

Dr. R.W. Johnstone's report to the Local Government Board upon an outbreak of enteric fever in the Urban District of Ormesby.

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Johnstone, R. W.
Great Britain. Local Government Board.

Publication/Creation

London : Printed for His Majesty's Stationery Office by Darling & Son, 1909.

Persistent URL

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REPORTS

TO THE

LOCAL GOVERNMENT BOARD

ON

PUBLIC HEALTH AND MEDICAL SUBJECTS.

(NEW SERIES No. 17.)

Dr. R. W. Johnstone's Report to the Local
Government Board upon an outbreak of
Enteric Fever in the Urban District of
Ormesby.



LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, LTD., 34-40, BACON STREET, E.

And to be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LTD., FETTER LANE, E.C.; or
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E. PONSONBY, 116, GRAFTON STREET, DUBLIN.

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Dr. R. W. Johnstone's Report to the Local Government Board upon an outbreak of Enteric Fever in the Urban District of Ormesby.

ARTHUR NEWSHOLME,

Medical Officer,

15th September, 1909.

FOR many years past enteric fever has been unduly prevalent in the Urban District of Ormesby. In the year 1908, an outbreak of unusual severity led the Board to direct an inquiry into the circumstances connected with its causation and spread. This inquiry was allotted to me, and I visited the district in January, 1909, and on other occasions.

The Ormesby Urban District lies directly south-east of the borough of Middlesbrough, and adjoins it. At the census of 1901 the population was 9,482, and the number of inhabited houses 1,838. Since then there has been considerable development. In 1908 there were 3,023 houses, and the population was variously estimated from 12,500 to 15,500. The latter figure is probably the nearer to the truth, and taking into account the number of houses in 1908 I think the population may be taken as approximately 15,000.

The area of the district as given in the census report, 1901, is 2,833 acres, but nearly the whole of the population is concentrated at North Ormesby and Cargo Fleet, which are only separated from Middlesbrough by the North Eastern railway line. The rest of the district is purely agricultural and has a population of about 400 persons. Estimated from the number of existing houses the respective populations of North Ormesby and Cargo Fleet in 1908 were 12,800, and 1,800.

North Ormesby is practically continuous with Middlesbrough. The houses are set closely together, and with the exception of the market square there are no open spaces in the town. As a rule there are no gardens, and the yards are cramped for space, especially at corner houses. Each row of dwellings faces direct upon a street and is separated from the parallel row behind by a

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narrow back lane, and by the yards. The back lanes are generally arched over at either end by buildings; they are well paved with scoria brick, and are kept fairly clean. Most of the houses have four rooms.

Cargo Fleet lies a few hundred yards north-east of North Ormesby. The houses here are on the whole more modern than those in North Ormesby, but otherwise the short description above applies equally to Cargo Fleet.

SANITARY CIRCUMSTANCES OF THE DISTRICT.

Excrement disposal.—This is effected by privy middens and pail closets, with about 50 water-closets. Prior to the end of 1908 a contractor was employed to empty the middens and pails in North Ormesby and Cargo Fleet; the contents of the middens were removed every two months, and those of the pails every fortnight. The contract was not satisfactorily carried out and the district council have now undertaken the work themselves.

The privy middens are large covered-in structures, each midden having two privies and serving two houses. The bottoms are purposely left pervious, with a view to allowing the liquids to soak away. The roofs are often leaky and sometimes dilapidated.

Drainage and sewerage.—In North Ormesby and Cargo Fleet each house is provided with a trapped gulley in the yard for slop water. A four-inch drain is carried from the gulley underneath the privy midden to the sewer. In its passage under the midden the drain is laid with open joints with a view to conveying the soakage from the midden to the sewer. Many of the yard gulleys were observed to be choked or otherwise faulty. The sewers are glazed socketed pipes, jointed with clay, ranging in diameter from 9 to 21 inches. Until the end of 1908 there was no sewer ventilation. Owing to the level nature of the locality and its inconsiderable elevation above sea level the sewer gradients are often too flat; in one instance, indeed, the gradient was found to be in the wrong direction. Owing to this condition the sewer behind the reversed gradient remained permanently full or almost full of sewage, forming a water trap which prevented gas from the sewage tanks finding its way into the sewers or house drains behind this trap. It was locally suggested that gas emanating from the sewage tanks was concerned in the spread of enteric fever in North Ormesby in 1908, and the theory was supported by the allegation that the part of the town least affected by the fever was protected from sewer gas by the trap described above. This matter will be considered later.*

