Report upon the cause of the increae of mortality from diphtheria in London.

Saint Pancras.

HEALTH DEPARTMENT.

REPORT

UPON

The Cause of the Increase of Mortality from Diphtheria in London.

BY

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Saint Pancras.

HEALTH DEPARTMENT.

Vestry Hall, Pancras Road, N.W.

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To the Members of the Health Committee.

Gentlemen,

In accordance with the instructions of your Committee I beg to present herewith a report upon the probable causes of the increase of diphtheria.

Comparing scarlet fever, diphtheria, and enteric fever in the three previous decennia, the following are the results as recorded in Tables 18 & 19 of the Registrar General's last Annual Report.

Annual Mortality per million living.

Decennial Periods.	England and Wales.			London.		
	Scarlet Fever.	Diphtheria.	Enteric Fever.	Scarlet Fever.	Diphtheria.	Enteric Fever.
1861-70	971	187	(886)*	1133	179	(904)*
1871-80	719	121	326	600	122	244
1881-90	338	163	198	335	259	189

* Includes also Typhus and Simple Continued Fever.

It will be observed that the scarlet fever mortality per million for London fell from 1133 in the first to 600 in the second decennium, and in the 47th report (1884) of the Registrar General, it is suggested that the greater fall in

London than in England and Wales may have been due to the provision of greater isolation and hospital accommodation. This would appear to be corroborated by the fact that in the next decennium more isolation hospitals having been provided in the larger towns, the fall in the mortality in England and Wales was greater even than in London, and the two ratios per million were almost equal in 1881-90.

The mortality from enteric fever fell in London from 244 per million in the decennium 1871-80 to 189 per million in the last decennium, and in and in England from 326 to 198 per million, due to improved sanitation. Comparing London with England, exactly the same order of fall in mortality is observed as in the case of scarlet fever. In the decennium 1861-70, enteric fever was embraced under the head of Fevers, which included also typhus and simple fever; at this period the combined mortality from the three diseases in London was higher than in all England and Wales, the former being 904, and the latter 886. The effect of sanitation first became apparent in London when the mortality from enteric fever, taken alone, in the next decade fell below that in England and Wales; in the last decade, when sanitary measures outside London had also improved, the ratios for England and for London fell so as to approach each other.

Turning to diphtheria on the other hand, in both England and London the mortality was less in the second decennium than in the first, but in the last decennium it was greater than in the second, and in London had increased to a higher ratio even than in the first. Comparing London to England, in the first decennium the ratio of mortality was about 5 per cent lower than in England, in the second was about equal, and in the third it was about 60 per cent. higher.

Dr. Longstaff, in his paper on "the Geographical Distribution of Diphtheria in England and Wales," in the extra supplement to the Report of the Medical Officer of the Local Government Board for 1887, found the death-rates from diphtheria per million of population, according to density to be as follows:—

Districts according to density of population.	1855-60.	1861-70.	1871-80.
Dense Districts	123	163	114
Medium „	182	164	125
Sparse „	248	223	132

The noticeable feature in these figures is that a progressive diminution in the mortality from diphtheria appears to have been taking place in rural districts, being most marked in the mostly sparsely inhabited.

Dr. Thorne Thorne, Medical Officer of the Local Government Board, in his work upon diphtheria published in 1891, showed in tabular form (Table No. IX.) that since 1871, whereas the annual death-rates from all causes, from the seven principal zymotic diseases, and from enteric fever, have been steadily falling in England and Wales, in the large towns, and in London, the annual death-rates from diphtheria have been rising slightly in England and Wales, more markedly in the large towns, and most markedly in London.

