VACCINATION IN DIFFERENT COUNTRIES.

Years.	The German Empire.[1] Number of Vaccinations.	Scotland.[2] Successful vaccinations.	Scotland.[2] Per cent. of births.	Holland.[3] Vaccinations.	Dutch Colonies.[3] Vaccinations and revaccinations.	England.[4] Successful vaccinations of children.	England.[4] Per cent. of children not accounted for.	Japan.[5] Vaccinations.	Austria.[6] Vaccinations.	Austria.[6] Per cent. of living born.	British India.[7] Successful vaccinations.	British India.[7] Per 1,000 of the total population vaccinated.
1885	.....	.....	....	.....	1,407,927	757,714	5.8	4,325,437	678,677	77.3	4,703,214	
1886	.....	110,864	86.6	.....	1,307,239	754,059	6.4	5,842,447	691,460	80.3	4,950,893	
1887	.....	107,077	86.0	.....	1,378,470	733,980	7.1	3,066,491	694,357	79.3	5,202,595	
1888	2,487,484	106,734	86.6	.....	1,810,131	719,103	8.5	2,360,239	727,802	82.0	5,640,967	
1889	2,485,485	104,931	85.4	.....	1,297,703	707,161	9.9	1,970,292	703,897	79.1	5,709,462	25.7
1890	2,463,268	103,635	85.2	112,594	1,354,801	682,560	11.3	1,985,580	710,034	79.0	5,974,598	28.9
1891	2,462,603	107,482	85.3	118,209	1,424,923	693,117	13.4	2,224,791	768,621	88.4	5,882,683	26.8
1892	2,444,821	107,352	85.8	128,756	1,482,929	663,657	14.9	6,086,472	816,767	88.8	6,396,480	27.5
1893	2,433,779	108,117	85.0	123,870	1,903,001	661,513	16.1	7,994,702	751,780	83.8	6,716,134	28.9
1894	2,534,040	106,840	85.8	163,412	1,873,680	626,126	19.2	4,225,927	749,708	81.2	6,869,271	30.3
1895	2,513,900	108,035	85.7	109,194	1,536,571	624,690	20.5	2,848,646	734,069	81.4	7,223,591	32.0
1896	2,533,227	110,033	85.1	117,653	1,830,071	602,922	22.9	4,679,232	763,864	87.1	7,309,087	32.3
1897	2,630,176	108,378	84.0	119,830	1,736,041	578,639	22.7	15,701,684	742,200	78.2	7,144,474	31.5
1898	2,679,015	108,981	83.2	124,257	2,265,721	562,737	21.5	.....	734,989	77.8	6,880,915	30.2
1899	2,735,923	109,261	85.5	125,709	2,838,343	617,113	17.2	.....	.....	.....	7,457,916	32.9
1900	2,764,778	111,487	84.8	129,000	3,244,236	.....	....	.....	.....	.....	7,865,711	31.8

[1] Germany. "Die Ergebnisse des Impfgeschäfts im Deutschen Reiche," 1888–1900.
[2] Scotland. Reports of the Registrar-General of Scotland, 1886–1900.
[3] Holland. Reports of the Central Bureau of Statistics, 1900, p. 14.
[4] England. Reports of the Local Government Board, 1885–1900.
[5] Japan. Reports of the Central Sanitary Bureau, 1885–1897.
[6] Austria. "Oesterreichisches statist. Handbuch," 1885–1900. Also, "Statist. Sanitätswesen," Wien, 1901.
[7] British India. Reports upon the Sanitary Measures in India, 1885–1900.

The figures in the foregoing table are those of vaccinations performed by public officials only, and do not include many which are done by private practitioners. Such figures are obtainable only in countries where the value of such information is properly estimated. Unfortunately, in the United States, as a general rule careful records of vaccination are not kept, except in a few cities, and but little is known as to the number or the results of the vaccinations made in each year.

In every case the record should not be considered complete unless it contains at least the name and address of the person vaccinated, and the results of an inspection made within ten days afterward.

The blank form on the opposite page, simplified from those now used in England, gives the essential items necessary for a public record of vaccination.

In the following table are presented from official sources the numbers of vaccinations and revaccinations in several foreign cities mostly for the five years 1895–99.

VACCINATIONS IN LARGE CITIES, FIVE YEARS 1895–1899.

	Living births.	Primary vaccinations.	Re-vaccinations.	Total vaccinations.	Primary vaccinations. Per cent. of living births.
London[1] (1895–99)	668,012	400,502	.....	400,502	59.9
Paris[2] (1895–99)	293,375	178,419	256,849	435,268	60.8
Vienna[3] (1895–99)	125,500	110,689	30,837	141,526	88.2
Budapest[4] (1895–98)	88,319	92,970	42,011	134,981	105.3
Milan[5] (1898–99)	24,896	18,069	41,240	59,309	72.6

[1] Reports of Local Government Board, 1895–1900.
[2] Annuaire Statistique, Paris, 1895–99.
[3] Statistisches Jahrbuch.
[4] Statistisches Jahrbuch.
[5] Municipio di Milano. Dati Statistici, 1900.

The foregoing figures relate to official vaccinations performed and recorded by official vaccinators; except in Vienna, where vaccinations performed and reported by private physicians are also included.

After deducting those infants who died unvaccinated, there still remained in London and Paris a large unvaccinated infantile population.

In the figures for primary vaccinations in Budapest a considerable number of older persons appear to be included, so that the number of vaccinations exceeds that of living births.

The vaccinations in Paris are reported by the following authorities: By thirty-four hospitals and asylums, by bureaus of charity, by the Academy of Medicine, by the general sanitary inspection service, and by those having in charge infants supported at public cost.

Germany has at the present day the most thoroughly vaccinated population in the world, since the compulsory law of that country is the most efficiently enforced.

The following figures present the numbers of the vaccinated and revaccinated for the year 1900.[8]

Total number liable to vaccination	3,101,465
Total number liable to primary vaccination after excluding exempts	1,739,968
Total number liable to revaccination	1,281,039
Total	3,021,007
Total number vaccinated (primary)	1,518,510
Total number revaccinated	1,246,268
	2,764,778

Of these 99.94 per cent. were vaccinated with calf lymph and only 0.05 of one per cent. were vaccinated with humanized lymph. Glycerinated calf lymph was used in 1,485,522 of the primary vaccinations and also in 1,218,243 of the revaccinations. (For further figures see table at the top of this page.)