Sewage disposal.—The sewage of North Ormesby and Cargo Fleet passes to settling tanks, situated about 100 yards north of the former locality. The tanks are roofed in but not so as to be air-tight, and the effluent eventually reaches the River Tees by way of the Middle Beck.

* The portion of the sewer in which the reverse grade occurs is marked on the accompanying map by arrows, and the sewers presumably trapped off from the tanks by the liquid sewage held up by the reverse grade are marked in black while the other sewers are marked in red.

Water supply.—North Ormesby and Cargo Fleet are supplied from the mains of the Tees Valley Water Board, with the exception of a small portion of Cargo Fleet which is supplied from a reservoir on Ormesby Hills.

Hospital accommodation and disinfection.—Cases of infectious disease are sent to the Middlesbrough Sanatorium situated about 2½ miles from North Ormesby, between Ayrsonne and Linthorpe. A charge of 6s. a day is made by the town council for each patient, besides one guinea for the ambulance.* During 1908, 30 enteric fever patients were removed to hospital.

The following measures for disinfection were taken during the outbreak of enteric fever in 1908. On notification of a case the inspector of nuisances, accompanied by an assistant, visited the house and used a thirty per cent. solution of cyllin to soak the walls and contents of the privy midden, or pail closet. After the removal of the patient sulphur was burned in the room. Bedding was burned at a furnace near the sewage tanks. When the patient was nursed at home sanitary pails were provided, and removed twice daily, the contents being buried after disinfection with cyllin. Disinfectants were supplied free, and a printed circular was left giving full directions for the prevention of the spread of infection. The medical officer of health personally visited all cases.

HISTORY OF ENTERIC FEVER IN THE DISTRICT PRIOR TO 1908.

TABLE I.

Showing the notifications of enteric fever in Ormesby Urban District during each year of the period 1894-1907 inclusive, and the number of deaths from the same cause.

—	Cases.	Deaths.	—	Cases.	Deaths.
1894	16	1	1901	12	2
1895	42	7	1902	7	1
1896	13	1	1903	8	2
1897	16	2	1904	12	1
1898	44	2	1905	3	1
1899	21	2	1906	11	3
1900	4	—	1907	19	4

From this table it will be seen that there has long been undue prevalence of enteric fever in the district, although in occasional years the incidence of the disease has not exceeded, or has not even attained the average.†

* These charges are defrayed by the urban district council except in the case of paupers, who are paid for by the Guardians.

† Notifications and deaths of imported cases at the North Ormesby General Hospital are not included in this table.

TABLE II.

Showing the seasonal incidence of enteric fever in the Urban District during the period 1894-1907 inclusive.

January, 11 cases ...	May, 3 cases ...	September, 48 cases
February, 9 ,, ...	June, 8 ,, ...	October, 57 ,,
March, 12 ,, ..	July, 18 ,, ...	November, 18 ,,
April, 11 ,, ...	August, 25 ,, ...	December, 8 ,,

Here it may be noted that the usual October maximum and May minimum are well marked. The only important variation in an individual year was in 1907 when there were two cases in May and none in October, the bulk of the cases occurring in July and August.

ENTERIC FEVER IN THE DISTRICT DURING 1908.

Sixty-five persons were attacked during the year, and 51 houses were invaded. All the cases were in North Ormesby except two, one in January and one in September, which occurred in Cargo Fleet. The cases* were distributed over the year as follows:—one in January, one in June, three in July, 16 in August, 14 in September, 24 in October, two in November, and four in December.

In view of the fact that only two cases were reported in the urban district outside North Ormesby, detailed consideration of the outbreak may be confined to this locality.

