ON
SMALL POX AND VACCINATION.
ANALYTICAL EXAMINATION OF ALL THE CASES ADMITTED
DURING SIXTEEN YEARS,

AT THE
SMALL POX AND VACCINATION HOSPITAL, LONDON;
WITH A VIEW TO ILLUSTRATE THE PATHOLOGY OF SMALL POX, AND
THE PROTECTIVE INFLUENCE OF VACCINATION, IN DEGREES VARY-
ING ACCORDING AS THE VACCINATION HAS BEEN PERFECTLY
OR IMPERFECTLY PERFORMED.

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WITHIN the last few years Smallpox has been several times epidemic in London. Many vaccinated as well as unvaccinated persons have been attacked by it, and the public have become, in consequence, somewhat anxious about their security. I have, therefore, thought that the profession would be interested, and that they might possibly elicit useful information from the leading particulars, arranged and classified, of the patients admitted for sixteen years, at the Smallpox and Vaccination Hospital, London. During the period alluded to—1836 to 1851, inclusive—smallpox has been epidemic four times, viz., in 1838, 1844, 1848, and 1851, besides a short epidemic in the winter of 1840-1. Rather more than half of the patients admitted with smallpox into the hospital, have had the disease after having been vaccinated. The particulars of each patient

were entered at the time in the register of the hospital, in the majority of instances by myself. Having analysed these records with minute accuracy and strict fidelity, I beg now to place the results before the Society.

The analysis will be found to have reference principally to the following points :

1. Natural smallpox.
2. Smallpox after smallpox.
 - a.* After natural smallpox.
 - b.* „ inoculation.
3. Smallpox after vaccination.
 - a.* Number of cicatrices.
 - b.* Character of cicatrices.
 - c.* Vaccinated, but without cicatrices.
4. Febrile eruptive diseases mistaken for smallpox.

No one could be long in attendance at the Smallpox Hospital, and fail to be struck by the remarkable difference presented to his notice between the vaccinated and unvaccinated patients, and also between the vaccinated cases themselves, some patients having smallpox in a mild form, wholly devoid of danger, whilst others have it in great severity, scarcely if at all lessened by the previous vaccination. Under these circumstances it became desirable to ascertain carefully, so far as possible, all the antecedents regarding the vaccination of each individual admitted, with a view of discovering, if possible, the cause of this difference, to be able to account for the extreme mildness of the disease in some cases, and the danger and unmitigated course, sometimes death, in others.

Smallpox in the unprotected, remains to this day as virulent as it perhaps ever was, destroying about one third of all whom it attacks, and is especially destructive to infantile life. Vaccination, when performed in infancy, affords almost complete protection against the fatality of smallpox up to the period of puberty. This disease does not usually occur after vaccination until several years have elapsed ; at least, such is the general experience of the Smallpox Hospital,

although there have been some instances to the contrary. The particulars, unfortunately, of the progress of the vaccination, as observed by medical men, are but rarely noted at the time, and preserved,¹ so that when variola occurs it becomes necessary to trust to the accounts given of the vaccination by the patients themselves or their friends, and to observe carefully the appearance of the cicatrices left by the vaccination; smallpox occurring in the great majority of instances in persons between 15 and 30 years of age, the vaccination having been, with but few exceptions, performed in infancy. After this lapse of time from vaccination, the most trustworthy evidence we can generally obtain of its perfection is from the cicatrices, and this evidence I shall be able to show is a very good guide to the general amount of protection conferred by vaccination, if not to be depended on even in each individual case, it is so when the observation is extended and applied to the community at large. My intention in bringing this subject before the Society is not to dwell on individual cases, except so far as they form one comprehensive whole; but to look at the subject in its widest grasp, to treat of the cases in the aggregate, by hundreds and by thousands, as they have occurred in hospital practice extended over a series of years. A few exceptional cases could perhaps be found to the rule of practice it will seem desirable to draw from the accompanying records; but these very exceptional cases have been the cause of complicating the subject so much when viewed from a limited range, that the profession have been in some doubt what to do, and what to recommend: to endeavour to set these doubts at rest, and to contribute to the public good by indicating how the practice of vaccination may be improved, is the aim of this communication.

It will, perhaps, be objected, and very properly, that the experience of an hospital, as regards the mortality, is not the best criterion by which to judge of the true value of vaccination. In this I should entirely agree, if the evidence rested alone on the mortality; such, however, is not the

¹ There are records, posted alphabetically, of all the persons vaccinated at the Smallpox Hospital, from 1799 to 1838.

case. No one is more alive than myself to the great amount of evil, as well as the great amount of good attendant on hospitals; of evil from collecting the sick together in large numbers, and I would have been the last to have brought forward the experience gained in an hospital of the protective influence of vaccination, as observed in England, if a tithe of the same amount of information on this particular subject, and collected in the same systematic way, were available from other sources; but, unfortunately, it is not.