England.—In England in 1899 the statistics were as follows:

Number of births	929,189
Number successfully vaccinated	617,113
Reported as insusceptible	5,379
Had smallpox	4
Number in respect of whom certificates of conscientious objection have been received, under law of 1898.	33,573
Died unvaccinated	113,516
Vaccinations postponed	16,605
Remaining	142,999

The percentage of children not accounted for, as compared with the births, was 17.2, that of 1898 having been 21.5.

Japan.—The following table presents the number of vaccinations in Japan in 1897 (the latest publication of the Central Sanitary Bureau).[9]

TOTAL VACCINATIONS IN JAPAN IN 1897.

	Successful.	Unsuccessful.
Primary	1,259,796	411,869
Revaccinations	4,458,265	9,571,754
Total	5,718,061	9,983,623

The success ratio of primary vaccinations was 75.3, that of revaccinations 31.8 per cent.

RECORD OF VACCINATION.

To be filled on the day of Inspection.

Number.	1.	2. Date of Vaccination.	3. Name of Vaccinated Person.	4. In case of Revaccination at ages over ten years, of persons previously successfully vaccinated, mark R.	5. Age. Yrs.	5. Age. Mos.	6. Residence. (Street and Number.)	7. Source of Lymph. Name of Producer.	8. Number of separate scarified areas or punctures made.	9. Initials of Vaccinator.	10. Date of Inspection.	11. Result. Successful. Number of separate vesicles produced.	11. Result. Unsuccessful.	12. Initials of Inspector.	13. Certificate of School Vaccination given. Yes.	13. Certificate of School Vaccination given. No.	14. Remarks.
	1																
	2																
	3																
	4																
	5																
	6																
	7																
	8																
	9																
	10																

These forms may be conveniently made into books of 100 or 200 in each, sufficient for 1,000 or 2,000 vaccinations. If made up in this manner, the columns should be wider than those shown in the sample, and a blank space of two inches should be left between columns nine and ten for the convenience of folding and binding, the fold being made at that point.

The whole number of primary vaccinations in Japan in the ten years 1887–96 was 11,726,601, and the revaccinations in the same time were 16,709,064, making a total of 28,435,665. The total number vaccinated in 1897 (15,701,684) was more than half as many as the sum of the vaccinations of the preceding ten years. This enormous number is accounted for in the official report as follows:

"The furious rage of smallpox, and the cheapness of the price of vaccine lymph sold by the government institutes encouraged vaccination, and the number of vaccinated persons was very numerous compared with that of preceding years."

Italy.—The following figures presenting the number of vaccinations in Italy in the five years 1889–93 are given in "La Legislation et l'administration sanitaire en Italie, Rome, 1894."

NUMBER OF VACCINATIONS IN ITALY, 1889–93.

1889	1,194,390	1892	1,997,114
1890	1,618,880	1893	2,353,716
1891	1,930,502		

In many of the United States, in consequence either of the entire absence of laws relative to vaccination or on account of the lax enforcement of such as exist, it is probable that the ratio of vaccinations to births is less than that of most of the countries of Europe, unless a few cities of the former may be excepted in which efficient boards of health have enforced annual vaccinations and revaccinations.

A general vaccination was made by the State Board of Health of Illinois in 1882, in which 233,340 vaccinations were performed in a population of over 3,000,000 people. Of these, 153,936 were primary vaccinations and 79,404 were revaccinations; the former being about double the annual number of births, the latter being estimated at 25 per 1,000 of the population.

A publication issued by the State Board of Health of Tennessee, April 1st, 1902, estimates the number of persons in that State who had been vaccinated in the previous three years as 753,617, or 41 per cent. of the total population. Of the white population 36 per cent. had been vaccinated, and of the colored population 50 per cent.

For the three years ended February 19th, 1902, there had also been in the same State 13,106 reported cases of smallpox, with a mortality of only 276 deaths, or 2 per cent.

The following statement occurs in the Report of the Surgeon-General of the United States Army for the year ended June 30th, 1899:

The population of Porto Rico is about 900,000. Smallpox was of frequent occurrence. It was decided to vaccinate all who had not recently had smallpox. This was carried out rapidly and efficiently; 786,290 persons were vaccinated.

By an order of January 27th, 1899, every resident "who has not had smallpox was ordered to be vaccinated, and hereafter all infants before reaching the age of six months."

The vaccine lymph was produced from heifers reared upon the island, and the cost of the work was $28,536.17.

THE PROTECTIVE POWER OF VACCINATION.—In order to consider this phase of the question intelligently, and to determine satisfactorily the protective value of vaccination and of revaccination against smallpox, it will be necessary to consider the subject: *first*, by a comparison of the period before, with the period following, the introduction of vaccination; *second* (since it may with reason be urged that epidemics of several infectious diseases have become less severe within a century or more), a comparison of different populations living under similar conditions, except that of vaccination; and *third*, a consideration of the effect of vaccination upon the age-distribution of smallpox.

1. *The Period Before and the Period After the Introduction of Vaccination.*—It will be necessary in this connec-

tion to review the history of smallpox, for a century or more, in different countries.

"At the present day," says Simon, "the very success of vaccination may have blinded people to its importance. It is very easy to be bold against an absent danger, to despise the antidote while one has no painful experience of the bane."

Smallpox is fatal to a large proportion of those whom it attacks; it is eminently infectious from person to person; it seizes, with very few exceptions, upon all unvaccinated persons who for the first time come within its range.

Although smallpox has been described with accuracy by early writers, notably by the Arabian physician Rhazes, its history previous to the eighteenth century must be regarded as in a great measure defective, in consequence of being confounded with measles and with other diseases.

It is known that not a decade passed in the seventeenth and eighteenth centuries without the occurrence of devastating epidemics of smallpox in Europe. In England from seven to nine per cent. of all deaths were attributable to smallpox. In London it averaged from four to eight per cent. of the total deaths. Capt. John Graunt, in his observations on the Bills of Mortality of London (published in 1665), gives the number of deaths from smallpox for twenty years (1629 to 1636, 1647 to 1658), as 10,576, out of a total mortality of 229,250. It was also the seventh in the order of destructiveness upon the population, consumption being first.