Annual Mortality from Diphtheria per 1000 *living.*

Year.	England and Wales.	28 large Towns.	London.
1871	0·11	—	0·10
1872	0·09	—	0·08
1873	0·11	—	0·09
1874	0·15	—	0·12
1875	0·14	—	0·17
1876	0·13	—	0·11
1877	0·11	—	0·08
1878	0·14	—	0·15
1879	0·12	—	0·15
1880	0·11	—	0·14
1881	0·12	—	0·17
1882	0·15	0·16	0·22
1883	0·16	0·16	0·24
1884	0·18	0·17	0·24
1885	0·16	0·17	0·22
1886	0·15	0·16	0·20
1887	0·16	0·18	0·23
1888	0·17	0·21	0·30
1889	0·18	0·26	0·39
1890	0·18	0·24	0·33

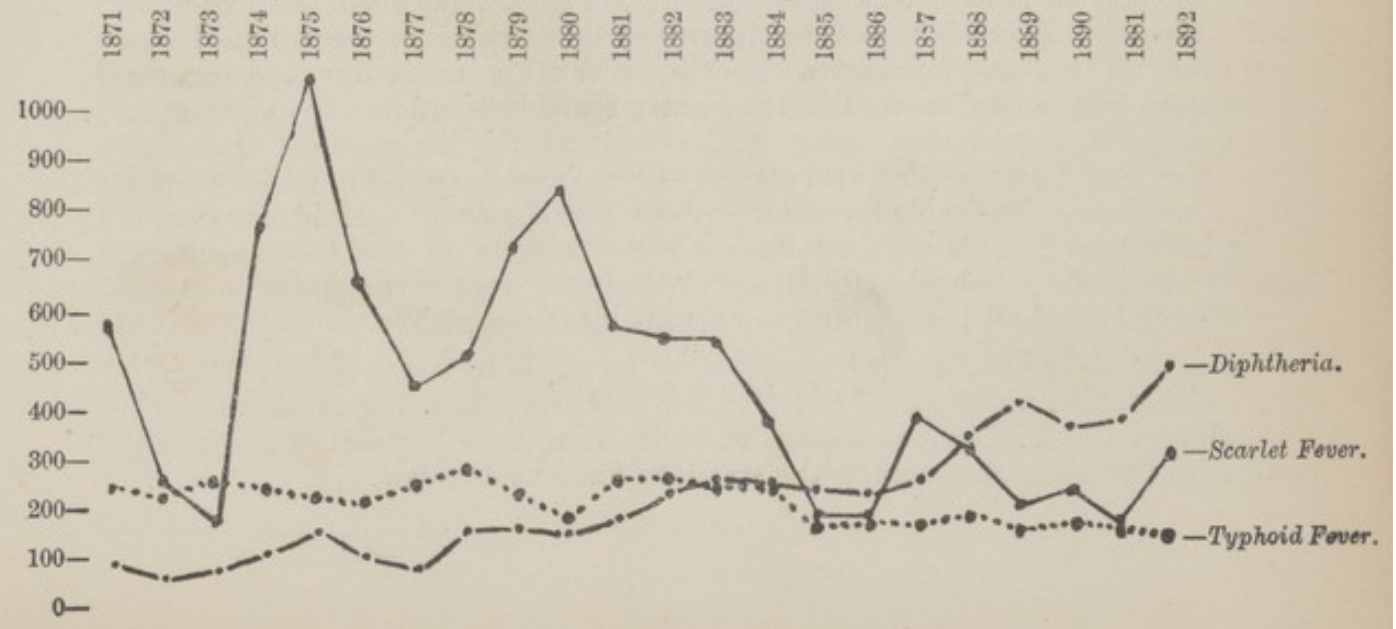
In searching into the cause of this apparently persistent and progressive increase of the mortality from diphtheria in London, the first point that strikes one is that, unlike that of scarlet fever, the mortality of diphtheria is not subject to great epidemic fluctuations, but, like that of typhoid fever, it is comparative steady, as the following diagram shows.

Diagram I.

LONDON.

CURVES OF ANNUAL DEATH RATES PER MILLION LIVING.

From the Registar General's Annual Summary of London and Great Towns.



This diagram also shows that whereas the mortality rate of diphtheria is steadily rising, that of typhoid is equally steadily falling *pari passu* with improving sanitation, and that that of scarlet fever is also falling *pari passu* with increased hospital isolation, no hospital accommodation having been provided for diphtheria until the end of 1889.

