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VARIATION IN TYPE OF INFECTIOUS DISEASE AS SHOWN BY THE HISTORY OF SMALLPOX IN THE UNITED STATES 1895-1912.*

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As many of the states have no efficient registration of deaths, and as large areas of the rural portion of the country and many cities have no notification of disease, or at least very incomplete notification, full and accurate data as to the prevalence of smallpox in the United States are not available. This disease, however, is more likely to be reported than is perhaps any other, and deaths from it, over a large part of the country, are returned with a fair degree of completeness. The table which follows is derived from the various reports and other publications of the Public Health Service. The number of deaths, except in the more sparsely settled portions of the South and West, is probably not very much too small. The number of cases on the other hand, particularly when the disease is of a mild type, is very much understated. Altho the figures for the last few years are much more nearly complete than in the early part of the period covered, at the best they indi-

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cate only approximately the prevalence of the disease. The figures for 1912 omit returns from a few of the states in which they are known to be very defective, as the Public Health Service does not consider it fair to other states to subject them to such comparison in its tables. Data from Porto Rico and Alaska are not included in the table.

A part of the epidemiological data has been obtained from the Public Health Service.¹ Much material has also been derived from a study of state and municipal reports, from articles in medical literature, and by correspondence. It is difficult, however, especially after the lapse of some years, and with changing officials, to obtain epidemiological data except from the best organized health departments.

CASES AND DEATHS FROM SMALLPOX IN THE UNITED STATES, 1895-1912.

Year	Cases	Deaths	Fatality Percentag
1895	2,826	589	20.84
1896	1,752	336	19.18
1897	613	38	6.20
1898	3,639	213	5.85
1899	10,957	449	4.10
1900	20,140	806	4.00
1901	48,205	1,127	2.34
1902	54,005	2,083	3.86
1903	40,675	1,448	3.56
1904	17,965	709	3.96
1905	13,946	368	2.64
1906	12,497	90	0.72
1907	17,216	59	0.34
1908	31,190	81	0.26
1909	20,072	154	0.77
1910	27,176	484	1.78
1911	23,263	105	0.45
1912	20,190	235	1.16

It must not be assumed that the general mildness of the disease is indicated by the above fatality rates. In nearly every year there were more or less localized outbreaks of the severe type, and if these be omitted, as will be done when discussing them, it will be seen that the case fatality over most of the country has been very much less than appears above.

Smallpox had been of the usual severe type and had prevailed to a considerable extent throughout the United States previous to the summer of 1897. With the exception of the mild smallpox in the South, about to be considered, and a few severe cases in the

¹ The writer is greatly indebted to Dr. Trask of the Public Health Service for much assistance.

city of New York, this disease had, by July 1, 1897, entirely disappeared from the country. In fact, during the whole year, except in the three states where it early became epidemic, there were reported to the Public Health Service less than 100 cases with about 30 deaths. These were scattered over 16 states. The local outbreaks in which these cases occurred seem to have been efficiently controlled and the disease stamped out.

During 1896 a very mild type of smallpox began to prevail in the South and later gradually spread over the country. The mortality was very low and it was usually at first mistaken for chicken pox or some new disease called "Cuban itch," "elephant itch," "Spanish measles," "Japanese measles," "bumps," "impetigo," "Porto Rico scratches," "Manila scab," "Porto Rico itch," "army itch," "African itch," "cedar itch," "Manila itch," "Bean itch," "Dhobie itch," "Filipino itch," "nigger itch," "Kangaroo itch," "Hungarian itch," "Italian itch," "bold hives," "eruptive grip," "beanpox," "waterpox," or "swinepox." Various tales were told as to its origin: that it was imported from Cuba, Mexico, or Central America, or was brought home by our soldiers after the Spanish War, but it certainly appeared before war with Spain was even declared.

From November 20, 1896, to July 10, 1897, there were in Pensacola, Fla., 54 cases of smallpox without a death and in Escambia Co., in which Pensacola is situated, many more cases also without a death. Where it came from is not known, nor whether it had any connection with the 18 cases and 2 deaths which occurred in Pensacola in May-July of that year, or with the 48 cases and 8 deaths which occurred at about the same time in Key West at the extreme southern part of the state. But as the type seems first to have been noticed in Pensacola and as there had recently been an outbreak of the usual form of the disease in that vicinity, the most likely hypothesis is that the mild type of the disease originated there as a "sport" or "mutation" from the normal, and as the normal form of the disease had, at that time, disappeared from the South, the new type had a chance to spread extensively without being mixed with the old strain.

Early in May a similar type of the disease was noticed in

Lowndes Co., Ala. It was traced thence backward to several other places and, according to Sanders, the state health officer, was derived early in the year from Pensacola. It continued to spread throughout the state and during the year ending March 31, 1898, had caused 3,638 cases with 51 deaths. It was carried from Montgomery, Ala., about the last of March, 1897, to Memphis, Tenn., and thence back to Birmingham, Ala., early in May, where it developed into an extensive and lengthy epidemic. Birmingham is a flourishing manufacturing city, with numerous rail connections, and the disease spread thence to many localities in adjoining states. It passed from Alabama to Georgia in the late summer and thence back again to northern Florida. In October, 1897, the disease was introduced from Birmingham into Middlesboro in the extreme southeast of Kentucky, whence during the next few months it spread to numerous places in the adjoining portions of Kentucky, Virginia, West Virginia, and to at least 19 different places in Tennessee.

In 1898 the new type of smallpox extended into a much larger territory and, because of its low mortality and atypical character, began to attract much attention and to give rise to all sorts of theories as to its origin. It continued in northern Florida and was imported into the center of the state from Georgia. It also continued to prevail extensively in Alabama, especially around Birmingham. Early in January, it was carried from Birmingham to Little Rock, Ark., where it caused 129 cases and 2 deaths, and gradually spread to other parts of the state. From Birmingham it was carried directly across Tennessee into many localities in Kentucky. As early as January, 1898, it had been brought to several points in South Carolina from Georgia, and at about the same time it was carried from South Carolina to North Carolina. It appeared in Norfolk, in the eastern part of Virginia, in March, but the source is not known. All through the South the larger number of cases was among Negroes who paid little attention to the disease and who, as railroad and steamboat laborers, and as servants, carried it from place to place. From Norfolk it was carried to Philadelphia late in 1898. From western Virginia, where it had been carried the year before, it spread into West

Virginia and thence to Bedford Co., Pa., in July, 1898, and thence to several other places in that state.