In Berlin, from 1783 to 1797, one-twelfth of all deaths, according to Casper, were from smallpox. M. de la Condamine estimates that one-tenth of all deaths in France, amounting to 30,000 annually, were from smallpox. Three and a half millions perished from it in Mexico in the sixeenth century. In 1734 nearly two-thirds of the population of Greenland were swept away by it. In Iceland 18,000, out of a population of 50,000, died of smallpox. Catlin, in his "Letters and Notes on the Manners and Customs of the North American Indians," says: "I would venture the assertion, from books that I have read and from other evidence, that of the numerous tribes that have already disappeared, and of those that have been traded with, quite to the Rocky Mountains, each one has had this exotic disease in their turn, and in a few months have lost one-half or more of their numbers."

Wernher says, in his recent work, "Zur Impffrage": "Before the introduction of vaccination smallpox had become a permanent disease which never entirely ceased in one year, and every three or five years became a great epidemic.

"In non-epidemic years one-tenth of all mortality was from variola, in epidemic years one-half. Very few men escaped smallpox till old age; almost every one sickened at least once in his life of this horrible, murderous disease.

"Countless mortals who escaped death were maimed by loss of sight. Of new-born children, one-third died of smallpox before their first year; one-half before their fifth year of life. There was no family which had not heavy losses to deplore. In the country the mortality was greater than it was in the city.

"Physicians and Government possessed no means against this abominable evil. Isolation was impracticable from the general, widespread nature of the disease. Men accepted the pest as an unavoidable fate.

"The loss which Europe suffered from this one disease amounted to many millions. It was a principal factor which deterred or kept the population from progress; and to lead us back to these conditions are the efforts of many ignorant mortals directed."

Comparing the present conditions with those just stated the author goes on to say:

"We now find no child mortality from smallpox among vaccinated children.

"Also, among adults, whenever vaccination and revaccination are maintained, mortality from smallpox is at an end."

The following familiar table is herewith quoted from the "Report of the Epidemiological Society of London," and contains very conclusive evidence of the decline of smallpox in different countries after the introduction of vaccination. Two series of facts are presented. (1) The number of persons per million of the population who died of smallpox annually *before* the introduction of vaccination; and (2) the number per million who died annually of the same disease after its introduction. The periods are not in all cases the same, but the statistics are those which it was possible to collect for the periods named.

Period relative to which data are given.	Country or city.	Approximate Average Annual Death Rate by Smallpox per Million Inhabitants.	
		Before introduction of vaccination.	After introduction of vaccination.
1777–1806 and 1807–1850.	Lower Austria	2,484	340
1777–1806 and 1807–1850.	Upper Austria, and Salzburg	1,421	501
1777–1806 and 1807–1850.	Styria	1,052	446
1777–1806 and 1807–1850.	Illyria	518	244
1777–1806 and 1838–1850.	Triest	14,046	182
1777–1803 and 1807–1850.	Tyrol and Voralberg	911	179
1777–1806 and 1807–1850.	Bohemia	2,174	215
1777–1806 and 1807–1850.	Moravia	5,462	255
1777–1806 and 1807–1850.	Silesia (Austrian)	5,812	198
1777–1806 and 1807–1850.	Galicia	1,194	676
1787–1806 and 1807–1850.	Bukowina	3,527	516
1776–1780 and 1810–1850.	Prussia (Eastern)	3,321	56
1780 and 1810–1850.	Prussia (Western)	2,372	356
1780 and 1816–1850.	Posen	1,911	743
1776–1780 and 1810–1850.	Brandenburg	2,181	181
1776–1780 and 1816–1850.	Westphalia	2,643	114
1776–1780 and 1816–1850.	Rhenish Provinces.	908	90
1781–1805 and 1810–1850.	Berlin	3,422	176
1776–1780 and 1816–1850.	Saxony (Prussian).	719	170
1780 and 1810–1850.	Pomerania	1,774	130
1774–1801 and 1810–1850.	Sweden	2,050	158
1751–1800 and 1801–1850.	Copenhagen	3,128	286

In the accompanying chart (Fig. 4925) are also presented the data relative to the mortality from smallpox in Sweden before and after the introduction of vaccination, by which it appears that in the twenty-four years before the introduction of vaccination in 1801 the mortality from smallpox counted 2,050 victims annually out of each million of the population, and after the introduction of vaccination this mortality was reduced to 158 per million annually. The period anterior to 1773, included in the original, has been omitted, since the deaths from smallpox previous to that year were not separated from those from measles.

No complete statistics of American cities for the period before the introduction of vaccination can be obtained. The data contained in the accompanying table are compiled from the most reliable historical sources, with reference to the prevalence of smallpox in Boston.

After the settlement of the colony at Plymouth, in 1620, smallpox appeared frequently in Massachusetts, among both the Indian tribes and the English settlers. Such epidemics occurred in 1631, 1633, 1639, 1677, 1678 (from 700 to 800 died in this year), 1702 (213 died, which was about 4.4 per cent. of the population). In 1721, with a population of 11,000, there were in Boston 5,989 cases of smallpox, more than half the population taking the disease, of which number 850 died. In the words of the historian: "The disease ran riot over the town, feasting on all who were susceptible to its poison" (Dr. Toner, in publications of Mass. Med. Soc., 1866, vol. ii.).

In 1730, with a population of 15,000 people, 4,000 were sick, and about 500 died. A vessel from London, with smallpox on board, was wrecked in 1751 near Nahant, and spread the disease again, and there were 7,653 cases, and 545 deaths. It broke out in the American army at

Cambridge in 1776, and Dr. Waterhouse wrote: "There were scarcely enough men free from it, or not liable to take it, to keep guard at the different hospitals."

In 1792, 8,346 had smallpox. In this epidemic it is stated that, out of a population of 19,484, 10,655 had already had smallpox, and that only 221 persons escaped having it, the remainder having moved out of town.

So virulent did it at times become as to compel the legislature to hold its sessions in some other town (Report of State Sanitary Commission of 1850, pp. 64–70).

