Mr. Spear's report to the Local Government Board on the continued prevalence of diphtheria in the Aylesbury urban sanitary district.

Mr. Spear's Report to the Local Government Board on the continued Prevalence of Diphtheria in the Aylesbury Urban Sanitary District.

George Buchanan,
Medical Department,
December 5th, 1888.

Part I.—Diphtheria Prevalence.

In February 1886 Dr. Gresswell made inquiry on behalf of the Board into a high mortality from diphtheria in Aylesbury. An epidemic prevalence of the disease had lasted from the middle of the previous October, and at the time of his visit was still continuing. The schools of the town had, it appeared, been largely concerned in the spread, if not in the development, of diphtheria. Out of 37 household invasions recognised since the commencement of the outbreak, the first sufferer had in 30 cases been attending one or other of three public elementary schools within two days of falling ill; and, further, ulcerative sore-throat, to which Dr. Gresswell was disposed to attribute a part in the elaboration of diphtheria, had prevailed amongst the children attending one of these schools before the latter disease was recognised.

Previous inquiry.

Information contained in Dr. Gresswell's report regarding the recent annual mortality from diphtheria is brought up to date in the table below.

Recent mortality from Diphtheria.

Table I.—Deaths from Diphtheria in Aylesbury.

Years.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	Four Months, 1888.
Deaths - -	0	1	5	1	0	15	16	27	5

Note.—One of the five deaths in 1888 was registered as due to scarlatina, but was afterwards recognised as from diphtheria.

In addition to the above, two deaths were registered as due to "croup" in 1887; and one in March 1888 (these all occurring in neighbouring houses). In 1887 the death of an infant, in a house in which diphtheria prevailed, was registered from "convulsions." In 1887–88 the deaths of two infants from "bronchitis" were registered in families in which diphtheria made its appearance within six days and within two days respectively; in June 1887 the death of a child, aged 14, was registered as from "measles, ulceration of fauces, laryngitis," from a family in which a death from diphtheria had occurred seven days before; and in March 1888 one from "acute laryngitis" in a family that had suffered from diphtheria in the previous December.

It will be seen that the average annual death rate from diphtheria in the five years 1880–84 was equal to ·17 per 1,000 of the estimated population of 8,000, or slightly higher than the average diphtheria rate of England and Wales; but in the three years and four months following, the annual average was 2·2 per 1,000 of the then estimated population, or 13 times the previous rate, and in 1887

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it was as high as 3·2. My own inquiry then has been concerned with a long standing and increasing prevalence of the disease.

This prevalence has not, however, been continuous, and the seasonal incidence of the disease has been marked. The epidemic of 1885–86, the first part of which was reported upon by Dr. Gresswell, commenced in October and lasted until the end of the following March, after which the disease extended but slowly until June. From the 15th of July until the following April (1887) no death from diphtheria was registered, and so far as I can ascertain non-fatal cases occurred in only three widely separated houses.* The fact of this intermission may at least be affirmed as regards *recognised* diphtheria. As to the possibility of mild and hidden cases maintaining a continuous chain of infection, it is certainly true that "simple sore-throat" had prevailed throughout the winter of 1886–1887; catarrhal rhinitis, likewise, with some offensive discharge, has been spoken of to me as common during this period. But as to the diphtheritic nature of the catarrhal affections that were thus interposed, the absence throughout a long series of cases of the distinctive appearances of diphtheria, the freedom from fatality and from characteristic sequelæ, must be allowed weight. On the other hand, when diphtheria prevalence was again established, although that of "simple sore-throat" had then diminished, several cases of illness occurred not distinguishable, it is said, from the apparently simple affection, except for characteristic sequelæ; and here and there unequivocal cases of diphtheria were associated, apparently causally, with attacks that from a clinical standpoint alone would be considered non-specific. The possibility, suggested by Dr. Thorne, of *potential* and gradually developing specificity attaching to an apparently benign disease has likewise to be considered; and as to this the importance of negative testimony, such as that above referred to, deducible from long continued absence of fatality, &c., is certainly discounted on finding that, as regards unequivocal diphtheria, *virulence* is a quality subject to seasonal variation. In the epidemic of 1887–88 in Aylesbury, the maximum fatality was observed only after a prevalence of some months of the recognised disease. From April to the 20th of November (nearly eight months) 86 cases and 10 deaths occurred; then, during the next eight days there were 10 deaths, all amongst recent cases. From the 20th November to the end of the year there were 45 cases and 17 fatalities.

Prevalence of "Sore-throat."

The medical gentlemen of Aylesbury favoured me with clinical accounts of the sore-throat spoken of as prevalent. In recognisable features the affection does not appear to differ from that of an erythematous or follicular tonsillitis. The small white or yellowish specks on the swollen and hyperæmic mucous membrane of one or both tonsils, common to that affection, never, it is said, assumed the appearance of the thick continuous membrane of developed diphtheria, and disappeared after one or two days' duration; slight follicular erosions of the tonsils were frequently seen. The lymphatic glands were often enlarged and tender; and for a day or two constitutional disturbance was present. Albuminuria, in the few cases in which it was looked for, was never observed. General debility of some duration frequently followed these attacks, but distinct paralyses were absent. Children and young adults were attacked in largest proportion, and occasionally, it is said, several members of a family suffered simultaneously, or more often in rapid succession. Dr. Eagles, who tells me he has seen perhaps 200 of these cases, speaks of them as generally multiple, and is convinced of their infectiousness. Dr. Hilliard likewise holds this view.

Dr. Gresswell reported the first case of the epidemic of 1885–86 to have occurred in October in the person of a child (Flory R.), living in Church Row, St. Mary's Square. No evidence of recent exposure to infection was discovered, but it was noted that a servant maid had in the month of February previous returned to her home in the same row after an attack of diphtheria; that the girl suffered from a "relapse," so as to be invalided until June, and that cases of sore-throat occurred in her family subsequently to her return in February. The first recognised case in the epidemic of 1887–88 occurred in this same row of six cottages, two doors from the R's. The sufferer, aged $3\frac{1}{2}$ years, had attended the British Infant School for one week, but, from choice simply it is said, not from any ill-health, had discontinued such attendance on March 4th, a full month before her seizure. She was attacked on April the 5th and died on the 11th. A baby-brother,

Recognised outbreaks of Diphtheria: one of 1885–86.

one of 1887–88.

* Of these solitary outbreaks, one of which occurred in August and two in October, I could obtain no satisfactory explanation. In one case, however, the disease had prevailed in the same house 10 months before: in another, the first sufferer had, it was stated, passed through an attack 18 months previously while living elsewhere. In two of the three houses the disease again made its appearance during the progress of the 1887–88 epidemic.

aged nine months, had died on the 30th of March, after 14 days' illness, from what was registered as "difficult dentition, bronchitis;" and at the latter date an elder child was feeling poorly, it was said, although without any complaint of sore-throat. From the history there seemed no sufficient reason to suspect diphtheria in these cases, but whichever was the first attack in this household, no suggestion of recent exposure to infection could be discovered.