It is important to note these points because diphtheria resembles scarlet fever in its power of spreading directly from person to person, and also resembles typhoid fever, in that either diphtheria, or some form of throat diseaes closely allied with it, may arise from certain insanitary conditions. Comparing the two last diseases, whereas typhoid only occasionally spreads directly from one person to another, diphtheria always spreads with great facility from person to person; and whereas typhoid varies in direct proportion to insanitary conditions, the relationship of diphtheria to insanitary conditions is overwhelmed by the influence of personal infection. So that, whereas the improvement of sanitation markedly decreases the mortality of the former, it appears to have no effect upon the latter, and whereas the increase of general density of population in all districts, of special density in towns, and of aggregation in schools, only remotely and indirectly affect typhoid, they closely and directly affect diphtheria.

Dr. Thorne Thorne has called marked attention to the special incidence of diphtheria in children attending schools, and concludes "that apart from age susceptibility, 'school-influence' so called, tends to foster, diffuse, and enhance the potency of diphtheria, and this, in part at least, by the aggregation of children suffering from that 'sore-throat' which commonly is prevalent antecedent to, and concurrently with, true diphtheria." The period of life at which there is most susceptibility to acquire diphtheria is from 3 to 12 years of age, and school attendance increases the risks of personal infection by the aggregation and prolonged association of children together.

The progress of educational legislation traces the progressive increase of elementary education, and of school attendance.

In 1870, the Elementary Education Act was passed for the establishment of School Boards and Elementary Schools.

The Act of 1872 empowered the London School Board to borrow money and to erect further offices.

By the Elementary Education Act of 1873, any out-relief given to the parent or guardian of a child aged from 5 to 13 years, was made conditional on the child receiving elementary education.

In the Act of 1876, a child was defined as a person between the age of 5 and 14 years. A certificate of proficiency or of due attendance at school was required for the employment of a child over 10 years of age, and further provision was made as to the employment and education of children in factories, 250 attendances being necessary; and for the payment of school fees for poor parents, 350 attendances being nccessary. An Order of the Court was made obtainable for enforcing the attendance of a child at school. Day Industrial Schools were established. An increase of the Parliamentary grant was made. School Attendance Committees were given power to make bye-laws like School Boards, and to appoint local committees.

The Act of 1880 compelled bye-laws to be made by every School Attendance Committee, under Sec. 74 of the Act of 1870, respecting the attendance of children at school, and prevented children from 10 to 13 years of age being employed previous to reaching the standard fixed by bye-law.

By the Education Code Act, 1890, a special grant of £10 annually was made to schools where the population was less than five hundred, and "elementary education" was not to be the condition of a Parliamentary grant to Evening Schools.

By the Elementary Education Act, 1891, schools in which the fee for each child from 3 to 15 years of age did not exceed ten shillings a-year, were allowed a fee grant of that amount and rendered free.

But, the average number of children on the roll of the London School Board annually gives a more definite idea of the increase of elementary education in London, and for the purposes of comparison I have framed the following table:—

LONDON.

Year.	Census Population	Number of Deaths from Diphtheria. Registrar General's Annual Summary, 1892.	Average number on roll of Board and Non-Board Schools.	Number of Cases of Diphtheria admitted to Hospitals of Metropolitan Asylums Board.	Number of Cases of Diphtheria notified.
1861	2,804,000	674			
1862		730			
1863		799			
1864		611			
1865		431			
1866		462			
1867		447			
1868		495			
1869		340			
1870		334			
1871	3,254,260	344	222,518		
1872		267	240,927		
1873		320	319,149		
1874		419	370,794		
1875		581	387,023		
1876		387	405.467		
1877		316	426,953		
1878		566	444,322		
1879		575	468,564		
1880		544	483,493		
1881	3,815,544	657	498,504		
1882		857	519,130		
1883		952	557,562		
1884		951	570,280		
1885		904	592,421		
1886		851	591,565		
1887		953	617,343		
1888		1,311	628,801	(2 months) 89	
1889		1,617	644,068	722	(2 months) 981
1890		1,382	653,932	942	5,870
1891	4,211,743	1,435	661,497	1,312	5,907
1892		1,885	678,309	2,009	7,781
1893		—	700,107	2,848	13,026