The distribution of the fever in point of time, during the period of chief prevalence in North Ormesby is shown in the following table.

TABLE III.

Showing the number of cases of enteric fever in North Ormesby during each week of the period August 1st, 1908, to November 27th, 1908, and the number of houses invaded during each week of the same period.

Week ending	Number of Cases.	Number of Houses Invaded.	Week ending	Number of Cases.	Number of Houses Invaded.
Aug. 7th ...	2	2	Oct. 9th ...	1	—
„ 14th ..	5	5	„ 16th ...	6	4
„ 21st ...	5	4	„ 23rd ...	5	5
„ 28th ...	4	1	„ 30th ...	5	5
Sept. 4th ...	3	3	Nov. 6th ...	5	2
„ 11th ...	6	4	„ 13th ...	—	—
„ 18th ...	2	1	„ 20th ...	—	—
„ 25th ...	2	1	„ 27th ...	1	1
Oct. 2nd ...	3	3			

It will be seen from this table that there was no sudden “explosion” of the fever, but rather a steady prevalence of the disease during

* It was found possible to ascertain with tolerable accuracy the dates of onset of the fever during 1908. Both here and in dealing further with enteric fever during 1908, I have used the dates of onset in preference to those of notification.

August, September, October, and the early part of November, followed by a rapid drop in the occurrence of cases.

There was marked localisation in the distribution of the fever. The first case in North Ormesby in 1908 occurred on June 29th in Stephenson Street, the next on July 2nd, in James Street, close by, the next on July 11th, in Telford Street, at quite a different part of the town. Other cases followed in the neighbourhood of the first two houses invaded, and throughout the remainder of the outbreak the disease showed a marked preference for the neighbourhood of Stephenson Street, and James Street. Not more than a dozen houses were invaded in other parts of the town.

The greatest concentration of cases upon area was in parts of Stephenson Street and Peirson Street, which back upon each other. In this block there are 33 houses, and nine of them were invaded, with 13 cases.

On the map supplied with this report invaded houses are marked by red spots.

TABLE IV.

Showing the age incidence of enteric fever in North Ormesby during 1908.

Age.	0-5	-10	-15	-20	-25	-30	-35	-40	-45	+45
Number of Cases	8	9	5	7	8	12	5	5	3	1

Thirty-one males were attacked, and 32 females. Nine of the males attacked were under the age of 10.

CONSIDERATION OF THE AGENCIES WHICH MAY HAVE HAD CONCERN IN THE SPREAD OF ENTERIC FEVER IN NORTH ORMESBY DURING 1908.

Direct personal infection.—Altogether 49 houses were invaded by the fever, and in nine of them the first case was followed by one or more further cases. Of these latter, which numbered 14 in all, four were attacked less than a week after the preceding case in the same house, and may therefore be regarded as having contracted the infection from some other source. Nine of the remaining 10 occurred in houses where the first patient was nursed at home, and the tenth case occurred in a house from which the preceding patient had been removed to hospital seven days before, on the seventh day of the disease.

Two persons who were in the habit of visiting infected houses were attacked, also one person who was nursing a case of enteric fever, and one woman who had repeatedly visited a sister who was suffering from the disease.

In addition there was a series of nine cases amongst seven families all related to one another, and mostly living in the same street, in which personal infection may conceivably have played some part.

Water supply.—North Ormesby is supplied throughout by the Tees Valley Water Board. The possibility, however, of this supply having become infected at its source was negatived by the

fact that Middlesbrough and other places supplied with this water had not suffered from the fever in unusual degree during the period of its excessive prevalence in North Ormesby. Nor, indeed, was the distribution of fever in time such as characterises an outbreak of enteric fever caused by the specific pollution of a public water supply at its source. Moreover the marked localisation of the fever in North Ormesby itself was inconsistent with causation of this sort.

