barrier to our weighing carefully its potency of carriage by other channels, since the same power of direct infection is possessed by such diseases as typhoid fever, erysipelas, and puerperal fever. This power, however, being so much greater in the case of scarlet fever, is liable to hinder us from directing our attention to such possibilities as I now suggest.

It might be supposed at first glance that the suggestion here made as to the means provided by defective privies for the continuance of scarlet fever might be checked and controlled by a comparison of one district with another or of one town with another, and that those districts and towns in which defective privies were most known to prevail ought to give the highest rates from scarlet fever. Possibly something might be gathered from that source. But it must be pointed out that these considerations glance at urine as well as at solid excreta, and that consequently we cannot look to the midden system as necessarily showing a worse result than the pails. Further, the factor of direct infection at school, at home, and at play, which is itself a variable one, introduces an element of great complexity.

DIPHTHERIA AND "SORE THROAT" IN RELATION TO POLICE MANURE.

BY

A. K. CHALMERS, M.D., M.O.H., Glasgow.

THE cases forming the subject of this enquiry* occurred in an outlying district, and the questions to which answers were sought were (1) was diphtheria introduced into the district by police manure, and (2) did the manure traffic in any way influence the continuance of diphtheria therein after its introduction? An answer to the first of these questions must almost of necessity be of a speculative sort; but in regard to the second, there appears to me ample reason for thinking that the proximity of one of the schools in the district to a railway siding, where it was the custom to unload manure waggons, played a considerable part in rendering the throats of school children susceptible to the disease, once it had been introduced.

The first feature which attracted attention was the time-distribution of the cases. In September, one death occurred in the village of A.; in November, there were four cases—two of which died—three of the cases, with both deaths, being in the neighbourhood, while the fourth was in the village of A. Thereafter nothing is reported in A. till March, when a fatal case occurs at a farm house, fully one mile distant from the village. Meanwhile, a fatal attack had occurred at the village of

B. in December, and again in April another case was reported from that district. There are thus eight cases with only two recoveries, six being in A. or its vicinity, and two in B. The series thus formed was an interrupted one; in other words, there was nothing in the time-distribution, apart from those occurring in November, to suggest direct personal contact among the individual cases as the source of infection in any of them.

In each of these cases a personal enquiry was made into the sanitary circumstances of their respective homes, and it was possible to exclude such conditions as water and milk supply, dampness of walls, drainage, etc., from further consideration, as having no essential bearing on the incidence of the disease.

It has just been stated that one of the fatal cases occurred at a farm house distant fully a mile from the village of A., and I purpose relating the history of the disease in this family as told me by both parents, because of the line of enquiry which it suggested. There are now remaining seven children of this family, whose ages range from $1\frac{1}{2}$ to 16 years. The fatal illness occurred in a boy, Alexander, aged 6 $\frac{1}{2}$, who sickened on the 6th and died on 12th March. But three other children of the family were ill of indefinite throat symptoms before this. R. (aged 11), Standard V. at school, took ill early (about second week) in February; J., aged 10, Standard IV. at school, a few weeks later; and G., aged 3 years and 9 months, on March 5th, that is on the day before the fatal illness in the fourth child began. R.'s illness only kept him from school one day. J. was absent, I afterwards found from the school register, from February 12th to 23rd. The mother thought these illnesses were due to a "cold," but she noticed that the nasal discharge was different from what she was accustomed to see accompanying that condition. Both children were present when this was being told me, and in reply to queries were very decided in stating that there had been pain in the throat on swallowing. This pain in R. lasted for a week (although he had been absent but one day from school). From this history it seemed probable that the fatal illness in this family was in reality the fourth case of diphtheria in the household, and had been acquired by direct personal infection. The boy who died did not sleep with the others, but with one of the servants. The suggestion that the earlier illnesses of this family were in reality diphtheria was strengthened by the following circumstance: During my visit the parents told me that their ploughman's children were at the time ill of symptoms, which the farmer's wife said were quite like those from which her own children R. and J. had suffered. On afterwards examining the ploughman's children, a boy and girl, both under school age, I found them to be suffering from diphtheria, the boy having sickened on March 30th, the girl on April 4th.

