10,403 cases, informed us that when he found one good mark and three imperfect marks, he might class them as a case of two good marks, or he would ignore the three imperfect marks and class the case as one of a single good mark.

Dr. Gayton, among his 10,403 cases of smallpox admitted to hospitals of the Metropolitan Asylums Board between the years 1870 and 1884, found 2085, or 20 per cent. of the whole number, to be what he calls "vaccinated with good marks," while Mr. Sweeting, at another of the Board's hospitals in the years 1880–85, out of 2584 cases only placed 39, or 1·5 per cent., in the category of "good vaccination."[5] It is evident that such a difference indicates a wide margin for personal discrimination as to what is and what is not "good vaccination."

At Dewsbury,[6] Dr. Coupland reports that while smallpox proved fatal in ten cases out of 175 with two marks, no death occurred among the 34 cases with only one mark; and again, while one death occurred among the 42 persons with four or more marks, all the 210 with three marks recovered.

[1] 4706–11.
[2] 11,892.
[3] 11,893.
[4] 1700–1706.
[5] Vol. ii, p. 245, App. 3689.
[6] Dewsbury Rep., p. 115.

Dr. Luff's figures for London[1] show a higher fatality among those with two marks than in those with one mark; in the former it was 3·4 per cent., and in the latter 2·7 per cent. In Marson's figures the one mark cases were accorded a fatality of 13·8 per cent. in 1852–67.

Dr. Savill[2] does not classify the Warrington cases according to marks, but he gives cases and illustrations to show that smallpox is sometimes more severe in those members of a family who present first-class or typically perfect scars than in those who show indifferent evidence of vaccination. Such cases, he was subsequently led to think, were exceptional.

Mr. Sweeting's figures[3] seem to show that age has an important bearing upon any influence the number of the vaccination marks may exert. Thus over 30 years of age he found that the fatality was—

With 1 mark,	124	cases with	19	deaths, or	15·32	per cent.
,, 2 marks,	149	,,	20	,,	13·42	,,
,, 3 ,,	105	,,	16	,,	15·23	,,
,, 4 ,,	50	,,	7	,,	14·00	,,
,, 5 or more,	27	,,	4	,,	14·81	,,

So that it would appear that after 30 years of age the number of the scars is a matter of indifference as regards fatality of smallpox.

130. We cannot, in view of the diversity of classification adopted, and the abundant sources of error to which such basis of division is inherently liable, attach any great importance to statistics dealing with the number of the cicatrices. As to quality, it seems that the character of scars is largely dependent on conditions other than the nature of the lymph employed, and any relationship between quality of scar and succeeding smallpox may be the result of such conditions, and not of the influence of the lymph inoculated.

131. There has been a change in the age-incidence of fatal smallpox; smallpox has been less a disease of child-

[1] Vol. i, App., p. 116. [2] Warrington Rep., p. 42.
[3] 3717.

hood than it used to be. Statistics collected last century, and especially during the inoculation period, when smallpox was almost endemic, seem to show that a large proportion of all children suffered from it, and the deaths from the disease were mostly those of children. Records of the seventeenth century suggest that the disease at that time was less prevalent, and affected adults as well as children. It has been pointed out that "the whole question of the age-incidence of fatal smallpox depends on the frequency of the epidemics.[1] If an epidemic comes once in 20 years you will not have the same proportion of deaths under five years as you have in a place where it comes in a period of less than five years. It all depends upon that; and there is no possibility of getting any general law from isolated places."

132. While it seems to be true that last century in towns and places where, through absence of any precaution against spread, or by promiscuous inoculation, smallpox was kept endemic, the bulk of the smallpox deaths were of persons under ten years of age, this does not appear to have been uniformly the case in the country, or in places where the disease was only introduced at long intervals.

133. Thus in a most careful account of an outbreak of smallpox in the little parish of Aynho, in Northamptonshire, in 1723–4,[2] preserved in the Royal Society's Library, it is stated that of 132 cases of the disease only 28 were under ten, and of the 25 deaths only four, or 16 per cent., were under ten. In many records from different towns the large proportion of the total deaths from smallpox which occurred in children is brought out, some 80 per cent. of the whole being under five.

134. During the present century, and especially since 1870, the larger incidence of fatal smallpox on adults has attracted attention. There have been considerable differences in different places and in different epidemics. Thus in Paris in 1842–51 it was observed that 66 per cent. of

[1] 25,743. [2] 24,802.

the total smallpox deaths occurred in persons above the age of five, while in London at about the same time only 32 per cent. of the whole were above that age.[1] It is obvious that various causes, *e. g.* the ages of the exposed population and other local considerations, must be borne in mind in arriving at any conclusion as to the cause of the observed phenomena. Thus, smallpox if it spread in a school would necessarily fall upon a different age class from what it would if it spread in a factory or barracks.

135. In Sections 171–192 the change of age-incidence has been fully treated in special relation to changes in the law and in regard to vaccination; in this relation it is therefore unnecessary to labour the point further.

136. It is important to bear in mind that the change we are discussing is not merely a change of distribution of a fairly constant or diminishing number of smallpox deaths as between infants and adults, but that there has actually been in proportion to the population at each age during certain years an increasing death-rate of adults from smallpox, notwithstanding the increasing use of vaccination and re-vaccination.

137. Thus in the table contained in the 43rd Report of the Registrar-General for England it is shown that if a comparison be instituted between the smallpox death-rate at different ages during the period 1872–80 (when vaccination was as efficiently enforced as it ever has been) with the period 1847–53 (when the practice was voluntary) we find that at every age over ten years the chance of dying of smallpox was greater in the period of compulsory vaccination.

[1] First Report, App., p. 76.

Mean Annual Deaths in England and Wales at Different Ages per Million living at each such Life Period.

—	0–	5–	10–	15–	25–	45 and upwards.
1847–53. Voluntary vaccination . .	1,617	337	94	109	66	22
1872–80. Compulsory vaccination . .	323	186	98	173	141	58

These figures are so serious that they have been urged by Dr. Bridges [1] as sufficient ground for a revision of the law; he thinks that if these facts had been generally known at the time the Legislature would have hesitated as to the compulsory law.

138. The London figures are not less remarkable:

Annual Smallpox Death Rates per 100,000 *at Different Ages in London.*[2]

—	0—5 years.	5 years and upwards.
1851–60 . .	130	13
1861–70 . .	116	14
1871–80 . .	113	34
1881–88 . .	37	16

Thus we see that, except in the last period (which has been one of increasing default in regard to vaccination), and then only in the case of those under five years of age, there has been no substantial reduction of smallpox mortality, while at all ages over five the mortality from smallpox has been actually greater in the last three periods than in the first. Such saving of life as there has been in London in the

[1] 30,871.

[2] Thorne, 1st Report, p. 118.

period 1851–88 was most noticeable in the period 1881–88, and was confined to children under five years of age.

139. It has been urged that the observed changes in age-incidence of smallpox mortality point to vaccination rather than sanitary reforms as the cause of the difference, since sanitary reforms should operate equally upon all ages, while vaccination might be expected to affect especially the young. There are, however, some considerations which prevent the acceptance of this explanation, at any rate for the whole of the facts. The increased death-rate from smallpox in persons above the age of childhood might with equal reason be ascribed to vaccination, or at least seems incompatible with the belief that the influence of vaccination against fatal smallpox is of an abiding character. Moreover, it has been pointed out by the Registrar-General [1] in his report for the year 1879 that sanitation operates differently upon the general mortality of persons at different age periods. He calls attention to the fact that "while the mortality in early life has been very notably diminished, the mortality of persons in middle or advanced life has been steadily rising for a long period of years."[2] He adds, "That the sanitary efforts made of late years should have more distinctly affected the mortality of the young is only what might be naturally anticipated; for it is against noxious influences to which the young are more especially sensitive that the weapons of sanitary reformers have been chiefly directed." He further suggests that the enhanced mortality at later ages may in part be due to the indirect influence of sanitation by preserving from early death a vast number of children of permanently unsound constitution who so diminish the healthiness and add to the death-rates of later ages. At any rate, there is evidence to disprove the assertion that sanitation in the wider sense must affect mortality at all ages equally.

140. Again, it has been fairly urged that, in order to ascertain whether the shifting of the age-incidence of fatal smallpox can be fairly attributed to vaccination rather than to sanitary reforms, it is desirable to institute a comparison

[1] 363. [2] 516.

between smallpox deaths or death-rates at different ages, and other comparable diseases rather than with the deaths or death-rates from *all* diseases.

141. Dr. Ogle [1] thinks that the zymotic diseases would be the better ones to compare smallpox with, but he truly observes, "It is impossible to make similar comparisons in the case of scarlet fever or measles, and diseases that only affect children. Fever is the only one of the zymotic headings that you can take, because it is the only one that affects all ages to any extent. Fever is, therefore, the only disease which it is possible to subject to this kind of investigation."[2]

142. Now in regard to typhus, which is not at the present time responsible for many deaths under five years of age, we learn that, comparing the earliest quinquennium which the Registrar-General's figures enable us to use with the quinquennium 1886–90, a fall of 46·9 per cent. in the children's share, *i. e.* from 6·4 per cent. to 3·4 per cent. For the same period in the case of typhoid fever (even when the necessary correction for varying classification in regard to remittent fever has been made) there is a fall of 51·7 per cent. in the children's share, *i. e.* from 17·4 per cent. to 8·4 per cent. For smallpox (even without any correction for chicken-pox) there is a fall during the same period of the children's share equal to 36·9 per cent., *i. e.* from 31·1 per cent. to 19·6 per cent.

Not only, then, do we find that in certain other zymotic diseases comparable with smallpox a shifting of age-incidence of the deaths, so that the children's share is less and the adults' share greater than was formerly the case, but the shifting would appear to be somewhat greater in the case of typhus and typhoid fevers than in the case of smallpox.

143. The diminution of mortality of infants side by side with increase of mortality of older persons, which has been claimed to specially indicate the influence of vaccination upon

[1] 516. [2] 518.

smallpox mortality, seems to be also true in a remarkable manner of influenza.

The Registrar-General in his Fifty-fourth Report institutes a comparison between the great influenza epidemics of 1847–48 and 1890–91, and calls attention to the fact that "the epidemic of 1890–91 was distinguished from the equally fatal epidemic of 1847–48 by the greater comparative severity with which it attacked persons of middle age;" and the table he gives shows that, while at ages under 15 there was a lower rate in the last epidemic, at ages from 15 to 55 there was an enhanced mortality, while above 65 there was again a reduction.

144. We find in these facts evidence that in diseases other than smallpox, and against which no artificial protective is invoked, there has been a change in the age-incidence of deaths and death-rates in the same direction as, and not very dissimilar in amount from, that which has been asserted to be distinctive of smallpox in consequence of the special influence of vaccination upon it. We are bound to conclude that a theory of causation which takes no account of these phenomena is unequal to an adequate explanation of the whole case.

145. If we are right in our conclusion that causes other than vaccination are operative upon the age-incidence of fatal smallpox, and if, as we hold, sanitary measures are influential upon smallpox mortality, and if it be true that "it is against noxious influences to which the young are especially sensitive that the weapons of sanitary reformers have been chiefly directed," we should naturally expect to find that in sanitary or healthy districts as compared with less sanitary or unhealthy districts the reduction of smallpox mortality would be greater among the young than among the adult population.

146. That this is actually the case has been shown in Section 149 of our colleagues' report. It is true that the admitted fact is there referred to the greater opportunity

afforded to town dwellers of catching smallpox and catching it early. We are, however, quite unable to agree with our colleagues that overcrowding upon area or within dwellings ought not be regarded as an insanitary circumstance, and the fact remains that sanitation or environment, or, at any rate, means other than vaccination, exert a profound influence, not only upon the amount of smallpox mortality, but also upon its age distribution.

147. That vaccination cannot be accepted as an adequate explanation of the shifting of age-incidence of fatal smallpox, or, at any rate, as the sole explanation of the phenomenon, is proved by the fact that a very considerable shifting has been observed in the case of deaths from smallpox of those certified to have been unvaccinated. Now it is only since the year 1881 that the Registrar-General has classified the deaths from smallpox into three groups,—the vaccinated, the unvaccinated, and the "not stated." Confining our attention to the unvaccinated, we learn that of 3746 deaths in the years 1881–93, 1483 were under five years of age, or 39·5 per cent.[1] Now it has been repeatedly stated that the normal proportion of deaths from smallpox under five to the total smallpox deaths last century (and vaccination apart) may be taken as 80 per cent.[2] What then is the explanation of the reduction of the proportion by one half? It has, indeed, been alleged that vaccination may indirectly have produced the effect by reducing the amount of smallpox or controlling its virulence. If this explanation be regarded as satisfactory, it may equally be urged that any measures such as isolation and more efficient precautions against contagion may also exert a powerful influence, not only upon the amount of smallpox, but also upon its age distribution amongst the unvaccinated.

148. In this connection it is not without interest to note the varying distribution of fatal smallpox according to age in the epidemic year 1871 in different districts of Scotland:

[1] Vol. i, App., p. 76. [2] 973–8.

——	Total deaths.	Deaths under five.	Deaths under five, per cent. of total.[1]
Principal towns (with population above 25,000)	886	195	22·0
Large towns (with population from 10,000 to 25,000)	143	32	22·3
Small towns (with population from 2000 to 10,000)	209	55	26·3
Mainland rural districts . . .	183	25	13·6
Insular rural districts	11	0	0·0

In Dundee the highest proportionate infantile mortality of all was observed, the percentage under five being 28.[2]

We are not aware of any statistics pointing to the more thorough vaccination of the populations in the rural and island districts; indeed, there is reason for thinking that default is more common in those parts than in the towns;[3] there is, however, evidence indicating that the greater healthiness of the country districts shows itself in the smaller proportion of the total deaths which occurs under five years.[4]

We learn from the City Chamberlain of Glasgow ('Vital, Social, and Economic Statistics of Glasgow, 1891') that while in Glasgow, in 1875–79, 45·02 per cent. of the total deaths from all causes were under five, and in the small towns 35·59 per cent., in the mainland rural districts the proportion was 26·77 and in the insular rural districts 19·90. We think it not improbable that the age distribution of deaths from such a disease as smallpox, and the mortality from it at different ages may be largely governed by the extent to which, by precautions against contagion and by sanitary surroundings the disease is kept within bounds and prevented from securing foothold upon the settled population. Where the contrary conditions prevailed and the spread of the disease was permitted and promoted, as in London and other large towns last century, the preponderant proportionate mortality of children was what we should naturally expect.

[1] 816–9; Public Health Repts., No. IV, p. 67.
[2] Ibid., p. 71. [3] 26,867–26,875.
[4] 6th Report, App., p. 654.

149. The claim that a second vaccination or re-vaccination places a person in better position as regards attack or death from smallpox is based largely on the experience derived from re-vaccination of soldiers, and of nurses and attendants whose duties bring them into close relation to the disease.

It will be seen from the reports made to us that re-vaccination is by no means an absolute protection. At Warrington, of 64 re-vaccinated persons living in houses invaded by smallpox, eight were attacked, giving an attack rate of 12·5 per cent.

In London, of 108 cases of smallpox in re-vaccinated persons, seven were severe, and four, or 3·7 per cent., fatal, a fatality rate higher than in the once vaccinated class.

150. The army, in obedience to numerous orders, has been very thoroughly re-vaccinated, and, in the opinion of Brigade-Surgeon Nash, "it is as perfect as endeavours can make it," and, indeed, he was unable to suggest any means whereby it could be made more thorough than it is.[1] From the table he put in we learn that from 1860 to 1888 inclusive there were 3953 cases of smallpox and 391 deaths in the army, giving a case mortality of 9·9 per cent. Considerable variation is to be observed in the attack rate, and the mortality in the re-vaccinated soldiers according to where they are stationed. Thus, in the year 1888, the attack rate among troops in the United Kingdom was one per 10,000, in the colonies 3, in India 15, in Egypt 42, and the death rates were per 10,000 in the United Kingdom ·1, in the Colonies 0, in India 1·4, and in Egypt 11·9.[2] The explanation of these differences is to be found in the difference of the degree of exposure to contagion in different places. Thus in Cairo and Assouan in 1889 an excessive amount of smallpox among the troops was traced to this cause.[3] There were 42 cases and six deaths, giving an attack rate of 12·2 per 1000, and a death rate of 1·75 per 1000, rates as high as those for the whole population of Warrington during the epidemic.

The Army Medical Report for the year states:

"A detachment of the 1st Battalion Welsh Regiment was stationed at Assouan during the latter part of 1888 and the

[1] 345; 3559; 3560. [2] Vol. ii, App. 8, p. 278. [3] 3551.

early part of 1889; during that time an outbreak of smallpox occurred among the native population, and the disease broke out among the troops; two cases also occurred on the voyage from Assouan to Cairo. Notwithstanding all the precautions taken in Cairo, and due regard having been paid to vaccination and re-vaccination, the disease kept on the increase, and in the month of May presented signs of doing so still further. The Welsh Regiment, which suffered most, was in Kasr-el-Nil Barracks, which are situated near a crowded thoroughfare and on the banks of a navigable river. It being more than probable that the disease was derived from natives, the Welsh Regiment, on the recommendation of the principal medical officer, was removed to Abbassiyeh, where the situation is healthier, and intercourse with the natives could be prevented. Smallpox, the principal medical officer, Deputy Surgeon-General Jameson remarks, is always more or less prevalent among the natives in Cairo, and indeed throughout Egypt, and as there exists no means of segregating affected cases it is certain that patients in various stages of the disease are permitted to walk about, and to frequent the bazaars and streets to the great danger of the public."

After these precautions were adopted there appears to have been a considerable reduction in the amount of smallpox among the troops in Egypt.

In the report of the Army Medical Department for 1888, speaking of smallpox mortality in Bengal, it is stated, "The greatest number of cases occurred at Lucknow, 32 with five deaths; it is stated that all the men had been re-vaccinated, and the cases varied from being very mild to severe and confluent."