After the introduction of vaccination the mortality from smallpox in Boston was as follows, so far as the records can be obtained:

	Deaths.		Deaths.
From 1811 to 1820	6	From 1861 to 1870	500
From 1821 to 1830	8	From 1871 to 1880	1,094
From 1831 to 1840	214	From 1881 to 1890	24
From 1841 to 1850	534	From 1891 to 1900	32
From 1851 to 1860	732	For 1901 and 1902	267

By reference to the tables relative to the prevalence of smallpox, which for the eighteenth century present only the date of epidemic years, since other data are not to be had, it will be seen that the highest ratio of deaths from smallpox, in any epidemic year since the introduction of vaccination (2.95 per 1,000 of the living population), was much less than that of the lowest epidemic year before its introduction.

Among the few records as to the prevalence of smallpox before the general introduction of vaccination, one of the best is found in a recent paper by Dr. John C. McVail, of Kilmarnock, Scotland, published in 1882 (Fourteenth Report of Medical Officer of the Local Government Board of England, p. 39). It presents a most graphic picture of the prevalence of smallpox at that time. It appears that a schoolmaster of Kilmarnock,

Smallpox in Boston before the Introduction of Vaccination. Epidemic Years Only.

Year.	Population.	Cases of smallpox.	Deaths from smallpox.	Death rate from smallpox per 1,000 inhabitants.	Remarks.
1631 [1]	.....	....	Very many.		
1633 [2]	.....	....	Very many.		
1639 [3]	150	....	Very many.		
1677 [4]	4,000	....	Very many.		
1678 [5]	4,000	....	Very many.	.....	700–800 died in Massachusetts, exclusive of blacks.
1702 [2]	6,750	....	213	31.5	
1721..	11,000	6,006	850	77.3	Inoculation introduced.
1730..	15,000	4,000	500	33.3	
1752..	15,731	7,669	569	36.2	
1764..	15,520	5,646	170	10.9	
1776 [6]	5,750	5,392	57	10.0	
1778 [6]	10,000	2,243	61	6.1	
1792..	20,000	8,346	198	9.9	

[1] Increase Mather. [2] Report of Sanitary Commission, 1850.
[3] Webster's History of Pestilence. [4] Charlestown Records.
[5] Felt: Annals of Salem. [6] Population changeable; years of war.

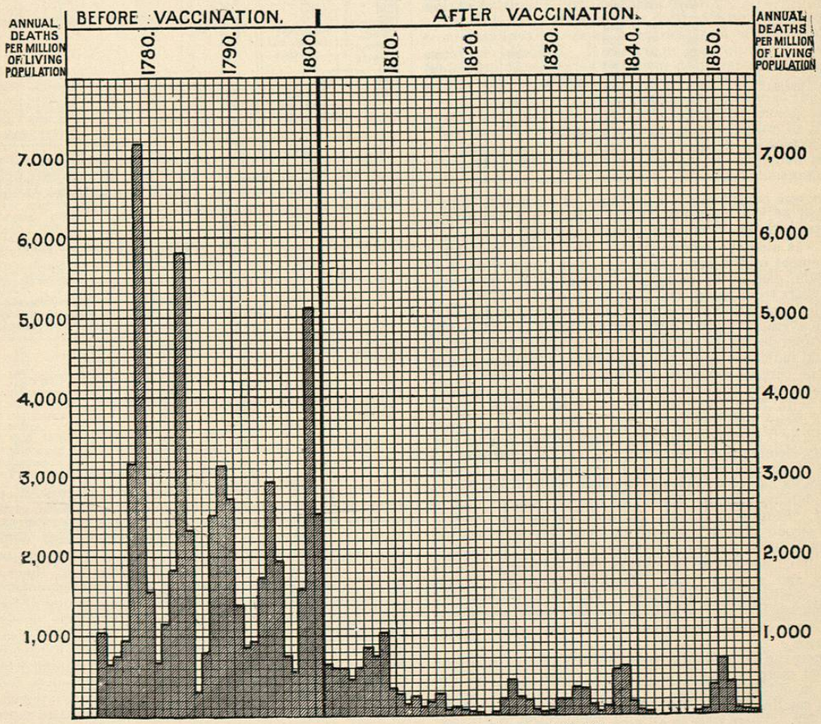

Fig. 4925.—Death Rates from Smallpox in Sweden, 1773–1855.

SMALLPOX IN BOSTON AFTER INTRODUCTION OF VACCINATION.

Year.	Population.	Cases of smallpox.	Deaths from smallpox.	Death rate per 1,000 inhabitants.	Year.	Population.	Cases of smallpox.	Death from smallpox.	Death rate per 1,000 inhabitants.
1811.	33,000		2	0.06	1857	.....	....	2	0.01
1812.	.....		....	....	1858	.....	....	3	.02
1813.	.....		....	....	1859	.....	....	156	.97
1814.	.....		....	....	1860	177,840	....	162	.92
1815.	.....		4	.12	1861	.....	....	7	.04
1816.	.....		....	....	1862	.....	....	13	.07
1817.	.....		....	....	1863	.....	....	11	.06
1818.	.....		....	....	1864	.....	....	113	.63
1819.	.....		....	....	1865	192,318	....	115	.60
1820.	43,298		....	....	1866	.....	....	51	.26
1821.	.....		....	....	1867	.....	....	144	.75
1822.	.....		....	....	1868	.....	....	8	.04
1823.	.....		....	....	1869	.....	....	6	.03
1824.	.....		1	.02	1870	250,526	....	32	.13
1825.	58,277		1	.017	1871	.....	....	28	.11
1826.	.....		....	....	1872	2,592	738	2.95	
1827.	.....		3	.05	1873	.....	1,103	302	1.21
1828.	.....		2	.03	1874	.....	3	2	.008
1829.	.....		....	....	1875	341,919	7	1	.003
1830.	61,392		....	....	1876	.....	1	2	.006
1831.	.....		4	.06	1877	.....	....	4	.012
1832.	.....		2	.03	1878	.....	....	....	....
1833.	.....		....	....	1879	.....	....	....	....
1834.	.....		4	.05	1880	362,839	7	1	.003
1835.	78,653		7	.10	1881	.....	44	6	.017
1836.	.....		6	.09	1882	.....	24	8	.022
1837.	.....		13	.16	1883	.....	8	1	.003
1838.	.....		3	.04	1884	.....	1	1	.003
1839.	.....		60	.09	1885	390,393	11	2	.005
1840.	93,383		115	1.23	1886	.....	1	....	....
1841.	.....		57	.61	1887	.....	4	....	....
1842.	.....		42	.45	1888	.....	8	1	.002
1843.	.....		55	.06	1889	.....	10	2	.005
1844.	.....		....	....	1890	448,477	1	....	....
1845.	114,366		31	.27	1891	.....	....	....	....
1846.	.....		92	.81	1892	.....	....	....	....
1847.	.....		23	.20	1893	.....	26	4	.008
1848.	.....		21	.19	1894	.....	77	22	.045
1849.	.....		21	.19	1895	496,920	....	....	....
1850.	136,881		192	1.40	1896	.....	....	....	....
1851.	.....		63	.46	1897	.....	10	....	....
1852.	.....		12	.09	1898	.....	....	....	....
1853.	.....		6	.04	1899	.....	29	5	.010
1854.	.....		118	.86	1900	560,892	7	....	....
1855.	160,490		132	.80	1901	.....	504	79	.14
1856.	.....		78	.49	1902	.....	1,024	188	.32