* The whole circumstances of the outbreak were made the subject of a confidential enquiry, so that none of the places are herein mentioned by name.

SCHOOL ASSOCIATION.

I have already said that the boy R., at the farmhouse just mentioned, was only absent from school for one day, although the pain in his throat continued for a week, and that during his sister's illness—its true nature being at the time unsuspected—the other children of the family continued in regular attendance. I also learned that certain of the other children who had been attacked attended the village school at A.

It is obvious that in a village population with one elementary school the importance of school association may readily be over-rated, for the village children will attend the village school, and—given a prevalence of disease among children of school age—the incidence of school attendance may, although general, be quite arbitrary and altogether insignificant. In considering the question of school attendance in relation to the present cases, therefore, I have endeavoured to eliminate such errors of construction as were at least apparent. From the infant mistress of the school at A., who has been many years in the school, I learned that her impression was that "sore throat" as a cause of absence among the children had been more frequent during the past winter (1893-4) than at any previous time within her knowledge of the school. This observation, she believed, was specially true of the infant room (including Infants and Standards I. and II.), and chiefly therefore affecting children up to nine years of age. With the view of testing this impression by an appeal to the school register, I asked the teachers to prepare certain tables for me, from which the following figures are taken:—

TABLE I.—Showing number of children absent in certain months from "Infants" and "Standards I. and II.," stated as a percentage of the children on the roll. (School A).

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Mean of five years, ending March, 1893 ...	20.8	16.5	20.47	24.8	22.9	21.6	24.9
September, 1893, to March, 1894 *...	26.3	28.6	27.8	31.5	21.8	31.6	22.3

* Months during which outbreak occurred.

The infant mistress's impression was therefore correct as regards the months September to December, and also as to February. For the months of November and December the disparity, indeed, is greater than these figures show, because in November and December, 1891, the average number absent exceeded the mean by 11.3 and 10.4 respectively—an excess which the log-book explains by stating that influenza was then present; while in December, 1892, the mean is again exceeded by 5.6, stated in the log-book to be due to snow-storms. Regarding the figures for the months January and March, an average of 32 per cent. were absent in January, 1890 (against a

mean of 22.9 for the five years), which the log-book explains by a reference to the prevalence of stormy weather, and on every occasion but one where the monthly average during 1893-4 exceeds the mean of the five years some corresponding explanation is found in a note in the log-book. For several months in succession (September-December) there had therefore been in the infant department an increase in the proportion of children absent, as compared with the mean of the preceding five years, while for the months January-March other causes were in operation, which, as already explained, tended to vitiate any comparison based on the mean number absent. I have already referred to the infant mistress's impression that the absentees were largely from her own department, and the following table largely confirms this impression:—

TABLE II.—Showing number of children absent from Standard III. and upwards, stated as a percentage on the roll. (School A).

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Mean of four years, ending March, 1893 ...	27.5	19.3	19.5	27.7	19.7	20.5	21.8
September, 1893, to March, 1894 }	31.0	39.0	24.5	17.0	16.0	10.5	16.0

Here the increase in the proportion of children absent during the past as against the mean of the four preceding winters is limited to the earlier months.

The school building consists of two larger and a smaller (class) room. The infant department occupies one of the larger rooms, the other is occupied by all the Standards from IV. upwards, while Standard III. meets in the smaller (class) room, which is entered from the Upper Standard Room. The children absent from "sore throat" from Standard III. and upwards were twelve in number, and the standard and month in which the absences occurred are as follows:—

Standard.	Nov.	Dec.	Jan.	Feb.	Mar.	Total.
III. ...	1	1	-	-	1	3
IV. ...	-	-	1	-	1	2
V.* ...	1	1	1	2	-	6
VI. ...	-	-	-	-	1	1
	2	2	2	2	3	12

* One date unknown.

Of these twelve children, only two were boys, and it falls here to be noted that the girls in all the upper standards assemble in the infant room for sewing from three to four o'clock daily, after the infant department has been dismissed for the day. In a similar manner the absentees from the same cause in the infant room can be distributed as follows:—

	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total.
Infants ...	-	-	3	2	-	1	5	1	12
Standard I. *1	-	-	3	0	2	-	-	-	6
Standard II. -	1	4	-	-	5	-	-	-	11
	1	1	10	3	7	1	5	1	29

* One in each of these recognisably suffered from diphtheria.