Although the inferences drawn on any disease, from the mortality of hospitals exclusively, might fairly be objected to, for the reasons well explained by Mr. Farr, in the 'Third Annual Report of the Registrar General,' 8vo, p. 97, still these inferences are not without their value, as the class of cases reported on can generally be obtained in much larger numbers at hospitals than from any other source, and when allowances have been made, as I have made them, in reporting on the patients, and drawing the averages from them collectively at the Smallpox Hospital, we can arrive very nearly at the truth, the great object I have had before me in undertaking these inquiries. To obtain this point, all the patients have been entirely excluded, in calculating the averages, who were affected by superadded disease, just as much as if they had never been admitted into the hospital at all, and the deductions have been made from those who were seemingly affected by smallpox only. All practical men will readily admit that it is impossible, even in rural practice, to meet with a large number of cases of any one disease unmixed with and uninfluenced by other diseases. The same thing occurs in hospital practice. Patients suffering from other diseases are attacked by smallpox and die, who would recover from smallpox but for the injury done to the constitution by the previous disease; and although a large majority of the fatal cases from superadded disease, at the Smallpox Hospital, has undoubtedly arisen from erysipelas, gangrene, &c.,¹ the same thing, unfortunately, is taking

¹ Observations on Ochlesis, or the Disorder generated by the accumulation of the Sick, by George Gregory, M.D., 'Medical Times,' vol. xix, No. 496, p. 431.

place often at our general hospitals, as well as at the Smallpox Hospital, and has given occasion, within the last few years, for the production of papers on hospital diseases;¹ but, in general hospitals, the evil seems to be of less consequence,—or at all events is less thought of,—than at the Smallpox Hospital, because the deaths, and other results, do not there, as they do at the Smallpox Hospital, interfere with a great scientific and pathological question, namely, the protective influence of vaccination. Assuming, however, the Society will give me credit for being fully alive to these evils of hospitals, and for having used my utmost care to exclude, so far as possible, from my calculations of averages of mortality, all cases affected specially by hospital mischief, as well as other forms of superadded disease, such as phthisis; the several *idiopathic* inflammations of vital organs, as pneumonia; puerperal fever,—a disease closely allied probably to erysipelas, if not identical with it, &c., &c.

A most unfortunate and indirectly fatal complication is gonorrhœa, both in the male and female; to the latter more especially. From the inability of the patients to use ablution, carefully, themselves, to the parts affected, once or twice daily, and from the extremely disagreeable nature of this duty for others to perform for them, the parts are not always kept properly clean, the consequence is they are very apt to become gangrenous; absorption of the gangrenous matter ensues, which is followed by pyæmia, phlebitis, the formation of large abscesses all over the body, in short, the usual train of evils produced by the absorption of a morbid animal poison: these cases have been included, of course, in the returns under the head of gangrene, but they would not have arisen had it not been for the gonorrhœa. Allowances having been thus made, the patients are described, as far as it is perhaps possible to describe them, as suffering from

¹ Cases of Hospital Gangrene, and of diffuse Inflammation of the Cellular Membrane, which occurred in St. Bartholomew's Hospital, in December, 1846, and January, 1847, by Holmes Coote, Esq. and Luther Holden, Esq., 'Lancet,' 1847, vol. i, p. 441.—The Nature and Treatment of Erysipelas: being the subject for the Jacksonian Prize for the year 1849, by Peter Hinckes Bird, Esq., M.S. Library of the Coll. of Surgeons.

smallpox only, as much uninfluenced by other diseases as the same number of cases would be if taken from private and parochial practice, where the accommodation for the sick is often anything but favorable for their recovery, except in selected cases, which of course would not apply to the community at large, as this question ought to be applied, any more than hospital cases, so that when the remaining evils between hospital and private and parochial practice have been relatively balanced, the results would be perhaps nearly the same.

Viewing the question, then, as it actually occurs in practice, and to simplify, and enable me to make my report on this large number of patients, 5982, as clear and concise as appeared to me to be possible, they have been arranged annually for sixteen years, on one systematic plan, and from these annual and other tables, altogether 87 tables, the whole have been combined, and finally formed into a series of six tables, comprising, it is hoped, most of the principal points of interest in the inquiry.

Of the series, the first table shows the number of patients admitted at the hospital in each year, distinguishing males from females, whether vaccinated or otherwise, and gives the outline of the disease under which each was suffering. It includes 185 cases of febrile diseases, principally eruptive, but not variolous, although sent to the hospital as such, and furnishes the result of the whole, with the rate per cent. of mortality.

The second table gives an analysis of all the cases of smallpox, viz. 5797, classed under nine different headings, the form of the disease in each case, and the result, with the rate per cent. of mortality under each division.

The third table gives the ages of the unprotected patients, and the rate per cent. of mortality, calculated at different periods of life, for every five years up to thirty, and every ten years afterwards.

The fourth table further exhibits, separately, the leading particulars of 3094 cases of smallpox after vaccination, showing, from a careful examination of each patient, the number and character of the vaccine cicatrices, the form of

the variolous disease, and the result, with the rate per cent. of mortality from smallpox, after deducting the cases of superadded disease. It also shows the rate of mortality, from smallpox, in patients having one vaccine cicatrix, particularising whether good or indifferent, and the average; as well as with two, three, four, or more cicatrices; and of those reported to have been vaccinated, but who were without any cicatrix.

The fifth table shows, in quinquennial periods, the ages of the vaccinated patients when attacked by smallpox; *where* they were vaccinated, and the rate of mortality.

And the sixth table states, in periods of five years, the ages of the patients at the time they were vaccinated, who have subsequently been admitted with smallpox at the Smallpox Hospital.

There is probably no subject in the whole range of medical science to which the numerical method of investigation is more applicable than to the results obtained, and the effect produced on life, by vaccination. At the present day it is unnecessary for me to dwell on its advantages over other modes of inquiry; it has, fortunately for the advancement of our art, taken the place in a great measure of hypothesis and mere opinion, which was of but little value, for the most part, on subjects of inquiry like the present, unsupported by any documentary evidence, compared with the exactness we arrive at by arranging and classifying a large number of kindred cases, and drawing our deductions from the whole. Much the same impression might have been and doubtless was often left on a careful, observant mind, but then other persons could not have been equally satisfied that the deductions drawn were the correct ones, as they can be when the cases and the particulars are placed numerically before them, and from which each inquirer can form his own opinions. The tables which I have thus arranged, and now present to the Society, contain information which has occupied a portion of every day in collecting for sixteen years, and which may be combined and studied in a variety of ways; on some of the leading features of each table I will proceed to offer a few comments, taking them in the order of succession.