As early as February, 1898, it was noticed in Greene Co., Miss., adjoining Alabama and later in other parts of the state. It was also carried by a traveling show from West Virginia to New York state where there were 300 cases in 40 localities, but with only 1 death. The disease appeared at three points in Ohio, at one place brought from Georgia, and at another, a hotel, probably by colored waiters from North Carolina. In November, 1898, it appeared among boat hands in Cincinnati. From Ohio a few cases developed in Michigan, and from Michigan three outbreaks developed in Ontario. Smallpox of a very mild type also appeared in Nebraska City, Neb., as early as August, 1898, from some unknown source, perhaps, as suggested by Bracken, from Arkansas. Its nature was not discovered for some time, so that it spread rapidly, not only in Nebraska, but during the same year infected many points in Kansas and Iowa.

In December, 1898, the mild type of smallpox appeared in Soulangue Co. at the western extremity of the province of Quebec. It was said to have been brought from Cleveland, Ohio. It was reported to have disappeared from this section early in 1899.

It is difficult to determine the appearance of the disease in Texas owing to the fact that in this state the problem was complicated by the presence of more or less of the severe type derived from Mexico. There appears, however, to have been mild smallpox in El Paso from August, 1898. Several colored persons were attacked and it may well be that the disease was brought by rail from Arkansas or Nebraska.

The disease must have been present in Montana in November, 1898, among railroad laborers, as a case from that source was imported into Minneapolis, December 8. According to Munn of Denver, a ranchman from Texas brought mild smallpox to Colorado in December, 1898, and distributed it through Florence, Pueblo, Boulder, Trinidad, and other places. The disease may also have existed in New Mexico in the latter half of the year, tho a very severe type was prevailing at the same time, as in La Cruces, where there were 428 cases with 166 deaths.

In 1899 the disease continued to prevail in the same mild form in all the southern states where it had occurred the year before, and also in Ohio and in Ontario. It was imported into Ontario from the states several times in 1899 and subsequent years. It was reintroduced into Michigan from Ohio and Kentucky. It spread northward from Virginia into the District of Columbia, Maryland, Pennsylvania, New Jersey, New York, and Rhode Island, tho only a few cases occurred in New England. There was a great deal of mild smallpox around Norfolk, and the many vessels plying between Norfolk and northern ports were a frequent means of dispersal. It was also again introduced into Pittsburgh, probably up the Ohio. The steamboat traffic on the great rivers seems to have been as efficient a means of dispersal as the coastwise traffic. Many places along the Mississippi River and its tributaries report infection brought by colored help on the river steamboats. As these steamboats stop at many points it is impossible, except in rare instances, to find the real source of the disease, but the states lying along these navigable rivers were, without doubt, infected from one another again and again. Cincinnati was infected from this source in 1898, and early in 1899 Newport and Covington, Ky., were infected from Cincinnati, as was also New Orleans early in February. In January Louisville was infected by a colored man from a steamboat. River towns in Indiana and Illinois were invaded early in the year from Pittsburgh, Louisville, and Arkansas, and Memphis was reinfected from the latter source. St. Louis also became infected in January and Galveston in March. Valparaiso, Ind., was infected from Mississippi in June.

Altho, as has been stated, the disease was brought to New England from southern ports, it did not seem to spread much from this source. The chief source of mild smallpox in New England for many years, beginning with 1898, appears to have been the province of Quebec. The outbreak which began in western Quebec in 1898 is said to have ceased in January, 1899, but a few cases may have lingered unrecognized. According to Pelletier of Montreal, there was no smallpox in Quebec from the last of January to August 18, at which time it was introduced into the eastern part of the province by a man from Taunton, Mass. While no smallpox

was reported from Taunton at that time, the city is close by Fall River where the disease was prevailing among the French, and French mill operatives are constantly passing from city to city. Mild smallpox has continued to prevail in Quebec ever since and has been brought by mill hands into the New England states many times and has also probably returned to Quebec from these states. Many of our New England cities are largely French and the train ride to Canada occupies only a few hours. The fact that mild smallpox appeared among French mill hands at Waterville and Winslow, Me., in January, 1899, and was present among the French in Fall River probably early in the spring, tho it was not discovered until May, suggests that the disease lingered in Quebec all winter, tho doubtless, as claimed by Pelletier, the great outbreak in August was due to a reinfection from the United States, from which also the first infection of Quebec was derived.

During the first few months of 1899 mild smallpox appeared in nearly all of the Pacific and Rocky Mountain states. According to Woods Hutchinson, at that time in Oregon, infection appeared to have come by way of Texas, California, Nevada, and southern Idaho to Oregon whence it quickly spread to Washington, Utah, and the Dakotas. According to Shoemaker of Sacramento, it was introduced into that state in February from Ogden, Utah. It was introduced into Missoula, Mont., in February from New Mexico and in March was prevailing among the Indians in Poplar and Harlem in that state. The mild type was probably present in Arizona as well as New Mexico and by June was prevailing in mining towns in Indian Territory and among Indians in Oklahoma. It was also present in Wyoming. Brought into Minnesota in January by a car conductor from the Pacific coast, it was reintroduced from Nebraska in May and later from North Dakota. It spread from Minnesota to Wisconsin.

In 1900 mild smallpox appeared among French Canadians in New Hampshire and Vermont. Early in the year it was reported from New Brunswick, being probably derived from Quebec, and in February it was in Nova Scotia. It was carried from Seattle, Wash., to Alaska and appeared in British Columbia. It was reintroduced into Colorado from all the adjoining states and was

again carried to California from Colorado, Arizona, and Kentucky. It prevailed extensively in Ontario and was reintroduced several times from Detroit and other places in Michigan. The disease became very prevalent in the middle states but there was not quite so much in the southern states where it first appeared.

From the preceding review it appears that an exceptionally mild type of smallpox had, within a period of about four years, gradually extended over the whole continent of North America north of the Mexican border. This type of the disease has been more or less prevalent ever since. The maximum prevalence was probably attained in 1902, when, outside of the communities where the severe type was prevailing, there were reported about 45,000 cases with a fatality of about 1 per cent.