This localisation, however, was consistent with the possibility of infection due to specific polluting material having gained access to local mains, whether through defects in these or in the course of repairs undergone by them. Inquiry was accordingly made on these points, and it was found that 35 alterations or repairs were made to mains in North Ormesby during 1908. In no instance was any relationship in time observed between repairs to the mains and occurrences of fever that was suggestive of causative connection. It is true that several cases of fever occurred in Stephenson Street about a fortnight after the addition of a stop tap to the local main, this, however, was not a repair but an addition, and there had already been six cases of fever in this street.

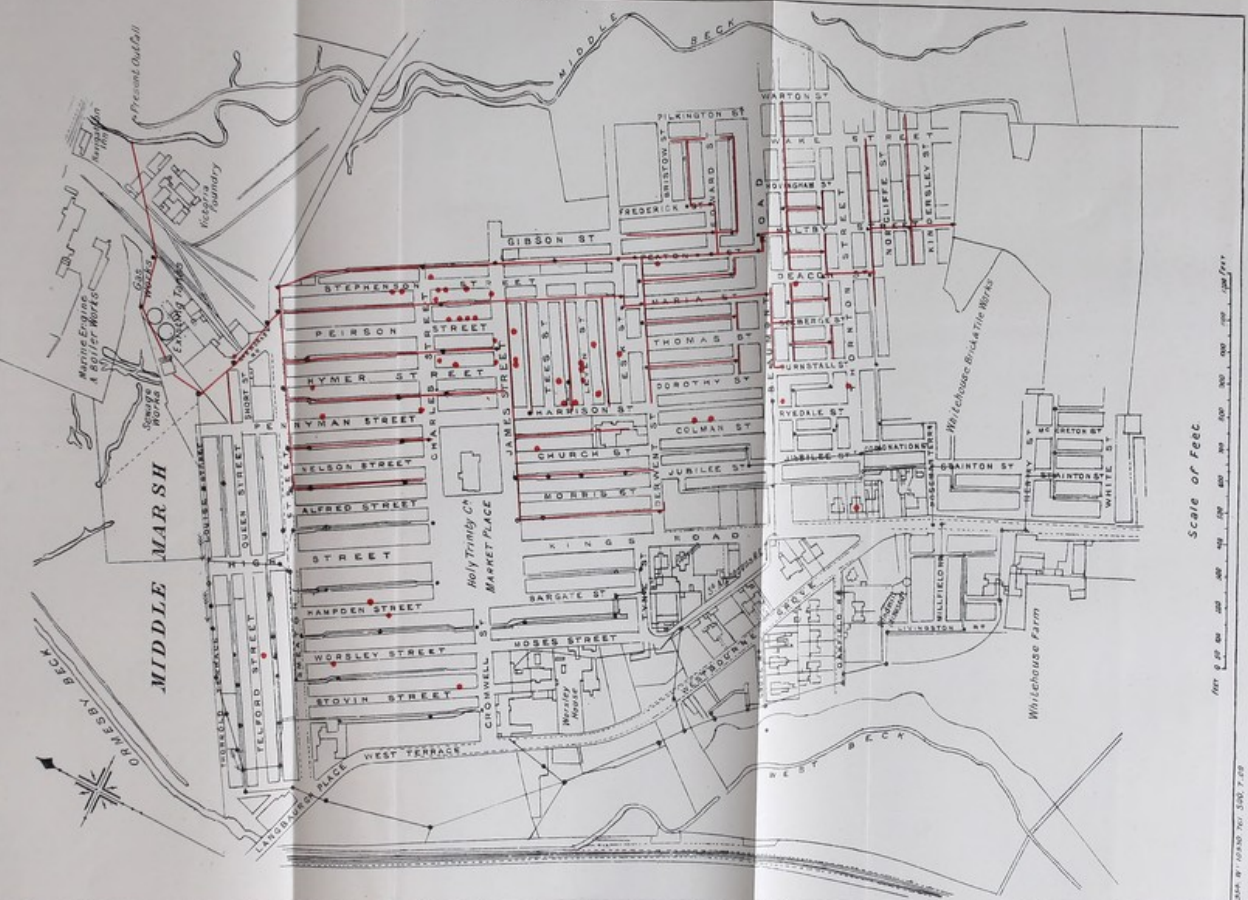
Attention was also directed to the possible contamination of house water supplies through faults or leakages in the supply pipes within the house yards. It was found that 212 repairs to such pipes had been effected in North Ormesby during 1908, but in no instance was any connection traced with subsequent occurrences of fever.