TABLE I.
Summary and General Classification of the Patients admitted annually at the Smallpox and Vaccination Hospital, London, during a Period of Sixteen Years, from 1836 to 1851, inclusive.

YEARS.	Number of patients.			Natural smallpox.		Smallpox after vaccination, with and without cicatrices.		Smallpox after vaccination or inoculation.		Febrile diseases, principally eruptive, but not various, although sent to hospital as such.		RESULTS.					
												Died.				Discharged.	
	Males.	Females.	Total.	Affected by superadded disease.	Rate per cent. of mortality.												
1836	215	114	329	185	70	1	—	131	12	12	2	245	59	25	84	4	25·53
1837	156	95	251	142	44	—	—	97	1	12	1	205	31	15	46	5	18·32
1838	424	288	712	387	155	—	—	306	33	19	—	524	117	71	188	30	26·40
1839	102	53	155	61	22	—	—	83	4	1	—	128	16	11	27	1	17·41
1840	186	141	327	189	87	3	—	124	8	11	—	232	52	43	95	5	29·05
1841	209	148	357	189	64	2	1	151	10	15	—	282	51	24	75	5	21·00
1842	91	64	155	77	30	2	—	62	4	14	—	121	23	11	34	4	21·93
1843	92	68	160	77	27	2	—	69	—	12	—	133	21	6	27	3	16·87
1844	391	256	647	302	117	4	3	337	50	4	1	496	87	64	151	18	23·33
1845	240	144	384	137	63	4	—	227	15	16	1	305	54	25	79	3	20·57
1846	96	56	152	57	22	2	—	88	7	5	—	123	17	12	29	2	19·07
1847	270	191	461	167	50	8	3	275	28	11	—	380	49	32	81	10	17·57
1848	449	247	696	254	103	4	2	428	63	10	—	538	99	69	168	39	24·13
1849	123	77	200	71	22	4	—	115	11	10	—	167	22	11	33	5	16·50
1850	199	115	314	129	42	2	—	174	16	9	—	256	43	15	58	3	18·47
1851	438	244	682	230	78	9	—	427	26	15	—	578	64	40	104	9	15·24
Totals.....	3681	2301	5982	2654	996	47	9	3094	268	2	1	4703	805	474	1279	146	21·38

TABLE I.—The numbers admitted each year will be found to have fluctuated considerably, of course, in an hospital devoted to the reception of patients suffering from a disease liable to great variation from its epidemic character ; so much so that during some years the admissions have been four or five times more numerous than in others. The total difference in the admission of males and females has been as three to two, three males to two females ; the rate of mortality has been nearly the same, less by 1 per cent. only in females than in males. The average annual mortality has been 21 per cent., ranging between a minimum of 15 and a maximum of 29. And it will be found generally to have been greater in epidemic times, owing partly to the greater severity of the disease, and partly, probably, to the evil influence of collecting together, in a space too limited for them, a large number of sick persons. This will be rendered visible by observing the diminished mortality which has already taken place, during a severe epidemic since the new hospital at Highgate Hill has been in use, which is placed in a more healthy situation than the old hospital at Battle Bridge was, and where the space for patients is much larger, upwards of 2000 cubic feet being allowed for each. The general sanitary arrangements are also much better. The new hospital came into use in July, 1850.¹ It ought, however, to be stated that on three different occasions, during the epidemics of 1838-44-48, when it was impossible to receive, for want of room, all the applicants for admission, and in order to afford as much assistance to the public as possible, severe cases only were admitted, and many mild cases, after vaccination, recommended to find accommodation elsewhere. In this way the mortality at the hospital was necessarily increased, rendered greater per cent. than it would have been had all the applicants been admitted indiscriminately. It has besides, fre-

¹ After having given considerable attention to the subject for several years, I have observed that the cubical space allowed for patients with smallpox, and like diseases, such as typhus, scarlatina, &c., should not be less than 2000 cubic feet for each patient.

quently come to my knowledge at other times, that a severe case has been sent to the hospital, whilst a mild case or two, in the same house, has been kept at home. This is only what might be expected, but it helps to account for the increased mortality there may be per cent. in hospitals from any given disease, over the mortality per cent. from the same disease amongst the public at large in private houses.

185 cases of febrile diseases, not variolous, have been admitted in the sixteen years, and about twice as many were seen on their arrival by the medical officers of the hospital prior to admission, and were not received; but as this does not in any way alter the order of frequency in which errors of diagnosis occurred with regard to the several mistaken diseases, it will probably be interesting to the Society to know the diseases which have been most commonly mistaken for smallpox. When arranged, they come under 21 different heads, but, as may be supposed, some diseases have misled much more frequently than others. Of the 185 cases, 50 were measles, 33 lichen febrilis, 30 varicella vera, 27 fever, making 140 of the 185. The next disease in order of frequency is urticaria, of which there were 8 cases. It will, therefore, be seen that measles, lichen, varicella, and fever, have led to mistakes much more frequently than any other diseases. Of the cases of fever, a few arose, in my opinion, from the infection of variola in vaccinated individuals, which terminated in two or three days with the initiatory fever, but without the formation of the characteristic variolous eruption.

TABLE II.

Analysis of the Cases of Smallpox admitted at the Smallpox and Vaccination Hospital, London, from 1836 to 1851, inclusive.