151. The evidence in regard to the re-vaccination of nurses has been fully dealt with in Sections 313—329 of the report.[1] They seem to enjoy a greater immunity from smallpox than re-vaccinated soldiers; and instances are on record showing that attendants who have not been re-vaccinated have also enjoyed an immunity which has been remarkable. The table given in Section 329 of the report compares the

[1] 1390*a*; 22,211–22,222; 31,013.

liability of taking three infections with the liability of taking one. Cases of smallpox have been instanced in attendants and nurses who have been re-vaccinated; in such cases it is generally noted that the re-vaccination was not successful.[1] While some hold that an unsuccessful re-vaccination is of no account, others, in accordance with the teaching of Jenner and Bryce, regard it as indicative of insusceptibility, and assert that as long as a person is liable to successful vaccination he is liable to take smallpox; and that, therefore, insusceptibility to re-vaccination indicates protection.[2]

152. When we consider the large number of attacks and deaths by smallpox which have occurred amongst our thoroughly re-vaccinated army on foreign service, the attack rate of re-vaccinated persons living in houses invaded by smallpox at Warrington and Dewsbury, as well as the number and fatality of re-vaccinated persons attacked by smallpox in London, we are forced to the conclusion that the remarkable immunity recorded in the case of nurses in smallpox hospitals cannot be wholly accounted for by the fact that they have been re-vaccinated. In the hospital at Bicêtre during the siege of Paris, in the midst of a larger accumulation of smallpox patients than has ever been known before or since, the immunity of those attendants and doctors who had neglected re-vaccination was even more marked than in the case of the orderlies, who were nearly all re-vaccinated. We attach considerable importance to the narrative given by M. Colin of his experience as Chief Medical Officer to the Bicêtre Hospital during the siege.[3] The point of his narrative is that while 15 of the re-vaccinated or well-protected hospital orderlies took the disease, not one of the 80 who composed the medical and nursing staff, so many of whom had neglected re-vaccination, was attacked. He says ('La Variole,' 1873, p. 114): "Nous avons démontré, en deuxième lieu, que le personel hospitalier de Bicêtre a été peu éprouvé par la variole, dont il ne se manifesta aucune atteinte parmi les quarante médecins et pharmaciens attachés à l'établissement, ni parmi les quarante

[1] 6th Rep., App., p. 687. [2] 1837–1839; 4734–5.
[3] 12,389–95.

religieuses qui soignaient nos malades nuit et jour, et qui habitaient le centre de l'hôpital; grand nombre de ces personnes cependant n'avaient point voulu céder aux conseils que je leur donnais de se faire revacciner." It is sufficiently clear that M. Colin, though an impassioned advocate of vaccination, was so struck by the complete immunity of the medical and nursing staff, who by their neglect of re-vaccination appeared to offer less guarantees of protection than the orderlies, nearly all of whom had been re-vaccinated under his own eyes, that he thought it necessary to attempt an explanation.

153. The theory he expounds is not original, it has been broached by other authorities, and is applicable to some other contagious diseases. M. Colin (pages 39 and 90) suggests that a certain tolerance is acquired by repeated exposure to contagion, and that in those who are not at once attacked the receptivity to the disease becomes exhausted. The theory may or may not be true, but it has often been observed that in cases in which nurses have taken smallpox from their patients it has been at such interval of time, usually about a fortnight after exposure, as would suggest that those who are very susceptible take the disease at once; and it is possible that, as M. Colin suggests, those who do not thus fall ill acquire the immunity which repeated exposure tends to give. Dr. Gayton[1] has called attention to the fact that many "nurses and servants, persons well vaccinated, suffered from sore throat and headache on their first exposure to smallpox contagion. It is reasonable to believe that their illness was the result of smallpox poison," but he doubts whether it would be correct to say that they had smallpox. Vaccination, especially if with matter of variolous origin, may, when performed at such a time prior to exposure as to preoccupy the system, operate in the same direction.

154. With a view to prove the truth of the theory that cow-pox is the smallpox of the cow—varioliæ vaccinæ—and also to establish fresh lymph supplies, numerous attempts

[1] Homerton Report, 1875.

have been made by several observers [1] in various ways to infect bovine animals with the virus of human smallpox. In the majority of the experiments the results have been negative.[2] In a few, when the smallpox matter has been diligently rubbed into scarifications, or denuded surfaces, or punctures, certain results have been obtained which have been variously interpreted.[3] The positive results have generally been redness, tumidity, or papules at the points of insertion. In some of the successful cases, appearances approaching what may be described as vesicular have been obtained,—a few, indeed, have exhibited the physical appearances of vaccine inoculated on the calf; such vaccine results have sometimes appeared not at the points of insertion, but at some distance from them. In none of the experiments have the usual signs of natural cow-pox been found to result.

155. Some of the cases [4] in which vesicular results were obtained are certainly open to the objection that under the circumstances under which the experiments were made, there was the possibility, and even the probability, that vaccine virus (accidentally communicated) accounted for these results.

156. Matter obtained from the local products of such variolations of animals, when inoculated on human beings, in the hands of Chauveau and others,[5] gave rise to smallpox, which proved to be infectious. In the hands of others,[6] matter taken from the local results, even when these bore no resemblance to vaccine vesicles, after serial inoculations on animals and human beings, approximated so closely to the vesicles of ordinary vaccination as to be indistinguishable from them; in such cases there does not appear to be any ground for believing that the communicated disease, whatever its nature, is any longer infectious.

[1] 168. [2] 169. [3] 12,283.
[4] 5129; 24091.
[5] 171–2. [6] 12,292.

157. In order to obtain local results on human beings similar to those of ordinary vaccination, by the application of matter derived from human smallpox, it does not appear necessary to resort to the cow as an intermediary. One of the earliest experimenters who succeeded in variolating the cow, Dr. Thiele, of Kasan,[1] described a method of storage and dilution of smallpox virus, whereby he was enabled to cultivate lymph giving results indistinguishable from vaccine. Dr. Walker, who carried on a large vaccination practice in London in the beginning of the century, appears to have entertained similar views, and practised the dilution with water of the smallpox virus ('Memoirs of Lettsom,' vol. iii, p. 351).

158. Adams, in 1805, had already succeeded in obtaining perfect vaccine results without rash, with smallpox lymph taken from a mild variety of that disease. Guillou, in 1826, again records the fact that all the local appearances of vaccination could be obtained with lymph of undoubted variolous origin.[2] Indeed, results approximating to these appear to have been arrived at by some inoculators in the previous century, who claimed to give smallpox without fever or eruption, and with no other symptoms than those occurring on the inoculated arm; it was, however, pointed out[3] that such modified variolation did not give the same immunity as that which usually occasioned an eruption.[4]

159. While it is probable, then, that the insertion of smallpox matter into the skin of a calf can produce vesicles similar in some cases to those obtained by the inoculation of cow-pox matter, we are not aware of any evidence to show that the inoculation of the pox of the cow on the human skin has ever produced smallpox. In this sense, then, cow-pox and smallpox are not convertible, and we think it is incorrect to speak of cow-pox as the smallpox of the cow.

[1] Vol. i, App., p. 68 (note).

[2] 4895.

[3] 24,891–24,907.

[4] Cf. Mudge, 'Dissertation on Inoculated Smallpox,' p. 20; Bromfield on Inoculation,' p. 44; Adams, 'A Popular View of Vaccine Inoculation,' 1807.

160. Moreover, there is a considerable amount of evidence showing that morbid fluids derived from other and apparently distinct diseases can when inoculated give rise to vesicles like those of vaccine, not only in the cow, but in the human subject.[1] The virus of cattle plague, of horse-grease and horse-pox, of sheep smallpox, and of syphilis, and it has been alleged the application of tartar emetic, have given rise to vesicles when intentionally or accidentally inoculated which differ from vaccine vesicles less than these differ amongst themselves.[2] Matter obtained from some of these sources, other than cow-pox, has been at various times used to start fresh strains of lymph for vaccination. If from such varied sources vaccine results can be obtained, it by no means follows that because from human smallpox a vaccine vesicle can under certain circumstances be raised, there is therefore any special or essential inter-relation between cow-pox and smallpox.

161. Various more or less speculative views have been advanced to account for the ascertained facts in regard to immunity towards disease, whether natural or acquired. It has, indeed, been suggested [3] that acquired immunity is in some way connected with the chemical results upon the tissues of the febrile process by whatever means occasioned. This subject needs fuller investigation, but there is some evidence[4] which at least suggests that diseases held to be specifically distinct may exert some kind of temporary antagonism towards one another.[5]

162. Though smallpox and cow-pox still occur in many parts of the country, such outbreaks do not appear to be in any way associated as cause and effect, though special attention has been directed towards the discovery of such relationship. We therefore conceive the correct view to be, that among the various morbid fluids whose inoculation into

[1] 12,295; 12,174–12,233; 11,594–11,604; 11,540–5; 21,975.

[2] 11,484–7; 27,142; 8894–8900.

[3] 12,414; 12,236; 24,181–3; 25,995. [4] 4619–4622.

[5] Jenner employed vaccination to render dogs immune against distemper, and De Carro claimed it as antidotal to the virus of the plague.

the calf's skin can produce a "vaccine" result, smallpox matter is one ; but this fact no more implies the identity of cow-pox and smallpox than does a similar result from the inoculation of other viruses imply the identity of either smallpox or cow-pox with the diseases furnishing such viruses.

163. The question very naturally arises whether, seeing that lymph from various sources has been from time to time set going, there is any difference to be observed between the various stocks in their influence upon subsequent small-pox. Unfortunately it is no longer possible to distinguish between the various stocks now in circulation. Neither is it possible, in view of the law against inoculation, to submit the present or fresh stocks to the variolous test. It has been plausibly conjectured that vaccine lymph of variolous origin, such as Woodville's, or that of Ceely and Badcock, and of other experimenters in the variolation of cows, may be of superior efficacy to that derived from cow-pox, horse-grease, cattle plague, &c.

164. It is by no means clear that lymph from sporadic cases of cow-pox obtained from time to time has been derived from the true cow-pox of Jenner as distinguished from those varieties which have been termed "spurious." We know that Jenner attached the greatest importance to such discrimination. Spontaneous cow-pox, which produced no erysipelas, and showed no phagedænic disposition, he regarded as spurious. "This disease," he said, "is not to be considered as similar in any respect to that of which I am treating, as it is incapable of producing any specific effects on the human constitution. However, it is of the greatest consequence to point it out here, lest the want of discrimination should occasion an idea of security from the infection of the smallpox, which might prove delusive."

165. It was the cow-pox derived from the greasy heel of the horse that gave the true cow-pox, according to Jenner ; matter from the horse direct, he found, did not impart immunity towards smallpox.

In a later publication he stated that he "found that some of those *who seemed to have undergone the cow-pox*, nevertheless, on inoculation with the smallpox, felt its influence just the same as if no disease had been communicated to them by the cow. This occurrence led me to inquire among the medical practitioners in the country around me, who all agreed in this sentiment, that the cow-pox was not to be relied upon as a certain preventive of the smallpox. This for a while damped, but did not extinguish my ardour; for as I proceeded I had the satisfaction to learn that the cow was subject to some varieties of spontaneous eruptions upon her teats; that they were all capable of communicating sores to the hands of the milkers, and that whatever sore was derived from this animal was called in the dairy the cow-pox. Thus I surmounted a great obstacle, and in consequence was led to form a distinction between these diseases, one of which only I have denominated the *true*, the others the *spurious* cow-pox, as they possess no specific power over the constitution."

166. Investigations carried out under the medical department of the Local Government Board, and especially by Dr. Klein, have served to show the number and variety of the diseases of the teats and udders of cows, and the difficulty of accurately discriminating between them. In reporting on some of these diseases in 1887, Dr. Klein observed:[1]

"In view of this second differentiation of a definite disease from among the mass of cow diseases that show sores on the teats, the old division into true and spurious cow-pox has become manifestly insufficient. It is seen that the name 'spurious cow-pock' has in all probability been used to cover a variety of sores, having essential differences in nature, just as until the time of Jenner the name 'cow-pock' had covered along with various other things the disease which we know as vaccinia. But it is one thing to have learnt the essential nature of those sores in the cow that are concerned with vaccinia or scarlatina in the human subject, and another thing to affirm the distinguishing characters by which those

[1] 27,125; L.G.B. M.O. Rep., 1888–9 and 1887–8.

sores may be recognised from other sores that once on a time laid claim to being equally with them 'cow-pox' or 'spruious cow-pox.' Our new discontent with the name 'spurious cow-pox' does not at once give us a knowledge of the nature of those sores which remain on the list; and we are now learning that there are many different kinds of such sores."

167. It is evident that the diagnosis of the various diseases which have been collectively termed cow-pox is no easy matter; and it is to say the least doubtful whether the many new stocks which have been put in circulation have been all of the same species.[1] It is certain that several stocks have been derived from so-called "spontaneous" cow-pox, as, for instance, that of Laforet, from which the National Vaccine Establishment was supplied when the calf lymph station was inaugurated.[2]

168. We regret that in the course of our inquiry we have not obtained from the experts who have favoured us with their views any satisfactory definition of "vaccination." No definition of the term appears in any of the Vaccination Acts. Our late and much regretted colleague, Mr. Bradlaugh, we know attached great importance to this point.

169. Mr. Ceely, so far as we are aware, was the last in this country to apply the variolous test to a new stock of lymph. He thus tested 21 persons who had been inoculated at periods varying from 5 to 31 months previously with his matter got by variolating the cow.[3] In every case some effect resulted; in nearly all papulo-vesicular elevations or "mother-pustules" appeared at the insertions. In a few there was slight fever, which in one case proved to be infectious, and in one child with four fine scars, the result of the inoculation five months previously, there was an eruption of hard warty papules over the whole body, several of which suppurated.[4] These experiments were held to prove that a certain amount of immunity had been conferred by the previous inoculation, although no control experiment was made

[1] 27,129–27,132.
[2] 4278–9.
[3] 12·303–4.
[4] Vol. iv, App. 1, p. 412.

to show the effect of the matter inoculated in the same way upon unprotected persons.

170. It is impossible now to distinguish the various stocks of vaccine in use; it is, however, clear that much of that now current in this country and abroad is not derived from cow-pox at all, and probably still less is derived from that special variety of cow-pox which Jenner regarded as the true or protective variety. It is scarcely probable, unless, indeed, it be held that all viruses that will give rise to the physical appearances of a vaccine vesicle when inoculated are identical, that one and all should be endowed with precisely the same effects *quâ* immunity towards smallpox. If we had to express a preference for lymph derived from any of the sources described, we should give it to that of variolous origin, provided always it has been rendered incapable of giving rise to infection.

171. In Section 361 of our colleagues' report, an analogy is suggested between vaccination against smallpox and Pasteur's protective inoculations of animals with attenuated viruses to protect them against certain epizootics.

We have already given our reasons for doubting the assertion that the cow-pox is the smallpox of the cow, and it should be remembered that M. Pasteur, in borrowing the term "vaccination" to describe his inoculations, was careful to point out that the difference is great in some respects between the two classes of facts (*Lancet*, November 6th, 1880). If, however, the view which regards vaccination as analogous to the Pasteur inoculations be correct, it may be of interest to follow out the analogy into practice.

172. The chief diseases of flocks in which protective inoculations have been tried on a large scale are anthrax and pleuro-pneumonia.

173. Experience, however, seems to prove[1] that the protective inoculation of anthrax, while it gives rise to a certain amount of immunity for an indefinite period towards subse-

[1] Board of Agriculture Rep. under C.D. Animals Acts for 1894; 10,984.

quent "experimental" inoculation with the virulent material, leaves the "vaccinated" animals still liable to infection in the natural way. Experiments in this country, in France, and in Germany have not confirmed M. Pasteur's original contentions. The tendency of modern opinion and practice appears to be rather in the direction of the adoption of the "stamping-out system" by the poleaxe, destruction of infected carcases, and disinfection, rather than of reliance upon the "stamping-in" system of protective inoculations. In the last report of the chief veterinary officer of the Board of Agriculture, we read that "Dr. Klein's reports appear in the Report of the Medical Officer of the Local Government Board for the years 1881–82, but the results which followed his investigations were in direct conflict with the statement made by M. Pasteur, since all the sheep vaccinated by Dr. Klein either died as a result of the injection of the vaccine material, or succumbed to anthrax when inoculated with the virulent material, after being what was considered immune to the disease."[1]

It is further stated in a report by Professor Muller, of the Royal Veterinary School of Berlin,[2] that "preventive inoculation of anthrax has not many, I may even say no, friends in Germany," and that "preventive inoculation was practised from 1882 till 1885 or 1886 in the provinces Saxony and Posen by four or five great landowners or farmers who have suffered great losses every year by enzootic anthrax, and were induced to try inoculation by the apparent good results gained in Parkisch. The virus was obtained in all cases directly from Paris. In the beginning these inoculations were repeated every year, but little by little they were discontinued. I believe that preventive inoculation is now fully abandoned in Prussia, and has not been practised during the last five or six years."

On the other hand, we learn from Professor Muller that "the general opinion of scientific authorities in Germany is that the best measures against anthrax are a careful destruction of carcases, and a most careful disinfection, and that inoculation will have no effect in lessening the loss caused by this disease."

[1] 26,007–26,014. [2] Ibid.

174. In regard to pleuro-pneumonia, the experience seems to be very similar, and to point to the conclusion that while the "stamping-out" system of slaughter and disinfection appears to be adequate to the eradication of the disease altogether, such result cannot be obtained by protective inoculations.

The report of the Departmental Committee of 1888 on pleuro-pneumonia is to the effect that protective inoculation "cannot be depended on as an efficient means of exterminating pleuro-pneumonia." The Committee attached especial importance to the experience of the rival methods in the Netherlands. They stated:

"We have, with your Lordship's approval, and the sanction of Her Majesty's Treasury, summoned before us M. Lameris, one of the Government veterinary surgeons, residing at the Hague. In view of the fact that Holland is the only country in the world from which, after having obtained a good foothold, pleuro-pneumonia has been eradicated, the evidence of this gentleman possesses considerable interest and importance.