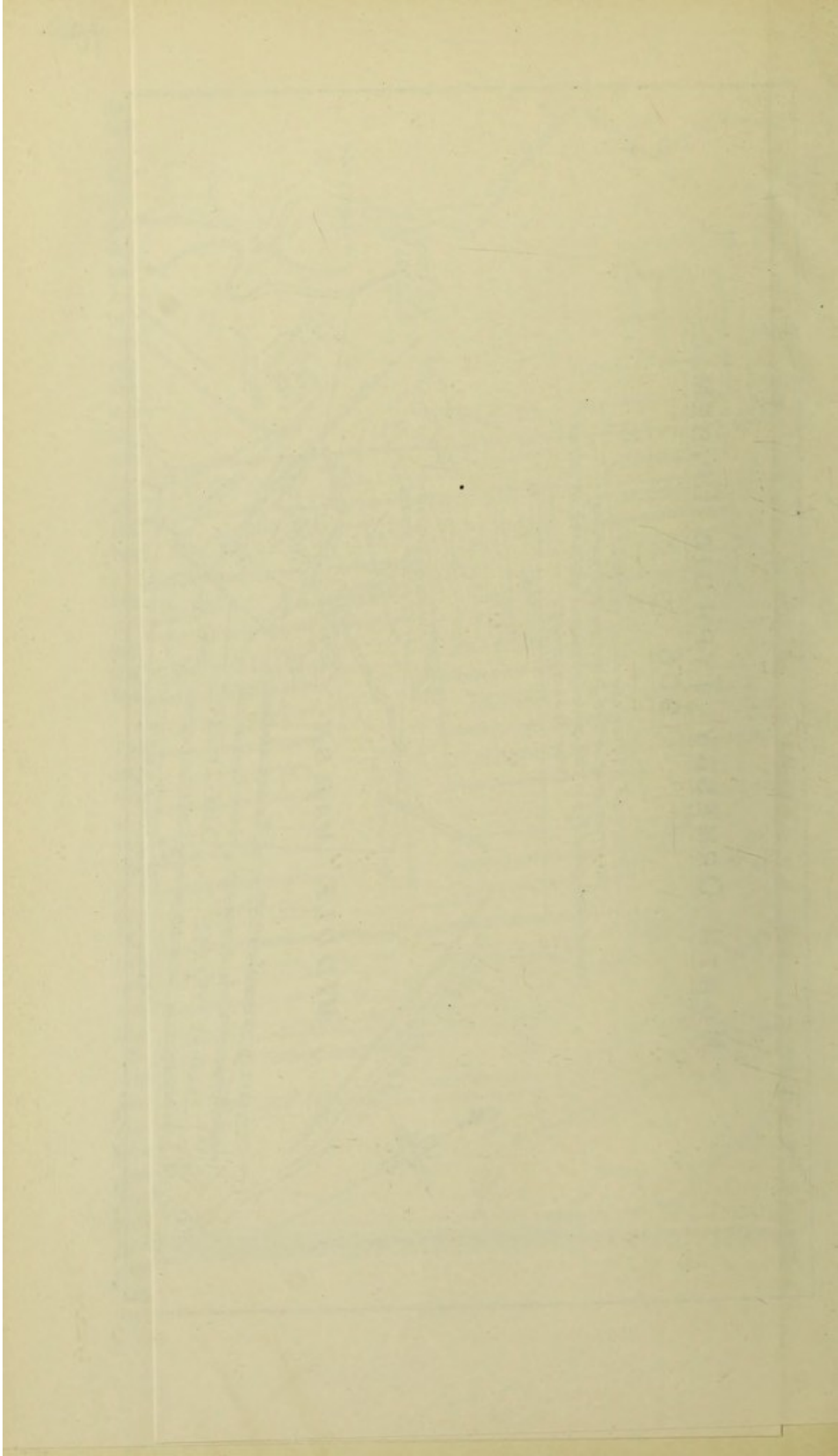
Sewerage and drainage.—At the time of the outbreak of fever in 1908 the sewers in North Ormesby were not ventilated. It was suggested that gas from the sewage tanks found its way back along the sewers and escaping through the open jointed house drains had a causative connection with the outbreak of enteric fever. This suggestion was occasioned by the existence of the accidental water trap referred to under Drainage and Sewerage, p. 2 above, which it was alleged protected from tank emanations those sewers which served the part of the town where there had been but little fever. It appeared, however, on investigation that while the area not protected in this way from tank emanations included the heavily attacked portion of the town, it also included a considerable part of the town which was lightly attacked or not attacked at all; indeed, the heavily attacked neighbourhood constituted less than one-fourth of the whole area exposed to the tank emanations. In addition it was found that it was very doubtful whether the amount of sewage retained by the reverse gradient was sufficient to completely fill the sewer and form an efficient water trap. Moreover, in the absence of pressure at the tanks,^o it appears improbable that gaseous emanations from them would travel along almost level sewers against the current of the sewage. In order to make the matter clear, I have marked the reverse gradient in the sewer by arrows on the accompanying map. I have also indicated the sewers trapped off by colouring them black, while the other sewers are indicated in red. Cargo Fleet, all of which was unprotected by the reverse gradient is not included on the map.