The centers of greatest prevalence have of course shifted, to a considerable extent, from year to year. The disease would die out in some states, perhaps to reappear again later. This happened in several of the southern states where the disease first attracted attention. Perhaps New England and New York have had as little of the disease as any parts of the country, while the Middle West has suffered more severely and continuously. It has also prevailed continuously in the province of Quebec.

On the whole the disease seems to have shown a tendency to diminish, somewhat, in severity. This tendency is not marked and the somewhat lower case fatality noted in later years may be due to the better recognition of cases, now that the type has become more widely known. At first fatalities of 1 to 2 per cent and even more were commonly reported, while later fatalities have often been much less. Thus in North Carolina in 1910 there were 3,875 cases with 8 deaths, a fatality of 0.2 per cent, and in 1911 there were 3,294 cases in that state without a single death.

The mild type of smallpox which has prevailed so extensively in the United States was, as has been shown, also pretty well distributed over Canada and Alaska. According to Dr. Liceago it was imported into Mexico but no facts or figures are given. It does not seem to have invaded Cuba, Porto Rico, Hawaii, or the Philippines. According to Seheult¹ of Trinidad, mild smallpox

¹ *Proc. Roy. Soc. Med.*, 1908, 1, Epidem. Sec., p. 229.

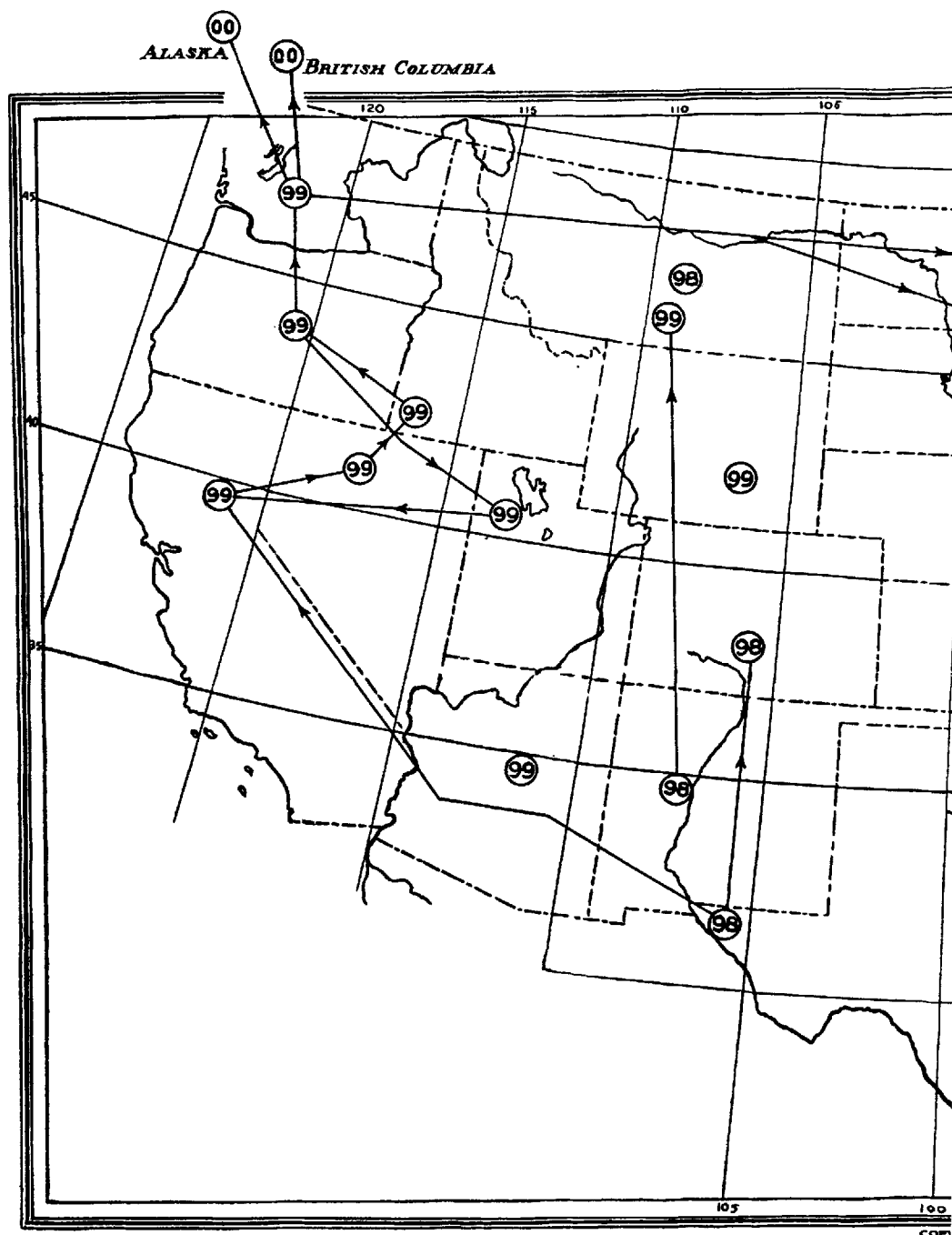


CHART 1.—Showing the extension of mild smallpox in North America, 1896-1900 circles, the year of appearance. The route of infection, when known, is shown by a line. If the route is known to have followed a river and its tributaries, the river itself indicates the route of infection.

was introduced into Barbados in 1902 from Venezuela where it had been prevailing for a year and where it had probably been imported from Canada. An article in the *Lancet*¹ states that it was carried from Barbados to St. Kitts, St. Vincent, Demarara, and Grenada. Carini² describes a very mild outbreak in Brazil in 1910 in which the case fatality of 5,000 cases was 2.3 per cent. In discussion Marchaux quoted Ribas as stating that the disease was introduced at Bahia.

It seems highly probable that the mild type of smallpox was carried to England from Boston in 1902 and probably during the following years. Smallpox was introduced into London, probably from Paris, in 1901 and developed into an extensive outbreak with a case fatality in that year of 14.7 per cent. The next year the fatality among 7,796 cases was about 17 per cent. In Liverpool the case fatality of 560 cases was 3.6 per cent. The disease had been introduced from Boston in December, 1901, and January, 1902, and it is probable that both types were imported as both types were certainly existent in Boston and other parts of New England. The next year there were 1,720 cases in Liverpool with a case fatality of 8.2 per cent. E. O. Stallybrass, port medical officer of Liverpool, however, writes that the outbreak in Liverpool did not impress him as being of a particularly mild type tho some such cases were discovered. It appears probably that a modicum of these mild cases was what kept down the fatality in Liverpool; and some of these, or other cases in the stage of incubation, imported from the United States in that and the following years, were the source of the mild outbreaks noted in other parts of England. Chart 1 shows graphically the extension of the mild type of the disease.