That is twenty-nine children properly belonging to the infant room and ten girls of the upper standards who spend one hour of each day sewing therein suffered from a throat affection, which in four of their number was recognisable as diphtheria. It will also be observed that one of these four was the first illness recorded. The four cases recognised were widely scattered throughout the series, but it is reasonable to connect them one with another through the other members. Clinically, it is very frequently difficult to say where sore throat ends and diphtheria begins; and this separation in time of the recognised cases but adds point to the suggestiveness of a series, with indefinite throat symptoms, which begins and ends in fatal cases of true diphtheria. It must be remembered, too, that many of these cases had no medical attendant, and that the other children of a household, where one was absent from "sore throat," continued in attendance at school. The girls of the upper standards, it has been said, had a sewing-lesson daily in the infant room, and ten of their number suffered from "sore throat." This contrasts with only two cases in the boys of these standards who had no occasion to be in the infant room, and it is impossible to escape the conviction that the larger number of the girls attacked is connected in some way with the time they spent in this room.

Moreover, the impression created by the whole circumstances distinctly was that the eight cases reported were only the major incidents of a prevalent throat affection, the nature of which was in some way related to diphtheria; and I afterwards learned that this corresponded with the view entertained by the medical practitioners who attended many of the cases.

Pursuing the line of inquiry which I have related in connection with the school at A., I visited the public schools in B., one of which (the infant school) two of the originally reported cases had attended. These sicknesses occurred in December and April. The infant school is a modern building, and accommodates infants and Standard I. It is at some little distance from the building in which the other standards are taught. In neither school, however, had the attendance varied much in the past winter, and calculations made on the lines of Tables I. and II. afforded a striking contrast to what we have seen happening in A. school during several months of winter.

Table III.—showing number of children absent from B. Infant School, during certain months, stated as a percentage of the number on the Roll.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Mean of three years ending March, 1893	14	15	18	26	18	15	16
Sept., 1893, to March 1894	12	15	14	17	12	22	18

POLICE MANURE IN RELATION TO INFECTION.

Investigation on the lines just referred to had widened the scope of the enquiry. For, instead of considering chiefly whether any or all of the eight cases first mentioned could be regarded as sporadic and definitely referred to the importation of police manure, it became more important to enquire whether the throat affection, as ascertained to exist, could be related to the manure traffic in any way capable of definition.

The villages of A. and B. are situated in an agricultural district, and much police manure is imported by rail, sometimes from a considerable distance.*

That police manure may become a vehicle for the transmission of the virus of specific disease has been elsewhere demonstrated. Enteric fever has frequently followed the use of such manure when containing human excreta, but it should be observed that this has chiefly resulted from manurial pollution of a water-supply. The belief that diphtheria may not be spread by the dejecta is based on the assumption that patches of the diphtheritic membrane, if swallowed, are deprived of their specific properties by the processes of digestion. It is to be observed, however, that diseased areas are not infrequently found both in the stomach and intestines of persons dead of the disease, and that any of the virus present in any part of the intestinal tract, lower at least than the former, is likely to be voided in an active form. Apart from this, there is a general admission that articles soiled with the throat and nasal discharges of such patients will contain the virus in an active form—unless measures are taken to ensure its destruction—and that in a dried state the virus of diphtheria may remain potentially active for about three months. It is certain that all people are not careful or capable to follow instruction as to the disinfection of such soiled articles; and besides, all cases of diphtheria are not recognised. There is, therefore, every likelihood that domestic refuse thus soiled will find its way occasionally into a manure heap, but the quantity of such specifically infected material present in the bulk of City manure must at all times be infinitesimal.