^o They were not covered in so as to be air-tight.

NORTH ORMESBY TYPHOID EPIDEMIC. 1908

Inverted houses shown by red dots.
Reversal gradients in Sewer marked by arrows.
Sewers trapped from the bank by reverses gradient in black.
Other sewers in red.





Milk supply.—Milk is supplied wholesale from 11 farms to retailers living in North Ormesby ; seven of these farms supplied milk to houses in which enteric fever occurred. In no instance was there marked association of the disease with the milk supplied from a particular source, the greatest number of houses invaded amongst those supplied from any one farm being nine. This number was noted in relation with two farms, which were, as a matter of precaution, visited and inspected. In neither case, however, was there any evidence of the presence of infection, nor any history of illness of a suspicious nature in the family of the farmer or among the farm hands.

Investigation as to the incidence of the fever among the customers of retail milk sellers also gave negative results. There are 46 retailers of milk in North Ormesby, who are mostly dealers in other articles, such as oil and cured fish, and whose trade in milk is usually small. Of these 46 retailers, 17 supplied milk to one or more invaded houses : in no instance did the number of invaded houses supplied by any one milk seller exceed six.

Nine invaded houses were supplied with condensed milk alone, and 18 with condensed milk as well as with ordinary milk from one or other of the milk sellers referred to above. In four houses the milk supply could not be definitely ascertained.

Shell-fish, consisting mainly of mussels and periwinkles, are hawked in the streets of North Ormesby. They are usually obtained from the Tees below Middlesbrough, where the river is badly contaminated with sewage. Out of 62 cases in which inquiry was made it was found that 16 had eaten shell-fish within a period of 5 to 21 days before the onset of enteric fever. That is 25·8 per cent. of those questioned had eaten shell-fish a short time previous to their illness. In order to obtain some figures with which to compare this percentage, a census was made of two or three typical streets in North Ormesby, and inquiries were made as to the consumption of shell-fish, ice cream, fried fish, and later on of uncooked vegetables. Inquiries as to shell-fish were made at 174 houses, and it was found that in 16 shell-fish of one sort or another were consumed in the summer of 1908. 827 persons were interrogated and 60 of them gave affirmative replies. That is in 9·2 per cent. of the houses, and in the case of 7·3 per cent. of the individuals, shell-fish had been taken during the summer of 1908. It appears then that amongst those attacked by enteric fever there were more than three times as many persons who had eaten shell-fish during the period of 5 to 21 days preceding their illness as was to be expected from the figures obtained at the local census. The disproportion is much more marked when it is considered that the census inquiry included the whole summer, while the inquiry made from patients included only a particular period of 16 days. These figures afford strong presumption that the consumption of specifically infected shell-fish contributed to spread enteric fever in North Ormesby during 1908.