Wherever this mild type of smallpox has appeared there has usually developed a controversy as to its nature. The public and the general practitioner consider smallpox a serious disease and they are loath to believe that an affection so mild as is usually observed in this type can be real smallpox. The prodromal symptoms are not usually severe, and when the eruption appears, they disappear entirely. After that, in the great majority of cases, the patient remains practically well. Often the patient is able

¹ *Lancet*, 1903, I, p. 1248.

² *Bull. soc. path. exot., Par.*, 1911, 4, p. 35.

to be up and about during this stage but this is not usually the case. There is usually no secondary fever and one's vocation can be followed with no discomfort. The eruption generally is not very profuse and often is limited to a few widely separated pustules scattered over the body. Quite often there may be not more than a dozen, and sometimes less. Usually the eruption passes through the same stages and presents the same general appearance as in the typical disease, but the stages are almost invariably shortened, so that from the time it first appears until the "seeds" may be picked out of the soles of the feet, even less than two weeks may be occupied, and this even when there is considerable eruption. William M. Welch says that in many of the vesicles no umbilication is seen and often on the third or fourth day the vesicles change to pustules, and almost immediately shrinking and drying begin. On many of the pustules true crusts do not appear but the exudation seems to be absorbed with little or no desquamation. Sometimes a sort of warty excrescence remains for a time but finally is absorbed. The redness left by the eruption often disappears in three or four weeks after recovery and there are, in many cases, very few or no permanent skin lesions observable. As is stated by Welch, the real cause of the difference in the eruption is its comparatively superficial character, yet even in the mildest cases the "shotty feel" is generally present and the eruption is usually at a glance distinguished from the still more superficial chicken pox eruption. The fatality is sometimes among thousands of cases as low as 0.1 per cent or even less. It is perhaps not surprising that many have been led to consider it not smallpox at all. I think, however, that health officers and clinicians all over the country, who have had an extensive experience with the old type of the disease, as well as with its present form, are convinced of their identity. The reasons are the same period of incubation, the characteristic, tho mild, prodromal symptoms in an overwhelming proportion of cases, the development of the eruption at the normal time, the distribution of the eruption, and its perfectly characteristic appearance in most cases. The crucial test of the identity of the two forms is, however, to be found in their immunity relations. It has everywhere been found that persons who have

had smallpox, or who have been successfully vaccinated, are at least as immune to the mild as to the severe type. It is also found that persons who have had the mild type are equally immune to vaccinia. Persons who have a very sparse eruption of the variola may sometimes be successfully vaccinated during the early part of the attack. It is, however, not surprising that in such a mild attack immunity is not at once established.

While atypical smallpox was spreading over the country the normal and more severe form appeared from time to time in various places causing more or less extensive outbreaks. For a number of years typical smallpox, exhibiting a considerable fatality, seemed to maintain a foothold in New York City, and in fact the abnormal mild type appears never to have extensively invaded that city. It is probable that the disease in New York was largely derived from foreign sources. Certainly many cases are each year brought on incoming steamships and occasionally one may slip by quarantine during the stage of incubation. The following table (p. 182) shows the cases, deaths, and case fatality in that city since 1898. It will be seen that an extensive outbreak of the severe type began in 1900 and extended over a period of two years.

In 1897 there were three cases with two deaths in Chicago. The disease was imported from Mexico. In December severe smallpox attacked the Zuni Indians in New Mexico among whom it prevailed for nearly two years.

In 1898 there was considerable severe smallpox in the Southwest derived from Mexico where that type of the disease was prevailing. In December it appeared among the Moqui Indians in Arizona where in the following year it caused in a tribe of 900 persons, 590 cases and 184 deaths. There was also some smallpox in Texas at Brownsville, El Paso, and Laredo, and 30 cases with 7 deaths at Columbus. According to the Kansas State Board of Health *Report*, smallpox of the normal type was introduced by an immigrant from Russia into Marion Co., Kan., in December, 1898, where it caused 56 cases with 7 deaths. It spread to adjoining territory and also to several points along the Santa Fe Railroad. In November of 1898 there was an outbreak of 32 cases with 10 deaths in Lincoln Co., Okla., mostly in Straud and Chandler.

It extended into the Indian Territory, causing 50 deaths. There was also an outbreak of unknown origin in Carroll Co., Mo., about the same time, causing 15 deaths in 56 cases. This outbreak continued well into the spring of 1899. Perhaps the outbreak of 95 cases and 11 deaths in Kansas City during May of that year

CITY OF NEW YORK.

Year	Cases Reported	Deaths from Smallpox
1898.....	16	1
1899.....	90	18
1900.....	157	12
1901.....	1,950	410
1902.....	1,516	310
1903.....	43	5
1904.....	74	7
1905.....	46	9
1906.....	100	6
1907.....	58	9
1908.....	17	1
1909.....	9	2
1910.....	16	5
YEAR 1900		
January.....	8	1
February.....	3	
March.....	10	
April.....	4	1
May.....	10	1
June.....	9	1
July.....	1	
August.....	2	2
September.....	1	
October.....		1
November.....	39	5
December.....	70	
Total.....	157	12
YEAR 1901		
January.....	70	10
February.....	128	32
March.....	220	37
April.....	200	40
May.....	456	66
June.....	364	71
July.....	244	80
August.....	118	35
September.....	27	10
October.....	23	11
November.....	47	7
December.....	62	11
Total.....	1,959	410

was an offshoot of this. There were also some severe cases in St. Louis. The location of these "normal" cases in Oklahoma, Kansas, and Missouri, all in frequent communication with the states bordering on the Mexican frontier, as well as with Mexico itself, renders it probable that this group of cases had its ultimate origin in Mexico, tho of this there is no direct evidence, except in Kansas,

where it is stated that some of the cases were derived from New Mexico.