No record.

who was considerably in advance of his times, kept a record of the mortality of his parish in a beautifully written volume. This schoolmaster, Robert Montgomerie, was also the session clerk. The record contains a statement of the name, date, age, and cause of death of all who died in the parish of Kilmarnock for the thirty-six years from March 1st, 1728, to March 1st, 1764.

The population of the town in question is estimated to have averaged 4,200 for the period under consideration. The total deaths for the thirty-six years were 3,860, which would indicate a death rate of 24.36 per 1,000 per annum. In the careful record of the schoolmaster, which is divided into groups of six years each, four causes are credited with fully two-thirds of the total deaths. These were decay, age, smallpox, and fevers. What is meant by decay it is not easy to state; that old age is not a necessary element is evident from the fact that deaths at the ages of one and two years are attributed to it. The term embraces nearly all chronic diseases causing emaciation and debility, among which, of course, consumption is chief. From such cause or causes there were 915 deaths. The second disease was age, with 625 deaths, which appears to have formed a convenient class for all persons who lived beyond seventy years, and for many between sixty and seventy years. Omitting smallpox, fevers were credited with 545 deaths. This term probably included scarlet fever, which is not mentioned elsewhere, and also, perhaps, pneumonia and other acute febrile diseases.

There can be no doubt, says Dr. McVail, that smallpox caused more deaths, by a long way, than any other disease in old Kilmarnock. The entire number of deaths from smallpox in this little parish for the thirty-six years was 622. There were in all nine epidemics in the thirty-six years, the average time between the epidemics being four years. They came with terrible regularity.

The following table presents the data of these epidemics of smallpox by years and by ages:

Year.	Total deaths.	Age in years at death.							Age not stated.
		Under 1.	1.	2.	3.	4.	5.	6 and over.	
1728	66	7	14	12	14	9	5	4	..
1729									
1730	..	..	..	..	..	..	..	..	1
1731	..	..	..	..	..	..	..	..	..
1732	..	..	..	..	..	..	..	..	..
1733	45	12	9	13	6	4	..	1	..
1734	..	..	..	..	..	..	..	..	..
1735	..	..	..	..	..	..	..	..	..
1736	66	12	20	20	8	1	1	4	..
1737	..	..	..	..	..	..	..	..	..
1738	..	..	..	..	..	..	..	..	..
1739	..	..	..	..	..	..	..	..	..
1740	66	15	21	9	14	2	2	2	1
1741	..	..	..	..	..	..	..	..	..
1742	..	..	..	..	..	..	..	..	..
1743	..	..	..	..	..	..	..	..	..
1744	74	15	13	19	11	10	2	3	1
1745									
1746	8	3	2	1	1	..	..	1	..
1747	..	..	..	..	..	..	..	..	..
1748	2	..	..	1	1	..	..	..	..
1749	84	12	17	22	15	12	..	5	1
1750									
1751	1	..	..	..	1	..	..	..	..
1752	..	..	..	..	..	..	..	..	..
1753	1	1	..	..	..	..	..	..	..
1754	95	23	25	15	15	10	5	2	..
1755	..	..	..	..	..	..	..	..	..
1756	..	..	..	..	..	..	..	..	..
1757	46	11	11	13	6	4	1	..	2
1758									
1759	..	..	..	..	..	..	..	..	..
1760	..	..	..	..	..	..	..	..	..
1761	..	..	..	..	..	..	..	..	..
1762	66	7	7	10	9	10	8	4	3
1763	2	..	..	1	..	..	..	1	..
Totals	622	118	139	136	101	62	24	27	9

In seven of these nine epidemics the death rate for the year was higher than the birth rate, in one year to the extent of seventy-two per cent. The statistics of these years are summed up in the following table:

EPIDEMIC YEARS IN WHICH THE TOTAL DEATHS EXCEEDED THE TOTAL BIRTHS.

Year.	Births.	Deaths from all causes.	Deaths from smallpox.	Excess of deaths over births.
1728–29	111	162	66	51
1736–37	135	147	66	12
1740–41	95	164	65	69
1749–50	134	149	79	15
1754–55	146	203	95	57
1757–58	125	132	37	7
1762–63	132	173	66	41
Total	878	1,130	474	252

It will prove instructive to compare the greatest epidemic of modern times, in the same town, with the greatest to be found in the old records. In the year 1874 there were 141 deaths from smallpox in Kilmarnock, which then had 24,000 inhabitants, or at the rate of 5.8 per 1,000 living. The old epidemic was, therefore, four times as severe as the modern one, and it should be remembered that while the former epidemic had only a period of four and a half years in which to collect its victims, no serious epidemic had occurred for more than thirty years previous to 1874. One can hardly conceive what would be said at the present day about an ordinary annual death rate as great as that of what we have learned to look upon as a terrible epidemic, and yet an annual epidemic equal to that of 1872–73 would do little more than represent the conditions which prevailed in the eighteenth

century. Similar statistics for other English towns confirm these statements of Dr. McVail.