It will be found later on that there is reason to regard the houses having privy middens as more liable to invasion by the fever, than those with pail closets, or water-closets, and in view of this it is interesting to note that of the 16 persons attacked after the consumption of shell-fish nine lived in houses with pail closets and

seven in houses with privy middens. This nearly equal incidence goes to indicate that in this group of 16 we have a different determining factor, not the class of closet, but in all probability the shell-fish consumed.

Fried fish is a common article of diet in North Ormesby, and in the northern counties generally. It has more than once been accused, in my hearing, by medical officers of health in northern districts of acting as a vehicle for the spread of enteric fever. Two cases of enteric fever were notified from a fried fish shop in North Ormesby on the 24th of September, 1908, and one case on the 5th of September from another fried fish shop.

In these circumstances some attention was devoted to this article of diet. I visited several of the fried fish shops in North Ormesby during the evening when trade is in full swing. The method of preparation and sale is as follows:—Pieces of raw fish are removed from a stack on the counter by means of a pair of tongs, they are dipped in batter and then dropped into a bath of boiling fat or oil. When browned they are removed from the fat or oil with the tongs and placed upon a shelf to await the customer's order, becoming more or less cold, according to the length of time which elapses before they are purchased. When an order is received the pieces of fish are taken from the shelf with the fingers, wrapped in a piece of newspaper and handed across the counter to the customer. The dangerous part of this process is obviously the handling and the newspaper. I found, however, that the papers were bought specially for the purpose, and had probably not been previously opened. But the handling of the fried fish by a person suffering from enteric fever, or bearing about him the infective material of that fever, might readily lead to specific contamination of the fish, and, through it, to transmission of the disease to others.

It was ascertained that out of 59 persons attacked by enteric fever in North Ormesby, 39 had eaten fried fish shortly before their illness, that is 66·1 per cent.

At the census alluded to above, 827 persons were interrogated as to whether they habitually eat fried fish, and 573 of them answered in the affirmative, that is 69·3 per cent. habitually eat fried fish. Here the correspondence between the number expected from the census and the number of habitual fried fish eaters actually attacked by fever, is very close, and goes to exonerate the fried fish.

Eleven of the 39 persons who had eaten fried fish had procured it at J——'s, where there was a case of enteric fever on September the 5th, but none of them had procured it from R——n's, where there were two cases of enteric fever on September the 10th. Four of J——'s infected customers were attacked before September the 5th.

There are 15 fried fish shops in North Ormesby, eight of which supplied fish to invaded houses. The number of invaded houses amongst the customers of each shop varied with the distance of the shop from the most heavily infected area. Thus R——e, of 63, Stephenson Street, supplied 13 invaded houses, J——, of 7, Harrison Street, supplied 11, T——n, of 10, James Street, 11, T——d, of 33, Beaumont Road, five, D——, of 21, High Street, two, and A——, of 45, Hampden Street, two. As a

rule fried fish is obtained from the nearest available shop, which would suggest that the varying incidence of the fever on the customers of the several shops was determined by the greater or less proximity of the shop to the infected area.

Taken as a whole, the evidence is not such as to indicate that the consumption of fried fish played any part in the transmission of the fever in 1908.

Ice cream is consumed in considerable quantities in North Ormesby during the summer months. Out of 827 persons interrogated for purposes of comparison, 153 or 18.5 per cent. partook of ice cream during the summer, either habitually or occasionally, chiefly the latter. In 61 cases of enteric fever when inquiry was made it was ascertained that 11 had taken ice cream within one month of their attack; that is 18 per cent.

I inspected the premises of some of the ice cream vendors, and I found that the process of preparation involves prolonged boiling of all the materials used, so that this article of diet is not in itself a likely vehicle for conveying infection. The same cannot be said of the glasses in which it is retailed, which are seldom sufficiently cleansed after use by the previous customer.