On April 6th, the day following the little girl's seizure, another girl living in Bicester Road (nearly half a mile from Church Row)who was a pupil at the British Infant School up to the time of her seizure, was attacked. She had not visited at Church Row (situated on the other side of the school from her house), and no evidence of exposure to infection could be obtained. This child died on the 16th. Both these cases were single ones, so far as any recognisable diphtheritic seizure was concerned, or so far as any illness was concerned, except that above mentioned in Church Row.

On April 14th (as nearly as can be said—some trifling sore-throat may have existed a few days earlier), a child living at a place called New Zealand, not far from Bicester Road, sickened. She attended a small dame school in Ripon Street, but was acquainted with the second child referred to above, with whom she may, before that child's confinement to the house, have associated. No other suggestion of exposure to infection could be found. A sister fell ill ten days later.

During the first week of May, two children of a family in Northern Road, Bicester Road, pupils at the British Infant School, were seized, at an interval of five days, with diphtheria; another family at New Zealand (the first sufferer not attending school) was infected, and the wife of the master of the St. Mary's School, in a different part of the town, fell ill. In these cases, again, except in so far as the school may have afforded opportunities for the school children, and except for a remote chance in the case of the lady from a visit to the British School mistress, exposure to danger of infection (and the existence of apparently simple sore-throat as well as of recognised diphtheria was of course searched for) could not be shown.

The order of attacks that, whether from clinical or etiological evidence, are here regarded as diphtheritic, was as follows:—

TABLE II.

——	Total.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1887.													
Family invasions	79	—	—	—	3	8	8	6	8	6	3	24	13
Cases - -	131	—	—	—	4	12	14	7	13	11	9	32	29
Deaths -	27	—	—	—	2	—	1	1	4	1	1	10	7
1888.													
Family invasions	12	6	4	1	1								
Cases - -	26	11	7	3	5								
Deaths -	5	2	2	—	1								

The influence of personal infection: generally.

Of course the existence of hidden sources of infection was always inquired for; still the suspicion that an inconspicuous, and perhaps even unnoticed, disease of the throat may originate true diphtheria makes it extremely difficult to speak with any confidence as to the part that infection from person to person may have played in the epidemic disease. The gradual growth of the epidemic under investigation is strongly indicative of some slowly progressive mischief such as would be supplied by the multiplication of foci of personal infection; and, in a large number of instances, the history of individual seizures supports the view that this has been one of the chief operative causes. Still, allowing for all such cases, and excluding also those in which the first sufferer had within a fortnight attended a school where some earlier sufferer is known to have been received, there remains a notable proportion of initial cases, a proportion equal to 30 per cent. of the total number, as to which no evidence of previous

exposure to infection, either from developed diphtheria or from mere "sore-throat," could be obtained. It is somewhat remarkable too, if personal infection were the all-important factor in the disease extension, that its effect should have been so moderate in individual household invasions. Of these, the attacks were single in 52 cases, or 57 per cent. of the total number, and in 23 of the remaining 39, the disease extended to two inmates only of the infected dwelling; an experience the more significant since, as a rule, little precaution as regards isolation, &c., was observed.

The *sequence* of cases in houses where multiple attacks occur affords evidence probably of comparatively little value in an examination of this kind where the disease in question is diphtheria; the incubative and prodromal stage being so very variable and the former often of such short duration. So far as it goes in this case, the evidence is consistent with the view that personal infection was accountable for the occurrence of the great majority of secondary cases. In 16 households a second attack occurred within a week of the first; in only two could there be said to be no appreciable interval between first and second seizures. On the other hand, in several instances the interval was prolonged—from three to ten months in eight cases—so as to constitute what may be called recurring outbreaks. To this point I will again refer.

Importation.

In no case during the last epidemic did I find reason to conclude that the infection had been imported from other districts. On the other hand, there was evidence of its transmission from the town into the Aylesbury Rural District in three instances, and a probability of such transmission in two others.*

As to the influence of schools; age and sex distribution.

The age and sex distribution in the 157 cases that occurred between April 1887 and May 1888 is shown in the subjoined table. Of initial attacks in families, 66 per cent. were amongst children of school age, 4 to 14; of secondary cases, 56 per cent. belonged to that age. Some slight preponderance of the disease was observed upon the female sex.

TABLE III.

Epidemic, 1887-88.	Sex.	Total.	Under 1	1-4.	4-8.	8-12.	12-16.	16-25.	25-40.	40-60.
Initial attacks in families.	M.	42	—	4	14	13	4	5	1	1
	F.	49	—	7	19	10	3	3	5	2
Subsequent attacks	M.	29	1	4	8	6	5	2	2	1
	F.	37	1	7	10	8	4	2	4	1

* In three cases referred to the circumstances are of some interest. At Weedon, a child, aged 5, sickened on October 4th, and died on October the 8th, of what is stated to have been well-marked diphtheria. She had not been away from the village for some time, but a brother went daily to the British School at Aylesbury. He suffered just before, and at the time of his sister's illness, from a "bad cold," with fœtid nasal discharge, but although confined to the house for a few days, received no medical attention, nor were any paralytic symptoms afterwards observed. Cases of diphtheria had occurred in two neighbouring cottages in March 1886, spreading apparently then from an imported case, but there had been no appearance of the disease in the village during the 18 months' interval. There had, however, been a few well marked cases of scarlatina (the diagnosis being verified by subsequent desquamation, dropsy, &c.).

At Dinton, a village in which I found sewage nuisances deplorably prevalent, sore-throat of the kind I have described had been general during the close of 1887. In January 1888, what is described as distinct diphtheria appeared in one family, the first sufferer being a young man, whose occupation took him almost daily into Aylesbury. No spread of the disease took place beyond his house; but from the evidence we now possess of the influence, at the least in predisposing a population to epidemic diphtheria, of prevailing "sore-throat," it cannot be doubted that the little village of Dinton had a very narrow escape from a serious disaster.

At Oving, a girl, aged 14, sickened with diphtheria on November the 13th, 1887, and died on the 24th; her brother was seized on that day, and died on the 30th. The medical man in charge of the cases after performing tracheotomy was likewise attacked. No other cases of diphtheria were known of in the neighbourhood. The first sufferer had for some time only been away from home once, and then to a tea-party held on the 8th of November in the Corn Exchange, Aylesbury; *i.e.*, five days before definite symptoms of infection were observed.

The next table shows the incidence of the disease, at different periods of the epidemic, upon children attending different schools and upon non-attendants. School children.

TABLE IV.