2. *Comparison of the Vaccinated with the Unvaccinated in Like Periods of Time.*—If, now, it shall be urged, as it is occasionally, with some degree of reason, that certain malignant diseases have almost disappeared, at least from among civilized nations, and that the disappearance, or comparative rarity, of smallpox is not a necessary consequence of vaccination, let us then examine the condition of the vaccinated, as compared with that of the unvaccinated, with reference to their immunity from smallpox, while living in a similar environment and at the same period of time.

Wherever extensive parallel observations are made upon large populations of the vaccinated and of the unvaccinated, as exposed to epidemics of smallpox, the protective power of vaccination is especially manifest.

In the accompanying table are given the statistics of different populations in which observations are made upon the comparative immunity from smallpox of the vaccinated and the unvaccinated. It will be noticed that in the majority of the instances noted, the mortality among the vaccinated was but one-fifth or one-sixth of that of the unvaccinated, and that the highest mortality among the vaccinated was less than the lowest among the unvaccinated.

Places and dates of observation.	Total number of cases observed.	Death rate per 100 cases.	
		Among the unvaccinated.	Among the vaccinated.
France,[1] 1816–41	16,397	16.1	1.0
Canton Vaud,[2] 1825–29	5,838	24.0	2.2
Verona,[3] 1828–39	909	46.6	5.6
Milan,[4] 1830–51	10,240	38.5	7.6
Breslau,[5] 1831–39	220	53.8	2.1
Württemberg,[6] 1831¼–35¼	1,442	27.3	7.1
Carniola,[6] 1834–35	442	16.2	4.4
Vienna Hospital,[2] 1834	360	51.2	12.5
Carinthia,[6] 1834–35	1,626	14.5	.5
Adriatic,[2] 1835	1,002	15.2	12.8
Lower Austria,[2] 1835	2,287	25.8	1.5
Bohemia,[7] 1835–55	15,640	29.8	5.2
Galicia,[2] 1836	1,059	23.5	5.1
Dalmatia,[2] 1836	723	19.6	8.2
London smallpox hospital,[7] 1836–56	9,000	35.0	7.0
Vienna Hospital,[7] 1837–56	6,213	30.0	5.0
Kiel,[7] 1852–53	218	32.0	6.0
Malta,[8]	7,570	21.1	4.2
Epidemiological Society Returns[8]	4,624	23.0	2.9
Illinois[9]	1,931	48.6	6.1
Leicester,[10] 1892–93	347	12.3	.8
Sheffield,[11] 1887–88	6,088[12]	32.6	4.9

[1] Wunderlich's Handbook, iv., 201.
[2] Steinbrenner.
[3] Rigoni-Stern: Die Vaccination und ihre neuesten Gegner, 1854.
[4] Canstatt's Jahresbericht, 1852.
[5] Heim.
[6] Med. Jahrb. d. Oesterr. Staates, 1838
[7] Report of Coll. of Surgeons, and Statement of Professor Hebra.
[8] Seaton.
[9] Fifth Report of State Board of Health, 1882.
[10] Report on Epidemic of Smallpox, Leicester, 1893.
[11] Dr. Barry's Report, 1889.
[12] The deaths of the unvaccinated children under five years of age were 46.7 per cent. of those attacked, while those of the vaccinated children were only one per cent.

One of the most valuable reports of modern times, bearing upon the subject of the value of vaccination, is the report of Dr. F. Barry, upon the epidemic of smallpox in Sheffield, in 1887–88. Dr. Barry, an inspector of the Local Government Board of England, was instructed to inquire into every influence which could possibly bear upon the epidemic of smallpox at Sheffield. After making a most thorough and searching investigation, as his report shows, no influence could be discovered beyond the single dominating one of vaccination.

Dr. Buchanan's introductory to this report sums up the results as follows:

	Per 1,000 of each class stated.			
	Attack rate.		Death rate.	
	Vaccinated.	Unvaccinated.	Vaccinated.	Unvaccinated.
Up to ten years	5.0	101	0.09	44
Living in invaded houses	78.0	869	1.0	381
Over ten years	19.0	94	1.0	51
Living in invaded houses	281.0	686	14.0	371
All ages	15.5	97	.7	48
Living in invaded houses	230.0	750	11.0	372

In the foregoing table the figures represent the rates per thousand of the child population under ten years, of persons over ten years of age and of persons of all ages; first, as applying to the population of the borough generally, and secondly, as applying to the enumerated population of the invaded houses. In a brief summary Dr. Buchanan further says, "the vaccinated children had, as compared with the unvaccinated in the same town, a twentyfold immunity from attack by smallpox, and had a four hundred and eightyfold security against death by smallpox; that in the invaded houses the vaccinated children had, as compared with the unvaccinated, an elevenfold immunity from attack by smallpox, and a three hundred and eighty-onefold security against death by smallpox, and that as regards all ages the vaccinated among the population generally had, as compared with the unvaccinated, a sixfold immunity against attack, and a sixty-fourfold security against death."

The following table presents the deaths and death rates from smallpox in those countries from which reports could be obtained. It shows, in general, in the lower table of relative figures the lower death rates from smallpox in well- or comparatively well-vaccinated countries. The figures for several years are not accessible in the reports of Japan, Italy, Hungary, and Spain. (See p. 126.)

Evidence was presented, for example, before the British Commission that there was but little opposition to vaccination in Scotland and Ireland as compared with that which existed in England. The result is apparent in the table.

Surgeon-General Sir William Moore testifies that the large yearly ratio of vaccination in India has had a very marked effect in the reduction of smallpox in that country.[37]

He also states his experience in India before vaccination had been generally introduced. He says he marched during an epidemic of smallpox a distance of one thousand miles, surrounded by smallpox. "Those suffering from the disease in a minor degree were in the streets, generally children, occupied in their accustomed play; or if too ill, lying neglected on the ground; and these represented a portion of the whole suffering from smallpox, the remainder, unable to leave their dwellings, awaiting death in their houses. Any one cognizant of the after-effects of smallpox will at once understand the amount of suffering which must occur among those recovering from the immediate disease. The consequent effects on the eyes, the ears, the skin, the limbs, the joints, and the general constitution, at least equal in gravity the direct consequences of the disease. Roughly speaking, from calculations based on observing the people passing through the streets of certain cities, ten per cent. had lost the sight of one or both eyes, and an equal number had permanent injury of some organ or member; and of these affections the great majority could be traced to smallpox. From special inquiry I found nearly eighty per cent. of the population were more or less marked with smallpox."