It will be remembered that the manure is undergoing decomposition as the result of the action of putrefactive organisms present. These organisms penetrate the mass and adhere to the solids, so that if the smaller particles are blown about, the organisms are carried with them. The gases which result from the action of these organisms are offensive to most people, and exposure to them is productive of some more definite discomfort to some. Nausea, vomiting, and diarrhoea, admittedly may be thus caused; and the foreman on one of the farms has seen the farm hands when unloading

* The quantities and dates of despatch are before me, but it is unnecessary to reproduce them here.

trucks of "long manure"* so attacked. Sore throat also may follow exposure to manure effluvia, but this would seem to be due rather to the organisms adhering to the lighter solid particles which may be associated with the effluvia than to the gases themselves. It has been alleged that septic conditions, such as septicaemia and certain allied states may sometimes result from exposure to manure effluvia, but the precise relationship is difficult to determine, although such cases suggest that septic organisms, like the putrefactive ones, may be present in the air which has passed over a manure heap.

In considering a little more in detail the evidence which exists as to the relationship of individual cases of the disease to the manure traffic, three hypotheses may be advanced:—

(1) The disease was introduced by personal infection;

(2) It originated in the district; or,

(3) Having been introduced, the local conditions were such as to favour its spread.

In dealing with the question of school attendance, I have already shown that the experience at A. was in marked contrast to that of B. These schools are situated about a mile apart, and in both cases of undoubted diphtheria occurred; but in A. this was associated with many cases of sore throat, and the attendance was markedly affected, whereas in B. no such effect on the attendance was experienced. Moreover, in the village of C., which is not two miles distant from A. in the other direction from B., no cases of diphtheria were reported during the year 1893, although there was much sore throat of an unknown nature during the winter. It would appear, therefore, that some special influence affected the children while attending A. school by which the contrast can be explained, and its proximity to the centre of the manure traffic of this district requires consideration.

This school is distant only ninety yards from the siding at A. Railway Station, where it is usual to unload manure waggons. In B. the station and school are a considerable distance apart.

The station-master at A. informed me that the waggons in which the manure arrive are uncovered, as also are the carts in which it is driven from the station. It is usually unloaded at the siding furthest from the passenger platform, but should this happen to be occupied when manure arrives the siding nearest the platform is chosen. The unloading is usually done between the hours of 7 a.m. and 5 p.m.: The traffic, moreover, is conducted, apparently, without regulation, except one which imposes a penalty on the consignee if waggons are not unloaded within forty-eight hours of their arrival. During the unloading and driving

(which latter operation brings the carts much nearer to the school) the stench in the school is excessive, and the infant mistress is frequently sickened by it. Windows and doors must be shut when it is going on. Recalling what I have previously said regarding the various forms of disease associated with exposure to manure effluvia, it is evident that we have here the conditions of a somewhat crude experiment on a large scale. Further, the conditions are not those of a merely passing exposure to noxious effluvia which may be escaped from at will, but are those of continued and compulsory presence within the confines of a school-room, of children just at the period of life when they are most susceptible to the deleterious influences of a poisoned atmosphere.

The history of the first reported case in A. school is very definite. The school re-opened after the summer vacation on September 4th, 1893, and on September 8th J. W. Y. is found by the infant mistress to be affected with hoarseness. She is sent home, is seen by a doctor, found to be suffering from diphtheria, and dies on September 15th. This, so far as known, is the first case in A. in 1893.

Seventeen days had intervened between the last load of manure leaving the station at A., and the date when this child was found to be ill. Drop-pings from the waggons and carts, however, lay about the sidings, and the child along with others occasionally searched this refuse for pieces of broken earthenware. She lived in one of a row of six houses containing a population of forty-eight persons, twenty-five of whom were under twelve years of age. This row is separated from the railway siding by a garden, and from the school ground by the highway. It is about thirty yards nearer the manure siding than the school building. The gate giving access to the siding from the highway is at one end of this row, and about sixty yards from the part of the siding where the waggons are usually unloaded. On enquiry at these families I could discover no recollection of any throat illness in July or August in any of them; and none of the others were ill at the time No. 1 died. Three cases, however, happened later (November and March), and they are included in the associated cases of sore throat occurring among the children attending school. It would therefore appear that the first case was not related to any recent exposure to manure effluvia during the unloading of waggons at the station, and there are no known coincident cases to suggest that the influence to which she was exposed was general. There remains the question of gross pollution of her fingers in handling such manure as remained about the siding, but this aspect will be considered later in discussing a suggested explanation of the origin of such cases as seem to be of a sporadic character. The child had not been away from the village for some time before