Schools.	No. of Children on Books.	Initial Attacks in Families, 1887–88.										
		Total.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.—April 1888.
British - - -	467	20	1	3	1	3	—	—	2	6	2	2
St. John's - -	271	12	—	—	—	1	—	1	—	7	1	2
St. Mary's - -	302	5	—	1	1	—	—	—	—	3	—	—
Walton - - -	224	—	—	—	—	—	—	—	—	—	—	—
"Latin" - -	40	1	—	—	—	—	1	—	—	—	—	—
Free - - -	100	2	—	2	—	—	—	—	—	—	—	—
Private Day Schools (six represented).	143	12	1	—	2	1	3	—	—	3	—	2
Total school attendants.	?	52	2	6	4	5	4	1	2	19	3	6
Non-attendants -	?	39	1	2	4	1	4	5	1	5	10	6

NOTE.—The three schools first mentioned above were closed on November 29th, at the request of the Sanitary Authority, and remained closed until January 1st. The three cases entered against them in December occurred within 4 days of their closure.
These three schools were closed also for the summer holidays from July 29th to August 29th.

The facts given in the above table cannot be studied without a strong suspicion that at one period, in the month of November, certain schools became centres of infection. From April to November the evidence would not, I think, justify such suspicion, for although during that time certain schools are seen to have suffered more than others, this was not, on the whole, inconsistent with the explanation that their pupils chanced to be drawn from the more infected localities.* I have shown that in already infected households, where all may be said to be exposed to infection, children of school age, 4 to 14, supplied 56 per cent. of secondary attacks, and this may probably be taken as indicating approximately the normal disposition to infection at such age. From the commencement of the outbreak until November the proportion of school children (attendants) amongst primary sufferers was equal to 55 per cent. of the total number.† During November, of 24 primary attacks, 19 were amongst children attending school. On the 29th of that month certain schools, as mentioned above, were closed, and remained closed throughout December, so that further comparison for that time is, of course, invalidated.

The "explosion" in November.

When the circumstances come to be more closely examined a doubt, however, arises whether this excessive activity of the infection in November resulted simply from opportunity offered by school attendance. If it were only this, it is singular that *three* of the public schools should be simultaneously involved in the greater activity; and then, as to different classes and divisions of the schools, except at St. John's, where the infants suffered in excess, there was no particular incidence of the disease in this more intimate sense. Coincident activity of the infection, although less marked, was noticeable also amongst the pupils of private day schools, and amongst "non-attendants," a little more noticeable than appears from the above table, for just at this time one of those "recrudescences" of the disease, in a family infected some months before, occurred, as well as one other case which, although I have not classed it as a "recrudescence," the interval since the previous attack being short, was probably of that nature; it was now, too, that one of the families in the rural district was infected from the town. The disease, again, exhibited at this period, as I have said elsewhere, extraordinary increase of *fatality*. It is

* Walton, and the immediate neighbourhood of the Walton Schools, remained throughout almost entirely free from the disease. The western side of the town, whence the British Schools derive a large number of pupils, was, on the contrary, early and seriously infected. The Free School is supplied from a wider source, but the two children belonging to that school infected in May both lived in New Street, in the more involved quarter of the town.

† It will be remembered, however, that the elementary schools were closed during August. The comparison, for this and other reasons, is not exact, and possesses only approximate value.

necessary to subdivide the cases further than is done in the preceding table to show how suddenly the infection became active at various points.

It is worthy of remark that the "explosive" force of the 1885–86 epidemic was also manifested in November. The 37 household invasions included in Dr. Gresswell's inquiry were thus distributed:—in October, 5; in November, 15; in December, 11; in January, 4; first half of February, 2.

It is to be noted also that the increased fatality of the disease in November 1887 did not appear to be associated with any particular strain of cases, or with school attendance. Four of the British School children, infected during that month, died; two of the St. John's children; two of the St. Mary's; two of those attending private schools; and (exclusive of the country case) three "non-attendants."

TABLE V. DAILY RECORD of initial attacks and of deaths during November.

School, &c.	Class.	November.																				Dec.	
		11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	1.	2.
British	Boys (163)	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	1	–
	Girls (168)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	1	–
	Infants (136)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	1	–	–	–	–	–
St. John's (no Boys' School).	Girls (120)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Infants (151)	–	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	–	–	2	1	–	1
St. Mary's	Boys (113)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
	Girls (73)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Infants (116)	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Private Schools	Collegiate	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–
	Miss Cole's	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Miss Wadam's	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Non-attendants	—	–	–	a1	–	–	–	1	1	–	1	–	1	–	–	–	–	–	–	–	1	1	1
Total family invasions.	30	1	1	1	1	–	–	3	2	–	2	–	1	1	2	4	–	1	1	2	2	3	2
Deaths (amongst November cases.)	11	–	–	–	–	–	–	–	–	–	1	2	1	1	1	1	1	1	1	–	–	1	–

NOTE.—The returns up to November 29th as to school children give the date of leaving school through illness.

a. Case at Oving infected from town. [The two deaths resulting from this extension to the rural district are not included above.]

A classification of these November cases according to *habitation* gives a result, some idea of which may be gathered from the following statement:—

It would seem that the grouping observed is greater in amount than can be accounted for by influence of school attendance, and somewhat different in kind. The large incidence, however, upon the infants of St. John's school will have been noticed. Within so short a time that a round of personal infection could scarcely have brought it about, various individuals—children at different schools and "non-attendants"—have appeared to become infected in the same localities.

TABLE VI.

Localities comprising	Families invaded.	School attendance, &c. (respecting initial sufferer).
Cambridge Street, with short cross streets—Eastern Street, St. John's Road, and Mill Street (about 200 houses).	8	6, St. John's School. 1, British ,, 1, Non-attendant.
Walton Street (town end), with Great Western Street, Market Square, and Market Street (about 100 houses).	8	3, Different private schools. 1, St. Mary's. 4, *Non-attendants.

[* In one of these, the sufferer (the only one of his family) lived in the suburbs, but attended his place of business daily in Market Square; another was the case at Oving (page 4), in which infection had apparently been contracted during an afternoon and evening spent at the Corn Exchange, Market Square.]

(*continued*)

Localities comprising	Families invaded.	School attendance, &c.
Whitehall Street and Ripon Street (about 50 houses).	3	2, British School. 1, Non-attendant.
Castle Street (lower end) and Oxford Road (about 60 houses).	3	2, St. Mary's School. 1, British „
New Street and Malden Terrace (about 80 houses).	3	2, British School. 1, St. John's „
Northern Road (23 houses)	1	British School.* [*Shortly before this child's attack the disease had re-appeared for the second time, after a short interval of apparent freedom from infection, in a neighbouring house in Northern Road.]
Four isolated cases		1, a child attending the British School; 1, St. John's School; 2, Non-attendants.

Summary of evidence as to schools.