"From the evidence of M. Lameris it appeared that for many years inoculation was practised by owners of cattle, and so impressed were they by the benefits which appeared to result from that operation, that they petitioned the Government to make the inoculation of cattle in Holland universal and compulsory. The Ministers, however, declined to accede to this request, not only on the ground of expense, but because of the difficulties attendant on the carrying out of such a law, and of obtaining sufficient inoculating material.

"In 1871 an order was issued for the compulsory slaughter of all actually diseased animals, compensation being paid out of the royal funds. After three years, compulsory inoculation of suspected cattle was also employed, though not universally. These combined methods of treatment, however, although reducing the disease, failed to eradicate it, and therefore the system of stamping out was adopted, and since 1885 the Netherlands have been practically free from pleuro-pneumonia.

"M. Lameris was very decided in his opinion that com-

pulsory vaccination could not have cleared his country of disease; that stamping out was the safest and most certain way of attaining this result, and proved, in the long run, to be the cheapest."

175. In the case of sheep smallpox, which more closely resembles the smallpox of man than does any disease of the lower animals, and in which accordingly it was hoped, and declared by Sacco and others,[1] that protection might be artificially secured, Dr. Seaton stated the accepted view when he said, "No fact is more conclusively established than the utter worthlessness of vaccination for saving sheep from smallpox" ('Handbook of Vaccination,' p. 42).

176. Attention has recently been directed to protective inoculations against cholera, with more or less successful results;[2] but while such protection may be a matter for individual choice, the sanitary vigilance carried out under public authority seems to have been strikingly successful in preventing the disease from spreading in this country.

Reference III.—The objections made to Vaccination on the ground of injurious effects alleged to result therefrom.

177. It was at one time officially maintained that against "the vast gain" by "vaccination there is no loss to count. Of the various alleged drawbacks to such great advantages the present state of medical knowledge recognises no single trace."[3]

The Select Committee of 1871 reported "that if the operation be performed with due regard to the health of the person vaccinated, and with proper precautions in obtaining and using the vaccine lymph, there need be no apprehension that vaccination will injure health or communicate any disease." Even more recently this view has been re-affirmed in a pamphlet entitled, Facts concerning vaccination for heads of families, "revised by the Local Government Board,

[1] 10,969. [2] 25,927–25,983.
[3] Simon, 1857, Papers, p. lxvii, vol. i, App., p. 93.

and issued with their sanction," which states that "as to the alleged injury from vaccination, all competent authorities are agreed that, with due care in the performance of the operation, *no risk of any injurious effects* from it need be feared."[1]

We agree with our colleagues that, notwithstanding repeated and emphatic assertions to the contrary, the admission must without hesitation be made that risk attaches to the operation of vaccination.

178. The statements contained in Sections 399—421 of the Report appear to us to give ample reason at least for hesitation in retaining compulsory vaccination in any form. We allude especially to the following statements, in which we generally concur :

Section 399.—"It is not open to doubt that there have been cases in which injury and death have resulted from vaccination."

Section 409.—"It must not be forgotten that the introduction into the system of even a mild virus, however carefully performed, is necessarily attended by the production of local inflammation and of febrile illness."

Section 410.—"It is established that lymph contains organisms, and may contain those which, under certain circumstances, would be productive of erysipelas."

In Section 413 we are told that vaccination may become exceptionally risky, through special circumstances over which, in our opinion, the parents can have little or no control, such as the prevalence of disease in the neighbourhood.

Section 417.—"It may, indeed, easily be the fact that vaccination, in common with chicken-pox, measles, smallpox, and other specific fevers, does occasionally serve as an exciting cause of a scrofulous outbreak."

Section 418.—"It is freely to be admitted that vaccinia, like varicella, does occasionally cause an irritable condition of skin which may last long, but it is exceedingly improbable that it is responsible for any substantial increase in the number of chronic skin diseases in children." And again, "Amongst the inconveniences connected with vaccination is the production of contagious forms of eruption, such as

[1] 21,853; 1871 Committee, 3210.

have been classed under the names of porrigo and impetigo contagiosa. These eruptions are not attended with any risk to life, nor by any permanent injury to health, and they are usually curable by simple measures. References to these eruptions have been made by many witnesses.[1] Their occurrence has no doubt not unfrequently caused prejudice to the practice of vaccination." And in Section 419 is recited the case of "a child previously in good health, and vaccinated with calf lymph by means of a needle which had never been used before, who died about six weeks afterwards with severely ulcerated arms, and ulcers in several parts of the body and limbs. No precaution had been neglected, and the event could only, as in other similar cases, be attributed to what is known as idiosyncrasy on the part of the child, a peculiarity of health attended by exceptional susceptibility to the specific virus of vaccinia."

In Sections 420 and 421 it is pointed out that "it was at one time doubted whether syphilis could result [from vaccination], and it was even confidently asserted that it could not," but that "Facts which were, not long after the issue of Mr. Simon's report, brought before the profession, and which were carefully investigated, made it certain that the negative conclusion which had been arrived at was a mistaken one, and from that time no doubt can have been entertained by any that it is possible to convey syphilis in the act of vaccination."

179. Putting together all these admitted elements of danger, though each may be slight in itself, we think that the sum of them constitutes a very serious objection even to the modified form of compulsion favoured by our colleagues.

180. It appears to us that the case for even this modified compulsion is practically surrendered in Section 437, where our colleagues insist on the right of parental option as to the lymph to be used, on the ground that the risk of syphilis from arm-to-arm vaccination, however slight, is "naturally regarded by a parent with abhorrence." We cannot understand on what principle a parent is entitled to refuse arm-to-

[1] 22,876–22,903; 23,029; 23,064–23,067.

arm vaccination, because he regards its risks with abhorrence, but is not entitled also to refuse the not unreal risks of calf lymph, though he also regards these with abhorrence.

181. We are not prepared to attach much weight to figures put in by Dr. Ogle,[1] instituting a comparison between Leicester and the whole of England and Wales in regard to the changes in the infantile mortality from various diseases. To make such comparison valuable it would be, as Dr. Ogle seemed inclined to admit,[2] better to compare an urban population similar to that of Leicester, but in which vaccination was thoroughly carried out. If we want to ascertain by the method of differences whether vaccination exerts a detrimental effect by increasing the mortality from certain infantile diseases, it is surely imperative to see that the places or times compared differ as little as possible in respect of circumstances other than vaccination.

182. In the statistics which Mr. Biggs furnished[3] we do not find any evidence that the increasing disuse of infantile vaccination in Leicester has prejudicially affected the mortality of young children; on the contrary, there has not only been a marked reduction of the general death-rate since 1875, but a reduction in the death-rate of infants under one year, a rate which reached its highest point since 1838 in the period 1868–72, when vaccination was most thoroughly enforced.

183. We must remember that though machinery exists for registering the success of vaccination, there is no system for notification of untoward results, or any means other than the certificates for obtaining official information of the total number of deaths directly or indirectly due to vaccination.[4] In Scotland there appears to be even less provision for inquiry into alleged ill-results than is the case in England.

184. Our colleagues hold that though some of the dangers

[1] 27,197.
[2] 27,199–204.
[3] Vol. iv, App. 3.
[4] 3887; 28,016–38,021.

said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, they are relatively few in proportion to the amount of vaccination that is done. They suggest an analogy with railway accidents, as an example of a risk that is every day disregarded. They quote the figures given by Dr. Ogle as showing one death to 14,159 primary vaccinations.[1]

We give reasons for thinking the number of deaths underestimated; but accepting the ratio as correct, it is interesting to compare it with that of the number of railway passengers killed to the total number of passengers.[2]

Year.	Number of passengers killed from causes beyond their own control, from accidents to trains in the United Kingdom.	Number of passenger journeys (exclusive of journeys by season-ticket-holders).	Proportion returned as killed (from causes beyond their own control) to number carried.
1881	23	622,160,000	1 in 27,050,435
1882	18	654,838,295	1 in 36,379,905
1883	11	683,718,137	1 in 62,156,194
1884	31	694,991,860	1 in 22,419,092
1885	6	697,213,031	1 in 116,202,171
1886	8	725,584,390	1 in 90,698,049
1887	25	733,670,000	1 in 29,346,800
1888	11	742,499,164	1 in 67,530,000
1889	88[3]	775,183,073	1 in 8,808,875
1890	18	817,744,046	1 in 45,430,224
1891	5	845,463,668	1 in 169,092,733
1892	21	864,435,388	1 in 41,163,589
1893	17	873,177,052	1 in 51,363,356
1894	16	911,412,926	1 in 56,963,307

[1] Sect. 434; Sect. 379; Sect. 403; 6th Report, p. 647.

[2] Accidents on Railways, Board of Trade Report, 1894.

[3] Including 80 killed and 262 injured in collision near Armagh. Number of season tickets issued in 1894, 1,185,000.

England and Wales: Deaths ascribed to vaccination, 1881–91.

Year.	Number of deaths.	Primary vaccinations.
1881	58	766,179
1882	65	764,518
1883	55	763,092
1884	53	766,338
1885	52	758,992
1886	45	755,337
1887	45	735,536
1888	45	720,991
1889	58	708,919
1881–89	476[1]	6,739,902[1]
1890	43	(Not yet published.)
1891	43	(Not yet published.)

We cannot help thinking that if railway statistics showed one death to 14,159 passengers, a railway journey would be a much more anxious affair than it is at present.

185. We are deeply impressed with the sad cases of severe illness and suffering and death which the investigations of medical men appointed by the Commission have, after rigid scrutiny, failed to disconnect from vaccination.[2] We are also struck with the fact that under the circumstances which must obtain in the houses of the poor, additional risks to health and life are encountered, and that the operation cannot be regarded as free from even the more avoidable risks, except under conditions and precautions it is perfectly impossible to secure. To compel vaccination under such circumstances, even if its value were greater than it is, is in our opinion morally indefensible. It is with a sense of shame and amazement that we hear of instances in which parents who have lost one child from the effects of vaccination have

[1] One death to 14,159 primary vaccinations.

[2] Appendix.

been prosecuted and fined for refusing to submit another child to the operation.[1]

186. Drs. Barlow and Acland found that about half the cases of vaccinal injury investigated by them (93 out of 189) were of inflammatory or septic origin, and other cases in which the question of syphilis had been raised (38) in many instances proved to belong to the inflammatory or septic category. They further state that "there are a certain number of cases in which, from causes which cannot at present be foreseen or prevented, serious results ensue from cutaneous eruptions, such as generalised vaccinia, impetigo, eczema, &c.," though in their experience the number is small. They "are of opinion that a certain proportion of children will always suffer after vaccination from various forms of cutaneous eruption. These seem to be more frequent after vaccination with calf lymph, and are for the most part free from danger, though often giving rise to considerable distress." They also think that "calf lymph as now usually employed tends to produce more severe inflammatory reaction than that which has been humanised."

In regard to the mode of vaccinating, Drs. Barlow and Acland state they "have seen many cases of severe inflammation, abscess, erysipelas, and septic infection which have followed the use of some mechanical vaccinator;" and further, that they "have frequently seen ulceration result from the insertions being placed too near together, so that the vitality of the tissues between them has been destroyed, and a slough produced."

187. Among the 32 fatal cases investigated by Dr. Luff, in which vaccination was a determining cause or factor in the fatal event, there were 22 of erysipelas, three of cellulitis, three of septicæmia, three of pyæmia, and one from exhaustion.

188. Dr. Coupland deals with injuries due to the quality of the lymph, and to septic infection, and adds a third category which he terms "Cases of deranged health, and even serious symptoms, evolved by the constitutional disturbance induced by vaccination in weakly or predisposed subjects."

[1] 6745; 13,743.

In reference to these cases he suggests that "unless small-pox were prevalent at the time it might often be preferable to defer vaccination for several months than to adhere too rigidly to the statutory age, irrespective of the condition of the child and its surroundings. In particular he deprecates the vaccination of very young infants, as is the practice in regard to workhouse children and those born in lying-in institutions."

189. We were surprised to learn that this highly objectionable practice has been approved and encouraged by the Local Government Board.[1]

190. Erysipelas in varying degrees of severity is the most frequent of the ill results arising from or accompanying vaccination. It may amount to little more than an inflamed arm, or an extension of the areola which surrounds the vesicles on the eighth to the twelfth day, or it may be widespread and severe, affecting the cellular tissue, and may terminate in death. Deaths from "erysipelas after vaccination" were separately classified by the Registrar-General for England and Wales during the years 1859–80; there were 390 in all so certified. There is ample reason for believing that many other such cases have occurred, but in which no mention of vaccination appeared on the certificate of death.[2]

Years.	Deaths from erysipelas after vaccination.	Years.	Deaths from erysipelas after vaccination.[3]
1859	5	1870	20
1860	3	1871	24
1861	2	1872	16
1862	3	1873	19
1863	11	1874	29
1864	13	1875	37
1865	10	1876	21
1866	10	1877	29
1867	4	1878	35
1868	9	1879	32
1869	19	1880	39

[1] 3963–6.

[2] 14,796; 13,835; 13,839; 14,819; 14,453; 15,270; 15,355.

[3] Vol. iv, App. iii, Table 3.

191. At an inquiry held by inspectors of the Local Government Board into certain deaths alleged to have been caused by vaccination at Norwich in 1882, it was shown that eight children suffered from erysipelas "due to some abnormal peculiarity or contamination of the lymph;" four of these died; in only one was vaccination mentioned on the certificate of death.[1]

Another inquiry was made by the Local Government Board into cases of erysipelas following upon vaccination at Gainsborough in 1876, of which six died; in none of these was vaccination mentioned on the certificate of death, though the searching investigation which was subsequently made failed to dissociate the operation from the fatal erysipelas.[2]

Other inquiries have been made by the Local Government Board; in 1886 into three cases of fatal erysipelas after vaccination at Sudbury; in 1887 into a fatal case of erysipelas at a military hospital; and in 1889 into a fatal case of post-vaccinal erysipelas at New Humberston.[3]

192. In addition to the above series of published reports of injuries of an inflammatory or septic character arising from vaccination, we find in a memorandum prepared by Dr. Ballard a selection of cases found among the older records of the Local Government Board. These include—

1. A series of nineteen cases of erysipelas from vaccination at Warrington, with five deaths, in 1871.

2. A case of serious erysipelas from vaccination with National Vaccine Establishment lymph at Stoke Newington in 1871, in which inquiry elicited that violent inflammation had occurred in others vaccinated with lymph from the same vaccinifer; the vaccinifer having an inflamed arm on the thirteenth day and a small abscess in the axilla.

3. Six cases of serious inflammation and three deaths in a series vaccinated with ninth day lymph from one vaccinifer at Appleby in 1873.

4. Several cases of erysipelas and inflammation with five deaths in a series of vaccinations at Chelsea in 1875.

[1] 15,222; Vol. iv, App., p. 478.
[2] 14,819; Vol. iv, App., p. 466.
[3] 14,149, 15,337.

5. Twelve cases of excessive inflammation, six of erysipelas with three deaths, two cases of axillary abscess, and one large ulcer in a series of vaccinations at Plomesgate in 1878.

6. Ten cases of erysipelas or abscesses with four deaths and several cases of eczema in a series of vaccinations at Clerkenwell in 1879, in which "it is clear that the erysipelatous contagion was imparted at the time of vaccination."

7. Three cases of extensive erysipelas from vaccination at Blandford in 1883.

8. Three fatal cases of erysipelas from vaccination at Sudbury in 1883.

193. Between November 1st, 1888, and November 30th, 1891, 132 cases of inflammatory or septic disease (mostly erysipelas), following vaccination and terminating fatally, were the subject of inquiry by the Local Government Board. They have been classified as follows by Drs. Acland and Coupland :[1]

Cases in which vaccination was followed by glandular abscess	3	Cases LXXXI, CXXXIII, and CLXIV.
Cases in which vaccination was followed by cellulitis or sloughing, and in which there is ground for supposing that the lymph or vaccinator were at fault	3	Cases LX, XCIV, and CXCII.
Cases in which vaccination was followed by cellulitis or sloughing, in which there is evidence of some extraneous source of danger	9	Cases XLII, LXXX, CIII, CXXVI, CXXXII, CXLVI, CXLVIII, CLXXVI, and CCIII.
Cases in which vaccination was followed by erysipelas in which no extraneous cause was found	14	Cases XXIII, XXVIII, XXX, XXXVII, XLI, XLIV, LXXI, LXXXIX, XCVIII, CIX, CXXXV, CXXXVII, CXLIV, and CLXXVIII.
Cases in which vaccination was followed by erysipelas in which there is evidence to show that either the vaccinator or the lymph were at fault	32	Cases XVI, XXXI, XXXIV, XXXV, XL, LXV, LXIX, LXXXIII, LXXXIV, LXXXV, C, CI, CIV, CVIII, CXVI, CXVIII, CXX, CXXVIII, CXLI, CXLII, CLV, CLXVI, CLXVIII, CLXIX, CLXXII, CLXXIV, CLXXIX, CLXXXV, CLXXXIX, CXCVII, CXCVIII, and CXCIX.

[1] Appendix.

Cases in which vaccination was followed by erysipelas in which there is evidence to show that there were extraneous sources of danger apart from the method of vaccination or the lymph	43	Cases XV, XVII, XX, XXI, XXIV, XXIX, XXXII, XXXIII, XXXVIII, XXXIX, XLIII, LXII, LXVII, LXXXVI, LXXXVII, LXXXVIII, XCII, CVI, CXIV, CXVII, CXXII, CXXIII, CXXIV, CXXXI, CXXXIV, CXXXVI, CXXXIX, CXLV, CXLIX, CLI, CLII, CLVI, CLIX, CLXVII, CLXXV, CLXXVII, CLXXX, CLXXXII, CXC, CXCI, CXCV, CC, and CCII.
Cases in which vaccination was followed by erysipelas in which the vesicles were irritated or the scabs injured	8	Cases XVIII, XXII, XXV, LXVIII, CXIII, CXV, CL, and CLIII.
Cases in which vaccination was followed by ulceration of vesicles	4	Cases CLXXIII, CLXXXVIII, CXCIII, and CCI.
Cases in which vaccination was followed by pyæmic or general septic infection, and in which there is ground for suspecting that the lymph or the vaccinator were at fault	5	Cases LXXXII, XCVII, CVII, CVII (*a*), and CXXI.
Cases in which vaccination was followed by pyæmia or general septic infection in which there is evidence of insanitary surroundings or other sources of danger	11	Cases XXVII, LIV, LIX, LXX, LXXVIII, LXXIX, XCI, CV, CXII, CXXV, and CCIV.
Gangrenous or phagedænic ulceration	1	Case XIX.