* A variety composed of stable-litter and slaughterhouse refuse.

sickening, nor had the family been visited by any from other villages. It will not have escaped observation that the illness follows within four days of the opening of the school, so that a mild and unrecognised case in another child would explain it. Following her sickness, a very distinct succession of cases occurred among those children more especially who spent all or part of their time in the infant room. It cannot seriously be advanced that the special incidence in this room is to be explained on the ground that the upper standard room is at the further end of the building from the railway station, and that the effluvia and dust would not therefore get equally ready access to both rooms. And yet all the boys, save two in the upper standards, escaped, so far as can be ascertained. Objection might be taken to the position of the conveniences provided for the children at this school. But chiefly there falls to be noticed an underground built drain, probably intended for sub-soil drainage, but into which it seems likely that urine will pass, although I had no opportunity of verifying this. This drain runs beneath the infant room, and when a test was applied to it outside, smoke gained access to the room. This drain is said to discharge its contents on the surface, at a lower level, on the other side of the roadway; but from its structure, deposits must be formed all along its course, and the infant department particularly would be exposed to emanations therefrom. Two conditions therefore were present which would produce in the children of this school a peculiar susceptibility to diphtheria, and it is impossible to allocate to each its proper degree of responsibility. Both admittedly are fitted to produce morbid states of the throat which form a ready culture ground for specific bacteria. As to whether any of the later cases occurring in the children attending this school had an independent source of infection, it does not seem necessary to enquire. Indeed, the almost complete freedom from infection of these children, who were taught only in the upper standard room, would suggest a negative answer. The infant room contained the specific germ, and the throats of the children exposed to it were already prepared for its reception. While the presence of the drainage defects make it impossible to allege that this preparedness was exclusively due to the manure traffic at the station, it is certain that children who are compelled to continue in attendance at school under such exposure to effluvia as is here described, are exposed to very serious risks of injury, and readily become victims to infectious disease.

Four of the original cases are dealt with in the foregoing remarks because of their attendance at school at A.

In regard to two others there was no police manure binged near the residence of either of them. One of them had no school connection whatever, nor was he known to have been in

any infected house, or in contact with any known source of infection. The other had younger members of her family at A. school, but was herself employed with a dressmaker in the village where she had many acquaintances, but no recollection that any of them had suffered from sore throat; nor had she visited houses where such illness was present. At the time they sickened manure was being spread on the fields, and out-of-door exercise exposed them to effluvia and dust.* The remaining two cases occurred in children attending B. school, but there is nothing to suggest that the school connection here was more than accidental. When the first of them sickened a large bing of police manure stood in a field from 300 to 400 yards to the west of the house. The parents remembered the bing without associating any smell with it, although scraps of paper were blown about and caught on the hedges nearer the house than the situation of the bing. It seems probable, however, that the disease was present in the village of B. before this, and it had been noted that a death from "membranous Laryngitis" in October was probably due to diphtheria. But at the time of enquiry it was impossible to bring the parents' recollection to any association with persons suffering from sore throat, although the father was aware that some cases did then exist. In regard to the last case on the list, it could be, however, definitely ascertained that no such association existed. In two of these cases, then, association with suspected cases is definitely alleged not to have happened, and it is necessary to enquire in what way police manure can be regarded as the possible source of such sporadic cases. I have already referred to the relative situations of the villages A., B., and C., and to the varied incidence of diphtheria in A. and B. I have also shown that there is reasonable ground for believing that some manure may contain the specific infection of diphtheria, although in infinitesimal quantities, and it remains to be considered how this may reach individuals and explain sporadic cases of the disease. Every practitioner familiar with the customs of the poor in disease has frequent illustrations of the various expedients resorted to for the reception of expectoration. A little heap of saw-dust or ashes is placed at the bedside, or it may be a piece of paper, or a broken dish. These finally find their way to the manure heap, which the children in the country search for bright pieces of broken glass and earthenware, or such other things as attract them, and their fingers become soiled in the search. The paper of the heaps gets blown about, and this was complained of as whitening the hedges between A. and B. A