PATIENTS ADMITTED WITH SMALL POX.	FORMS OF THE DISEASE.										RESULTS.		
	Eruption regular or unmodified.					Eruption irregular or modified.					Died.	Died, affected by superadded disease.	Ratio per cent. of Mortality from Smallpox, after deducting entirely the cases affected by super-added disease.
	Confluent.	Died.	Semi-confluent.	Died.	Distinct.	Died.	Confluent.	Died.	Semi-confluent.	Died.			
1. Unprotected	1821	936	597	51	167	8	17	1	17	—	1658	996	35.55
2. After natural Smallpox	3	—	2	—	—	—	3	—	3	35	14	—	—
3. After inoculated Smallpox	27	10	5	2	—	—	4	1	4	7	20	7	23.07
4. After Vaccination and Smallpox	5	2	—	—	—	—	1	—	—	2	3	2	Too limited for averages.
5. After Vaccination, or Inoculation, and Smallpox	1	1	—	—	—	—	—	—	—	—	1	—	
6. After Vaccination or Inoculation	2	2	1	—	—	—	—	—	—	—	1	1	
7. After Vaccination, with cicatrix or cicatrices	2787	428	153	232	89	—	486	24	416	3	2596	191	5.25
8. Stated to have been vaccinated, but having no cicatrix	290	138	67	33	16	1	42	5	20	—	216	74	21.73
9. Stated to have been vaccinated, but particulars of cicatrix not recorded	17	4	2	2	3	—	1	—	—	—	14	3	6.66
Total	5797	2409	1166	868	275	9	554	31	460	3	4523	1274	19.97

TABLE II.—Of the 5797 cases of smallpox, 2654, or 45 per cent., were unprotected; 47 cases, or less than 1 per cent., were after a previous attack of smallpox, or smallpox inoculation; 3094 cases, or 53 per cent., were after vaccination.

69 of the unprotected patients had the eruption modified as it is by vaccination, although it could not be ascertained that any of these patients had ever undergone vaccination. They were examples of mild natural smallpox, such as have no doubt occurred at all periods to a few favoured individuals, and in which, fortunately for the objects attacked, the disease leaves no trace behind. Some of the cases occurred in little children, whose mothers were at the hospital with them, and by whom it was perfectly well known no vaccination had ever been attempted. After making allowance in the unprotected for those who died affected by superadded disease, which was about 2 per cent., there died $35\frac{1}{2}$ per cent. of smallpox.

14 patients had smallpox after a previous attack of natural smallpox, and not one died. 27 patients had smallpox after having been some years before inoculated for smallpox, and they died at the rate of 23 per cent.

2787 bore marks of having been previously vaccinated; and after deducting the cases affected by superadded disease, which amounted, as in the unprotected, to 2 per cent., there remained a mortality of $5\frac{1}{4}$ per cent. from smallpox.

TABLE III.

Ages of the unprotected Patients admitted with Smallpox at the Smallpox and Vaccination Hospital, London, from 1836 to 1851 inclusive, with the rate per cent. of Mortality, calculated at different periods of life.

DATE. 1836-1851.	AGE IN YEARS.												TOTALS.
	0-5	5-10	10-15	15-20	20-25	25-30	30-40	40-50	50-60	60-70	70-80	80-90	
Patients . . .	356	334	270	571	669	270	154	18	8	2	1	1	2654
Deaths . . .	181	91	62	154	274	124	89	13	5	1	1	1	996
Per centage of deaths .	50	27	23	26	40	45	57	69		75			37

TABLE III.—Natural smallpox will be seen to be a most fatal disease at all periods of life; the most so in infancy, and advanced life; the least so from 10 to 15 years of age; under 5 years it is 50 per cent.; still greater, however, under two years; the mortality after the age of 20 rises suddenly, and increases gradually; at 30 it exceeds the mortality of infancy, and after 60 hardly any escape.

TABLE IV.—3094 patients with smallpox reported themselves to have been vaccinated at some period of their lives. Patients were never entered in the register as vaccinated unless the account of the vaccination was a tolerably clear one, either from the patient's own recollection, or the account received of it from his or her friends,—their belief that it had taken effect properly, and their trusting to it as their protection against smallpox. The only exceptions to this statement were—1st. Those who had the usual vaccine cicatrices on their arms, but knew nothing of having been vaccinated. 2d. Patients who were admitted while under vaccination; they were considered, at whatever stage the vaccination had arrived, as unprotected, and entered accordingly. Of the whole 3094 cases after vaccination, with and without cicatrices, there died, after deducting the cases of superadded disease, $6\frac{3}{4}$ per cent. 945 of the vaccinated cases were unmodified, and 2149 modified. Of the 945 unmodified cases, there died 231, or 24 per cent., by which it will be observed that there is a difference of one third in the mortality between these cases and the unprotected cases; therefore, although the eruption was not recorded in the register as modified or mitigated, the constitution must have received a protective influence, as regards fatality, to the amount of one third, or else there would not have been this difference in the number of deaths. Many cases were not entered as modified, though in my opinion at the time they would have been more correctly so entered; that opinion is sustained by the mortality, which would have been greater but for the disease having been influenced by vaccination.

1357 patients had one vaccine cicatrix, and of these there died, with a good cicatrix, $4\frac{1}{2}$ per cent.; with an indifferent cicatrix, just upon 12 per cent., the average being $7\frac{1}{2}$.¹

¹ A good vaccine cicatrix may be described, as distinct, foveated, dotted or indented, in some instances radiated, and having a well, or tolerably well, defined edge.

An indifferent cicatrix, as, indistinct, smooth, without indentation, and with an irregular and ill-defined edge.

888 patients had two cicatrices, and there died, with good cicatrices, $2\frac{1}{2}$ per cent.; with indifferent cicatrices, $7\frac{1}{4}$ per cent.; the average being a little over 4 per cent.