In 1899 the severe type continued to be more or less prevalent in Arizona, New Mexico, Missouri, Kansas, Arkansas, Indian Territory, and Texas. In the latter state there were 685 cases with 126 deaths in Laredo, and 56 cases with 15 deaths in Dallas. The source was Mexico. In Los Angeles a few severe cases had been imported from New Mexico, but the disease did not spread until a fresh importation, probably from Arizona, in 1899, resulted in 93 cases with 16 deaths. There was an outbreak of the severe type in the jail at Denver in January, 1899, said to have been imported from Manila. In the latter part of 1899 there was a series of severe cases in Minneapolis, apparently derived from the mild strain. Similar series of cases occurred once or twice in that city in subsequent years and are believed by Bracken to have had a similar origin.

Altho the case fatality for the country as given in the Public Health Reports was 4.1 per cent, if the severe outbreaks in Texas, California, Kansas, Oklahoma, Missouri, and one or two other places, are deducted, there remain nearly 10,000 cases with about 150 deaths giving a case fatality of 1.5 per cent.

In 1900 so far as the United States was concerned, altho small-pox of the mild atypical type was prevailing over large areas, the typical form, with a considerable case fatality, was reported only in Louisiana and New York City. In the parishes of Caddo (Shreveport), St. Tammany, and St. Landry, La., and in New Orleans, there was, during the last few months of 1899 and the first half of 1900, a considerable number of severe cases and deaths, tho there appears to have been more or less of the mild type present also. In Shreveport there were, in January, 46 cases of which 23 were confluent, with 6 deaths. In all there were reported 19 deaths in Shreveport and 386 cases with 30 deaths in the whole parish. There were 782 cases with 27 deaths in St. Landry between September 1, 1899, and February 6, 1900, and between October 28 and December 12, 1899, there were 23 cases and 8 deaths in St. Tammany, which is across the lake from New Orleans. The other parishes are in different parts of the state. The source of the infec-

tion is not known, but, as the disease was introduced into Shreveport from Mexico earlier in 1899, tho it did not spread, it is not unlikely that it had the same source later in the year. In New Orleans there had been an outbreak of the mild type in 1899 at which time it was prevailing generally throughout Louisiana, and it was stamped out about the middle of the year. In October the disease was again introduced from an adjoining parish and from the near-by places on several occasions during the remainder of the year. In January of 1900 the Charity Hospital was infected by an imported case and the outbreak resulting therefrom caused, up to April 30, 1900, 752 cases and 252 deaths, giving a case fatality of 32.2 per cent. According to the New Orleans health report the outbreak seemed to have been checked several times but was started up afresh by importations, and more or less of the severe cases continued to appear until the end of 1901. In 1902 there were scattered through the year 34 cases with 4 deaths and in 1903, 126 cases with 4 deaths. Leaving out the Louisiana cases and deaths, the fatality for the rest of the country was 1.5 per cent.

In April, 1900, a traveler from Japan, who was infected before reaching this country, was the cause of 44 cases in Winnipeg, many of which were very virulent, with 8 deaths. From the same source severe cases also developed in Port Arthur, Carleton Place, Thunder Bay, and elsewhere in Ontario, and an infected traveler carried this type of the disease to Montreal where the mild type of the disease was prevailing, and to this source 21 cases with 8 deaths were traced between April 22 and June 15, 1900. Throughout the province of Quebec during the first six months of 1900 there were, besides the above, 692 cases with only 3 deaths.

In 1901 there appears to have been an outbreak of typical smallpox with a very considerable mortality in Memphis, occurring chiefly in the first three months of the year. There were reported 416 cases with 72 deaths, while in Tennessee, outside of Memphis, there were 1,739 cases with 22 deaths. Of these 22 deaths, 10 with 293 cases were in 6 counties, leaving 1,446 cases and 12 deaths for the rest of the state. These figures indicate that, while the mild form of the disease prevailed extensively, there was an outbreak of the more severe type in Memphis, which was perhaps also the source of some of the fatal cases occurring elsewhere.

Early in 1901 northern New Jersey was infected from New York with a virulent type of smallpox. As was previously shown, an extensive outbreak began in New York the last of December or the early part of January. The mild type had occurred more or less in New Jersey, and cases continued to appear as the result of fresh importations chiefly from the South. A peddler from New York brought the severe type to Newark in March, 1901. From that time to the end of the year there were 387 cases with 71 deaths, giving a fatality of 18.3 per cent. The outbreak continued, but with decreasing intensity, until the close of 1902, having reached its maximum in May of that year. During 1902 there were, in Newark, 901 cases with 187 deaths, giving a case fatality of 20.6 per cent. Many near-by towns of northern New Jersey, as Jersey City, Hoboken, Elizabeth, Rahway, and Orange, were infected and many fatalities occurred. The infection in many instances was traced to Newark or New York. In the whole of New Jersey there were in 1901, 1,139 cases with 142 deaths, giving a case fatality of 12.5 per cent. Besides the outbreak in the northern part of the state, there were in Gloucester, Camden, and smaller places across the river from Philadelphia many fatal cases due to infection probably derived chiefly from the latter city, tho some cases came from New York. In this portion of the state, as well as about New York, the outbreak continued well into 1902. In 1903 there was an outbreak of the normal or severe type in Bordentown and in 1904 in Camden (opposite Philadelphia where the disease was prevailing) and in Trenton.

During 1901 the normally severe type of smallpox appeared in Philadelphia and some other parts of Pennsylvania. There had been only two cases of smallpox in Philadelphia up to March, when a well marked outbreak began to develop. According to the report of the board of health it started in the northern part of the city. It spread rapidly and during the remainder of the year there were 977 cases with 186 deaths, giving a case fatality of 19 per cent. It continued to prevail during 1902 as will be noted farther on. Some cases of a severe type with a few deaths occurred in other parts of the state, particularly in near-by counties, especially in Chester and Norristown, where, in some instances at least, the disease was traced to Philadelphia.