* One of the practitioners was distinctly of opinion that the prevalent sore throat was more closely associated with the spreading of manure on the fields than with the bringing of it, a distinction suggesting mechanical displacement of the lighter particles.

torn picture in bright colours lying on the roadway is none the less attractive to a child, although stained with specific expectoration; and it is not improbable, therefore, that a child will now and again handle articles so stained. By the hands the specific virus will readily reach the mouth, and some sporadic cases may be thus explained, for it will be remembered that in the dry state the bacillus of diphtheria may remain potentially active for some time. With regard to aerial transmission of the disease by particles blown from the manure, it would also appear that the possibility must be admitted as explaining certain sporadic cases. But as the actual agency in the spread of the disease, I am disposed to think that it must be much less frequent than the soiling of the children's fingers in handling the articles in the manure already described.

SUMMARY.

1. The cases of diphtheria occurring in the villages A. and B. were associated with many cases of sore throat otherwise.

2. Much of this sore throat was regarded by the medical attendants as infectious, and it is reasonable to assume that it formed the connecting link between several of the cases of true diphtheria which occurred. This is especially true of the cases occurring in connection with the school at A.

3. Recognisable diphtheria invaded the schools at A. and B., but only in the former was the attendance affected.

4. The first known and recorded case of diphtheria occurred in a child attending A. school, in an interval in the manure traffic, and immediately the school re-opened, after the summer vacation. Various sources of infection are discussed. It may be explained under 6 (b), as the child's habits would so expose it.

5. Diphtheria thus introduced, structural defects in drainage and proximity of the school to the centre of the manure traffic at the railway station combine to produce in the scholars an unusual degree of receptivity to the specific poison. It is impossible to allocate to these factors their several degrees of potency. The manure traffic alone would have produced it, and a recently-drafted by-law suggested for a Local Authority in England would prohibit the unloading of manure within the distance and under the conditions existing here.*

6. In two of the cases it is necessary to consider the question of sporadic origin. This presents itself for consideration in two forms:—

- (a) Aerial transmission of infected material with the lighter particles blown from the manure, especially during displacement, as in unloading waggons, or in spreading on the fields.

- (b) Specific pollution of the hands of the children in play.

Of these, the latter is probably the more frequent from the known habits of the children.

DIPHTHERIA IN CHELSEA FROM 1890 TO 1896.

BY

LOUIS C. PARKES, M.D., D.P.H., M.O.H. of Chelsea.

THE following table shows the prevalence of diphtheria and croup in Chelsea in each of the years (divided into quarters) under review. The year 1890, it will be remembered, was the first complete year of compulsory notification in London. Diphtheria and croup are classed together, as representing the same disease:—

	DIPHTHERIA AND CROUP NOTIFICATIONS IN CHELSEA.						
	1890.	1891.	1892.	1893.	1894.	1895.	1896.
1st quarter	36	65	36	49	55	37	92
2nd „	62	35	62	41	61	61	77
3rd „	117	39	56	57	56	84	196
4th „	91	52	51	92	78	134	—
Whole year	306	191	205	239	250	316	—

It will be observed from the above table that there was a considerable prevalence of the disease in 1890, a diminution in 1891 and 1892, a slight increase in 1893, and again in 1894, and a very considerable increase in 1895, the notifications in this year rising above those of 1890. The increase in 1895 took effect especially in the third quarter of the year, the notifications in this quarter being 30 per cent. in excess of the average of the 5 years 1890—1894; whilst in the last, or fourth, quarter of the year, the notifications were 83 per cent. in excess of the average of 1890—1894. This excessive prevalence has been continued without diminution during the present year, 1896. In the 1st quarter of the present year the notifications were double the average of the 6 years 1890—1895; in the 2nd quarter the notifications were 43 per cent. in excess of the average; and, in the 3rd quarter, the notifications were 288 per cent. in excess of the average of 1890—1895, or nearly treble the normal number.

The excessive prevalence of the disease in 1890 was due to an epidemic in Kensal Town. The number of cases in the Home District was not above the average. Since 1890 the disease has

* See Report on [Manure Nuisances, by Dr. Parsons, in the Supplement to the 21st Annual Report of the L. G. B. (England), p. 115.