On examining the table it is to be observed that whereas during the decennium 1861-70 the number of deaths from diphtheria decreased annually, during that of 1871-80 they increased annually, and in similar proportions. Although when the increase of population is taken into account the increase is not quite so great. Comparing the number of scholars on the roll of the London School Board, the influence of elementary education appears to have had some effect in producing this result. But, on scanning the decennium 1881-90, it is to be observed that there are two suddenly pronounced and permanent increases in the number of deaths, the first extending from near the beginning of the decennium to 1887, and the second from that year to the end and continuing into the next decennium.

These increases are seen more clearly on referring back to Diagram I. of curves of mortality produced above and previously commented upon.

On further examining this table it is apparent that these distinct and permanent increases in the number of deaths from diphtheria are out of all proportion to the increase of population and of scholars, and the last is more or less coincident with the commencement of notification of diphtheria, and of the admission of the disease to the hospitals of the Metropolitan Asylums Board. The mortality from diphtheria in the hospitals of the Metropolitan Asylums Board was falling during this period, as shown by the following table:

Year.	Admissions.	Deaths.	Mortality per cent.
1888 (2 months)	89	46	59·35
1889	722	275	40·74
1890	942	316	33·55
1891	1312	397	30·63
1892	2009	583	29·35

The hospital cases were therefore not the cause of the increase in the number of deaths from diphtheria in London.

These peculiar increases led me to examine more closely the statistical figures in relation to diphtheria, and to compare those relating to other diseases attacking the palate, uvula, tonsils, pharynx, larynx, and trachea. It was not possible to go further back than the beginning of the last decennium as previous to 1881 the Registrar-General gave no details of deaths occurring from these diseases in London. For the sake of brevity I have termed them throat-diseases, and in the following table the deaths from these diseases are set out:—

LONDON.—Deaths from Throat Diseases.

(Extracted from tables of causes of deaths at different periods of life, male and female, in Registrar-General's Annual Reports.)

Year.	Total Throat Diseases.	Diphtheria.	Total Throat Diseases other than Diphtheria.	Thrush.	Croup.	Laryngitis	Other diseases of Larynx and Trachea.	Sore Throat, Quinsy.*	Estimated population.
1881	1887	657	1230	164	663	260	52	91	3,824,964
1882	2318	853	1465	110	868	312	55	120	3,862,876
1883	2382	952	1430	134	824	283	46	143	3,901,164
1884	2295	951	1344	121	730	307	49	137	3,939,832
1885	2100	904	1196	104	690	264	26	112	3,978,883
1886	1873	851	1022	118	530	248	28	98	4,018,321
1887	2081	953	1128	80	626	259	46	117	4,058,150
1888	2279	1311	968	62	501	251	41	113	4,098,374
1889	2510	1616	894	84	458	218	41	93	4,138,996
1890	2373	1382	991	92	505	234	36	124	4,180,021
1891	2183	1433	750	70	339	210	33	98	4,221,452

* This includes Tonsilitis, Pharyngitis, and Œsophagitis.

From this table it appears that there has been a very marked fall in the number of deaths from thrush and croup, a distinct but less marked fall in those from laryngitis and other diseases of larynx and trachea, and an irregular and slight decrease under the head of sore throat, only observable on comparing the quinquennium 1881-5 with that of 1886-90. All these diseases, taken together, show progressive and very distinct fall in the number of deaths attributed to them. Diphtheria on the other hand shows a progressive and distinct rise, in fact, when compared side by side, the numbers of the two classes proceed in inverse ratio, and when the two classes are totalled together any increase disappears. Thinking that the influence of age incidence might have affected the result, I extracted the deaths from the several diseases and classified them in two categories, under 15 years, and 15 years and over, the incidence of diphtheria being greatest under 15 years. The result is shewn in the following table:—

LONDON.—Deaths from Throat Diseases—Under 15 *Years, and* 15 *Years and Over.*

(Extracted from tables of Causes of Deaths at different periods of life, Male and Female, in Registrar's General Annual Reports).