According to the *British Medical Journal* there were in the last epidemic of smallpox in Guatemala twenty-five thousand deaths from the disease. In that country there are no vaccination laws. Its population is about one-half as large as that of New England, in which there have not been so many smallpox deaths in the last sev-

enty-five years combined. The *Journal* characterizes Guatemala as an "antivaccination paradise" (*British Medical Journal*, 2, 1891, p. 1135).

At the Tenth International Medical Congress in Berlin, in 1890, Dr. Victor Desguin, of Antwerp, said that the medical inspection of schools in that city had been organized in a very complete manner since 1882, at which time revaccination was ordered for all school children who were twelve years old. It is performed with lymph, under every possible condition of security. It is furnished by the Central Vaccinal Institute of Belgium, and before delivery of the lymph an autopsy is made upon the animal from which it has been taken, to determine its condition of health, none being issued if the animal is found to be diseased. So that there is no danger of communicating either syphilis or tuberculosis.

DEATHS FROM SMALLPOX IN DIFFERENT COUNTRIES. ABSOLUTE AND RELATIVE FIGURES.

Absolute Figures.

Years.	Group I.								Group II.						
	German Empire.	Scotland.	Ireland.	Sweden.	Switzerland.	Holland.	Dutch Colonies.	England.	Italy.	Japan.	Belgium.	Austria.	British India.	Hungary.	Spain.
1880	....	10	389	175	173	79	....	648	....	8,210	4,135	14,232	69,849	13,386	12,165
1881	....	19	72	260	167	75	....	3,098	....	12,995	2,721	18,019	71,647	12,467	10,548
1882	....	3	129	159	22	153	....	1,317	....	41,849	1,570	21,154	85,148	12,160	19,933
1883	....	11	16	125	24	673	....	957	....	12,189	1,796	13,310	232,436	6,789	16,903
1884	....	14	1	58	64	62	....	2,234	....	410	1,355	11,521	333,382	3,992	10,648
1885	....	39	4	4	426	31	....	2,827	....	3,329	1,636	13,212	80,785	4,746	
1886	197	24	2	2	182	72	....	275	....	18,676	1,213	8,794	51,112	11,290	
1887	168	8	14	5	14	18	....	506	16,249	9,967	610	9,591	65,757	15,740	
1888	112	3	3	9	17	1	....	1,026	18,110	853	865	14,138	93,568	....	8,472
1889	200	8	0	2	3	10	....	23	13,416	328	1,212	12,358	125,453	....	6,183
1890	58	0	0	2	32	1	....	16	7,017	25	636	5,935	116,321	....	9,081
1891	49	0	7	2	26	10	....	49	2,910	721	1,300	6,838	93,745	....	6,854
1892	108	11	0	4	35	49	....	431	1,453	8,409	2,528	9,087	92,680	3,426	5,194
1893	157	68	1	25	15	190	963	1,457	2,698	11,852	2,103	5,821	63,178	1,224	
1894	88	129	72	21	51	625	422	820	2,606	3,342	537	2,512	41,609		
1895	27	47	146	0	1	79	231	223	2,998	268	298	1,164	43,328		
1896	10	2	4	2	8	34	337	541	2,033	3,388	130	897	132,784		
1897	5	10	3	1	1	1	588	25	1,003	12,276	140	1,450	160,059		
1898	15	2	0	1	2	7	673	253	420	....	158	2,521	55,798		
1899	28	1	1	1	....	0	2,012	174	214	....	257	1,899	48,598		

DEATH RATES FROM SMALLPOX PER MILLION INHABITANTS.

Relative or Significant Figures.

Years.	Group I.								Group II.						
	German Empire.	Scotland.	Ireland.	Sweden.	Switzerland.	Holland.	Dutch Colonies.	England.	Italy.	Japan.	Belgium.	Austria.	British India.	Hungary.	Spain.
1880	....	2.8	75.0	38.0	61.0	19.0	....	25.0	....	222	749	647	356	853	724
1881	....	5.1	14.0	65.0	59.0	18.0	....	119.0	....	351	487	819	362	789	624
1882	....	.8	2.5	34.6	8.0	37.0	....	50.0	....	1,122	277	962	430	765	1,172
1883	....	3.0	3.2	27.2	9.0	160.0	....	36.0	....	327	314	605	1,174	424	988
1884	....	3.7	.2	12.6	22.0	15.0	....	83.0	....	11	234	523	1,650	245	619
1885	....	10.0	.8	.9	149.0	7.0	....	104.0	....	88	280	575	450	287	
1886	4.2	6.2	.4	.4	63.0	17.0	....	10.0	....	485	205	382	249	676	
1887	3.5	2.1	2.8	1.1	5.0	4.0	....	18.0	550	256	102	417	313	932	
1888	2.3	.8	.6	2.0	6.0	.2	....	36.0	610	22	144	615	445		
1889	4.1	2.0	....	.4	1.0	2.0	....	.8	449	8	199	515	570	....	481
1890	1.2	....	....	.4	11.0	.2	....	.6	233	6	105	247	529	....	350
1891	1.0	....	1.5	.4	9.0	2.0	....	1.7	96	18	212	285	426	....	508
1892	2.2	2.7	....	.9	12.0	11.0	....	15.0	48	205	408	253	403	193	381
1893	3.1	16.5	2.0	5.2	5.0	40.0	14.0	49.0	86	289	334	243	274	69	285
1894	1.7	31.5	15.7	4.4	16.0	131.0	16.0	27.0	85	80	85	102	181		
1895	.5	11.5	31.8	....	.3	16.0	9.0	7.0	97	6	47	47	188		
1896	.2	.5	.9	.4	2.5	7.0	13.0	18.0	65	81	20	36	577		
1897	.1	2.4	.6	.2	.3	.2	22.0	.8	32	284	21	57	696		
1898	.3	.5	....	.2	.6	1.4	24.0	8.0	13	....	24	98	243		
1899	.5	.2	.2	.2	....	....	72.0	5.0	7	....	38	73	211		
Mean of 20-year period	1.8	5.3	9.0	9.3	22.6	24.2	26.0	33.8	179	202	206	358	475	516	605

Sources of Information for the Foregoing Tables.