194. Numerous cases, and two or three series of cases of post-vaccinal erysipelas, have been investigated by medical men appointed by the Commission. (See Cases 23, 115, 181, Appendix.)

Thus at some villages in Norfolk in 1890 there occurred a series of injuries from vaccination, which were investigated by Dr. Barlow on behalf of the Commission. In the course of March in that year some sixteen children suffered from inflamed arms, several exhibiting secondary abscesses in the axillary glands, with subsequent wasting and great disturb-

ance of health. Three terminated fatally; in one of these the death was certified to be due to "convulsions," in another to "pyæmia," and in the third to "asthenia, tabes mesenterica."[1] Dr. Barlow's conclusion on these cases is as follows:

"Analysis of these cases shows that the progress of the vaccination in some respects diverged from the typical course.

"In the majority there was a premature development of the vesicle, which within two or three days after insertion formed, broke, and discharged.

"In several there was prolonged ulceration with free discharge, but not in the cases I saw any very deep loss of substance.

"There was early and inordinate amount of inflammatory redness of the affected limb, and in some cases of the whole body.

"In one case (XIII) there was definite and severe erysipelas.

"In two cases there was a large diffuse secondary abscess of the leg, which was very serious indeed, and accompanied by great exhaustion. I am informed that this condition was also observed in one of the fatal cases (C. W. W.).

"In one case (No. II) the local condition was, I am informed, distinctly subsiding, and there was no indication of secondary abscess; but the child died from convulsions. Also in XII the local condition had quieted down, so that the vaccination sites were very small and scabbed over, and there were no indications of secondary abscess. But the child had sunk into a condition of marasmus with vomiting, and latterly green loose evacuations had been present. He succumbed the day after I saw him.

"I think it important to observe that in both II and XII the feeding of these infants had been very bad.

"For the most part, however, it is clear that the children had been previously healthy, and with two or three exceptions the mothers seemed to me to have been healthy. In two cases (VI, XIII) there was reason to believe the mothers suffered from local inoculations from attending on their infants.

[1] 14,890.

"I saw no reason to think that the other children in the several cottages were unhealthy, with one slight exception (XIII).

"The cottages were fairly wholesome. There was no proof of the family health having suffered previous to the vaccination. The infants vaccinated were, with a few exceptions, well tended.

"I could not ascertain that there had been any infectious fever prevalent in these villages which could have modified the vaccination in an adverse way.

"To sum up from the brief provisional investigation that I was able to make of these cases, it appeared to me obvious that some septic material had been introduced at the time of the insertion of the vaccine lymph, and that this was mainly responsible for the untoward results obtained."[1]

(See also Cases Nos. 5, 6, 7, 11, 14, 21, 27, 28, 30, 32, 36, 38, 39, 54, 72, 73, 81, 83, 86, 87, 88, 91, 96, 100, 104, 105, 106, 107, 108, 112, 114, 115, 116, 117, 118, 121, 122, 124, 125, 126, 135, 137, 156, 158, 161, 162, 165, 167, 169, 171, 175, 177, 179, 181, 183, 184, 185, 188, 189, 190, 197, 199, 200, 203, 204, 206, 207, 208, 211, 213, 215, 217, 218, 219, 220, 221, 235, 236, 239, 241, 242, 244, 245, 247, 248, 249, 253, 257, 258, 259, 260, 261, 262, 267, 268, 271, 312, 318.)[2]

195. An account of a somewhat similar series of cases of septic poisoning occurring in the course of some vaccinations at Asprières (Aveyron) in 1885, in which several deaths occurred, will be found in Appendix IV to the Third Report, p. 210.

196. The question has been much debated whether the erysipelas which accompanies or follows vaccination is due to accidental contamination, or is in some way incidental to or provoked by the changes which result from the insertion of the lymph. The question is not a new one. Jenner described "erysipelatous inflammation" as characteristic of the true as opposed to the spurious cow-pox. When this opinion of his was criticised, he replied, "In calling the inflammation that is excited by the cow-pox virus, erysipelatous,

[1] 9835–8844. [2] Appendix.

perhaps I may not be critically exact, but it certainly approaches near to it." And, indeed, he records an instance in which, in his opinion, the true cow-pox was excited in a herd of cows, and communicated to milkers, by matter derived from " an extensive inflammation of the erysipelatous kind, appearing without any apparent cause, upon the upper part of the thigh of a sucking colt."

197. The areola around the vesicles when at their height varies a good deal, and it does not seem possible to discriminate with precision between an exaggerated or indefinitely extended areola and erysipelas or erythema.[1] We learn from bacteriological investigations that vaccine lymph contains a great variety of germs or micro-organisms, some of which are accounted to be pathogenic or disease-producing, and though none of them have been identified as the active principle of the vaccine disease, it seems clear that in some specimens germs believed by high authorities to be those of erysipelas have been encountered.[2]

198. In view of these facts we are unable to regard vaccination as being as innocent of erysipelas as a prick of a pin or any ordinary surgical wound. While doubtless the treatment of vaccinated arms is frequently careless, and the surroundings of vaccinated infants often insanitary, and such circumstances may well provoke or aggravate untoward results, the evidence leads us to believe that vaccine lymph or the vaccine process is not unfrequently proximately related to erysipelas, inflamed arms, ulceration, sloughing, and axillary abscess.

199. Attempts have been made to discriminate cases of erysipelas following vaccination in which the disease is due to contamination of the lymph, from others in which some extrinsic cause is alleged. It has been suggested that the interval which elapses between the vaccination and the appearance of the erysipelas may enable the discrimination to

[1] 4402, 13,073, 13,083–6.
[2] 11,218–25; 27,133; 29,112–131; 11,059–111.

be made. But the duration of the incubation period of erysipelas is variously given by authorities from a few hours to several days or a fortnight.[1] In certain series of vaccinations, where several of the children vaccinated at or about the same time have been affected, and in which, therefore, the lymph was the probable medium of infection, the interval has varied from one or two days to two weeks, or even longer.[2] It is therefore not possible to exonerate the lymph with certainty by means of any such criterion. It has also been argued that in cases in which one or two children only out of a group of several children, vaccinated from one and the same vaccinifer, subsequently develop erysipelas, that the lymph must be held blameless.[3] But it has been specially remarked by Mr. Hutchinson that in cases of vaccino-syphilis it is not usually the case for all the co-vaccinees to be infected, though in such occurrence it is held that the lymph contains and imparts the superadded disease ('Illustrations of Clinical Surgery,' fasc. vi). It is not at all improbable that the power of resistance in different children to the infection of erysipelas varies considerably, and it may well be that vaccine which usually evokes an areola or erythema of varying extent may in certain constitutions develop erysipelas or cellulitis.[4]

200. In a memorandum which accompanies the report of the German Vaccination Commission, it is stated that—

"At the time when the vaccination law was promulgated the opinion prevailed generally that the dangers connected with vaccination to the life and health of the patient were unimportant, or rather, did not exist at all.[5] Thus it is set down in No. 4 of the final conclusions of the opinion drawn up by the Royal Prussian Scientific Deputation for Medical Affairs, dated February 28th, 1872, which document formed the principal basis for the projected law, 'that there existed no warranted fact in favour of a deleterious influence of vaccination upon the health.' It was, however, seen subsequently, very clearly, that this thesis could not be upheld.

[1] Vol. iv, p. 478.
[2] Norfolk series (Case 23).
[3] Cases 189, 200, 203.
[4] See Case 115 (series) in Appendix
[5] 9957–61.

In fact, very serious damage by vaccination has occurred anything but rarely, both before and after the promulgation of the vaccination laws. The more recent publications enumerate a great many cases of the transmission of contagious diseases by vaccination. Thus, up to the year 1880, fifty cases have become known in which syphilis inoculated with the vaccine caused illness to about 750 persons (Lotz on Smallpox and Vaccination, 1880, p. 113). A few separate cases of vaccine syphilis may perhaps be looked upon as being uncertain, but, on the other hand, others were not made publicly known, so that the figures quoted above are likely to be less than the number of cases that happened in reality. Still greater dangers than those connected with vaccine syphilis are threatened by vaccine erysipelas, which, as is now generally admitted, are far from uncommon. It is true that in many cases erysipelas may not be absolutely ascribed to vaccination, notably in the case of separate illness or the so-called late erysipelas. However, a number of cases of general illness taking place *en masse* have been registered, which happened immediately after vaccination, and, in accordance with the latest experience derived from the ætiology of erysipelas, admit of no other explanation beyond their having been caused by vaccination direct. Other diseases also have been transmitted by vaccination, or at least the possibility of such transmission must be admitted."

201. In regard to vaccine syphilis, in the pamphlet revised by the Local Government Board, and until recently widely circulated, it was stated:

"The fear that a foul disease may be implanted by vaccination is an unfounded one.[1] Such mischief could only happen through the most gross and culpable carelessness on the part of the vaccinator; and as all medical men now receive special training in vaccination, no risk of this kind need be at all apprehended. Of course vaccination, like everything else, requires a reasonable amount of care in its performance. *The alleged injury arising from vaccination is, indeed, disproved by all medical experience.*"

It was not only maintained that care could prevent all

[1] 21,854.

ill results, but it was asserted on high authority that "a well-formed vaccine vesicle is certain proof of a pure and unmixed vaccine lymph;" that a syphilitic vaccinifer must betray evidence of disease sufficient to forewarn the careful, and it has been stoutly maintained that it was the presence of blood in the lymph that occasioned the danger of transmitting syphilis, and that as all lymph sent out in tubes from Whitehall was microscopically examined so as to exclude the presence of blood-cells, the danger was infinitesimal.[1]

202. We agree with our colleagues that the possibility of vaccine syphilis, formerly denied, has been fully established.[2]

203. In this connection we recall the words of the late Sir Thomas Watson, F.R.S., late President of the Royal College of Physicians. Alluding to the risk we are considering, he said ('Nineteenth Century,' June, 1878), "I can readily sympathise with, and even applaud, a father who, with the presumed dread or misgiving in his mind, is willing to submit to multiplied judicial penalties rather than expose his child to the risk of an infection so ghastly."

204. We agree with Mr. Hutchinson that "it is absurd to assert that inherited syphilis is always to be detected, and it is a cruel injustice to imply that all accidents [of this kind] have been the result of carelessness."[3] Sir J. Simon has published a later view in which he states that "it is certain that the vaccine lymph of the syphilitic infant may possibly contain the syphilitic contagium in full vigour even at moments when the patient, who thus shows himself infective, has not on his own person any outward activity of syphilis."[4]

205. A committee consisting of Dr. Bristowe, Professor Humphry, Mr. Hutchinson, and Dr. Ballard, reporting upon a well-known case, said "it is conclusively proved that it is

[1] Simon's 1857 papers, p. 138; 21,853.
[2] Section 420. [3] 'Archives,' October, 1890; 30,943-4.
[4] Quain's 'Dictionary of Medicine,' p. 182; 30,971.

possible for syphilis to be communicated in vaccination from a vaccine vesicle on a syphilitic person, notwithstanding that the operation be performed with the utmost care to avoid the admixture with blood."[1] And it is recorded that in this case the vesicles from which the lymph was taken were described as "normal in appearance and not inflamed."

206. Dr. Husband, of the Vaccine Institution of Edinburgh, has established the fact that all lymph, however pellucid, does really contain blood-cells.[2] This not only disposes of the theory that lymph may be rendered innocent of harm if blood be excluded, but appears to render somewhat superfluous the labours of the microscopical examiner of lymph at the National Vaccine Establishment at Whitehall.[3] Such microscopical examination of lymph, being directed mainly to the exclusion of that which according to Dr. Husband is omnipresent, and being admittedly insufficient to detect and identify micro-organisms of pathogenic nature, it is not surprising that it affords no guarantee of the purity of lymph.

207. There is ground for believing that other cases have occurred which circumstances have prevented others from making public. Mr. Ward in giving evidence on the Leeds case incidentally referred to other cases.

208. A list of cases of vaccino-syphilis will be found on page 617 of our Sixth Report. Not only is the danger of vaccine syphilis now admitted to be "real and very important," but the safeguards which have been laid so much stress upon are now known to be illusory.[4] It remains to be considered whether the use of calf lymph will, as has been suggested, obviate the occurrence of syphilitic symptoms as the result of vaccination.

[1] Report L. G. B., 1882–3, M. O. H. supplement.
[2] 27,327–9; Sect. 430.
[3] 4059–70; 4140, 4159, 4173, 4199–4200.
[4] 10,215, 23,666, 21,854.

209. This subject is closely connected with what is known as the Leeds case of vaccino-syphilis. In view of the publicity which has been given to, and the importance of the issues involved in, this case, we think that the mode in which it has been dealt with in Section 427 of our colleagues' report can scarcely be regarded as satisfactory.

The child in question was vaccinated in March, 1889, and died at the Leeds Infirmary on July 1st in the same year. An inquest was held, at which Messrs. McGill, Ward, Littlewood, and Dr. Barrs, all members of the Infirmary staff, testified to the fact that the child died from vaccino-syphilis. The verdict of the jury was that the child "died from syphilis acquired at or from vaccination," and a rider was added to the effect that "when a parent requests calf lymph it is the duty of the medical man performing the operation to supply it if obtainable, or to explain to the parents his inability to comply with their request."

On July 17th, 1889, Dr. Ballard, one of the medical inspectors of the Local Government Board, received instructions in the usual way to inquire into the case, and he reported to the Board.

On February 27th, 1890, in reply to a question in the House of Commons, Mr. Ritchie, then President of the Local Government Board, stated that "an inquiry has been made by an inspector of the Board with regard to the case.[1] His conclusions are not the same as those arrived at at the inquest. He states that the child in question was the only sufferer from subsequent syphilis among all the children he reached and whom he saw that had been vaccinated with the same or any other lymph in the whole course of the vaccinator's March vaccinations; and further that the entire family to which the alleged vaccinifer belonged were, as far as he could discover by examination of them, free from any syphilitic taint or suspicion of such taint. The report of the inspector will be at the disposal of the Royal Commission on Vaccination."

The above reply implies, and the report of Dr. Ballard states, that the child died from hereditary syphilis. He alleges that the family of the deceased child was "a syphi-

[1] 23,686.

litic family."[1] He adds, "This conclusion is the direct contrary to that arrived at by the coroner's jury, as also by the surgeons at the Leeds Infirmary. Both the jury and the surgeons formed their opinions on the evidence and statements they received. If both came to an incorrect conclusion, as I hold they did, it was because they had not before them the whole story, as I have discovered and narrated it, and they were consequently misled."

210. Here the matter would probably have terminated as far as official inquiry went had the Commission not been sitting.

It was, however, agreed to ask Dr. Barlow to make an independent inquiry into the history of the case and the health of the family. He has reported to us that there is "no evidence of syphilis" in either parent of the child, and there is "no evidence of inherited or acquired syphilis" in either of the two elder children; and further he adds, "nor does the history of the third [deceased] child suggest to me that it was the subject of inherited syphilis." On June 18th, 1891, the results of Dr. Barlow's inquiry were stated by the President of the Local Government Board in the House of Commons in reply to a question by Mr. Herbert Gladstone.

We have since examined Messrs. Littlewood and Ward and Dr. Barrs, who adhere to the opinion that the child died from syphilis acquired by vaccination, and confirm the opinion of Dr. Barlow that there was no suspicion of syphilis in the parents of the child or their elder children.[2]

Mr. Hutchinson has also in a publication ('Archives of Surgery,' vol. i, No. 2) added the weight of his testimony to the fact that there is no evidence of syphilis in any of the family.

211. What then was the nature of the disease from which the child died? This question involves the larger question of the relationship of cow-pox and syphilis, between which diseases Dr. Creighton suggests that there is a close analogy.

[1] 23,701. [2] 23,701–3; 23,838–47.

212. Our colleagues hold, in accordance with the opinion on the case which Mr. Hutchinson published,[1] that "it may probably be classed with a few others as examples of gangrene and blood poisoning, the direct result of vaccination, which are not to be explained by supposing the introduction of any syphilitic or other poison."

213. It has indeed quite recently been recognised that it is possible for vaccination, even where the matter has been derived from the calf, to give rise to a certain train of symptoms (including snuffles, thrush, eruptions on the genitals, bubo in the armpit, phagedænic sores and nodes), symptoms, which have hitherto been regarded as peculiar to syphilis, and which in some cases have been benefited by mercurial treatment.[2] The real nature of such cases has given rise to much dispute; well-experienced surgeons, who saw these symptoms and examined them carefully, thought they could be none other than those of syphilis. Others of high authority regard them as "vaccinia" in a severe form. Dr. Creighton explains all such cases, as well as those of vaccino-syphilis, as due to cow-pox without contamination by human syphilis. Whatever their real nature, it is impossible to refuse to recognise them as the direct consequences of vaccination. Fuller knowledge is required to explain them, but when the assertion is made that the *transmission* of syphilis by vaccination is exceedingly rare, it must be borne in mind that the fact that vaccination with calf lymph, and therefore independent of venereal contamination, is capable of evoking symptoms indistinguishable by experienced surgeons from those of syphilis, has only recently been brought to the notice of the profession.