While typically severe smallpox was extending from New York toward the West it began to appear in the East also. It happened that in May, 1901, the disease was imported into New Bedford from the Cape Verde Islands causing 37 cases with 6 deaths. There had been more or less of the mild type in Boston, and in May severe cases began to appear. Their source is not known. The Health Department at one time thought that an infected letter received by a family with sick relatives in New York was the cause, but such fomites rarely give rise to the disease. Communication with New York is frequent and rapid, and it may have been brought from that city a number of times, or it may have had an entirely different origin. A case was certainly brought from New York on a barge in May, but it was not believed to have spread from this. A confluent case from New York came to Dighton, Mass., in May, but this also was supposed to have been controlled. In Wakefield there was a confluent case imported from New York. In Providence, R.I., there were in May and June several cases of typical smallpox among Italians. The origin was unknown. An outbreak of the mild type developed in Woonsocket, R.I., in the summer of 1901, probably imported from Canada, and continued well into the succeeding year in the early part of which severe cases began to appear. Whether they were an offshoot from the mild cases, or were imported from Boston, is not known. There were in all 375 cases and 25 deaths. In Providence in 1902, besides several single severe cases from Boston, there was a group of severe cases from the same source, and another group of typical cases among Italians from an unknown source, a group of mild cases from Canada, and another mild group of unknown origin, but at the time suspected to be from the West. Most of the cases from Boston, and also those developing from them, were of the severe type. At North Mountain, Nova Scotia, there was in September, 1901, an outbreak of the severe type due to an importation from Boston. The disease was also carried from Boston to St. Johns, New Brunswick, on September 30, 1901, and gave rise to an outbreak of 102 cases with 22 deaths in that city, while in the rest of the province there were 600 cases with scarcely a death. The Boston outbreak reached its height in January, 1902, and ended in June. In all there were 1,024 cases with 190 deaths.

As was to be expected, many severe cases occurred in neighboring towns having close communication with Boston such as Cambridge, Everett, Quincy, and Malden, as well as more distant places as Worcester, Lawrence, Lowell, Fall River, and Providence. At the same time there was more or less of the mild type of the disease in southern New England including Boston. Some of this could be traced to mill operatives coming from Canada. There was such an outbreak in Northbridge, Mass., in December, 1901.

During 1902 typical smallpox continued to spread in Pennsylvania tho it is extremely difficult to obtain accurate data except from Philadelphia. In that city there were in 1902, 1,342 cases with 231 deaths, in 1903, 1,637 cases with 278 deaths. In 1904 there were 887 cases with 229 deaths, and by the end of the year the disease had entirely died out.

For the rest of the state local reports are often lacking and the state reports are unsatisfactory, but during the latter part of 1902 several localities reported the presence of the disease with a considerable fatality. Thus there were in the latter half of the year 604 cases with 108 deaths in Alleghany Co. (Pittsburgh and Alleghany), 200 cases with 24 deaths in Johnstown, 91 cases with 11 deaths in McKeesport, 92 cases with 13 deaths in Mt. Carmel, with a few severe cases and deaths in other places. It is impossible to trace the source of these outbreaks, particularly as the mild type was prevailing in many places as in Lanesboro and vicinity where there were 182 cases, without a death, derived from the state of New York. From the great amount of smallpox in Philadelphia, and the frequent communication between that city and the localities infected, it is likely that a good deal, if not all, of the severe type in the state was derived from Philadelphia, tho, as will be shown, typical smallpox prevailed in Cleveland, Ohio, after April, and it is not impossible that some of the infection, especially in the Pittsburgh region, may have come from the West. During the year 1903 typical smallpox continued to prevail in Pittsburgh, Philadelphia, and many smaller towns until well into 1904, but by the middle of the summer it had pretty well died out of the state. A curious offshoot of the Pennsylvania epidemic occurred in Crook Co., Ore., where there were 29 cases with 9 deaths caused by a farmer who had come from Pennsylvania early

in 1903. Otherwise in Oregon, smallpox, tho prevalent, was of the mild type.

There had been mild smallpox in Cleveland, Ohio, in 1901, but it had disappeared and early in April, 1902, another outbreak of the normal type developed from an Italian immigrant who was infected when he landed in Hoboken where he stayed four days before going to Cleveland. This outbreak caused 1,248 cases with 224 deaths in Cleveland in 1902, giving a case fatality of 17.9 per cent. It continued well into 1903, causing 105 cases and 22 deaths in that year.

For the next year or two outbreaks of the normal type continued to appear at various points in the Middle West but it is impossible to obtain definite data as to their origin. The location, usually in towns of considerable size, having frequent communication with Cleveland and Pittsburgh, and indeed even with Philadelphia and New York, renders it likely that the disease was usually introduced from these centers. As Cleveland was the nearest focus it is most likely to have been the source. During the first half of the year there was no severe smallpox in the state outside of Cleveland but after the outbreak became established in the latter city it appeared elsewhere. In Norwalk, Huron Co., Ohio, there were in 1902, 49 cases with 6 deaths, in Mt. Vernon, Knox Co., Ohio, 14 cases and 4 deaths, in Toledo, 119 cases and 11 deaths, and in Youngstown, 67 cases and 16 deaths. In Ohio, outside of these places and Cleveland, there were 2,792 cases with 51 deaths, giving a case fatality of 1.8 per cent. Small outbreaks with high fatality were reported from several counties in Indiana during the latter part of 1902 as Clay, Clifton, Kosciusko, and St. Joseph. Early in 1903 Columbus, Ohio, became infected and there were reported 428 cases with 59 deaths. There was a number of deaths in Cincinnati, Toledo, and Dayton as well as a few severe and fatal cases in smaller places all over the state. In Indiana during 1903, especially in the first half of the year, a considerable fatality was reported in Marion (Indianapolis) and Franklin counties. According to Dr. Hurty it first appeared in Rockport, having been brought by steamboat from Arkansas, and several other points along the Ohio River were infected from the same source. In the latter

part of the year severe smallpox began to appear among the white population in Louisville and continued into 1904. Other places in Kentucky were infected from Evansville, Ind., and St. Louis, Mo., in 1904. Chicago had had, during 1901 and 1902, a good many cases of the mild type; in 1902, 339 cases with 5 deaths, while in 1903, there were 389 cases with 47 deaths; in 1904, 358 cases with 28 deaths, and in 1905, 546 cases with 61 deaths, and since then the cases have been few and mild. It was remarked in 1903 that the type of the disease was changing, which might well have been due to the importation of typical cases from Cleveland or other points in the East where it was prevailing. In 1904 severe cases began to appear in St. Louis, which is not surprising, considering its connections with Chicago. In the year ending March 31, 1904, there had been 253 cases with 1 death in St. Louis, but in the next year there were 854 cases with 86 deaths. It continued in severe form until well into 1905, causing in that year 171 cases with 20 deaths. According to the report of the Health Department, it became mild toward the middle of the year, ceasing in August. In 1904 the severe type also appeared across the Mississippi from St. Louis in East St. Louis, Ill. It also continued in a few places in Ohio, as Cuyahoga and Montgomery counties, tho throughout the rest of that state there was a great deal of the mild type. In Indiana, especially toward the latter part of the year, and running into 1905, there was more or less of the severe form. It was especially prevalent in Terre Haute and Vigo Co. In Pulaski Co., Ark., there were reported severe cases in the autumn of 1904 in places where previously the disease had been prevailing in a mild form. Severe cases of unknown origin were reported from Charleston, S.C., early in the year and later in Florence, S.C.