1. Germany. "Ergebnisse der amtlichen Pockentodesfallsstatistik im Deutschen Reiche," 1886–1899.
2. Scotland. Reports of the Registrar-General.
3. Ireland. Reports of the Registrar-General.
4. Sweden. "Bidrag till Sveriges Officiala Statistik," 1899.
5. Switzerland. "Statistisches Jahrbuch der Schweiz," 1900.
6. Holland. Annuaire statistique pour le Royaume des Pays-bas," 1899.
7. Dutch Colonies. "Annuaire statistique des Pays-Bas (Colonies)," 1899.
8. England. Reports of the Registrar-General, 1880–1899.
9. Italy. "Statistica delle cause de Morte," Rome, 1901, p. 12.
10. Japan. Reports of the Central Sanitary Bureau, Tokio, 1900.
11. Belgium. "Annuaire statistique de Belgique," 1901.
12. Austria. "Oesterreichisches statist. Handbuch," Wien, 1900.
13. British India. Annual Reports in the Sanitary Measures in India, 1880–1899.
14. Hungary. Bulletin de l'Institut International de Statistique, Rome, vol. x.
15. Spain. Bulletin de l'Institut International de Statistique, Rome, vol. x.

In nine years 15,259 children were vaccinated, of which 8,033, or 52 per cent., were successful. He says this ratio of success in revaccination is probably due to the fact that a considerable number of children enter the schools with false certificates of vaccination, either on account of inefficient performance or by reason of its omission.

Revaccination was not followed in any case by unusual results, beyond what could easily be controlled, the school registers giving the particulars as to absence in all cases.

Moreover, he says that revaccination was never followed by the development of scrofulous symptoms; a fact which he attributes to the plan adopted for strengthening feeble school children by proper medical means.

During this period of nine years there were in Antwerp 497 deaths from smallpox, only two of which were those of school children. They were children of seven and eight years, neither of whom had been revaccinated, and one had never been vaccinated. During this period there were, among an average annual school population of 13,506 children (subject to yearly renewals and changes), 53 cases of smallpox, none of which was among revaccinated children (Transactions of Tenth International Medical Congress at Berlin, vol. v., No. 15, p. 144).

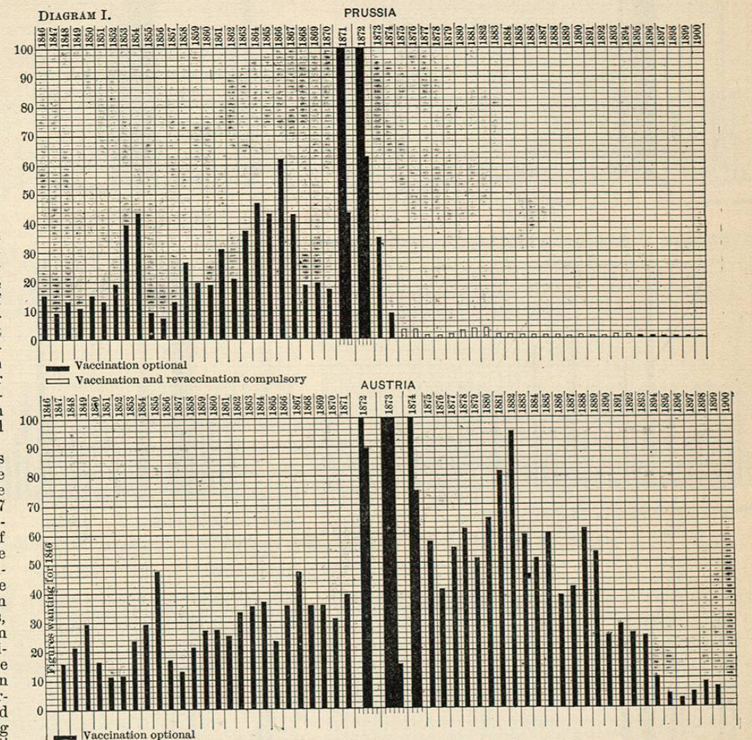

FIG. 4926.—Mortality per 100,000 Inhabitants, from Smallpox in Prussia, from 1846 to 1900, and in Austria, from 1846 to 1899. (From Schulz: "Impfung," etc., Berlin, 1888.)

The advantages of a system of compulsory vaccination and revaccination in protecting large communities from smallpox are clearly shown in the diagrams presented upon pages 127 and 128, copied from Schulz, "Impfung, Impfgeschäft und Impftechnik," Berlin, 1888, and reproduced in "Blattern und Schutzpockenimpfung," Berlin, 1896. The figures for completing these diagrams for the years since 1886 have been supplied from the official reports of the countries and cities represented.

Diagram I. presents the statistics of mortality from smallpox in Prussia and in Austria, showing the death rate per 100,000 from this cause in each country for a period of over fifty years, 1846 to 1900, in Prussia, and 1847 to 1899 in Austria. Vaccination was optional for the civil population in Austria for the whole period, while in Prussia it was compulsory after April 1st, 1875.

Diagrams II. and III. present the comparative mortality from smallpox of four German cities in which vaccination was compulsory after 1875, and that of four other large European cities in which it was either optional, or optional in the case of revaccination for the whole period (1861–1900), as it was in London.

The renowned statistician Körösi, of Budapest, has continued his valuable series of statistics. He contends that the ordinary comparisons of smallpox mortality in the periods before and after the introduction of vaccination, and the mortality from smallpox in countries and cities well or poorly vaccinated, do not constitute convincing proof of the value of vaccination. He entertained the idea that the proof could be sustained only when, in populous districts, the total number of the vaccinated and the unvaccinated is known, from which it would be easy to learn the mortality from smallpox among the vaccinated and the unvaccinated. But to obtain these figures from whole countries is not an easy task. The author's new method permits of a proof, in figures, of the influence of vaccination without a necessary knowledge of the number of the living vaccinated and unvaccinated. Until his inquiry was made, the vaccination question had been made to depend on the number sick or deceased from smallpox.

The tables which Körösi has published contain the number of persons treated for the most diverse diseases, and dying of the most diverse causes, their ages, and also whether vaccinated or unvaccinated. One table contains