Mr. Hutchinson says these cases look to him quite as much like vaccinia as syphilis, and were so closely parallel that were syphilis conclusively proved in any one, he would be prepared to admit it in the others.[3]

The publication of these cases brought to light others of a similar kind,[4] including several cases in the practice of a

[1] Sect. 427. [2] 21,989.
[3] 'Archives of Surgery,' Oct., 1889; 21,989. [4] Ibid., Jan., 1890.

public vaccinator in which the four vesicles merged into one deep ulceration and took months to heal up, and another series in which the lymph had been taken from a child who was vaccinated from calf lymph from the Local Government Board. In this last series there was not the same gangrenous inflammation as in the others, but a persistent formation of scabs. (*See also* Cases 11, 21, 31, 35, 39, 113, 162, 167, 169, 175, 177, 183, 199, 202, 204, 206, 207, 208, 214, 241, 258, 326.[1])

214. In view of the fact alluded to in our colleagues' report that these abnormal results may follow vaccination *with calf lymph*, the following words of Mr. Hutchinson are significant :—"The final supposition is that it is possible for vaccination independently of any syphilis, whether implanted or hereditary, to evoke symptoms which have hitherto been regarded as peculiar to the latter malady, and which are apparently greatly benefited by specific treatment."[2]

215. This view of the affinity and results of cow-pox is that which was foreshadowed in the writings of Auzias-Turenne, and which in this country has been chiefly advocated by Dr. Creighton.[3]

216. The remarkable increase of infantile syphilis, which some statistics show since 1853, has not received an adequate explanation. There is much to be said against setting the increase down to vaccination. We should only have expected vaccination to be to a very slight extent the cause of deaths from syphilis, and likely to be overshadowed by more potent influences, unless indeed there were ground for believing, as has been alleged on high authority, "that a large proportion of the cases of apparently inherited syphilis are in reality vaccinal."[4]

217. As regards leprosy, the evidence is conflicting. It appears to be a general opinion that among the various

[1] Appendix. [2] 'Archives of Surgery,' Jan., 1891; 21,975.
[3] 11,451, 21,973, 5573. [4] 10,205.

means by which the disease is propagated, inoculation is one; and this is held to be rendered more probable by the discovery of a bacillus which many authorities recognise as the cause of leprosy. This bacillus has been found by Arning in vaccine lymph. Several cases are on record, in which the disease seems to have been conveyed to healthy persons by discharges from lepers gaining access to raw surfaces; and there are a certain number of individual cases in which medical men of experience have concluded that vaccination has been the means of such communication.[1] There is no doubt that in the West Indies, and in other leprous countries, a general suspicion exists that native lymph may transmit leprosy; but evidence of wholesale propagation by this means is scanty and inconclusive, the most suggestive instances being those related by Arning in the Sandwich Islands.

218. In addition to inflammatory and septic complications, vaccination not unfrequently gives rise to skin eruptions. These vary immensely in character, and it is only in the most exceptional cases that a vesicular or pustular eruption like that of variola occurs. It has indeed been remarked that "the wonder is not that vaccination should sometimes produce an exanthem, but that it should ever be without one" (Hutchinson, 'Lectures on Clinical Surgery,' I, i, 18).

These secondary skin eruptions evoked by vaccination have by the French pathologists been termed *vaccinides*. They may be roseolous, or papular (lichen or prurigo), or eczematous, or impetiginous in type (Fournier, 'Leçons sur la Syphilis Vaccinale,' pp. 129–33). They may be very transient and trivial, or may become chronic and persistent, and in a few cases have caused death. (*See* Cases 12, 14, 25, 29, 35, 82, 95, 98, 109, 120, 129, 130, 138, 173, 180, 193, 196, 208, 214, 240, in Appendix.)

219. In reference to the possibility of consumption, tubercle, or scrofula being communicated or occasioned by

[1] 9991, 10,109, 18,895, 19,104, 10,094–19,164, 6, 9993, 18,106.

vaccination, it is necessary to bear in mind the prevalent belief that these diseases are due to a specific organism, and the fact that it has been found that tubercular disease can be readily conveyed from infected animals to healthy animals or persons by the medium of infected animal products such as milk. It seems that in a few cases a local development of tubercle in the form of lupus has taken place at the site of vaccination (*see* Case 26, also evidence of Mr. Dakers, VI Report, 21,219–83). In a few other cases the question has arisen whether constitutional infection of tubercle has not been evoked by vaccination. In a larger number of cases strumous symptoms, following upon the disturbance of health occasioned by vaccination, have raised the question of the relationship of the one to the other (*see* Cases No. 128, 52 [?], 89, and 131).

Thus Professor Felix von Niemeyer has expressed the view that—

"The injurious influence which diseases have on the constitution, and thereby on the tendency to consumption, manifests itself most frequently and in the most lasting manner in earliest infancy. It is fortunate if children escape disease, particularly in the first years of their life, during which by far the most rapid development of the body takes place, and when by favourable or unfavourable external circumstances the foundation is laid, in a great measure, for a strong and robust, or a weak and delicate, health. Even vaccination may, by the febrile disturbance preceding the eruption, as well as by that accompanying the suppuration, both of which are never absent, and, according to my numerous thermometrical observations, sometimes reach a very high degree, considerably weaken, more especially those children who are not very strong, and may leave behind it the germs of a disposition to consumption."[1]

The experiments of M. Toussaint indicate the possibility of inoculating tubercle upon animals by vaccination.[2] A paper by M. Dumontpallier on a series of casualties from vaccination in Paris in the 'Rapport sur les vaccinations

[1] 22,648–50. [2] 22,714.

pratiquées en France,' 1875, tends to suggest a similar possibility in the human subject. While cases of this kind would appear to be rare, we have little doubt the explanation quoted from Dr. Niemeyer would hold good in a larger number of cases.

220. It will have been observed that the diseases which have been alleged to have been conveyed by vaccination are those which modern pathology has shown to be inoculable, and we are bound to conclude that it is possible in the act of vaccination to convey any disease whose cause can reside in the inflammatory lymph of a vaccine vesicle.

Reference II.—Means other than Vaccination for diminishing the prevalence of Smallpox.

221. We are quite unable to agree with those who have maintained that sanitary measures have little or no influence upon smallpox.[1] We have already given our reasons for thinking that the teaching of the early sanitarians, like Howard and Haygarth towards the close of last century, initiated a new line of thought in the prevention of disease, and we believe the general improvement of the public health which then set in was due, in a large measure, to a greater sanitary activity, and that the falling off in the death-rates of fevers and smallpox, as well as in the general death-rate, is confirmatory of this view.

222. In speaking of sanitation we use the word in its widest sense; we are not speaking merely of drainage improvements, but we include the prevention of overcrowding on areas, or within houses and rooms, the proper construction of dwellings, so as to permit thorough ventilation; the promotion of cleanliness by adequate water-supply, and the prompt removal of filth accumulations. Related to these measures, but in a somewhat different category, are means directed against contagion, the speedy separation (in

[1] 770; 930.

suitable hospitals) of the infected from the healthy, the disinfection of persons and things, and the prevention of the propagation of the disease by inadvertent carelessness or by intentional inoculation.

223. If the view that attributes smallpox exclusively to contagion be well founded, it might indeed be possible to keep out the disease even from insanitary places by rigid isolation ; but experience shows that some, even of the contagious diseases, are dependent for their extension and severity upon influences other than contagion. The Royal Commission on Infectious Hospitals, in 1882, in their report called attention to the fact that the opportunity for contagion which the presence of a smallpox hospital might afford to a particular neighbourhood, is insignificant as compared with other deleterious influences from which London suffers.[1] The returns and maps showed "that a healthy neighbourhood in which a hospital has been planted, though to a certain extent injured, may yet be favourably compared as regards prevalence of smallpox with those localities in which from over-population and neglect of sanitary precautions the predisposing causes of disease are more deeply seated."

224. We agree with the epidemiologist Hirsch that "smallpox, as well as typhus, takes up its abode most readily in those places where the noxious influences due to neglected hygiene make themselves most felt." ('Hist. and Geo. Path.,' vol. i, p. 481.)

225. We find our own great sanitarian, Edwin Chadwick, in formulating his conclusions on the prevention of epidemics, while urging the separation of the unaffected from the affected when an outbreak occurs, yet maintained "that cases of smallpox, of typhus, and of others of the ordinary epidemics, occur in the greatest proportion, on common conditions of foul air from stagnant putrefaction, from bad house-drainage, from sewers of deposit, from excrement-sodden sites, from filthy street surfaces, from impure water,

[1] Report of R. C. in S. P. and Fever Hosps., p. xxiii.

and from overcrowding in private houses and in public institutions."

"That the entire removal of such conditions by complete sanitation and by improved dwellings is the effectual preventive of diseases of those species, and of ordinary as well as of extraordinary visitations."

226. There is evidence to show that in countries where, at the present time, sanitation has not made much advance, or where overcrowding, filth accumulation, non-isolation of the infected, and, in some cases, the continued practice of inoculation prevail, smallpox is still rife, in fact endemic, and its persistence is attributed to these causes, and that where these causes exist vaccination entirely fails to neutralise them.

227. Thus in the official sanitary reports from India, published annually, we find frequent references to the influence of such causes upon the prevalence and mortality from smallpox :—

In the Report on Sanitary Measures in India, in 1879–80, p. 142, it is stated : "The vaccination returns throughout India show the same fact, that the number of vaccinations does not necessarily bear a ratio to the smallpox deaths. Smallpox in India is related to season and also to epidemic prevalence ; it is not a disease, therefore, that can be controlled by vaccination in the sense that vaccination is a specific against it. As an endemic and epidemic disease it must be dealt with by sanitary measures, and if these are neglected smallpox is certain to increase during epidemic times."

Again, in the Report of the Army Commission of the Punjab for 1879, p. 186, it is stated : "Vaccination in the Punjab, as elsewhere in India, has no power apparently over the course of an epidemic. It may modify it and diminish the number of fatal cases, but the whole Indian experience points in one direction, and this is that the severity of a smallpox epidemic is more closely connected with sanitary defects, which intensify the activity of other epidemic diseases, than is usually imagined, and that to the

general sanitary improvement of towns and villages must we look for the mitigation of smallpox as of cholera and fever."

It is stated again in the Report for the Central Provinces, p. 206: "The past comparative immunity of the population had been attributed to efficient vaccination, and the people had accepted this protection, but their confidence has been shaken by the reappearance of a severe form of this disease. The sanitary commissioner states that he directed a special report on the subject to be made with the following result:— 'During the early part of the year there had been a good deal of chicken pock in Sambulpur town; that when smallpox broke out later on it attacked those who had been inoculated, vaccinated, and had previously had smallpox or chicken pock; 301 persons who had been inoculated took the disease; that 577 vaccinated persons were attacked, and 729 unprotected persons, or 1607 in all.'"

Again in the Report for 1884–5, p. 203, referring to the sanitary measures of the North-West Provinces and Oudh, it is noted: "The facts already stated show conclusively that the smallpox of 1884 was one of the most severe epidemics on record, and by far the most severe in these provinces since deaths were registered. We are thus brought face to face with the fact that notwithstanding the existence of an active vaccination service, smallpox swept over the provinces just as if there had been none. No doubt attacks and deaths had been prevented by the service, but it is clear that it has been incompetent to deal with the disease in its epidemic form."

Again, it is stated that, "as a matter of fact, the total vaccinations at all ages performed by this staff amounted to less than three times the number of deaths, and the operations under one year of age were not one and a half times the total deaths. These remarks are not intended to call into question the utility of vaccination. But in presence of the facts the question is a perfectly relevant one, namely, whether dependence can henceforth be placed on vaccination as a protection against a smallpox epidemic? The question of course answers itself. In ordinary years lives are no doubt saved, and lower smallpox death-rates may be co-

existent with numerous operations. But this and similar experience appears to show that the remedies, if such be available, will have to be extended beyond vaccination, and will have to deal with epidemic causes affecting localities and their inhabitants. If sanitary work be neglected no more dependence against smallpox epidemics can be placed on vaccination than can be placed on quarantine against invasions of cholera. The true remedies lie elsewhere altogether."

Inoculation is still practised in India, in many places, and in association with religious observances, in honour of Sitla, the goddess of smallpox. In Persia, inoculation is still to a large extent the custom; smallpox is endemic, and the majority of children suffer from the disease at an early age.

228. In Nubia and the Soudan inoculation is still practised, the disease being regarded as a necessity, and the mortality is stated to be high, especially among the blacks.

In Algeria smallpox is said to be endemic; the Arabs still practise inoculation, the most elementary precautions against contagion are neglected, and the treatment of the disease is like that in vogue here before the time of Sydenham.[1]

229. There can be little doubt that social position and sanitary environment have a potent influence on the prevalence as well as on the fatality of smallpox.

Dr. Farr, before the days of compulsory vaccination, pointed out the effect on causes of mortality of the selection exercised by insurance companies. Death from the eruptive fevers among such selected lives was rare; among 4095 deaths in the Equitable Society, during the years 1801–32, only one was from smallpox.

In the Norwich epidemic of 1819, Crosse noted that the epidemic was almost exclusively confined to the very lowest orders of the people.

The late Earl of Shaftesbury, in the debate on the Compulsory Vaccination Bill of 1853, observed that "it was perfectly correct that the smallpox was chiefly confined to the lowest class of the population, and he believed that with

[1] 8128; vol. vi, App., p. 756; p. 747.

improved lodging-houses the disease might be all but exterminated."

230. In 1875, Dr. Farr constructed life tables based upon the vital statistics of (1) all England, (2) Liverpool, and (3) healthy districts, in order to ascertain what effect healthy environment had upon zymotic diseases. His figures showed that—

For every Million born alive there would die, according to the Life Tables[1] —

—	In healthy districts.	In England.	In Liverpool.
By smallpox . . .	2,359	6,521	8,141
By fevers . . .	28,146	38,107	76,563
By measles . . .	6,912	12,865	26,973
By whooping-cough .	10,234	15,161	34,021
By scarlatina . .	21,403	30,021	38,302

Dr. Farr, commenting on these remarkable figures, states his opinion "that healthy sanitary condition as to food, drink, and cleanliness of person, house, and city, stands first in importance; after it, but subordinately, come quarantine, vaccination, and other preventives, as means of subduing mortality; for the mere exclusion of one out of many diseases appears to be taken advantage of by those other diseases, just as the extirpation of one weed makes way for other kinds of weeds in a foul garden."

231. That the difference observed between the figures for Liverpool and the healthy districts is not merely due to the denser population of the former affording greater opportunity for infection is, we think, shown by the fact that in industrial dwellings, where there is a considerable aggregation of persons upon area, but under superior sanitary supervision, there has been a marked immunity from smallpox. Dr. Southwood Smith long ago called attention to this fact

[1] Supplement to 35th Annual Report of Registrar-General.

('Results of Sanitary Improvements,' p. 17), and we learn from the Secretary of the Improved Industrial Dwellings Company that in 1880–82 there were but two deaths from smallpox among more than 15,000 tenants, while there were 3268 smallpox deaths in those years in London with a population of 3,800,000.

232. At Warrington in 1892–3 Dr. Savill notes[1] that a relation existed between smallpox rate and house rate. All but 11 of the 455 infected houses were rated at less than 16*l*. per annum, and 406 of them at 8*l*. and under; with the exception of these eleven, the smallpox was absolutely confined to the lower, or artisan, or working classes, whose gregarious habits pre-eminently favour the spread of the disease from person to person.

233. At Dewsbury we learn from Dr. Coupland's report[2] that the sanitary condition of the union was anything but satisfactory. In 1878 a disproportionately high mortality from fever had occasioned a special investigation. It was found that the mean death-rate from this cause had been 8·3 per 10,000 in Dewsbury, against 4·1 in London and 5·4 in the large towns of England. Although some improvement has taken place since that time there is much still to be done, especially in the matter of excrement disposal and house construction. The back-to-back system of dwellings is still the rule, especially in Batley. With but few exceptions the incidence of the disease fell upon members of the working-class community. Associated with the staple industry of weaving is a very extensive rag trade; the rags come from all parts of the world, and consist of cast-off wearing apparel in all degrees of filthiness.

Dr. Coupland observes that in the higher part of Batley, which is mostly residential, but few cases of smallpox occurred. Of the 266 houses in Batley that were invaded, and of which particulars were obtained, 171 had no through ventilation, 122 of these were back-to-back, and 7 were cellar dwellings. In Dewsbury more than 70 per cent. of the invaded houses had no through ventilation. At both

[1] Warrington Rep., p. 87. [2] Dewsbury Rep., p. 10.

places the proportion of cases of smallpox was larger in the houses where there was no through ventilation.

234. In reference to the question of the relation of sanitary measures to smallpox our attention was specially directed to an outbreak of the disease on board the steamship "Preussen" in 1886. It was suggested that in such a case the influence of vaccination could be measured without the disturbing influence that sanitary circumstances are alleged to exert. The case appears to have attracted considerable attention, and was quoted by the President of the Local Government Board, in the House of Commons debate of July 22nd, 1887, as strikingly showing the efficiency of vaccination (Hansard 22, vii, 1887, p. 1799).

It was stated in evidence[1] "that the Local Government Board in 1886 took some pains to get the figures as to the steamship 'Preussen,' bound for Australia, on board of which smallpox broke out. You have, of course, on a vessel, people living under the same sanitary circumstances, eating very much the same food, and in all respects practically alike, with the one solitary exception of vaccination. There were 312 persons on board this vessel. Of persons both vaccinated and re-vaccinated there were 55; four of those were attacked by smallpox, none died. Of persons vaccinated but not re-vaccinated there were 209, 45 of whom were attacked by smallpox, and three died; 13 persons had previously had smallpox, of whom three were attacked by smallpox, and none died. Of persons stated to be vaccinated but showing no scars there were 16, two of whom were attacked by smallpox, and none died. Lastly, there were 19 persons unvaccinated; 15 of these were attacked by smallpox, and nine died. This evidence is in expansion of that I gave, showing that sanitary circumstances have little or no control over smallpox when compared with the condition of vaccination or no vaccination."

235. Having examined Dr. MacLaurin, of Sydney, who had personal knowledge of the case, and the official reports from Melbourne and Sydney, we find—

[1] 994.

1. That the vessel was greatly overcrowded, carrying in all 723 passengers; the overcrowding led to a most insanitary state of things on board, and the vessel when inspected at Sydney was pronounced to be the filthiest ship the authorities there had ever had to do with.[1]

2. In addition to the cases of smallpox referred to in reply to Question 994 there were 29 cases among some 235 passengers who were disembarked at Melbourne. Of these cases 21 were vaccinated (nine with one mark, four with two marks, eight with three marks), of whom one died; seven were "doubtful" or "not stated" as to vaccination, of whom two died; one was unvaccinated and recovered.