Speaking again of the outbreak as a whole, there is marked contrast between the more recent evidence obtainable as to the implication of schools and that recorded as concerning the previous epidemic. Of late no school has played any predominant part in the spread of infection; except for the St. John's Infants' School during November, no one class or division of any one school suffered disproportionally in any very notable degree; throughout the epidemic a considerable proportion of attacks occurred unassociated with school attendance.

A distinction must, however, be drawn between this general evidence and that relating to the particular outburst in November. In the latter half of that month some special danger, it can scarcely be doubted, assailed the children attending the St. John's and the British Schools respectively. Before, however, concluding that this arose simply from the opportunities afforded by school attendance for the spread of the disease by personal infection, the following considerations, it seems to me, have to be borne in mind: The opportunity, arising from the presence of infected children, had existed for some months previously in both schools, and notably in the British School (*vide* Table IV.); the sudden outburst was simultaneous in both schools; the severity of the disease (as shown by the fatality) was coincidentally largely increased; the greater virulence of the disease at this time (in its spreading and its killing power) was not confined to these schools, although most noticeable there, nor to school children.

It will be noticed that the period of this exaggerated activity, the fourth quarter of the year, is the one in which diphtheria, speaking of the disease generally, is apt to show an epidemic impulse; and that the month was the one in which it became epidemic before in Aylesbury. Suppose then, that this activity is the result of some natural extrinsic condition (meteorological or other) operating upon the contagious principle of the disease so as to increase the danger of infection from person to person, in such case we should expect to see the proportion of secondary attacks in families largely increased at this time. That, however, does not seem to have occurred. The proportion of secondary attacks during November and December was equal to 65 per cent. of invasions, while in the other months of the disease prevalence the corresponding proportion was 77. The only alternative hypothesis, it seems to me, would be one which would contemplate the operation of some extrinsic agent upon a miasmatic, as opposed to a purely contagious, principle in diphtheria infection.

Other possible sources of infection; milk.

No suspicion attaches to the milk supply. In the case of 68 infected families milk was obtained from 15 different purveyors, and nine was the largest number of infected households supplied by any one of these. In eight families no milk, or only condensed milk, was used. The families infected in November were supplied from 11 different sources.

Water.

No special incidence occurred upon users of different water supplies. The public supply is widely distributed beyond Aylesbury, and 18 of the infected families resorted to private wells.

Diseases of animals.

Swine fever appears to have been the only recent epizootic of the neighbourhood. I found no evidence of connexion between ailments of domestic animals and the epidemic disease.

Locality; grouping of cases.

The disease was widely distributed over the town, so that no considerable locality entirely escaped. The houses in infected streets, &c. (those in which

from first to last in this most recent epidemic one or more cases of diphtheria have occurred), number 1,250 of the 1,600 houses, or thereabouts, in the sanitary district. There was, however, some notable grouping of cases, both as to time and as to place. In the lower half of Cambridge Street and the short streets branching therefrom, 17 of the 200 houses were infected; of the 200 houses in Whitehall Street, five were invaded, and similar small grouping was observed in the upper or town end of Walton Street, with the adjoining Market Square and Great Western Road; in the lower part of Castle Street, in Ripon Street, New Street, and elsewhere. Except for the short cross streets from Cambridge Street, the places named all belong to the older parts of the town, although the few very old courts and alleys are not represented. In Victoria Park, a modern and outlying locality, there was likewise a grouping of cases, but here was evidence, in four initial attacks, of importation from the town. Walton, another outlying locality, escaped in the epidemic of 1885–86, and in 1887–88 only two houses were infected; the disease being apparently introduced into one from the town, and spreading thence to the second, the charwoman and nurse's residence.

Recurrence of the disease in same locality.

The localisation of the disease was exhibited in another way, viz., by its *recurrence* in places that had been infected in the outbreak of 1885–6. (*Vide* appended plan.) Some appreciation of this may likewise be obtained by a comparison, shown below, of the localities in which fatal attacks occurred during the two epidemics. I have bracketed the streets, &c., that stand in juxtaposition.

TABLE VII.

Streets, &c.	No. of Houses.	Deaths during Epidemics of		Remarks.
		1885–86.	1887–88.	
Church Row	6	1	1	Initial cases in both outbreaks.
Parson's Fee	11	3	2	——
Hog Lane	9	1	—	——
Kingsbury	43	4	—	Non-fatal cases in 1887–88 in two houses, next door to those previously infected.
Cambridge Street	164	8	6	——
Anchor Lane	19	1	—	——
St. John's Street	11	1	—	Non-fatal attacks in house next door in 1887–88.
Eastern Street	8	—	1	Non-fatal attacks in same house in 1885–86.
Dropshort	49	2	—	Non-fatal attacks in house next door in 1887–88.
Whitehall Street	40	2	1	——
Ripon Street	11	1	2	——
New Street	55	1	—	Five families infected, 1887–88.
Maldon Terrace	26	—	1	One family infected, 1885–86. In 1887–88, three deaths, in addition, from croup. Those, and the fatal cases of diphtheria, in houses in immediate proximity.
Fleet Street	6	1	1	——
Mill Cottages	18	1	2	——
Northern Road	23	2	2	——
Bicester Road	73	—	1	Two families infected in 1885–86.
Southern Road	1	—	1	——
Buckingham Street	56	1	—	Three houses infected, 1887–88 (two being previously infected in 1886).
Nag's Head Passage	8	1	—	——
Market Street	8	—	1	——
Market Square	45	—	1	One family infected, 1885–86.
Great Western Street	16	—	1	——
Walton Street	78	—	3	——
Castle Street	46	—	2	——
Oxford Road	41	—	1	——
Victoria Park	110	—	2	——

In the first epidemic then the streets contributing the total mortality contained 529 houses, or an estimated population of 2,710, so that the death rate was 11·4 per 1,000 of the street population; in the second

epidemic the mortality rate was equal to 6·3 per 1,000 of this population, whereas in the remaining streets the corresponding ratio was 2·3. A summary such as this, however, scarcely serves to show the full parity of experience. To appreciate this the mortality of the several streets during the two epidemics (its variations and repetitions), given in the tabular statement above, as well as the notes contained in the last column, must be studied.

I have already discussed the influence that may be attributed to schools in the later distribution of the disease, and have given my reasons for regarding such explanation as incomplete. As to *class*, all descriptions of houses, from the Manor house downwards, have been involved during the two epidemics. The families of four of the members of the Local Board have been attacked, two of them twice, by the disease. The trading classes generally have suffered severely; a private boarding school for the sons of gentlemen was in July 1886 permanently broken up owing to repeated outbreaks of diphtheria. The house, a large one, standing in its own grounds, was in a much infected locality.

Recurrence in the same house.

The next step in evidence as to localisation of the disease would naturally concern its recurrence in individual houses, and then its appearance in houses immediately adjoining those infected during the earlier epidemic. My information on this head is naturally incomplete (the absence of a complete list of cases during the earlier epidemic, combined with the lapse of time, removals, &c., could hardly fail to result in this) but even as it stands it affords some positive testimony.