During July–September, 1904, there were 63 cases with 5 deaths in North Adams, Mass. According to L. A. Jones, who made a careful study of conditions, a part of the cases were derived from Ohio, most of them from Canada, and one group from another unknown source, the latter being all mild. There were in 1904 and 1905 a few severe cases in Minneapolis but these were, according to Dr. Bracken, referred to later, derived directly from cases of the prevailing mild type.

In 1905 severe smallpox continued in St. Louis, Chicago, and in Indiana and in South Carolina. It also appeared in Michigan. In Grand Rapids there were 272 cases with 34 deaths derived from Dorr in Allegan Co. in the same state. There was also severe smallpox in Jackson, Mich., but whether it was connected with the other two outbreaks I have not been able to determine. As usual, also, there were some severe cases in New York City, due in part at least to importations. There were also some deaths in Jersey City. In the localities above referred to in 1905 there were 2,021 cases with 272 deaths, giving a case fatality of 13.4 per cent. In the rest of the country there were 11,926 cases with 96 deaths, giving a case fatality of 0.8 per cent.

In 1906, so far as can be learned from the United States Public Health Reports, there appears to have been scarcely any severe smallpox in the United States. Altho there were reported 12,503 cases there were only 90 deaths and these were widely distributed. The largest numbers of deaths reported were 6 in 38 cases in New York City, 5 in 16 cases in Pittsburgh, March to June, 6 in 126 cases in New Orleans, and 25 in 271 cases in California. Most of the deaths in the latter state were in or about San Francisco after the earthquake, and it is impossible to learn whether the apparent high fatality was due to failure to record cases, or to weakened resistance on account of privations due to the disaster, or to importations, or to change in type. Leaving out these 451 cases and 42 deaths, there were in the rest of the country 12,052 cases with 48 deaths, giving a case fatality of 0.4 per cent.

As in 1906, so in 1907, smallpox in the United States seemed to be almost universally of the mild type. There were certainly no notable outbreaks of the severe form. In all there were reported to the federal government 17,216 cases with 59 deaths. The highest fatality and greatest concentration of deaths were in New Orleans, 248 cases with 10 deaths, New York City, 134 cases with 9 deaths, and San Francisco, 67 cases with 4 deaths. Altho it is not so stated in any reports, and it has been impossible to ascertain the facts by correspondence, it is to be noted that in this, as in many other years, a number of severe and fatal cases is reported from the great seaports like those just mentioned. That many

of these cases are importations is certain. Isolated, imported severe cases were also reported from Laredo and Galveston, Tex., Spokane, Wash., and Wilmington, Del. Taking out the cases and deaths above referred to, the total for the United States was over 16,000 cases with 29 deaths giving a case fatality of 0.17 per cent.

There was no considerable outbreak of the severe type in 1908 and the deaths were even more scattered than in the preceding year. There were reported from Arizona 110 cases with 4 deaths. Most of the severe smallpox along the Mexican border seems to have been imported from the latter country and tho no evidence is forthcoming it is not improbable that some cases at least in this year may have come from the same source. In New Orleans the cases seem to have been more serious than in the rest of the country, as they were also in 1907, there being reported 220 cases with 8 deaths. In Osceola Co., Mich., there were 34 cases with 4 deaths, source untraced. In Fall River there were 8 cases with 5 deaths derived from a woman who came from England and developed the disease a few days after arrival.

Since 1908 Dr. Trask of the United States Public Health Service has endeavored to secure special reports of all severe outbreaks which he has incorporated in his annual reviews of smallpox that appear in the reports. In 1909 the mild type prevailed very extensively, being reported from 42 states. The only outbreaks of the severe form noted by Trask were at Yorkville, S.C., in March and April and in and about Norfolk, Va., in April and May. In the former outbreak there were 20 cases with 8 deaths. The source was not traced. At Norfolk there were 84 cases with 17 deaths. The disease was introduced twice, first by a mild case from Frederick, Md., from which a fatal case arose, and later by three severe cases in sailors from a warship just arrived from abroad. The other cases in the outbreak were not definitely traced to either source. There were also scattered through Texas a number of severe cases with 14 deaths. No source is given for these, but the statement has been made by an experienced health officer in that state that, while mild smallpox has been epidemic for some time, practically all of their severe cases are due to importations, usually

from Mexico. If the deaths at Yorkville, Norfolk, and Texas are omitted, the case fatality for the rest of the country would be only about 0.5 per cent.

The number of cases in 1910 was greater than in the preceding year and the number of deaths more than double. Nevertheless over most of the country the disease continued to present a very mild type. Thus in North Carolina there were 3,875 cases with only 8 deaths. There were, however, a number of outbreaks of the severe type. Thus there were three such outbreaks in Michigan. The mild type had previously been prevailing in the localities in question and in March severe cases began suddenly to appear in Bay City, continuing until October; then the disease was carried to Saginaw. In Bay City and neighborhood there were 134 cases with 31 deaths and in Saginaw and vicinity 239 cases with 55 deaths. Shortly afterward the disease appeared in Lapeer, which is not far distant on a through rail connection. In that city, there were 36 cases with 17 deaths. The first case was an inmate in an institution who received visitors from Saginaw.

In April smallpox was brought to Cleveland, Ohio, by a foreign case imported through Philadelphia. There were 62 cases with 10 deaths.

While there was much mild smallpox in Texas there were several outbreaks of the severe type in Bee and Denton counties during the early part of the year. The source of the Bee Co. outbreak was Mexico, that of Denton Co. was not reported. So too in Oklahoma, tho in general the disease was mild and prevalent, there were outbreaks of the severe type in Grady and Oklahoma counties from March until late in the year. In Reno Co., Kan., the mild type prevailed during the year, but in July there were 3 deaths out of the 8 cases reported. While none of these outbreaks was traced, the relation in time and space renders it not improbable that they may have had their origin in Mexico. In Bellingham, Wash., there was a small outbreak of the severe type, 5 cases with 2 deaths, traced to Vancouver, B.C., and presumed to be contracted from some foreigners recently arrived at that port. In Marion Co., Ore., there were 17 cases with 9 deaths due to exposure to a case on a train running from Mexico City into the

states. In Philadelphia there were 10 cases and 2 deaths, all cases from foreign sources.