3. There were also, in addition, the crew, numbering 120, who had been vaccinated and re-vaccinated; of these fourteen were attacked and one died.[2]

The official report from Melbourne states "it is impossible to doubt that the ordinary rules for the preservation of health and enforcement of decency were neglected, and we fear the most obvious precautions against the spread of smallpox were omitted." Dr. MacLaurin, in his official report to the Sydney Board of Health, says, "Had the authorities at Albany, immediately on the ship's arrival, removed the smallpox patient to the shore, and suitably disinfected the ship, it is reasonable to conclude that the terrible amount of suffering and danger which has since ensued might have been almost, if not altogether, averted."

The facts do not appear to us to indicate that means other than vaccination have not a very potent influence over the spread of smallpox; and in this particular case it would seem that while smallpox paid little respect to vaccination or re-vaccination, sanitation was conspicuous by its absence.

236. We believe that the growth of knowledge in regard to the mode of propagation and control of contagious diseases both amongst animals and men, which has signalised the last hundred years, has a most important bearing upon the history and mode of dealing with smallpox.

237. In the earlier years of this century attention was

[1] 5945–6; 5952. [2] 5959–69; 5971–5.

repeatedly drawn to the great danger of spreading smallpox by carelessness in regard to contagion, and especially to the practice of inoculating out-patients at the smallpox hospital, and then allowing them to wander about in all stages of the disease. Mr. S. Bourne, M.P., in the House of Commons said, "If we were to prescribe a mode of spreading the contagion of smallpox, it would be difficult for human ingenuity to devise anything better adapted for the purpose than to inoculate out-patients at the smallpox hospital to the amount of 2000 in a year, and for these out-patients to resort there twice a week to be inspected." The objectionable practice of inoculating out-patients was at last given up at the hospital in 1808.

In 1813 Lord Boringdon introduced into the House of Lords a Bill "for more effectually regulating the spread of infection from the smallpox." He read documents from which it appeared that "owing to the constant open exposure of those who were inoculated with the smallpox in all stages of the disorder, great numbers were infected." Lord Ellenborough, in the debate which followed, pointed out that such exposure might be dealt with by indictment under the common law.

In 1815 the National Vaccine Establishment prosecuted in the King's Bench for the exposure of a smallpox patient after inoculation, whereby eleven persons were infected. The Court, in view of this being the first indictment of the kind, sentenced the offender to only three months' imprisonment.[1]

238. The writings of Rast, Haygarth, Faust, and others, published before the advent of vaccination, showed the enormous change which was taking place in the minds of medical men in regard to the part played by contagion, and therefore also in regard to the amenability of epidemics to human interference (see Sections 456—458 in the report of our colleagues).

239. Some of these writers, like Rast of Lyons, denounced the practice of inoculation as not only fundamentally wrong

[1] Moore, 'History of Smallpox,' pp. 305-6.

in principle, in that it tended to keep alive the contagion, but also as a failure in practice, in that it had actually increased the share of the total mortality borne by smallpox. He proposed in 1763 a system of isolation in extra-urban hospitals very like that which we have seen adopted in our own day. Haygarth's writings did much in this country and abroad to familiarise the public and the profession with the possibilities of hospital isolation as a preventive as well as a therapeutic agency, alike in the case of fevers and smallpox.

240. Thus we find in the 'Medical and Chirurgical Review' for the year 1796 (the year in which Jenner performed his first vaccination) a criticism of a work by Faust, of Leipzig,[1] entitled "'An Essay on the Duty of Man to separate persons infected with Smallpox from those in Health, hereby to effect the Extirpation of that Disease equally from the Towns and Countries of Europe,' in which it is stated . . . Thus it is proved that the smallpox is not a necessary or unavoidable evil of mankind; it can be annihilated, and ought to be: it is a sacred duty to deliver from its ravages the present and future generations, and we commit a heinous crime in not using the means in our power to put an end to so dreadful an evil. The question is by what means can this be effected? The whole mystery is explained in a single maxim. The first person ill in a place is the only source from which all the rest, perhaps hundreds and thousands, become affected; let him be put immediately into a situation where he cannot injure by contact those who have not had the disorder. It is the duty of the individual and of the community; it is a duty owed to society and to the human race. We observe this duty when a maniac becomes dangerous to society, and shall we omit it here, where the danger is infinitely greater, and perhaps causes the deaths of thousands? And in the former the separation lasts for years, and perhaps during life, whilst in the latter it is only necessary for a fortnight or three weeks; for the infectious period lasts only from the time of eruption to the complete falling off of the pustules. The principal

[1] 11,015.

means which M. Faust, therefore, points out for the execution of this great plan are:—1. That people of all conditions should first be instructed by sensible writings that the smallpox is not necessary nor unavoidable, that its existence depends on our will, and that it is our duty to annihilate it. 2. A description of the disease, with good ideas thereof, should be circulated in all villages, in order that it may be immediately recognised. 3. Near each great town a moderately large house should be erected for the smallpox, and an inspector appointed. 4. All the inhabitants of towns and villages should contribute to its support. 5. As soon as any person is attacked with the disease he should be immediately removed to a house of this description. . . . If these rules are duly followed, continues M. Faust, it may with certainty be depended on that in five or six years the smallpox will no longer be found to exist in the civilised part of Europe, just as the plague itself is extirpated."

241. Even after vaccination had been publicly announced, we find in the same leading Medical Review,[1] in 1799, an article on establishments for the extirpation of the smallpox, in which mention is made of "the ravages of smallpox since its first appearance in Europe;" and it is stated that "since the year 1721 its mortality in Germany has been endeavoured to be lessened by the practice of inoculation. But the lists of mortality show that this desirable end is far from having been fully attained. Plans for total extirpation of the smallpox, therefore, have been suggested by philosophers of various countries, and the probability of being able to effect it is amply shown. To do this, however, the exertions of the physician are incompetent, unless they be aided by the powerful hand of Governments, but this has hitherto been withheld. *The grand means, however, of extirpating this destructive malady is an early and strict separation of the infected from those that are sound.* In the year 1796 the Prussian College of Physicians made a favourable report to the King on this project, when it was resolved to establish a house for the purpose in the city of Halberstadt. It is to be hoped that

other countries will at length open their eyes to their true interest, and adopt a plan which cannot fail materially to affect the population of Europe. It will not be necessary then to attempt to disarm one disease of its powers by the introduction of another, the consequences of which cannot be fully known for a series of years to come."

242. Since vaccination was asserted to give the same protection as inoculation without spreading contagion, a point on which much stress was laid in the report of the House of Commons Committee on Jenner's petition. its acceptance in lieu of the old practice appeared to offer a simpler and surer method of exterminating smallpox than the isolation methods which were being advocated; and these for a long time remained in abeyance, while vaccination became the State-adopted method of dealing with smallpox.

243. In 1868 attention was again recalled to the value of isolation in dealing with smallpox by Sir James Simpson in a paper entitled a "Proposal to stamp out smallpox and other contagious diseases," in which the success which had attended the stamping-out system in dealing with certain animal pests was cited as an illustration of what might be accomplished by an analogous system applied to the infectious diseases of mankind.[1]

The paper, which will be found at page 40 of the fourth volume of our reports, is worthy of careful perusal. Sir J. Simpson's contention in brief was :—"For all that appears necessary for the purpose is simply the methodic temporary seclusion, segregation, or quarantine of those affected with smallpox, until they have completely passed through the disease, and lost the power of infecting and injuring others. The poleaxe was the chief and leading measure required to stamp out rinderpest. *Isolation is the chief and leading measure required to stamp out smallpox.*" And he proceeded to show that by the Public Health Scotland Act of 1867, and less satisfactorily by the Sanitary Act of 1866 for England, the Legislature had for the first time made such action possible to local authorities.

[1] 10,984.

244. It has been largely in consequence of the experience derived from the great epidemic of 1870–72, in which the failure of the compulsory infantile vaccination system became so apparent, that attention has again of late years been directed to the necessity of providing proper hospitals for isolation, and to the enormous influence of such isolation in limiting outbreaks of the disease. Dr. Seaton, the Medical Officer of Health for Surrey, in alluding to the experience of 1870–72 ('Brit. Med. Journ.,' Feb. 29th, 1896, p. 521), says: "The way in which the disease was seen to spread by the sometimes unavoidable and sometimes careless exposure of infected persons and things at public-houses, laundries, provision shops, &c., as well as in the workhouses and common lodging-houses, forced attention to the question of isolation. This had hitherto been kept in the background by the habit of relying wholly on vaccination as the great preventive measure against smallpox. Under the influence of panic smallpox hospitals so called were erected, but this did not take place anywhere until the disease had got firm hold of the population, and consequently they were little or no use in preventing epidemic diffusion."

245. It is instructive to compare the behaviour of smallpox, typhus, and scarlatina in London during the years of registration for which the figures are available for each of these diseases. The following table[1] enables us to trace the influence which sanitary reforms and hospital isolation have had upon each of these zymotic diseases:

Years.	Estimated population in the middle of each year.	Annual death-rate per million.		
		Smallpox.	Typhus.	Scarlatina.
1838	1,766,169	2161	—	—
1839	1,802,751	352	—	—
1840	1,840,091	671	—	—
1841	1,878,205	561	—	—
1842	1,917,108	188	—	—
1843	1,954,041	224	—	—
1844	2,033,816	887	—	—

[1] M. A. B., Report for 1895, and Reg.-Gen. Report for 1894.

Years.	Estimated population in the middle of each year.	Annual death-rate per million.		
		Smallpox.	Typhus.	Scarlatina.
1845	2,073,298	438	—	—
1846	2,113,535	122	—	—
1847	2,202,673	434	—	—
1848	2,244,837	722	—	—
1849	2,287,302	228	—	—
1850	2,330,054	214	—	—
1851	2,373,081	448	—	—
1852	2,416,367	480	—	—
1853	2,459,899	86	—	—
1854	2,503,662	277	—	—
1855	2,547,639	408	—	—
1856	2,591,815	205	—	—
1857	2,636,174	59	—	—
1858	2,680,700	90	—	—
1859	2,725,374	425	—	1277
1860	2,770,181	324	—	726
1861	2,815,101	77	—	846
1862	2,860,117	128	—	1221
1863	2,905,210	687	—	1706
1864	2,950,361	185	—	1097
1865	2,995,551	214	—	727
1866	3,040,761	457	—	622
1867	3,085,971	436	—	470
1868	3,131,160	191	—	929
1869	3,176,308	87	225	1839
1870	3,221,394	302	147	1875
1871 [1]	3,267,251	2421	118	582
1872	3,319,736	537	52	276
1873	3,373,065	33	82	191
1874	3,427,250	16	91	773
1875	3,482,306	12	37	1056
1876	3,538,246	207	45	651
1877	3,595,085	709	44	439
1878	3,652,837	387	41	495
1879	3,711,517	120	19	717
1880	3,771,139	124	20	820
1881	3,824,964	617	24	553
1882	3,862,876	110	14	519
1883	3,901,164	34	14	514
1884	3,939,832	307	8	362
1885 [2]	3,978,883	347	7	181
1886	4,018,321	5	3	172
1887	4,058,150	2	5	356
1888	4,098,374	2	2	295
1889	4,138,996	—	4	190

[1] Opening of Metropolitan Asylums Board Hospitals.

[2] Smallpox cases isolated out of London.

Years.	Estimated population in the middle of each year.	Annual death-rate per million.		
		Smallpox.	Typhus.	Scarlatina.
1890	4,180,021	1	2	206
1891	4,221,452	2	3	142
1892	4,263,294	10	3	273
1893	4,306,411	48	1	369
1894	4,349,166	22	1	222
1895	4,392,346	13	—	—

These figures confirm the conclusion to which the other evidence points, that while sanitary reforms have been followed by a reduction of the mortality from smallpox and fever, the recent development of proper hospital isolation has been most strikingly effectual in reducing almost to insignificance the mortality from those diseases in the case of which it has been most largely resorted to.

246. Prior to 1867 organised removal and isolation of infectious disease in London did not exist.[1] The Metropolitan Asylums Board was then formed, but the epidemic of 1870 had begun before any approach to adequate accommodation had been provided. At first admission to hospital was dependent on the order of a relieving officer, accompanied by a certificate of a district medical officer; but these restrictions have been removed, and the Metropolitan Asylums Board's hospitals are now free to *any person* reasonably suspected to be suffering from smallpox, fever, or diphtheria.

The effect of these increased facilities for treatment of smallpox in isolation hospitals has been that while in 1871–2 only 31 per cent. of the smallpox deaths occurred in hospitals, in 1893 87 per cent. took place therein.

247. On November 16th, 1881, a Royal Commission, of which two of our colleagues were members, was appointed to inquire into the nature, extent, sufficiency, advantages, and disadvantages, &c., of the Metropolitan Asylums Board's hospitals for smallpox and fever, and generally as to the

[1] 29,166–75.

operation of the Acts providing for the establishment thereof. In their report the Commissioners contrast the case of London with that of the provinces in regard to smallpox mortality; they say,—

"We find that from 1871 to 1880 inclusive, the amount of disease in London relatively to the population, though less than that in several other great towns, has always been greater than that in England generally, and its rate of diminution has been slower. In London, however, as in the country, till about the year 1860, that diminution was always going on. Then a change took place. While the general provincial mortality continued to decrease, the quinquennial average mortality of London will be seen by the table to have risen from its minimum of 195 per million in 1861, to 396 in 1867, and to have continued at a somewhat lower but still comparatively high rate till the statistics of metropolitan smallpox were disorganised by the exceptional visitation of 1871, and the reaction, amounting to virtual immunity, of the years 1873, 1874, and 1875. During the six following years, 1876–81, the London rate of mortality has gradually risen, on the quinquennial average, to 393. Comparing this average with that of 1861, we seem for the last twenty-one years to have been grappling with an evil influence which is fitfully but sensibly gaining ground upon us, . . . and which Dr. Munk, the experienced physician of the Smallpox Hospital at Highgate, believes to be increasing in the severe character of its attacks."

They made certain practical recommendations, several of which have been carried out; such as compulsory notification, disconnection from the poor law, removal of smallpox patients out of London, and the disuse of the intra-metropolitan hospitals for smallpox. The Commissioners were led to hope "that the immediate and complete isolation which ought to be secured by these means will greatly diminish the amount of smallpox, scarlet fever, and typhus in London."

They calculated that if their suggestions in regard to notification, &c., were acted on and produced the desired effect, three-fourths of the smallpox cases would find their way to hospital, and three-fourths of the deaths occur there,

and thus both the average and maximum number of cases and the mortality from smallpox would be greatly diminished. This calculation has been more than realised; more than 80 per cent. of smallpox deaths in London now occur in hospitals.

They, however, state that, having regard to the 43 years of registration statistics, "if we assume for the moment that the past is our best measure of the future, it would seem that we have to expect once in about 30 years an absolute mortality varying from 8000 to 10,000 deaths, and, apart from these extraordinary outbursts, that the sickness of the remaining 41 years will be indicated by a mortality ranging—

In 3 years from 2800 to 3600.
„ 17 „ 1000 „ 2800.
„ 13 „ 400 „ 1000.
„ 8 years being under 400.

41 years."

And that an accommodation for 2700 smallpox patients would accordingly be a more than safe estimate.

248. The actual deaths from smallpox in London in the years which have elapsed since the Commission of 1881 reported have been as follows:

1882	430
1883	136
1884	1236
1885	1419
1886	24
1887	9
1888	9
1889	0
1890	4
1891	8
1892	41
1893	206
1894	89
1895	55

It is in the highest degree satisfactory to find that the forecast based upon the experience from 1838 to 1881 has

not been verified by that of the subsequent years. London has not for two centuries been so free from smallpox as during the last ten years. In 1889 not a single death from that disease was registered in London; in 1887, 1888, 1890, and 1891 there were less than 10 per annum, and in not one of the last 10 years has the 400 minimum limit, which the Commissioners anticipated would be exceeded in 33 years out of 41, been surpassed. London, instead of comparing unfavourably with provincial towns in regard to smallpox mortality, has come to show better results.

249. To what cause is this remarkable decline of smallpox in London attributable? The excess of London smallpox in the past has been attributed to the relatively large proportion of the births that are unaccounted for as regards vaccination. Has the proportion become less of late? On the contrary, the returns to the Local Government Board show that the proportion of births not finally accounted for as regards vaccination in London has steadily increased from 4·3 per cent. in 1881 to 18·4 per cent. in 1892. We agree with our colleagues in thinking it impossible to attribute the decline to vaccination.[1] In 1885 the Metropolitan Asylums Board began to convey smallpox patients by steamer to the floating hospitals on the Thames at Long Reach. In 1889 notification became compulsory in London, and nearly all the reported cases of smallpox have been promptly isolated in such a manner as not to occasion infection from hospitals in crowded neighbourhoods. The comparative immunity that London has enjoyed of recent years is no doubt due to this policy which has been so vigilantly carried out by the managers of the Asylums Board.[2]

250. There are 400 beds in constant readiness at the ships, and additional accommodation is available at short notice at Gore Farm.[3] On receiving telephonic or other communication at headquarters an ambulance proceeds with a nurse to where the patient is,[4] and on receiving the certificate that the case is one of smallpox, and without any compulsion, the

[1] Sect. 472 of Report.
[2] 72,915; 1009–13
[4] 29,299.

patient is conveyed to the wharf where the ambulance steamboat is in readiness. Here the patient is seen by a medical officer of the Board, to confirm the diagnosis or otherwise. There are three ambulance steamers comfortably fitted up so as to carry 100 acute cases at a time.[1]

251. It is a matter of experience that it is easier to secure notification and isolation in the case of smallpox than in the case of any other infectious disease. The promptness and ease with which an outbreak of smallpox in Marylebone was dealt with successfully by the Board in 1894 afforded a striking illustration.[2]

252. The Asylums Board has no jurisdiction in regard to disinfection or vaccination,[3] nor is there in London any machinery for quarantining the inmates of infected households. Investigations which have been made in London and elsewhere have emphasised the local and personal infectiveness of smallpox, and the pedigrees of localised outbreaks have been definitely traced to single importations.