Nine houses invaded during 1885–86 were again, in the outbreak of 1887–88, the seat of disease. In other words, estimating the number of infected houses in the first outbreak at 80,* even at this high computation their inmates suffered during the recent epidemic more by 60 per cent. than the rest of the inhabitants of infected streets, or to somewhat more than twice the extent of their fellow townspeople generally.

Again, during the progress of the last epidemic, the disease made its appearance twice, by two apparently separate and distinct invasions, in eight houses; the interval between the first and second ranging from three to 10 months. (In three cases, three to four months; in three, four to five months; in one, six months; and in one, 10 months.) Before the second appearance of the disease the house had in each case been apparently free from infection for some weeks at least.

Appearance (after long interval) in adjoining houses.

In 10 cases the disease was found to have made its appearance next door to houses invaded during 1885–86. In two of these cases, however, the disease had meanwhile re-appeared in the house next door (the one invaded in the earlier year); the interval between the second invasion of the one house and the first of the other being, in the two cases, five days and four months respectively.

In considering the question of the recurrence of the disease in the same households, the possibility of family or individual predisposition has to be borne in mind. I can only say that I found no evidence to justify such an explanation. Except for the fact of recurrence, there was no evidence of greater disposition to spread in families in which two invasions occurred; and, as to *individual* susceptibility, in only one case did the disease start definitely a second time in the person of a previous sufferer.

In the case, again, of second appearances of the disease in a family during the same prevalence, the possibility of the occurrence of chronic attacks with prolonged infectiousness, or of mild inconspicuous attacks bridging the interval, has to be considered. The histories I have obtained lead me to believe that chronic cases, or cases attended by relapse so as to cover a long period of time, and at last perhaps proving fatal, may occur; but in the instances of "recrudescence" I have given, such explanation was, I think, sufficiently excluded. I will give the history of one such instance.

In Northern Road (a small private street of 23 houses, in which five cases of diphtheria and two deaths had occurred in the epidemic of 1885–86) two children of one family fell ill during the first week of May 1887. They were both attending the British School, but only one case of diphtheria, and that a month earlier, had up to that time occurred amongst their school fellows; indeed, these cases in Northern Road are mentioned on page 3 as amongst the earliest. The children recovered, and on June 6th were both attending school again. On September 23rd another child of the family, not attending school, was attacked by diphtheria. I could hear of no exposure to infection since her sisters' illness, nor could I learn on careful inquiry of any other case in this street during the interval of some four months that had elapsed. A fortnight later a young child of another family in the row sickened, and died after five days' illness. The house first invaded was apparently free from infection once more, and the school children were again attending school, when, about November the 8th, the baby, aged 18 months, sickened; another child, aged 4, not attending school, was seized on the 12th and died on the 23rd. A child belonging to another family in the road, a pupil at the British School, fell ill on the 21st of the month. The house where these recurring outbreaks occurred is, it may be remarked, damp, and, owing to drainage defects, exposed to sewage effluvia; the street itself is unmade, sloppy, and neglected.

* Dr. Gresswell gives 37 as the number of infected dwellings from the commencement of the first epidemic to February 21st, 1886, by which time six-tenths of the mortality had occurred; so that it is probable that the above estimate is considerably too high.

Summary (relating to the phenomena of the diphtheria prevalence).

The salient points of this diphtheria prevalence may be stated then as follows :—

1. An epidemic of diphtheria (reported upon by Dr. Gresswell) lasting from October 1885 to the end of March 1886, with slighter prevalence of the disease until July, in a town not before the seat of any such excessive mortality from diphtheria.
2. The first appearance of the disease in this earlier epidemic in a row of cottages into which a stray case of diphtheria had been imported some months before. Its subsequent spread for some time almost exclusively amongst the children of certain day schools.
3. The reappearance of the disease, after nine months' interval of almost entire freedom from recognised attacks, in April 1887. Its continued, but comparatively moderate, prevalence until November; and in that month, as in November 1885, an epidemic outburst.
4. The absence in this later prevalence of any history of importation; the freedom of milk or water or of domestic animals from any suspicion as agents in the dissemination of infection.

   The circumstances of onset, and, later, of epidemic outburst, apparently inconsistent with the theory of personal infection as a sufficient cause; and the difficulty in a large proportion of individual cases of ascribing the spread of the disease to that agency.
5. The first appearance of the disease in the later prevalence in the same row of cottages primarily infected in the earlier epidemic. Subsequently, its marked disposition to reappear in localities previously invaded.
6. The occurrence of sore-throat, of an apparently non-specific kind, preceding, and in a measure accompanying, the recognised diphtheria outbreaks.

Part II.—Sanitary Condition of the Town.

Considered in relation to Diphtheria Prevalence.

Topography.

The town is built on the summit and slopes of a slight eminence, the latter at its highest point some 50 feet above the surrounding Aylesbury Vale. Several rivulets drain the Vale, and on the south and east of the town, two branches of the "Bear Stream" flow just at the foot of the

Geology.

eminence. The geological formation of the district is the Upper Oolite, the summit of the eminence on which the town stands consisting of Portland Stone, and the slopes and land around of Kimmeridge Clay, overlaid by a rich mould. On the south and south-east, where Walton and the new surburban district of Victoria Park are situated, outcrops of Portland Stone again occur. The locality is said to be somewhat subject to fog. Some meteorological data are appended.

Some 700 of the houses of the district are situated upon the rock, the remainder (some 900) upon clay. Of the former, during the last epidemic, 4½ per cent. were infected; of the latter 6½ per cent. In the previous epidemic somewhat similar incidence was observed.

Streets and roads.

The central parts of the town are, as described by Dr. Gresswell, irregularly and closely built; with narrow roughly paved streets, and with a market square the source of much complaint by the residents of the immediate neighbourhood owing to its defective paving and surface drainage. The numerous private streets and roads of the less central localities remain with few exceptions (the exceptions being Ardenham Street, West Street, and Mount Pleasant, which have recently been sewered, metalled, paved, and channelled at a cost of 650*l*.) in much the same condition as Dr. Gresswell described, "commonly not levelled or drained, and in wet weather covered " with clay mud to the depth in some instances of half a foot." Northern Road and several of the cross streets from Cambridge Street, all of which were involved in the diphtheria outbreak, afford notable instances of this state of things.

House accommodation.