274 patients had three cicatrices, the mortality being with good cicatrices $1\frac{1}{2}$ per cent.: with indifferent cicatrices $2\frac{1}{4}$ per cent.; average $1\frac{3}{4}$ per cent.

268 patients had four or more cicatrices, and there died with good cicatrices just under 1 per cent.; with indifferent cicatrices none, the average being only $\frac{3}{4}$ of 1 per cent. There is a difference in the last statement between the mortality of those having good and indifferent cicatrices that does not accord with the previous results; but all candid minds will readily be convinced that the average would have been preserved had the numbers been greater to calculate from, for when all the numbers are taken together, there died, with good cicatrices, 3.04 per cent.; with indifferent cicatrices, 9.77 per cent. Then, again, as regards the number of cicatrices, there died with one and two cicatrices, 6.21 per cent.; with three, four, and more cicatrices, 1.30 per cent.

The danger from smallpox arises in the great majority of instances, solely from the quantity of eruption—from the extensive interruption and destruction of the functions of the skin produced by the pustules, in much the same way as from a severe burn or scald. Death may take place, and commonly does take place, without any perceptible disease of the internal organs essential to life, excepting the pustules on the air-passages, and congestion of the lungs, the latter being produced by the additional duty thrown upon them, as occurs whenever the healthy functions of the skin are interrupted. Knowing this,—that the danger arises principally from the quantity of eruption,—we may examine the question in another light. By referring to Table iv, it will be seen that, of 2245 patients, with one and two vaccine cicatrices, 392, or $17\frac{1}{2}$ per cent., had smallpox in a confluent unmodified form. Whilst of 542 patients with 3, 4, or more cicatrices, 36, or $6\frac{1}{2}$ per cent. only, had the confluent unmodified disease. Again, 1765 patients had *good* cicatrices, of whom 196, or 11 per cent., had the confluent un-

modified disease; whilst of 1022 with *indifferent* cicatrices, 232, or 22 per cent., just double the per centage of the above, had it in the unmodified form. Test the question in which way soever we will, the result is in favour of producing four vesicles at least at vaccination, with lymph that leaves good permanent cicatrices.

290 patients reported themselves vaccinated, but had no cicatrices, and they died at the rate of $21\frac{3}{4}$ per cent., which teaches us the important fact, that the mortality from smallpox is more than four times as great in persons who, though believing themselves protected by vaccination, are without cicatrices, as it is in those who bear vaccine cicatrices. Practically, this is a point of very great importance, and persons so circumstanced as to have no cicatrix, should be re-vaccinated, if young, upon attaining puberty, or at any subsequent period, without delay. 17 patients were entered as vaccinated, but the particulars of the cicatrices have been omitted in the register. These cases occurred in 1836-7-8. The collected number ought to have been rather larger. In making the tables, the cases were arranged yearly from 1836 to 1851, and one or two patients some years were found to have had the particulars about the cicatrix omitted. The numbers being unimportant, they were incorporated, for the sake of simplicity, with the list of cases without cicatrices; but when so many as 17 were found in 3 years, it was thought to be better to give them a separate heading. The total number of cases, however, so added to the list without cicatrices, did not exceed 20, and, so far as it goes, makes the per centage of deaths of the class without cicatrices rather less than it ought to have been.

TABLE V.

Ages of the Patients admitted with Smallpox after Vaccination, at the Smallpox and Vaccination Hospital, London, from 1836 to 1851 inclusive; and where they were vaccinated, so far as could be ascertained.

WHERE VACCINATED.	Number of Patients.	AGES OF THE PATIENTS.												RESULTS.			
		0-5			5-10			10-15			15-20			20-25			Rate per cent. of mortality from smallpox, after deducting entirely the cases affected by superadded disease.
		Admitted.	Died.		Admitted.	Died.		Admitted.	Died.		Admitted.	Died.		Admitted.	Died.		
Vaccinated at the stations of the National Vaccine Establishment, or at the Smallpox and Vaccination Hospital, or at the stations of the Royal Jennerian Society in London . . .	155	2	12	3	33	4	68	4	24	—	11	1	3	1	2	—	5.96
	370	5	2	29	76	1	135	7	77	5	26	3	13	1	3	6	4.93
Vaccinated in the Metropolis, but not at the Public Vaccine Institutions, so far as could be ascertained	1987	—	8	1	62	3	528	29	753	72	363	34	153	17	74	18	7.19
	79	—	—	—	—	—	16	1	36	2	15	2	7	—	4	1	3.89
Vaccinated in England and Wales	35	—	—	—	—	—	8	2	13	—	2	—	2	—	33	5	5.71
	279	—	2	—	6	1	47	1	103	6	80	13	19	1	16	2	6.95
" in Ireland	189	—	5	—	21	1	64	5	52	8	29	2	13	1	1	4	7.56
	3094	7	2	56	206	10	866	49	1058	93	526	55	210	21	102	20	6.76
Totals	3094	7	2	56	206	10	866	49	1058	93	526	55	210	21	102	20	6.76

TABLE V. But few patients under 10 years of age have been received with smallpox after vaccination. After 10 years the numbers begin to increase considerably, and the largest admitted are for the decennial period from the age of 15 to 25; and, although progressively diminishing, they continue rather large up to 30; from 30 to 35, they are nearly the same as from 10 to 15; but as in the unprotected, at this period of life the mortality is doubled, showing the cause to be, probably, as much or more depending on age and its concomitants, as on other circumstances. In still further advanced life, the rate of mortality will be seen to increase also, as in the unprotected state; but this tendency may be in a considerable degree counteracted there is but little doubt, by giving more attention than has hitherto generally been given to the perfection of the process of vaccination.