253. Attention has been of late drawn to the part played by tramps in the spread of smallpox. Mr. Scovell, of the Metropolitan Asylums Board, pointed out[4] the need for greater supervision of "shelters," and for the enforcement of greater cleanliness on the part of the vagrant population who use them. "Smallpox," he says, "is usually found to be rife among the lower and more uncleanly portion of the population." Dr. Birdwood,[5] who speaks from the experience of some 12,000 cases of smallpox, believes that attention to cleanliness and frequent ablutions prevent the spread of smallpox and diminish the amount of eruption; he cites the successful precautions taken against the infection of visitors to the smallpox ships, and the occurrence of discrete smallpox in babies, who are frequently washed, as evidence of the truth of his views.

[1] 29,174. [2] 658, 798, 29,224–5. [3] 29,301.
[4] 29,232; 29,274. [5] 31,376.

254. In the last report of the Metropolitan Asylums Board[1] we read, in reference to the recrudescence of cases of smallpox in June, 1895, that "the causes which produced this sudden spread of the disease were not far to seek. Of the 35 patients admitted during June, only six possessed a fixed home. Of the remaining 29, three were infected in a London infirmary where smallpox had been introduced by some undiscovered means in May, and seven were infected in another infirmary by the agency of a vagrant who developed smallpox shortly after his admission there. The remaining 19 were vagrants who possessed no lodging or no fixed lodging, or other persons of the lowest class of society, all of them sleeping, when they slept under a roof at all, in common lodging-houses, Salvation Army shelters, or the like."

255. The experience of Glasgow shows in a striking fashion how influential are hospital isolation and sanitary reform upon the prevalence and mortality of typhus and smallpox, and how relatively slight is the effect of these agencies at present upon whooping-cough and measles.

During the last half-century probably no large town has witnessed so great a change in its sanitary condition as Glasgow.

So late as 1842 the condition of its population was reported by Mr. Chadwick to the Poor Law Commissioners to be the worst of any he had seen in any part of Great Britain. Sanitation in the modern sense of the term scarcely existed. Typhus and smallpox epidemics devastated the city. In 1794 the Royal Infirmary was opened, and fever and smallpox were received into its wards, more from philanthropic motives than from any preventive intention. In 1862 the first municipal fever hospital was opened, and in 1876 the hospital treatment of infectious diseases passed wholly into the hands of the municipal authority, while hospital accommodation was made available for all classes in 1881. Meanwhile a City Improvement Act, and in 1867 the Scotch Public Health Act had been passed, and in 1870 the first sanitary inspector was appointed.

[1] M. A. B. Report for 1895, p. 152.

Since then extensive improvement schemes have been carried out, and municipal lodging-houses and a municipal washing and disinfecting establishment erected.

The vital statistics bear testimony to the effect of these reforms.

Deaths per 1000 *from—*

—	All causes.	Zymotics.
1855–64	30·0	7·8
1865–74	30·5	7·3
1875–84	26·8	5·0
1885–94	23·1	3·8

256. No diseases have shown so remarkable a decline during the period under review as typhus and smallpox have done. Their parallelism is best seen in the two accompanying tables, taken from a report of Dr. Russell, the able Medical Officer of Health for Glasgow.[1]

Glasgow—Deaths and Death-rates per Million from Typhus for 40 *years* (1855–94), *showing Number and Percentage which took place in Hospital for* 30 *years* (1865–94).

Year.	Deaths.		Death-rate per million.	Percentage of total deaths in hospital.[2]
	Total.	In hospital.		
1855	460	—	1291	—
1856	439	—	1211	—
1857	549	—	1487	—
1858	504	—	1340	—
1859	381	—	995	—
1860	408	—	1047	—
1861	475	—	1194	—
1862	533	—	1313	—
1863	671	—	1621	—
1864	1138	—	2705	—
1865	1177	612	2749	52·0

[1] 'Evolution of Public Health Administration,' Glasgow, 1895.

[2] The above percentages are as given by Dr. Russell. On the basis of the figures given in the second and third columns the percentage for the year 1886 is 83·3.

Year.	Deaths.		Death-rate per million.	Percentage of total deaths in hospital.[1]
	Total.	In hospital.		
1866	596	273	1361	45·8
1867	497	219	1112	44·1
1868	367	184	806	50·1
1869	970	507	2089	52·3
1870	544	282	1154	51·8
1871	284	117	577	41·2
1872	182	90	368	49·5
1873	68	35	136	51·5
1874	113	59	227	52·2
1875	96	51	192	53·1
1876	92	61	183	66·3
1877	70	52	139	74·3
1878	39	33	77	84·6
1879	55	45	108	81·8
1880	39	28	77	71·8
1881	48	37	94	77·1
1882	31	26	60	83·9
1883	50	36	96	72·0
1884	26	22	49	84·6
1885	15	11	28	73·3
1886	24	20	44	83·6[1]
1887	20	17	37	85·0
1888	22	17	40	77·3
1889	16	12	29	75·0
1890	14	12	25	85·7
1891	27	27	47	100·0
1892	10	9	15	90·0
1893	10	9	15	90·0
1894	9	9	13	100·0

[1] The above percentages are as given by Dr. Russell. On the basis of the figures given in the second and third columns the percentage for the year 1886 is 83·3.

Glasgow—Deaths and Death-rates per Million from Smallpox for 40 years (1855–94), showing Number and Percentage which took place in Hospital for 30 years (1865–94).

Year.	Deaths.		Death-rate per million.	Percentage of total deaths in hospital.[1]
	Total.	In hospital.		
1855	203	—	570	—
1856	127	—	350	—
1857	399	—	1080	—
1858	113	—	300	—
1859	201	—	525	—
1860	347	—	890	—
1861	131	—	329	—
1862	27	—	67	—
1863	349	—	843	—
1864	300	—	713	—
1865	26	3	60	11·5
1866	104	17	237	16·3
1867	32	5	72	15·6
1868	3	—	7	—
1869	2	—	4	—
1870	25	4	53	22·2[1]
1871	184	89	374	43·4[1]
1872	149	92	301	67·2[1]
1873	228	170	461	76·2[1]
1874	214	163	429	73·8[1]
1875	2	—	4	—
1876	8	6	16	5·7[1]
1877	13	10	26	0·9[1]
1878	2	—	4	—
1879	—	—	—	—
1880	2	2	4	100·0
1881	2	1	4	50·0
1882	—	—	—	—
1883	7	5	13	83·3[1]
1884	11	10	21	83·3[1]
1885	6	6	11	100·0
1886	2	2	4	100·0
1887	—	—	—	—
1888	—	—	—	—
1889	—	—	—	—
1890	—	—	—	—
1891	—	—	—	—
1892	6	5	9	83·3
1893	26	24	39	92·3
1894	5	5	7	100·0

[1] The above percentages are as given by Dr. Russell. On the basis of the figures given in the second and third columns the percentages for the following years are:—1870, 16·0; 1871, 48·4; 1872, 61·7; 1873, 74·6;

257. Grouping the figures for smallpox into quinquennia Dr. Russell obtains the following figures :

—	Total number of smallpox deaths.	Number of deaths in hospital.	Death-rate per million.	Per cent. of total deaths in hospital.[1]
1855–59	1043	—	565	—
1860–64	1154	—	568	—
1865–69	167	25	76	15
1870–74	804	518	324	65[1]
1875–79	22	16	10	73
1880–84	22	18	8	82
1885–89	8	8	3	100
1890–94	37	34	11	89[1]

and he adds, " These results are sufficiently striking without reference to a standard population. In the 10 pre-sanitation years there were 2197 deaths from smallpox ; in the 30 sanitation years 1060. In the 10 years of imperfect isolation in hospital there were 971 deaths ; in the 20 years of perfect isolation 89." Dr. Russell holds that " prevention is the aim and the *raison d'être* of hospitals and sanitary organisation, and the evidence of the success of prevention, in so far as isolation is concerned, is and may be formulated as an increasing proportion isolated of a diminishing total quantity of disease existing."

258. While sanitary reform has been so strikingly successful in the case of typhus and smallpox, measles and whooping-cough show a steady persistency. " The preventive utility of hospital isolation in the case of measles and whooping-cough is limited by various circumstances." Dr. Russell finds " the preventive results of the isolation of

1874, 76·2 ; 1876, 75·0 ; 1877, 77·0 ; 1883, 71·4 ; and 1884, 90·9. And for the quinquennia 1870–74 and 1890–94, they are 64 and 92 respectively.

[1] The above percentages are as given by Dr. Russell. On the basis of the figures given in the second and third columns the percentages for the following years are :—1870, 16·0 ; 1871, 48·4 ; 1872, 61·7 ; 1873, 74·6 ; 1874, 76·2 ; 1876, 75·0 ; 1877, 77·0 ; 1883, 71·4 ; and 1884, 90·9. And for the quinquennia 1870–74 and 1890–94, they are 64 and 92 respectively.

measles in hospital are in any case small," and the same seems to be largely true of whooping-cough. "Taking the last five years, after sanitation has done its best, whooping-cough is still left in the position of the most fatal disease, with a mortality of 979, but now very closely followed by measles, 941."

Death-rates per Million from—

—	1855–94.	1890–94.
Whooping-cough . .	1350	979
Measles	796	941

259. At Warrington, where in 1892–3, according to Dr. Savill, the Vaccination Acts had been so thoroughly carried out that more than 99 per cent. of the people, according to his census, are vaccinated, the want of proper isolation accommodation was held accountable for the extent of the epidemic. Dr. Savill says: "It will be gathered from the foregoing narrative that insufficient or imperfect isolation was an extremely important factor in the causation of the Warrington smallpox epidemic 1892–3. This was owing partly in some instances at the commencement to a non-recognition of the cases; but it was due chiefly to an absence of hospital accommodation sufficient for the reception and isolation of the patients as soon as they were attacked and identified.

"The sanitary authority had neglected to act on the recommendations of their medical officer of health in this matter of hospital provision. The purchase of additional land for that purpose was contemplated in the summer of 1890, but it was not carried out till October, 1892.

"It is rendered evident from a close examination of the facts of the epidemic that if the town of Warrington had possessed adequate hospital accommodation for infectious disease the epidemic would probably never have reached the dimensions it did, and the disease would in all probability

have been limited to a few cases in certain quarters of the town."

Warrington obtained notification by a private Act in 1879, and in the epidemic of 1892–3 only 16 cases out of the 667 escaped notification.

At the commencement of the epidemic the total provision for the hospital isolation of infectious diseases was 30 beds, or less than half the very lowest estimate of that required. As a consequence of this only 13 cases could be received into the Borough Fever Hospital by dangerously overcrowding every available space.

The hospital is situated in a rather thickly populated part of the town.

It appears that an outbreak of smallpox in May, 1892 (consisting of three imported cases and one secondary case), was effectually dealt with by isolation, disinfection, and quarantine; but on the 18th of the same month the medical officer of health reported to the sanitary authority that "up to the present time we have been able to cope with introduced cases notified from the borough, but, as I pointed out in February, 1889, there is very great danger in treating smallpox cases in close proximity with a populous neighbourhood as Aikin Street is, and two full wards of scarlet fever in our own grounds."

It was not, however, until the epidemic had established itself in the town that additional accommodation was provided in September, 1892, at some disused iron works in Dallam Lane. These were situated near the northern fringe of the populated part of the town, but there appears to have been ample opportunity for communication with the outside world, at any rate, during the height of the epidemic.

Owing to deficient hospital accommodation, 91 cases were left at home, either altogether or for periods varying from two to twenty-two days after the appearance of the rash. The limit of hospital accommodation was twice reached, viz. on August 23rd, when the old hospital became full, and on November 12th, when the new hospital was also full. Dr. Savill traces 308 and 102 cases respectively to lack of hospital accommodation at these periods of arrest of removal.

The spread of the disease within the hospital and workhouse are also attributed to insufficient isolation and overcrowding.

In the preliminary outbreak in May, 1892, the whole family was quarantined, and this may be the reason why this outbreak spread no further. With this exception no measures for the actual removal and isolation of the healthy members of an infected household were adopted in the case of the Warrington outbreak, and though persons were enjoined to avoid contact with the infected, there is reason for thinking little care was exercised in this respect, and no efforts at regular daily inspection and supervision, such as those adopted at Leicester, appear to have been made.

In view of the limited provision for isolation, we agree with Dr. Savill that "it is not to be wondered at that on this account the smallpox epidemic of 1892–3 reached the alarming proportions which it did."

260. The facts in regard to the methods adopted at Leicester and Sheffield will be found in Sections 480—487 of the Report.

261. In regard to Gloucester, although we have not yet received the complete report of Dr. Coupland, we learn from him that the following circumstances contributed to the extension of the disease:

1. "A main factor was the introduction of the disease into some of the public elementary schools."
2. The large and increasing proportion of cases retained at home, especially as "quarantine," which in the early periods was under supervision, came to be more a matter of advice than of control. Dr. Coupland believes that "the facilities of intercourse between neighbours will account for a great deal—in other words, the failure of isolation."
3. The hospital is situate within the city, and was crowded to excess, there being at one time two and even four in a bed; it is possible that the hospital contributed to the spread, but it is difficult to prove this. On the other hand, "there had been aroused

a deep feeling against the hospital; the mortality amongst the children admitted into it had been very high, and this feeling could not be eradicated, although the accommodation was extended and the organisation improved. Thus it happened that the majority of persons remained in their homes up to the last weeks."

4. The small sanitary staff was overtaxed; and Dr. Coupland reports there were serious defects in hospital administration.

5. The hospital accommodation was afterwards increased and the administration improved; that these efforts were not more immediately successful was owing to the unwillingness of the people to enter the hospital which had so suffered in reputation.

6. Dr. Coupland, in comparing the experience of Gloucester with that of Leicester, points out that Leicester has the advantage of being better organised in its Sanitary Department, and its Medical Officer is not, as at Gloucester, engaged in private practice. There is more "sanitary vigilance" at Leicester, and its sanitary staff is more numerous.

262. It is evident from the experience of Sheffield and Warrington that the most thorough carrying out of the vaccination laws will not prevent serious epidemics of smallpox and that well-vaccinated towns cannot afford to neglect the provision of hospital isolation in order to prevent smallpox running riot in their midst.

263. The evidence leads us irresistibly to the conclusion that the simplest and most successful method of limiting and stamping out smallpox outbreaks is and always has been to separate the diseased from the healthy, and to disinfect infected places, things, and persons.

264. In so far as this is practised smallpox is restricted and extinguished; in so far as this is neglected it tends to prevail, *i. e.* to become epidemic.

265. The principle to aim at, then, is that of universal exclusion from opportunity of infection. It is the opposite of the principle underlying the practice of inoculation, which is that of universal acceptance of the disease, and its artificial "sowing" or "buying."

266. The method of isolation or exclusion, although it had been suggested by a few, had not received much attention until after inoculation and vaccination had been tried, without achieving that success which it had been confidently hoped and asserted by the advocates of each was likely to result therefrom.

267. The history of dealing with smallpox, where it has been a matter of any concern, has been the history of passage from superstitious fatalism, or passive indifference, through the paralysing acceptance of "epidemic constitution" as the all-sufficient explanation, to active attempts, by inoculation or vaccination, to anticipate the disease.

268. During the practice of these latter methods, and side by side with them, there has gradually grown up a mass of evidence proving the efficacy of early isolation of notified cases of smallpox, disinfection, and quarantine, in controlling outbreaks.

269. There is also evidence showing that certain countries, by virtue of their geographical isolation, have enjoyed practical immunity from smallpox. The experience of places so dissimilar as the continent of Australia, the town of Leicester, and the county of London shows that, even with a considerable and increasing number of unvaccinated persons, an isolation system may be carried out with remarkable success.

270. Infantile vaccination as now enforced in the United Kingdom does not prevent epidemics.[1]

271. Notification and isolation appear to be accepted even in places where the greatest hostility to vaccination has been manifested.[2]

[1] 1770; 2988. [2] 5833; 5820.

272. Those who trust to vaccination say—vaccinate your child before it is three months old, and so render it less liable to have smallpox badly if it should happen at some future date to come in the way of it. Those who trust to isolation say—smallpox is notified to be here, now. Let the healthy be separated from the sick, let the latter be isolated at home, or if they cannot be properly attended to there, let them be removed to a suitably isolated hospital. There can be no doubt that the latter is the stronger position of the two; and in practice it has been found to secure the intelligent co-operation of the public.

273. In accordance with the sub-head No. 2 of the reference to the Commission, we would suggest the following as the means other than vaccination which should be employed for protection of a community from smallpox:

1. Prompt notification of any illness suspected to be smallpox. Improved instruction in the diagnosis of smallpox.
2. A hospital, suitably isolated, of adequate accommodation, in permanent readiness, and capable of extension if required. No other disease to be treated at the same time in the same place.
3. A vigilant sanitary staff ready to deal promptly with first cases, and if necessary to make a house-to-house inspection. The medical officer of health to receive such remuneration as to render him independent of private practice.
4. Prompt removal to hospital by special ambulance of all cases which cannot be properly isolated at home. Telephonic communication between Health Office and hospital.
5. Destruction of infected clothing and bedding, and thorough disinfection of room or house immediately after removal of the patient.
6. Daily observation (including, where possible, taking the temperature and inspection for rash) of all persons who have been in close contact with the

patient during his illness; such supervision to be carried out either in quarantine stations (away from the hospital) or at their own homes.

7. Closure of schools on the occasion of the occurrence of smallpox among the scholars or teachers.

8. Hospitals and quarantine stations to be comfortable and attractive, and so administered as to secure the confidence of the public. Hospital treatment to be free to all classes, and compensation to be paid to those detained or otherwise inconvenienced in the public interest, at the public expense.

9. Tramps entering casual wards to be medically inspected, their clothing to be disinfected, and bath provided. The measures for detection and isolation of smallpox in common lodging-houses, suggested in Section 507 of the Report, to be carried out.

10. International notification of the presence of smallpox and special vigilance at seaports in communication with infected places, after the plan adopted in the case of cholera.

11. Attention to general sanitation—prevention of overcrowding, abundant water-supply, and frequent removal of refuse.

Reference V.—Alterations in the Provisions of the Vaccination Acts with respect to Prosecutions for Non-compliance with the Law.