Year	Total throat diseases.	Diphtheria.	Total throat diseases other than diphtheria.	Thrush.	Croup.	Laryngitis.	Other diseases of larynx & trachea.	Sore throat, quinsy.
1881	1741 + 146	607 + 50	1134 + 96	164 + —	663 + —	209 + 51	31 + 21	67 + 24
1882	2174 + 144	808 + 45	1366 + 99	110 + —	867 + 1	254 + 58	45 + 10	90 + 30
1883	2210 + 172	892 + 60	1318 + 112	132 + 2	824 + —	229 + 54	29 + 17	104 + 39
1884	2124 + 171	883 + 68	1241 + 103	119 + 2	730 + —	263 + 44	30 + 19	99 + 38
1885	1972 + 128	854 + 50	1118 + 78	104 + —	690 + —	218 + 46	21 + 5	85 + 27
1886	1732 + 141	798 + 53	934 + 88	118 + —	530 + —	202 + 46	15 + 13	69 + 29
1887	1926 + 155	901 + 52	1025 + 103	80 + —	625 + 1	219 + 40	28 + 18	73 + 44
1888	2141 + 138	1242 + 69	899 + 69	62 + —	501 + —	215 + 36	33 + 8	88 + 25
1889	2370 + 140	1546 + 70	824 + 70	84 + —	458 + —	188 + 30	24 + 17	70 + 23
1890	2186 + 187	1320 + 62	866 + 125	92 + —	505 + —	180 + 54	18 + 18	71 + 53
1891	2010 + 173	1369 + 64	641 + 109	70 + —	339 + —	153 + 57	20 + 13	59 + 39

This table shows how little the numbers of deaths at 15 years of age and upwards affect the results. The numbers are few, but comparing the quinquennium 1881-85 with that of 1886-90, although there is an increase of 33 deaths from diphtheria, and a decrease of the same number from other throat diseases, equal only to 3·3 a year, the total numbers remain the same in the two quinquennia, showing a stationary number of deaths from all throat diseases at and over 15 years of age, and taking increase of population into account, an actual decrease of mortality. If we turn to the numbers under this age, we find the figures of the previous table, which are large, are corroborated by the enormous increase in the number of deaths attributed to diphtheria, and the decrease in the number from other throat diseases, and comparing the total number of deaths from both classes under fifteen years of age in the first quinquennium with the second there appears only an increase of 134, equal to 13·4 per annum, or taking population into account, also a decrease in the mortality.

The deaths, therefore, of 15 years and over, having so little effect, the total numbers have been taken in calculating the table of death-rates per million.