155 patients are reported to have had smallpox after having been vaccinated at the public vaccine institutions of London.

370 had been vaccinated in the metropolis, but not at the public vaccine institutions, so far as could be ascertained.

1987 patients were stated to have been vaccinated in the provinces of England and Wales.

79 in Scotland.

35 in Ireland. Only two a year. This is a very remarkable circumstance, when we bear in mind the large mass of Irish population resident in this metropolis, besides those here for a short time every year.

279 had been vaccinated in foreign countries; this number also includes a few, but very few, vaccinated in the British colonies.

189 did not know where they had been vaccinated: they were English, and principally country people.

The question, then, as regards the place where the vaccinations were performed, of the patients subsequently admitted with smallpox at the hospital, stands, collectively, per cent., thus :

Vaccinated at the Public Vaccine Institutions of		
London	5	per cent.
„ in the Metropolis, but not at the		
Vaccine Institutions, so far as		
could be ascertained	11	„
„ in the Provinces of England and		
Wales	64	„
„ in Scotland	2	„
„ in Ireland	1	„
„ in Foreign countries	9	„
Not known were vaccinated	6	„
	—	
	98	„
	—	

The remaining 2 per cent. are made up of fractions of the above.

TABLE VI.

Ages of the Patients at the time they were Vaccinated, who were subsequently admitted with Smallpox, at the Smallpox and Vaccination Hospital, London, from 1836 to 1851, inclusive.

DATE OF ADMISSION WITH SMALL POX. 1836—1851.	AGES IN YEARS WHEN VACCINATED.										TOTALS.
	0—5	5—10	10—15	15—20	20—25	25—30	30—40	40—50	50—60	Ages when vaccinated not stated.	
Patients	2794	101	64	17	6	—	—	—	1	111	3094

TABLE VI.—Of the 3094 patients admitted with smallpox after vaccination, 2794, or 90 per cent., had been vaccinated when under five years of age.

My opportunities of examining, with regard to previous vaccination, the foreigners admitted with smallpox at the hospital, and comparing them with each other, and with the same class of persons in this country, have led me to the conclusion that vaccination is performed in the best manner, generally, by the Danes, Swedes and Norwegians, and Germans, judging them by the standard shown in Table IV to afford the most effectual security: then come the Italians, and, from the few I have seen, the Spaniards; then the Scotch; then the Irish; and lastly, the English and French. The French who have been admitted as patients at the Smallpox Hospital, appear to have been very indifferently vaccinated; they have been but few, it is true, and these few may have been of the few badly vaccinated in France.

It will be observed, that two thirds of the whole number admitted with smallpox after vaccination had been vaccinated in the provinces of England and Wales. By 'provinces,' meaning the whole of England and Wales, except London, and the area included in the metropolitan district. I am most anxious to draw the attention of my professional brethren in the country to the above fact; and amongst that enlightened community, the feeling can scarcely fail to be otherwise than general, that there must exist some grave and lamentable evils (more especially affecting the humbler classes) connected with the circumstances under which vaccinations in country districts are performed. The details recorded in this paper may be urged as calling upon those of our provincial brethren whose position and ability give them influence, to lend their aid in tracing the evil to its root, and using their endeavours to remove a stigma, which, whatever may be its origin, is too likely to be shared by themselves with less skilful, less conscientious, and less scrupulous men. Some reasons may, perhaps, be assigned for a large number of persons in country districts being imperfectly vaccinated,

but there can be no justifiable reason why the rural inhabitants of England and Wales should be far less well vaccinated than are the rural inhabitants of Denmark, Sweden, and Prussia. That they are so, I know to be a fact, from the opportunities presented to me of observing large numbers of Germans more especially, who, from the efficient way in which they had been vaccinated, have had smallpox usually in the light varicelloid form. The subject is a delicate one to allude to—to point out defects is always painful, but the vital importance of the subject as affecting the health and lives of thousands, will be my excuse for the remarks now made, and for further calling attention to Table v, and the collected per centages at page 379. When so many of the lives of our patients are at stake, to say nothing of minor, though still grave evils, that may be prevented by greater care and better management,—it becomes a positive duty to express our opinions as strongly as may be consistent under the circumstances; to make at least an appeal to the profession, which will no doubt be promptly responded to by a more careful performance of an operation, which, though of minor importance in itself as a surgical operation, is of most serious importance in its consequences, as affecting health and life. If the great discovery of Dr. Jenner can avert, as I have shown it can when effectually carried out, the serious results of this terrible disease, it is surely desirable to be aware of any facts which might point out the means, and the necessity of performing the operation in a more complete manner. With good lymph, and the observance of all proper precautions, an expert vaccinator should not fail of success in his attempts to vaccinate above once in 150 times; yet a large number of those who take upon themselves the duty, think they do very well if they succeed, however imperfectly, five times out of six. Patients often present themselves with smallpox at the hospital, who state they have been cut 5, 6, 8 times, or more, for cowpox without effect. This is a great evil. It would happen but rarely in careful hands. Such persons think it is of no use having the operation tried again, that it will not take effect if they

do, and ultimately they are attacked by smallpox, and perhaps die; whereas, had they fallen into the hands of a good vaccinator, their lives would most likely have been saved. Instances of the above kind are of frequent occurrence at the Smallpox Hospital.

In December, 1836, a woman, *æt.* 54, and her son, *æt.* 15 years, were admitted with smallpox, and died in the course of five days: the daughter, a young woman, died of smallpox at their house in Hull Street, City Road, the day before the mother died at the hospital. All these poor people had been vaccinated three years previously, at a parish vaccination, at a village church in Suffolk, and bore marks of the vaccination. Now, knowing what we do of the protective powers of vaccination, it is almost impossible to suppose otherwise than that these poor people had been vaccinated with improper lymph. They, however, believed they had been efficiently vaccinated, and trusted to it for their security against smallpox. These three lives fell a sacrifice, most likely, to mere carelessness.