In certain of the older and more crowded courts several of the cottages have fallen out of occupation since Dr. Gresswell's visit. A number,

however, of the same class remain; although, owing to dampness, dilapidation, want of proper ventilation, and from unwholesome surroundings, they are unfit for habitation. Crown Court, Queen's Court, Bull's Head Square, in the central quarter, may be particularly mentioned; as well as small blocks and single dwellings (Frances Place, cottages in Whitehall Street, &c.) in various parts of the town. Other old cottages, although clean and less generally unwholesome, are seriously deficient as regards ventilation and air space (of these, examples may be seen in Friarage Road, Chapel Row, &c.). In the more modern cottage property, the absence in the past of proper building regulations is conspicuous. Proper elevation above the ground level, ventilation beneath the boards, the use of damp-proof courses, are, especially, requirements frequently lost sight of. Even now, with building byelaws, and a capable and energetic but overworked officer for their enforcement, it is found apparently extremely difficult to secure in building operations due regard to sanitary requirements. The Surveyor needs in this, as in other matters, more personal assistance, as well as all the moral support that the Authority can afford him.

Excrement disposal.

With a few exceptions in which privy pits are in use, excrement disposal is by pan closets connected with the sewers. In cottage property, flushing apparatus is scarcely ever provided; and as the drains in addition are generally of the most primitive kind, nuisances from choked and overflowing closet pans are of frequent occurrence.

Scavenging.

The removal of house refuse is more efficiently carried out than at the time of Dr. Gresswell's inspection. Victoria Park and a few isolated places only afforded cause for complaint on this head.

Water supply.

The mains of the Chiltern Hills Water Company are available in the town, and some four-fifths of the population obtain a supply from this source. The water is from deep wells and extensive adits in the chalk, one of the wells being situated at the summit of the Aston Clinton Hills, the other, newly sunk, near Tring. The water is of the usual pure quality of waters so derived, and is softened by Clarke's process before distribution. The service is on the constant system, but during last summer, as in the summer of 1885, an intermittent service had to be resorted to.

The remainder of the population obtain their supply from numerous local wells. Many of these are open to grave suspicion of contamination, and it should be the policy of the Authority to secure their disuse. No suspicion, however, attaches to them in connexion with the diphtheria outbreak.

Condition of the schools.

At the time of Dr. Gresswell's inquiry, the public elementary schools were found to be open to serious sanitary objection; on the ground, firstly, of inadequate room ventilation, and, secondly, on account of defective drainage and closet arrangements. The ventilation has, in most instances, been considerably improved by the introduction of what are known as Tobin's tubes, as to which, however, it appears to be forgotten that cleansing is required. In the matter of drainage the alterations effected cannot be spoken of as adequate. At the British Girl and Infants' School flushing apparatus has been attached to the closets, and some ventilation by pipe shaft has been provided in the drains. The closets, however, are still practically within the school buildings, and the infants' schoolroom, especially, is not sufficiently removed from danger of air contamination from this source; the danger being the more serious from the extremely defective and foul condition of the public sewer or culvert into which the closets discharge. At the St. John's and the St. Mary's Schools, a daily flushing of the closets by hand is still relied upon. The condition of the playgrounds requires attention for the avoidance of undue exposure of the children to wet.

Sewerage and drainage.

To the subject of sewerage and drainage of the town special attention needs to be directed. Some 10 years ago a scheme for its complete sewering was devised by Mr. Hawksley; but, although a sum of 25,000*l.* is said to have been spent, little more than the outfall and purification works (in themselves very complete), together with the necessary intercepting sewers, were constructed. The law was complied with, and so much of the sewage as was discharged at the end of the sewer system was purified, but the old tributary sewers were left all over the town; and the latter could have derived, so far

as health is concerned, exceedingly little benefit. Except for the occasional construction of a new sewer in place of an old one, matters have remained in this position ever since, and even when a new sewer has been constructed many houses that might have drained into it have remained connected with the ancient culvert. These culverts, containing sewage matters excessively foul from long retention, have, moreover, been allowed to ventilate themselves through the new sewer gratings, and to discharge their contents into the new sewers; with the result that the latter have themselves become excessively foul, and their ventilators so intolerable a nuisance that in the greater number of cases the people in the vicinity have insisted upon their closure.

Of these old culverts, there are, it is estimated, some five thousand yards in the town. They are built of loose brickwork, allowing percolation to take place freely into the soil, and those that I saw opened contained a large amount of thick black sludge. They lie generally shallow beneath the surface, and are occasionally beneath the kerbstone, so as to be quite close to the foundations of houses. Of many of them, however, no information whatever is obtainable, and from a not inconsiderable number of houses all excrement and slops (for it is to be remembered that this is now a "water-closet town") go no man knows where.

Private drainage is in large measure equally defective. Often constructed of brick or of "butt-jointed" pipes the drains not unfrequently pass beneath houses, so that the foundations of many houses must be impregnated with sewage effluvia. Unbroken drain connexion between the dwelling and the sewer is not uncommon.

I have shown that diphtheria, as defined in this report, has in its prevalence exhibited a notable and hitherto unexplained tendency to localisation. The corresponding facts as to the sore-throats, regarded as not being of diphtheritic nature, are not here recorded. Detailed examination of the circumstances shows these localisations to have been in almost every case associated with grave defects of sewers or drains; defects which have led to the contamination of the atmosphere in and about houses with sewage effluvia, and to sewage contamination of the foundations of houses. I will describe the conditions observed in a few typical cases.

The first case of diphtheria in each of the two epidemics occurred, without demonstrated exposure to recent risk of infection, in houses of one short row next door but one to each other. Some trifling alteration was made in the drainage after the first outbreak, and, after the second, owing to continued complaints of nuisance and of the entrance of rats into the houses (the latter a very frequent cause of complaint in Aylesbury), the common drain of these cottages was uncovered. It was a drain receiving the discharge of closet pans as well as slop water; it was carried beneath the floors of the kitchens, and it was constructed throughout its whole length of perforated bricks, so as to facilitate soakage from it.

A notable group of cases occurred just at the top of Walton Street, Market Square, and Great Western Street. Ten houses were invaded, three of them twice at long intervals, and the occupier of an office in Market Square was also attacked. The three houses invaded at the top of Walton Street were said to drain to a new pipe sewer, but on examination the drains of two of them were found to discharge into an old, open-jointed brick and flag culvert. It contained extremely foul deposit some inches in depth, and passed just beneath the flags of the footway close to the foundations of the houses. With this old culvert, moreover, the Market Place sewers (one old and one new), and the Great Western sewer, were connected. Naturally under the circumstances they were excessively foul, and most of their ventilators had been stopped up accordingly. In addition to this, the private drainage arrangements of nearly all the houses invaded were such that the air of the sewer would under the circumstances inevitably penetrate to the interior of them.

The sewer of Cambridge Street is a 15-inch brick culvert; the invert not jointed, and the bricks "laid dry." In a length of 400 yards it contains no ventilator. It was found to contain about two inches in depth of black deposit. The inhabitants complain generally of escape of foul air from gullies, private drains, &c., and this was so notably at one point, near Frances Place, around which a grouping of cases of diphtheria had occurred. The

private drains of this street are generally old, and of similar defective construction (unventilated and leaky); they were found to be carried beneath several of the infected houses; in three of the latter "internal connexions" were observed.