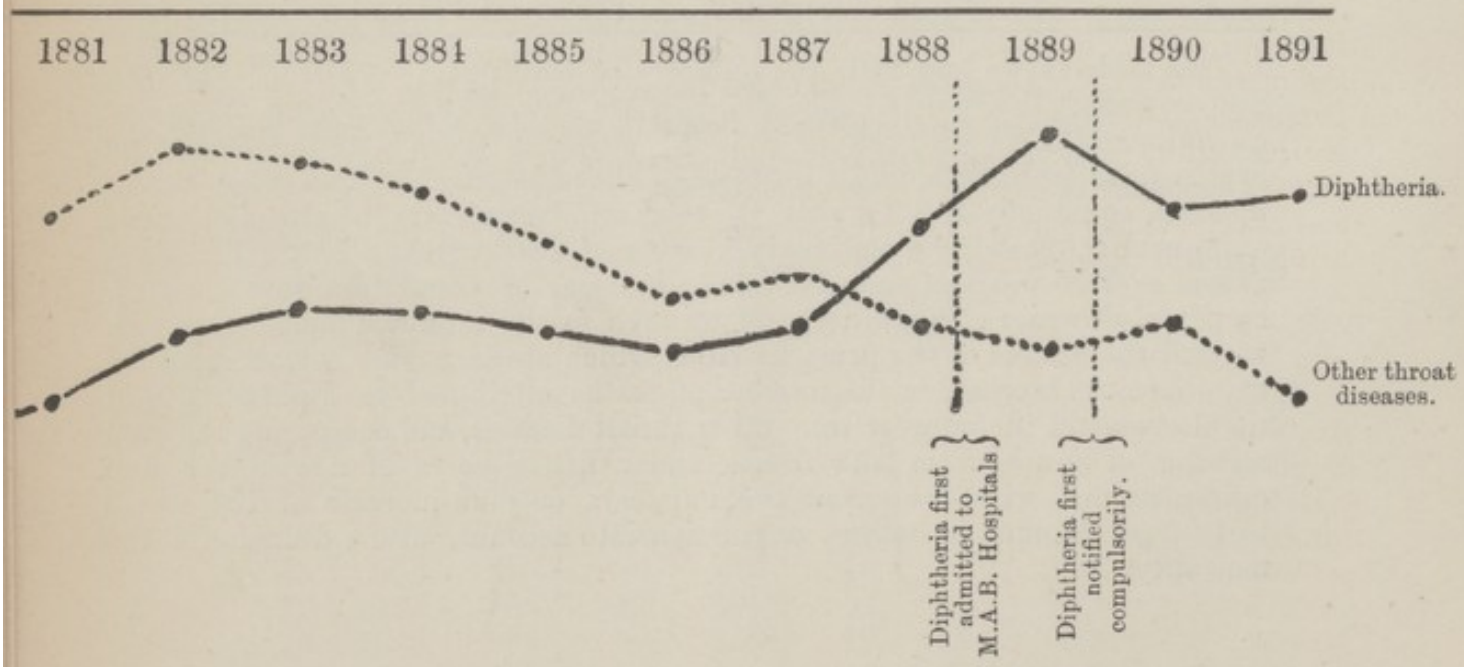
LONDON.—Death Rates per million living per annum.

Year.	Diphtheria.	Diseases of Throat other than Diphtheria.	Total Diseases of Throat.	Quinquennial Mean.
1881	172	321	493	
1882	222	379	600	
1883	244	366	610	562
1884	241	341	582	
1885	227	300	527	
1886	212	254	466	
1887	235	278	513	
1888	319	236	555	542
1889	391	216	607	
1890	331	237	568	
1891	340	177	518	—

In this table the progressive increase of mortality attributed to diphtheria and the equally progressive decrease of mortality due to other throat diseases in London are distinctly shown, the inverse ratio in the progression being so well marked and corresponding so closely that the total of the two classes of diseases shows no progressive variation, until the means of the two quinquennia are compared, and then it appears that the mortality from all throat diseases taken together is decreasing, a result for which the increase in diphtheria mortality had scarcely prepared us. This diagram of curves of annual death rates from diphtheria and from other throat diseases in London graphically represents the change that has taken place.

DIAGRAM II.

LONDON.—Curves of Annual Death Rates per million living.



The conclusions that I have therefore come to are:—

(1) That a slight diminution is taking place in the death rate from throat diseases taken as a whole; and

(2) That the great rise in the mortality from diphtheria corresponds with a great fall in that from other throat diseases.

As to the former, it may be due to diminished prevalence, or to greater vigilance, or to better treatment. Parents, guardians, teachers, nurses, medical men and the public generally are more alive to the danger of throat diseases than formerly. As to the latter, many causes are possibly at work, and a few words may be devoted to each.