The mortality alone, severe as it is, between the indifferently vaccinated, and the well vaccinated patients, is not the only evil result to be regretted of bad vaccination. Proportionate to the mortality has been the severity of the disease in those who escaped death; damaged health, and disfigurement for life is frequently the lot of those who have smallpox after having been vaccinated imperfectly in but one place; thus bringing on vaccination discredit, which is in no way due to it intrinsically, but is owing solely, with but very few exceptions indeed, to the want of proper knowledge of the subject, and of the necessary care with which the operation has been conducted.

Great judgment and caution should be used in the selection of vaccine lymph; in this lies one of the principal causes of failure in vaccinating, and subsequent insecurity of the individual, even when the vaccination does take effect. This advice is offered after seventeen years of constant practice of vaccination, and after the experience acquired by vaccinating between forty and fifty thousand persons.

Lymph for use is in its best state on the seventh day of the progress of the vesicle it is taken from—the day week from the vaccination. It should be taken when the vesicles are plump, and just before the formation of the areola. Under no circumstances should it be taken for use later than twenty-four hours after the areola has begun to form. If this rule were invariably observed, there would be, as I believe, but very few cases of severe smallpox after vaccination. At this stage of the progress of the vesicle the lymph is in the state most certain of taking proper effect, and of leaving the best cicatrices, indicative of its efficacy, a result shown in the accompanying tables to be of the greatest importance to individual security, in case of smallpox occurring in after life. A serious error in vaccinating is the use of blunt lancets—lancets unsuitable for other purposes. It is impossible to have a lancet too sharp for vaccinating, the sharper the lancet, the more perfect the success of the operation, even in good hands.

Mode of conveying lymph.—A convenient way, in practice, of conveying lymph about for use, is in stoppered bottles, the stopper on which the lymph is placed, and kept fluid, being ground flat, and projecting into the bottle. The lymph ought not, however, to be kept in this way above twenty-four hours in warm weather, or forty-eight in cold. Like all other moist animal matter, it soon begins to undergo chemical changes, which render it unfit for use. When it has become putrid, or even putrescent, it will produce the fatal results which are well known to follow inoculation with decaying animal matter. Much the same remarks apply, *mutatis mutandis*, to the lymph preserved in capillary tubes, as to that preserved in bottles.

Mode of vaccinating.—The arm to be operated on should be firmly grasped by the left hand of the operator, so as to make the skin tense, then, the lancet being already charged, with the right hand the lymph should be introduced by a puncture of a valvular shape, from above downwards, so managed that the lymph at each puncture may gravitate into the wound. In this way the lymph may be introduced

in five punctures,—the number I recommend,—from half to three fourths of an inch apart, without recharging the lancet; the skin being kept tight all the while, until the lymph has been introduced, care being taken that the punctures are not bruised, as too frequently happens by undue use of the lancet. It then matters not how much the wounds may bleed, as the bleeding will not interfere with the success of the operation.

Mode of preserving lymph.—By far the best way of preserving vaccine lymph, and also of transmitting it to a distance, is on ivory points. They should be *well* charged, not simply touched; the quantity allowed to dry, should be about equal in its wet state to half a drop; when the charged points are required for use, they should be lightly dipped in water, and placed for a few minutes on the edge of a book, so that the lymph may have time to become soft, much as it was when taken from the vesicle. Then, after making a puncture with a lancet, the ivory point may be inserted into the arm, and kept there with the thumb for a short time; or the moistened lymph may be scraped off the point, and at once inserted with the lancet. Several little niceties are required in vaccinating with preserved lymph, which are not, generally, so much attended to as they deserve to be, in order to ensure perfect success.

Re-vaccination.—For many years past I have practised re-vaccination extensively on persons applying for the purpose at the vaccination room; on the servants and nurses of the hospital, on persons coming to visit their friends, patients in the hospital, and, lately, on the numerous workmen employed in building the new hospital. The effect produced by re-vaccination sixteen or seventeen years ago was, with some few exceptions, nothing more than a little irritation, or at most an abortive vesicle with irregular areola. But, during the last three or four years, I have seen a great many persons, on whose arms the vesicles produced by re-vaccination have been quite, or nearly perfect, even on those who bore good cicatrices from the first vaccination. I have always recommended revaccination after puberty,

principally for this reason, it gives those who have been indifferently vaccinated in infancy another chance of being protected. Probably it does not afford the same amount of protection that the first vaccination, well performed, does. The great object to aim at is to vaccinate *well* in infancy, this should be looked upon as the sheet-anchor; and, therefore, a careless vaccination should be deprecated at all times, practised under the belief that if it fails to take effect properly, it will be of no consequence, as the operation can be repeated. By such proceeding the vaccination often takes effect badly, and will never afterwards take effect properly, and yet the individual may take smallpox severely. This should be viewed as, unfortunately, one of the imperfections in the practice of vaccination, but the knowledge of it teaches us the paramount importance of paying the strictest attention to the mode of performing the *first* vaccination.

In 1838 smallpox attacked the children in the Deaf and Dumb Asylum, and one or two a week, for three or four weeks, sickened with it, when Dr. Babington,¹ physician to the Asylum, requested me to re-vaccinate the whole of the inmates, about 260. I did so. Four days afterwards another child was attacked, who had received the infection of smallpox before he was re-vaccinated, but from this date the disease was arrested in the establishment. Some months subsequently, a servant, who had come fresh into the asylum, had smallpox, but the disease on this occasion did not spread to the other inmates.