The condition and construction of the sewer of Ripon Street and Whitehall Street, and the private drainage there, are, in essential respects, precisely similar. There also, amongst the group of infected houses, the escape of sewer air by private drains, &c., was complained of.

The Castle Street sewer, of similar construction, was opened for my inspection and found to be nearly choked with foul deposit. Three children of different families, living at or near the lower end of this street, died in November of diphtheria. They were known to have played together about an untrapped gully communicating with this sewer, at a place before complained of as horribly offensive from sewage effluvia. A child living in a house higher up the street had, in the previous June, suffered from diphtheria, and the same sewer had had opportunities of specific infection during the epidemic of 1885–86 from its higher ramifications.

The sewer into which the British Schools are drained was likewise opened for inspection. It was found to be of the same construction and half full of black deposit.

In a house in Mill Street, Cambridge Street, a woman, aged about 50, suffered from an attack of diphtheria in November. Her husband was infected about three weeks later, but the other members of the family, grown up sons, escaped. The circumstances were such that exposure to direct infection appeared to be most improbable; but it was found that the woman was accustomed to work in a cellar kitchen, having direct communication with the sewer, and much invaded by sewer air. A woman living at Parson's Fee, who suffered from a fatal attack, was, it seemed probable, infected under similar circumstances in a house in Great Western Street—a street the sewerage of which has already been described.

In St. John's Road, Cambridge Street, three children of a family (one of them aged nine months) sickened of the disease within a day or two of each other. The drainage had been before the subject of complaint, and now, on examination, an open-jointed pipe drain was found to be carried through the house just beneath the flooring. Sewage matter had been escaping at all the open joints, and the foundations were spoken of as "gutted" with sewage.

It is unnecessary for me to continue the relation of such cases. They might, if need be, be multiplied, but of themselves they afford a fair indication of the circumstances under which a large proportion of recent sufferers from diphtheria in Aylesbury were found to have been living.

It is admissible now to complete the summary given at the end of Part I. of the Report, as follows:—

7. Endemic prevalence of diphtheria in Aylesbury co-exists with a condition of sewers and drains that is productive of excessive filth contamination of soil and air.

Sanitary Administration.

Administration of the authority.

The Report of Dr. Gresswell, after the inquiry of 1886, dealt largely with the need for improvement in the sanitary administration of the district, and referred specially to the following circumstances as injurious to the public health:—The continued occupation of houses unfit for habitation; the accumulation of house refuse about dwellings; the defective construction and inadequate ventilation and flushing of many of the public sewers and private drains; the want of proper surface paving and channelling of many streets and courts; the nuisances arising from the proximity to dwellings of ill-kept slaughter-houses. In regard to the means available for checking the spread of infectious disease, the report further stated that notification of such disease to the Medical Officer of Health was entirely without system; that hospital accommodation for the isolation of infectious cases was of a merely provisional character and unsatisfactory; and that no public disinfecting apparatus or

public mortuary existed. Copies of this report were sent to the Local Authority, together with the recommendations of the Board thereupon. I have already noted all the action upon this matter with which the Authority is to be credited. The scavenging of the district, although not yet wholly satisfactory, has been improved; some half dozen private streets and courts, at most, have been paved and channelled; here and there some little local improvement has been effected in some particularly defective sewer or drain. In all other respects the sanitary circumstances of the district (the actual condition of premises as well as the means of defence against spreading disease) remain the same as when epidemic diphtheria invaded the town in 1885; with, probably, this important difference, that whereas before that date the half-blocked sewers and sewage-sodden soil were for the most part a source of insidious mischief to general health only, there exists now a probability that they have become the breeding-ground of a specific contagion capable of rapidly destroying human life.

JOHN SPEAR.

AYLESBURY.

DIPHTHERIA.

* Green Dots mark infected houses (so far as known.) Epidemic 1885–86.

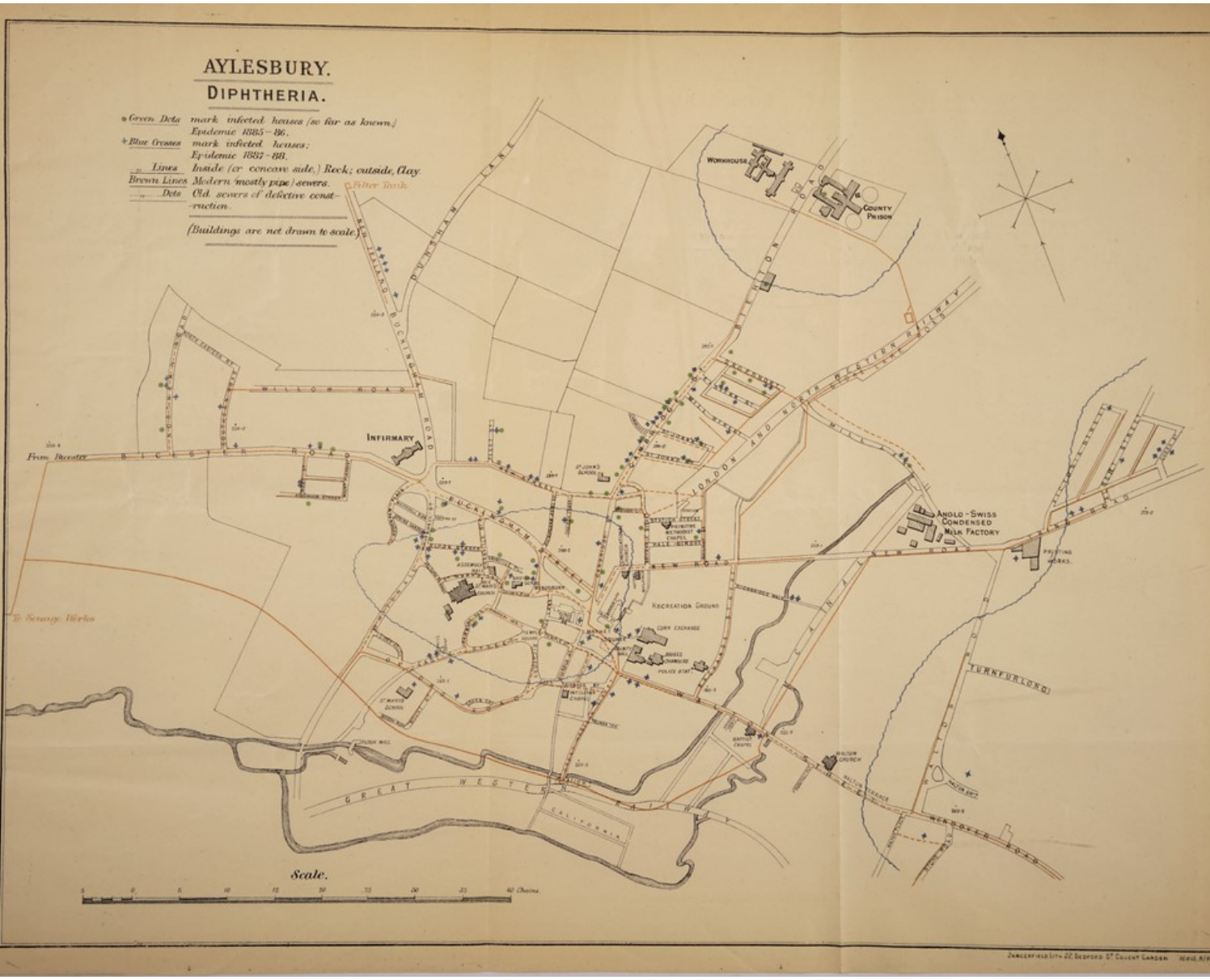
\+ Blue Crosses mark infected houses; Epidemic 1887–88.