The 672 cases included in the above mentioned severe outbreaks yielded 180 deaths, giving a case fatality of 26.7 per cent, while among the other 26,504 cases in the country there were only 304 deaths, giving a case fatality of 1.1 per cent.

In 1911 there were reported 97 cases with 25 deaths in El Paso Co., Tex., and 5 cases with 2 deaths in Guadalupe Co. The former was not traced, but the latter was from Mexico and the health officer stated that in his opinion all the severe smallpox in the state during the last 10 years was from that source. In November the malignant type of the disease appeared in Los Angeles. There had been some mild smallpox in the city during most of the year, but with no fatalities. In November, however, the virulent type appeared in the quarter of the city occupied by Mexicans, and, according to the health officer, was probably introduced from Mexico. From this time until the end of February there were 71 cases with 8 deaths. There were then 32 cases without a death, until July, 1912, when virulent cases again appeared, also from Mexico. This seems to be another instance in which the severe type was imported into a locality where the mild form was prevailing. In Topeka, Kan., there were 143 cases between May and October, with 23 deaths, apparently derived from a mild case of unknown origin. Omitting these severe cases, the case fatality for the rest of the country for the year was 0.2 per cent.

Besides the severe smallpox in Los Angeles in 1912 derived from Mexico, there were, in July, 3 cases in Pasadena with 2 deaths, the source being Los Angeles. In and about Pittsburgh there were, during the summer and autumn of 1912, 121 cases with 33 deaths. The first case was an importation from abroad, and tho connection with it was not demonstrated, the subsequent cases were among foreign residents in the same part of the city. As usual there was considerable smallpox of the severe type in Texas. In Tarrant Co., where Fort Worth is situated, from January 19 to May 22, there were 163 cases with 46 deaths. There were said to be two foci, one derived from Mexico and the other from Oklahoma. The disease was carried from this point to McCullough

Co., causing 10 cases with 4 deaths, and also to Dallas and thence to Hunt Co. Deducting the 853 cases with 168 deaths which occurred in Texas, Pittsburgh, and Los Angeles, there remain for the rest of the United States 19,334 cases with 67 deaths, giving a case fatality of 0.35 per cent.

Various theories have been advanced concerning the source and persistence of mild smallpox in the United States, most of which are clearly shown by the facts to be untenable. It cannot be due to any climatic or other environmental conditions, or to racial characteristics, for it has overspread nearly the whole continent and has appeared in the West Indies, South America, and South Africa and perhaps in England. It has affected all nationalities, and Negroes and Indians as well as whites. It has been urged by many that the mildness of the disease has been due to an acquired immunity due to the vaccination of many generations, but it has prevailed extensively in the United States, the least vaccinated of any civilized country, and reliable observers have noted its occurrence in persons whose parents were never vaccinated. Moreover the classical type of the disease whenever introduced does spread as readily as ever it did, and over large areas.

The mild type of smallpox was certainly not brought back by our soldiers from Cuba, Porto Rico, or the Philippines, for it appeared before the Spanish War was declared and the type has not occurred in those islands.

The disease appeared first in our southern states, probably in Florida in 1896. Its extension from that focus can be definitely traced over the larger part of the United States, Canada, and Alaska. It is true enough that its importation cannot be determined for a number of places, but the location and date of infection of these unconnected foci are such as to render it in the highest degree probable that they too were infected from the original source. Notable among such unconnected foci may be mentioned Nebraska City, Neb., Norfolk, Va., and Fall River, Mass. As there had been previously no smallpox of any kind in these places it can scarcely be assumed that the mild form was there derived from the normal type.

It appears, then, that the prevailing mild type was in all

probability a variation or mutation of the more usual type of the disease and that the entire North American outbreak was derived from the 1896 focus in Florida. It is of course possible that similar mutations may have occurred elsewhere in the United States but the history of this great epidemic, as given in the preceding pages, renders this supposition rather improbable. Everything indicates that the type arose suddenly, spread from a single focus, and has maintained itself with great persistence. As three weeks are perhaps more than the average time required for one case to develop from another, the virus of some of the cases existing today has probably passed through scores and perhaps hundreds of persons.

That, during this epidemic, severe cases have sometimes developed from mild ones is certain. Confluent cases and even deaths have occurred among large series of mild cases, tho perhaps it has less commonly happened in the last few years than formerly. That fatalities are sometimes due to weakness or intercurrent diseases is probably true. That the severity of the case is sometimes due to a special susceptibility to the virus is not improbable. That these severe cases which occasionally develop from the mild strain are due, sometimes, to a heightened virulence of the infecting organism is also probable. This is indicated by the fact that several severe cases in unrelated persons may develop from a mild strain. Bracken has carefully reported several such series as occurring in Minnesota in 1899 and Wood reports a similar series from the same state in 1912. Other instances have been noted in Hartford, Conn., and North Adams, Mass., and doubtless in many other places, but these will serve for illustration. A perusal of health reports and accounts of outbreaks suggests that during the last 15 years there must have been among the hundreds of thousands of mild cases, several hundred, and more likely several thousand, severe cases derived from them. Yet there have been certainly very few real outbreaks from such a source. This is not because severe cases are always recognized and efficiently isolated, for we have seen that when severe cases are imported the disease does spread. There may have been some outbreaks of the severe type derived from the mild type, but there cannot have been many, and it may be that there have been none. The mild type tends

to persist. The few severe cases derived from this type do not tend to persist. They are apparently not mutations but mere variations which tend to revert. The mild type, however, seems to be a true mutation which has shown a strong tendency to maintain its characters for at least 15 years.

The classical type of the disease, whenever it has been imported, has also shown its customary tendency to "breed true" and maintain its well known group of symptoms. The outbreaks are stamped out or run out and do not degenerate into the mild type.

The evidence points to the existence in North America during the last 15 years of two quite distinct strains of smallpox, one the long recognized type of the textbooks, the other marked by decided mildness of symptoms. The latter is probably a mutation from the former. Both strains tend to breed true, and tho it is possible that a few outbreaks of the severe type may have developed from the mild type there is no conclusive evidence that they have been numerous, or extensive.