For upwards of seventeen years of my connection with the Smallpox Hospital, not one of the servants or nurses of the hospital has been attacked by smallpox, although vaccination has been the only protection of many of them; but I have always re-vaccinated them on their first coming to live at the hospital.

¹ For an account of two similar occurrences and results, see a paper entitled, Cases of Smallpox which occurred in the Asylum for the Deaf and Dumb, with an account of the Re-vaccination of all the Children in that establishment, by Dr. Babington, 'Guy's Hospital Reports,' vol. i, p. 159.

On rebuilding the hospital lately, a large number of workmen were employed for several months after the arrival of the patients, most of these workmen consented to be re-vaccinated, two only were attacked by smallpox, but *they* were amongst the few who were *not re-vaccinated*.

The inferences deducible from the foregoing facts and statements are :

1. That natural smallpox destroys about one third of all whom it attacks.

2. That smallpox after smallpox is of comparatively rare occurrence in a population who owe their protection in large numbers to having gone through the natural, or inoculated disease. That a second attack of natural smallpox, as well as being rare, is probably not often fatal, and that protection seems to be the law. That after inoculated smallpox, an attack of smallpox has more frequently led to fatal results, but there is reason to presume, that the virus used for inoculation, like a great deal of the lymph used at the present day for vaccination, was often taken at too advanced a stage of the disease, and thus did not afford the full measure of protection it was capable of affording, if taken at a proper time. That when the disease does occur, it is sometimes modified, as it is after vaccination, and that the modification presents the same characters. That second attacks of smallpox are further presumed to be of very rare occurrence, as there is no instance recorded of a person admitted with smallpox a second time at the Smallpox Hospital, although the hospital has now been founded 107 years. That, as upwards of 20 different diseases are known by the author to have been mistaken for smallpox during the last sixteen years, and sent as such to the Smallpox Hospital, it may be fairly assumed that many of the cases reported amongst the public, during the last quarter of a century, as second attacks of smallpox, have been either in the primary or secondary instance, no smallpox at all. That smallpox does, however, occur a second time there can be no reasonable doubt, and one of the circumstances that seems to predispose the constitution to receive a second attack of the disease is, as after vaccination,

exposure for a time to great change of climate, either hot or cold.

3. That vaccination performed in infancy affords almost complete protection against the fatality of smallpox to the period of puberty. That a variety of circumstances conspire to make it almost impossible to ascertain exactly in what proportion to the vaccinated, cases of smallpox do subsequently occur, or might occur, if all persons lived to an advanced age; in illustration of which it may be stated that a woman, 83 years of age, was admitted at the hospital in 1844, with severe confluent natural smallpox, of which she died, who had nursed her own children, and her grandchildren with the disease, and had otherwise been exposed often to variolous infection, but never took it before. That of the small proportion to the great mass protected by vaccination, who do unfortunately take smallpox in after life, of those who have been vaccinated indifferently in but one place, about 12 per cent. die; but that of those who have been well vaccinated in four places or more, the proportion of deaths is less than 1 per cent.; so that by careful management the protection to life may be rendered all but perfect.

4. That as a matter of safety, it is well for all persons who were vaccinated in infancy to be revaccinated at puberty, this measure being more especially requisite for those who were either indifferently or doubtfully vaccinated in infancy, and still more especially necessary for those who though vaccinated, have no cicatrix remaining. Finally, as a matter of precaution, it is desirable that all persons should be revaccinated, on smallpox existing in the house where they are residing; a precaution, however, that will cease to be necessary to advise when all persons have the benefit of proper and efficient vaccination.

A circumstance has come to my knowledge in prosecuting this inquiry, which, in conclusion, I beg to submit to the Society. And although its bearing is not so rigidly precise as the rest of this communication, the point it conveys is of an important character, substantially true I believe, and

proper to be brought forward on this occasion, as showing, on a large scale, the protective powers of vaccination. Already it has been stated that in sixteen years, 155 patients, with and without vaccine cicatrices, or about 9 a year, have been admitted with smallpox at the Smallpox Hospital, who were reported to have been vaccinated at the Public Vaccine Institutions of London. In an Appendix to the Report from the Select Committee of the House of Commons on the Vaccine Board, in 1833,¹ there are some official returns for the previous five years, of the numbers vaccinated annually at the different stations of the National Vaccine establishment, at the Smallpox and Vaccination Hospital, and at the stations of the Royal Jennerian Society in London, which, together, will be found to amount to 102,114; this, divided by 5, gives an average of 20,422 as vaccinated yearly. About the same numbers had been vaccinated at these institutions for several years before the returns were made, were continued, somewhat increased, for several years later, until after the time of passing the Vaccination Act in 1840, and, with perhaps some slight diminution of late years, have been continued ever since. These persons so vaccinated were for the most part poor persons, and also for the most part stationary, living too in a town where smallpox is never absent, and in case of being attacked by it, likely to apply for admission at the Smallpox Hospital, the only place in London for the reception of smallpox patients; yet the numbers admitted with smallpox, who had been vaccinated at these public vaccine institutions, have amounted but to a fraction over 9 a year, or 1 to 2108 vaccinated; and the deaths from smallpox but to 1 in 36,305 vaccinated.

This may be truly designated one of the triumphs of medical science; a result more favorable and gratifying could hardly have found a place in the most sanguine and philanthropic hopes of the humane and illustrious Jenner.

¹ Report from the Select Committee on the Vaccine Board, with the Minutes of Evidence, and an Appendix, ordered by the House of Commons to be printed, 28th August, 1833, Appendix A, B, C, pp. 137, 141, 149.