Lines Inside (or concave side,) Rock; outside, Clay.

Brown Lines Modern (mostly pipe) sewers.

Dots Old sewers of defective construction.

(Buildings are not drawn to scale.)



Darlington Lith. 22 Bedford St Covent Garden

APPENDIX.

I.—*Vital Statistics.*

Year.	Rates per 1,000 of the Population of Aylesbury.					Deaths under 1 year of Age to 1,000 Births registered.
	Birth-rate.	Death-rate.	Zymotic Death-rate.	Death-rate from Phthisis.	From Bronchitis, Pneumonia, and Pleurisy.	
1881	28·9	14·8	1·2	—	3·5	88·4
1882	33·0	20·5	4·5	—	4·5	120·1
1883	30·8	18·2	2·2	—	4·3	138·2
1884	28·0	17·3	2·7	3·1	2·7	137·1
1885	34·1	18·4	3·2	2·0	3·2	101·4
1886	31·4	24·7	7·6	2·0	4·0	198·4
1887	33·3	17·0	4·0	1·7	2·7	112·8
Average of 7 years.	31·6	18·7	3·7	2 2	3·6	128·1
England and Wales (1886).	32·4	19·2	2·6	1·7	3·2	149·0

Note.—In the above return, the figures of which, so far as they relate to Aylesbury, are taken from the annual reports of the Medical Officer of Health, extra urban deaths (in infirmary, workhouse, and gaol) are excluded,

The general rates (in the lower column) are from the last Report of the Registrar-General. The figures for 1886 for England and Wales do not depart materially from those of recent years.

The deaths from zymotic diseases in Aylesbury during the last two years are as follows:—

1886—Measles, 17; diphtheria, 16; whooping cough, 16; diarrhœa, 8; pyæmia, 2; erysipelas, 1; rheumatic fever, 1.

1887—Diphtheria, 27; croup, 2; whooping cough, 1; erysipelas, 3.

II.—*General Sickness.*

An attempt to examine the comparative sick rate of the district by the records of a "sick fund" established for the benefit of the employés of Messrs. Hazell, Watson, and Viney, printers, &c., at Aylesbury and in London respectively, gave results tabulated below. In weighing these results the following considerations have to be borne in mind:—In Aylesbury women as well as men are admitted to the sick fund (as to this, however, a classification made for the last two years shows no excess of sickness amongst women); in London the surplus (if any) belonging to the fund is at the end of each year divided amongst the members, whereas in Aylesbury the surplus (if any) accumulates. In the latter town the payment of a small additional subscription entitles the members to medical aid. In London the average earnings while at work are somewhat higher than at Aylesbury; but, on the other hand, the members are allowed to draw sick pay for 26 weeks, as a maximum period, whereas at Aylesbury the period is 16 weeks. It is, of course, possible that different tradition and habit exist as to declaring on the sick fund, in the two places, although, as to actual malingering, a medical certificate is required in each case. The business premises and workrooms at Aylesbury are comparatively new, and have been designed with careful regard to sanitary requirements and the comfort of the workpeople; they are said to compare very favourably with those of the London house.

	Employés on Sick Fund.	Average Number of Cases of Sickness per Year.	Average Number of Days lost by Sickness per Member per Annum.
Employés of Messrs. Hazell, Watson, and Viney (Limited), Printers, &c.			
London: Kirby Street, E.C. - - - / Long Acre, W.C. - - -	510	40	2·8*b*.
Aylesbury - - - -	Males - 270 Females - 127	38*a*. 15*a*.	6·0*c*.

a. These figures refer to two years (ending June 1888) only.
b. Experience of 11 years.
c. Experience of 14 years.

My inquiries in the town led me to believe that a considerable amount of sickness of an ill-defined character was associated with defects of drainage, such as I have referred to in the report, and the people themselves not unfrequently attribute their ailments to this cause. I may refer to one instance as an example. In a house in New Road a child suffered from an attack of diphtheria in January 1888. I could not discover any exposure to infection, but it was noted that a family, certain members of which were convalescent from diphtheria, had moved into the adjoining house in the previous September. The common drain of the two houses was exposed at the time of my visit; it was found to be constructed of open-jointed pipes, and sewage had evidently been saturating the soil around the houses for years. In April 1887 the mother and two children of the family in which diphtheria last occurred suffered from what was described as "pneumonia." The drainage had at the time been suspected, and foul odours were complained of.

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*III. Meteorological Observations (Aylesbury).**

Month.	1884.		1885.		1886.		1887.	
	Rainfall in Inches.	Mean Temperature of Air ° F.	Rainfall in Inches.	Mean Temperature of Air ° F.	Rainfall in Inches.	Mean Temperature of Air ° F.	Rainfall in Inches.	Mean Temperature of Air ° F.
January - -	1·8		2·0	37·8	3·8	36·4	1·6	36·0
February - -	0·8		2·1	45·5	0·6	37·0	0·9	42·0
March - -	1·2		1·6	46·4	1·0	41·8	1·2	44·1
April - - -	1·2		1·6	55·1	1·3	52·8	1·1	52·3
May - - -	0·7		2·5	52·8	3·7	58·9	2·3	56·8
June - - -	2·2		2·0	68·3	1·5	66·3	1·3	72·8
July - - -	2·6		0 4	73·5	2·1	71·5	0·6	75·4
August - - -	2·7		2·0	64·9	1·3	68·7	1·5	73·4
September - -	1·7		3·8	59·2	2·0	64·2	3·2	62·0
October - -	1·7		5·1	48·9	5·2	55·0	1·3	49·9
November - -	1·4		4·9	43·1	3·6	47·2	3·1	41·7
December - -	3·1		0·7	39·8	4·0	38·3	2·0	36·2
Twelve months -	21·1	55·7	28·7	52·9	30·1	53·2	20·1	53·5

* Kindly supplied by Mr. James Copcutt.