1.—*The effect of the Infectious Disease Notification Act.*—This Act came into force in the Metropolis at the end of October. 1889, and has tended to more care and attention being bestowed, not only upon diphtheria, but upon all infectious diseases. On referring to Diagram II. it will be noticed that the great rises in the diphtheria mortality curve of the last decennium took place from 1881 to 1883, and from 1887 to 1889, antecedent to the introduction of compulsory notification, and that the persistent and gradually progressive fall in the mortality curve of other throat diseases commenced in 1883, seven years previous to the introduction of compulsory notification into the Metropolis. Furthermore, during the past decennium there has not been any rises in the mortality from other notifiable diseases comparable to that of diphtheria. It will be observed also that my conclusions are not based upon notifications but upon *deaths*, that the fatal—not the benign—forms of disease are in question.

2.—*The effect of the Reception of Cases into the Hospitals of the Metropolitan Asylums Board*—It will be unnecessary to discuss here the effect of the Board's hospitals upon diphtheria raised in the interesting Paper of Mr. R. D. R. Sweeting upon Post-Scarlatinal Diphtheria in the Transactions of the Epidemiological Society, 1892-3, nor the etiology of the various forms of diphtheritic throat affections treated so fully and with such exactitude by Dr. Klein in the supplementary Reports of the Local Government Board, seeing that it has already been shown by figures from the Asylums Board's own reports that the mortality of diphtheria cases admitted diminished in each succeeding year. It may be that the admission of cases to hospital may have had some slight indirect effect in directing more care and attention to sore throats, but the upward tendency of diphtheria commenced prior to this date, and therefore this effect would be only part of the generally increasing attention already being paid to the disease.

3.—*The effect of Sanitary Legislation generally.*—This must also be taken into account, for the Public Health Act, 1875, came into force during the very decennium when compulsory education came into force, and the effect of the Act was to stimulate the recognition and prevention of infectious diseases in England, especially in large towns. Compare the dates in the earlier tables of this Report. This stimulus, doubtless, extended to the Metropolis, and, in conjunction with additional sanitary legislation, directed closer attention to infectious diseases in London also.

4.—*The effect of Elementary Schools.*—Dr. Thorne Thorne has so fully and so carefully entered into this subject that his conclusion that increased school attendance has had a material influence in increasing the spread of Diphtheria is irresistable.

5.—*Alteration in Classification.*—Any changes made in classification by the Registrar-General are usually commenced at the beginning of a decennium and therefore would not affect the detailed London figures of throat diseases in this Report. The Superintendent of Statistics, Dr. Tatham, has kindly informed me that "membranous croup" was not classed with Diphtheria until the commencement of the present year (1894), although "diphtheritic croup" has been classed with Diphtheria for a long period, so that classification can have had little or no effect upon the returns of mortality.

6.—*Variation in Nomenclature.*—Improved medical diagnosis due to improved medical education and increased knowledge of diseases of the throat, enables these diseases to be more readily differentiated than formerly. Now, most forms of infectious sore throat are regarded as diphtheria, and the fatality of such diseases is recognised, whereas formerly the term was restricted to typical cases. The danger of the earlier practice has been pointed out in the many instances brought to light in which apparently simple sore throats in schools have culminated in serious and fatal epidemics.

7.—*Change of Type.*—In the last place, the question may be seriously asked whether the variation in nomenclature may not be due to a change of type in disease of the throat? Dr. Thorne Thorne says "that there is reason to believe that attacks of so-called sore-throat exhibit under certain favouring conditions a progressive development of the property of infectiveness, culminating in a definite specific type which is indistinguishable from true diphtheria." A change of type is probably taking place as the result of increased density of population, especially in towns, more particularly of the aggregation in schools, and of the effects of personal infection consequent on these. There is also a strong probability, and it only remains to be definitely proved, that a sore throat caused by insanitary or other conditions, may possess or acquire infective properties, and in passing from person to person may also acquire such virulence as to cause death from infectious sore-throat of a type which the clinician would certify as diphtheria, whatever the pathologist might declare it to be as the result of bacteriological examination.

I have the honour to be Gentlemen,

Your obedient Servant,

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