274. It must be obvious from what has been already said that we necessarily consider the legal enforcement of vaccination as inexpedient and unjust. We see no sufficient reason for withdrawing this particular medical prescription from the personal option which attaches to all other medical prescriptions or surgical operations; we do not think that medical authority or advice is likely to gain in confidence or respect, by the adventitious aid of the police, and fine and imprisonment. But even if vaccination were a more effective and trustworthy prophylactic than we hold it to be, we should still think the continuance of compulsion at the

present time to be an anachronism. The Final Report of the majority of our colleagues appears to us show this conclusively. The view there expressed of the value of vaccination differs very considerably from the opinion prevalent in and before 1853, the date of the first compulsory law. Whether such limited and conditional confidence in vaccination as is expressed in the report of the majority would have been held by the Parliament of 1853 to justify compulsion is of course a matter of opinion; but when we recall the unqualified assurances then given that universal efficient vaccination would secure universal immunity from smallpox, we must say, in our opinion, it would not.

275. Our inquiry has shown that medical opinion as to the degree of immunity afforded by efficient primary vaccination has been modified since 1853, the date of the first compulsory Vaccination Act.[1] At that time the Epidemiological Society used its influence to get the Act passed on the ground that the whole medical profession was agreed on the certain efficacy of vaccination as a preventive.[2] The evidence we have received shows that this agreement no longer exists. Amongst the professional witnesses who have favoured us with their views there are marked differences of opinion as to the length of the period during which primary vaccination is effective.[3] But not one of them has maintained Jenner's first claim that vaccination conferred a lifelong protection.

276. It is apparent from the history of legislation on this subject that the assumption underlying every amendment of the law was a strong and general belief that, if only the absolute universality of efficient primary vaccination could be secured, epidemics would be prevented, and practical immunity would be secured for the whole population throughout life.[4] On the other hand, we have it in evidence[5] that the epidemic of 1871–3 was as severe and wide-spread as any experienced during this century, and that in the course of this epidemic "a very large proportion of the total

[1] 685; 1755–71. [2] 12,919. [3] 1755.
[4] 12,913–22. [5] 685.

smallpox deaths of adults was amongst people who had at some time or other been vaccinated."

277. It would seem, therefore, that there is a certain amount of discrepancy at the present day between the theory on which the compulsory law is based and the actual state both of fact and opinion.

278. Under these circumstances it has been suggested to us that the obvious remedy is to amend the law by making re-vaccination compulsory.[1] But though such a course might receive a good deal of support from medical opinion, the evidence we have as to the condition of public feeling shows that it would be impracticable.[2]

279. This condition of things can hardly be considered satisfactory. The law as it stands enforces, under penalty of fine or imprisonment, a practice once thought to be an effectual preventive of epidemics, and a practical safeguard for every individual vaccinated. But this prescription of the law is now generally recognised as insufficient unless primary vaccination be supplemented by secondary or repeated vaccination. The question thus arises whether it is just or expedient to enforce at the cost of much local discontent a preventive which does not secure the end proposed, and which confessedly cannot now be supplemented by the only measures which, according to the medical opinions quoted, could make it effective.

280. In support of a continuance and reinforcement of the present law it is urged that if primary vaccination be not an infallible preventive, at least it always lessens the severity of the disease, if caught, and diminishes the mortality. It is, however, doubtful whether such results as these would have been held to justify compulsion when it was first proposed. And we cannot shut our eyes to the fact that this shifting of the ground of compulsion has reopened the whole question in the minds of many who accept this modified view

[1] 100–2, 118, 156. [2] 11,635.

of the Jennerian practice.[1] As Commissioners commanded to consider and report on "provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the law," we cannot avoid a reconsideration of this issue, which has very much to do with the unsettlement of public opinion on the Acts in question.

281. It cannot be denied that the law as it stands is of a very exceptional character. It is the only instance under our constitution of the universal enforcement by fine and imprisonment of a surgical operation. In all other cases, preventive sanitary law affects only outward circumstances, such as light and air, sewerage, overcrowding, public exposure of infected persons, and the like. In all such cases the social interests are so direct and predominant, and the individual claims affected are so slight, or so merely mercenary—as in the case of owners of insanitary premises—that the reasons for compulsion are simple and uncomplicated by any delicate question of personal rights. But compulsory vaccination goes beyond outward circumstances, and invades the integrity of the healthy body. It requires a wound, however slight, to be inflicted on every healthy infant born, and the contraction of a disease, however slight, of the successful cultivation of which the vaccinating surgeon must satisfy himself. The law gives the parent or guardian no option as to incurring the possible dangers of the operation. In all other cases he is allowed to decide on his own responsibility whether he will follow a particular medical prescription or not. But in this he must accept the operation with all its dangers, real or imaginary, at the dictation of the law. He may believe that he has lost previous children through the effects of vaccination. But nevertheless he must run the risk again, or be treated as a criminal. It may fairly be conceded that a compulsory law of this nature requires justification different both in kind and degree from that of laws affecting ordinary nuisances.

282. The case as put before Parliament in 1853 seemed exceedingly strong. But, unfortunately, it did not receive

[1] 18,042–3; 13,065; 13,143.

much discussion. It rested, as we have seen, on the practical unanimity of the medical profession in the opinion that universal primary vaccination would extinguish smallpox. It was argued that the plague of smallpox was such as to justify exceptional measures. It was believed that vaccination had already come into such general vogue that only carelessness accounted for occasional neglect. And, finally, it was assumed that there were no dangers to be feared such as might perplex the consciences of parents.

283. The evidence we have received shows that the same position cannot be held now. Eminent medical men, some of whom have appeared before us, are now maintaining that the protection supposed to be afforded by vaccination, even though repeated, is almost entirely illusory. Some allow, indeed, that the disturbance of the constitution set up by vaccinia may during its brief continuance prevent the development of smallpox from inoculation.[1] But in their opinion this protection is so exceedingly brief in its duration that it is of no appreciable value as a prophylactic against epidemics. Whether that opinion be scientifically justified or not, the fact that it is held by medical men of great scientific reputation has recently done much to encourage resistance to the law. Where doctors differ it seems difficult to resist the claim of parents to be allowed to choose for themselves which opinion they will follow.[2]

284. In 1853 there were few or no signs of opposition amongst the population when called upon to submit to the law. There was a general acquiescence in the assumption that the abatement of the virulence of smallpox from the commencement of the nineteenth century had been due almost entirely to the voluntary and partial adoption of vaccination. Those who neglected it were reasonably suspected of doing so, not from any conscientious conviction, but from mere carelessness and indifference to social welfare. It seemed right in the opinion of the time, therefore, that they should be compelled to adopt an apparently harmless precaution, which was believed only to need universal en-

[1] 11,843; 11,848. [2] 11,855.

forcement to secure the whole nation against a deadly disease. If these anticipations had been realised there seems no reason to doubt that the law would have continued to be enforced with little or no friction.

285. But in no year after the enactment of compulsion was the number of deaths reduced below 1500 until the year 1875. It was during the eighth decade of this century that resistance to the law began to spread widely; and the main point on which recalcitrants insisted was that experience proved the impotence of vaccination to prevent epidemics.

286. The case of Leicester, on which we have had a large amount of evidence, illustrates most clearly the origin and growth of local resistance to the law. It is proved that down to 1872 Leicester was, what is usually considered, a well-vaccinated town. During the years immediately preceding that date not more than 5 per cent. of the children born in each year were "unaccounted for." In other words, 95 per cent. were reported as satisfactorily vaccinated. In 1871, the year of the worst epidemic during the present century, the condition of Leicester was exceptionally good. Out of the whole 4446 children born there in that year, only 15 were found to be neglected, and in every one of these 15 cases the parents were prosecuted. It appears, therefore, that there was very little, if any, opposition to the law in Leicester at that time, and public opinion in its favour seemed to be confirmed by experience; indeed, the Medical Officer of Health of the borough, in his reports for the years 1869 and 1870, was able to state that vaccination had been "sedulously attended to," and he claimed the immunity of the town from smallpox as evidence of the effect of vaccination. While the epidemic in the country at large carried off 23,126 people in 1871, Leicester only lost 12. But in 1872 the town was not so fortunate. The deaths from smallpox suddenly rose to 346.

287. According to the evidence we have received, it was experience of this epidemic that fostered the rapid growth of opinion in Leicester adverse to vaccination. The ground

taken was that vaccination had not protected either the population at large or the individuals vaccinated, and that therefore it ought no longer to be enforced. There were other reasons, such as the growth of a belief that the operation is injurious and sometimes fatal. But the origin of the movement was the disbelief in vaccination as a prophylactic. The election in 1887 of a board of guardians, of whom a majority were opposed to compulsion, led to the entire abandonment of prosecutions, and the law has since that time been locally in abeyance. Experience of a more recent outbreak in 1893–4 has not changed local opinion. On the contrary, it is alleged that the cessation of vaccination, together with the adoption of sanitary and isolation measures (to which we have referred in a former part of this report), have been much more effective in saving life than was the enforcement of the law at the period of the previous epidemic.

288. The prevalence of this opinion is by no means confined to Leicester. In December, 1891, we issued to all boards of guardians in England and Wales a number of questions concerning their mode of carrying out the law, the enforcement of which rests with them. The replies showed that in 122 unions compulsion had either been temporarily suspended until the report of the present Commission, or had been entirely abandoned, independently of our inquiry. These unions include, in addition to Leicester, a number of important towns, such as Reading, Falmouth, Derby, Darlington, Gateshead, South Shields, Colchester, Westham, Gloucester, Burnley, Bury, Oldham, Lancaster, Wigan, Wolverhampton, Ipswich, Eastbourne, Coventry, Hull, York, Middlesboro', Scarborough, Bradford, Dewsbury, Halifax, Keighley, and others.

289. The law is also in abeyance by resolution of the guardians, in the following Metropolitan Unions, viz., Camberwell, Hackney, Islington, Lambeth, Mile End, St. Olave's, St. Saviour's, and Shoreditch. Making allowance for the fact that in about forty-six of the 122 unions the suspension of the compulsory law is professedly only temporary

until this Commission shall have reported, we cannot regard without anxiety and fear the painful conflict that would be inevitable if an attempt were made to revive and re-enforce the compulsory law in these localities against the prevalent opinion of the inhabitants.

290. Indeed, even to make the attempt would be impossible without a considerable change in the law. For at present the duty of enforcement lies with the guardians, and it is made a test question in their election. If we could suppose that the evidence laid before us would have the effect of changing local opinion, we might count on the future election of guardians willing to carry out the law. But a large part of that evidence has been published already, and there is hitherto no appearance whatever of any change in the local opinion of the unions above mentioned, except in the rare cases in which epidemic has occasioned panic. Each year of our labours has witnessed not an increase, but a decrease in the numbers of guardians elected in these unions by the supporters of compulsion.

291. It appears, therefore, that if the present law is to be made really effective, this can only be secured by imposing the duty of its enforcement on the police, under the direction of inspectors of the Local Government Board. There is too much reason, however, to fear that even this would not be sufficient without a material increase in the severity of the law. The evidence received[1] as to the prevalence and strength of conscientious objections on the part of parents convinces us that a considerable number could not be compelled by any penalties of fine or imprisonment to bring their children for vaccination or to allow the operation at their own homes. People who show this spirit are considered martyrs by their neighbours, and a few such cases soon create a local agitation against the law. The only way of enforcing the law without prosecution of parents would be to empower public vaccinators to seize children by the aid of the police and vaccinate them by force. But the attempt would probably create an agitation such as no Government could withstand.

[1] 6052–6764.

292. The difficulty of compulsion is greatly enhanced by the undeniable fact that vaccination is attended by an appreciable amount of danger. The constitution of a child is always more or less disturbed by it; and though the number of cases in which this disturbance assumes a painful or fatal form bears small proportion to the number of infants vaccinated, yet a certain amount of risk remains undeniable; and the question whether this risk should be encountered or not is naturally regarded as a matter of parental responsibility. We are unable to report that this risk is infinitesimal or unimportant.

293. The degree of risk which parental feeling may justly be compelled to encounter is scarcely susceptible of statistical statement. If we were in a position to affirm that there is absolutely no danger, our task might be much simplified. But when once the reality of appreciable danger is proved, as we hold it to be, it becomes a very delicate question how far the law is morally justified in interfering with the discretion of parents. It may be urged that a very great danger to the community might justify the enforcement of a proved and indispensable safeguard even at some risk to individuals. But the danger from smallpox to any community using such precautions as we have recommended is not now great enough, nor is the safeguard of sufficient certainty, to fulfil these conditions.

294. It is true that in a considerable number of the cases examined for us the injury or death is reported to have been only indirectly due to vaccination. Insanitary surroundings and parental ignorance, or even parental neglect, are assigned in some cases as the causes of complications. But even in such cases it is clear that, apart from the vaccination, the contributory causes alone would not have produced the results admitted. An operation which for its safety requires complete sanitation, with care and skill on the part of every mother, would seem to be scarcely a fit matter for universal compulsion.

295. On this point we may quote the language of M. Depaul, for some time superintendent of the vaccination service in

France, as reported and approved by the late M. Lefort, himself a strong advocate of vaccination but an opponent of compulsion. In his final reply on a long discussion in the Académie de Médecine, M. Lefort said: "A law to make vaccination compulsory seems to me vexatious, ineffective, and impracticable. I cannot put out of my mind the offensiveness of such a law to free men; nor can I any more put out of my mind that the father of a family also has rights of which he can hardly be disposed to deprive himself in order to entrust them to the Government. Still, if we could—not indeed entirely suppress smallpox, but at least diminish it substantially by violating this liberty, I could even assent to this notwithstanding my repugnance; but as it is not so I cannot assent to this compulsion. Here, gentlemen, it is not I who speak, but it is M. Depaul, for long the director of our vaccine service, who uttered these words on this platform on March 20th, 1881." ('Bulletin de l'Académie de Médecine,' 3me série., tom. xxv, No. 7, séance du 17 février, 1891, p. 270.)

296. On the whole, then, we are of opinion that a resolute and universal enforcement of vaccination is neither possible, nor expedient, nor just. It is not possible, because there exists a sufficient amount of conscientious opinion opposed to it to give recalcitrants the credit of martyrdom, and because in great centres, such as Leicester, it is questionable whether even the police could carry out compulsion without the aid of the army. It is inexpedient, because it concentrates attention on a safeguard proved to be insufficient in itself, and leads to the neglect of sanitation and isolation, which our evidence shows to be more effective. It is unjust, because to meet a danger often remote by a defence at best uncertain, it overrides parental responsibility and disregards parental feeling.

297. The proposal of our colleagues is, that, while abandoning the attempt to enforce vaccination upon those who honestly object to it, we should continue to press it by force of law upon the indifferent and negligent. In the matter of re-vaccination, however, their proposal is different; they

are impressed with the transient influence of vaccination, and recognise the need of re-vaccination as early as nine or ten years of age, and advise its repetition at intervals, but they do not suggest that the repeated operation, which they regard as essential, should be pressed upon the indifferent and negligent, as in the case of the primary operation.

298. Now the whole principle of securing the protection of a community from smallpox by the artificial production of a mild disease (whether it be inoculation or vaccination) is based upon the thoroughness of the procedure in two directions:—(1) In applying the inoculatory process to *every* individual; and (2) in securing to each individual operated upon the maximum of protection the process is capable of securing.

299. The proposals of our colleagues appear to us to fail upon their own showing in both directions. They recognise the impossibility of securing the primary vaccination of every person, and open a means of escape for objectors. They are also not prepared to recommend that re-vaccination should be pressed in the same manner as the primary operation at a time when the vaccinated have lapsed into susceptibility to smallpox.

This serves to prove that any such system must at best be a broken reed on which to rely for the protection of a community from smallpox epidemics.

300. We believe the methods of isolation of the infected, disinfection, and the observance of strict cleanliness are both more successful and more legitimate methods for the State to encourage. They have the advantage of applying the preventive only where it is required; and they do not necessitate an operation upon the person of every healthy individual.

301. We, therefore, recommend that the law be amended by the repeal of the compulsory clauses of the Vaccination Acts. But in consideration of the prevalent belief in the value of vaccination as a prophylactic for an indefinite period

we suggest that in other respects the law should be left as it is, subject, however, to such modifications as are recommended for the diminution of attendant risks. The precedent established in the case of the abolition of compulsory church rates might be followed with advantage. In that case all machinery for laying and collecting the rate was left intact, though the power of enforcement was taken away. The effect of our recommendation, if adopted, would be that vaccination would continue to be provided as at present for those who desire to avail themselves of it, but efforts to secure vaccination would be limited to moral influence,—in a word, the whole country would be in the position of those unions in which the guardians have abandoned compulsion.

302. The grounds on which we object to the enforcement of vaccination by penalties necessarily lead us also to object to any method of indirect compulsion. We regard as both inexpedient and unjust exclusion from any branch of the public service because of the refusal to submit to vaccination or re-vaccination. The injustice is perhaps most severely felt in the case of candidates for employment as pupil-teachers in public elementary schools. There are now districts in which, owing to the general opposition to vaccination, scarcely a girl or boy can be found who is legally eligible, and candidates have to be brought in at great inconvenience from surrounding districts. The existence of an exceptional case or cases in which such rejected candidates have at some time afterwards taken smallpox is in our view no justification for the continuation of this grievance. Statistics furnished to the Commission prove that large numbers of vaccinated or re-vaccinated persons have taken the disease ; and we are not aware of any evidence to show that vaccinated pupil-teachers have any special immunity. If our recommendations were carried out the danger of contagion would be greatly diminished, in schools, as elsewhere.

303. On the whole, then, while there is much in the report of our colleagues from which we dissent, and we have accordingly abstained with reluctance from adding our signatures to theirs, we are at one with them in holding that

it is unwise to attempt to enforce vaccination on those who regard it as useless and dangerous. We, however, go further, and agree with our colleagues Mr. Whitbread and Mr. Bright, that it would be simpler and more logical to abolish compulsory vaccination altogether.

W. J. Collins,
J. Allanson Picton.

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