Uncooked vegetables comprising cress, lettuce, radishes, celery, and onions were inquired into. Cress is little used in North Ormesby, but the others are in common use, and are generally grown by the consumers at their allotments.* Forty-seven enteric patients were questioned on their consumption of uncooked vegetables, and only 19 (40.4 per cent.) had eaten them within a month of their illness, whereas out of 846 persons interrogated at the census alluded to above, over 90 per cent. were in the habit of taking uncooked vegetables at one time or other. I am not satisfied that the inquiries made from the patients were sufficiently minute—stress appears to have been laid especially on cress, and full enquiries as to all the other vegetables were not always made. So far, however, as the evidence goes, there is no reason to suspect uncooked vegetables of having been a vehicle of infection.

Excrement disposal.—The large covered privy middens which exist in the district afford constant opportunity for the spread of excremental infection both by the soiling of the pavement of back streets during the process of emptying, and by affording breeding places for house flies, whence they can carry infection to food in the houses. In the year 1908 the houses in North Ormesby with privy middens numbered 1,391, while those with pail closets numbered 1,296, nearly an equal number.

The total number of houses invaded in North Ormesby was 49. Thirty-four of these had privy middens, 13 had pail closets, one had a water-closet, and one had both pail closet and water-closet. Thus the houses with privy middens suffered $2\frac{1}{2}$ times more severely than those with pail closets, although the number of privy middens and pail closets in the town was almost exactly the same. The number of house flies was unusually great in September and October of 1908. I was informed at some of the invaded houses

* Privy midden refuse is commonly used as manure on the allotments in North Ormesby.

that so numerous and persistent were they that it was necessary to beat them off each piece of food as it was conveyed to the mouth. It is true that the principal breeding place for house flies is stable manure, and there was a stable in the centre of the greatest agglomeration of cases which occurred; but house flies also breed in privy middens, and whatever may be their place of origin they can obtain free access to privy middens, and there is no doubt they are capable of conveying infection from them, if it be there. The contents of privy middens in North Ormesby were removed once in two months during 1908, and the house fly in warm weather requires but a fortnight to pass from the egg stage to the imago, so that ample opportunity was afforded for breeding in the middens. Of course, the fly is unable to carry the specific infection unless it is there for him to carry, so that a spot map of the cases and stables in North Ormesby, as would be expected, showed no grouping of cases around stables; but where a stable existed in connection with contaminated middens,* as at the back of Peirson Street and Stephenson Street, the grouping of cases around it was marked.

From measurements taken at 48 houses in different parts of North Ormesby it appeared that the average distance of the privy midden from the pantry was 16 feet, the measurements varying from $4\frac{1}{2}$ feet to 28 feet. The average distance from the nearest living room window was 15 feet, the measurements varying from 7 feet to 27 feet.

Inquiry was also made with a view to ascertaining whether there had been relationship between privy middens and prevalence of enteric fever in the whole urban district during the 10 years immediately preceding 1908. With this object the notifications of enteric fever during these years were scrutinised, and the nature of the closet accommodation in the invaded houses ascertained, each case being verified when necessary by personal visit. In order to obtain an idea of the comparative numbers of privy middens and pail closets existing during these years, it is necessary to go back to somewhat ancient history. In 1882 there were 1,580 houses in the urban district, all of which had privy middens. On the adoption of building byelaws in that year, it was determined to discourage the building of privy middens, and no more have been built. During the 26 years since 1882, 198 privy middens have been converted into pail closets. It seems reasonable to allot at least 100 of these conversions to the 10 years, and in the absence of definite information I have allotted ten conversions to each year. In 1908 there were 1,641 houses in the whole district with pail closets and 1,382 with privy middens. The number of new dwellings erected in each of the preceding 10 years having been ascertained, simple subtraction with an allowance of ten conversions in each year gives the approximate number of houses with pail closets and houses with privy middens for each year. They are set out in the following table, and although the respective numbers of pail closet houses and privy midden houses are not absolutely accurate, yet a very fair idea of the comparative incidence of enteric fever on each class of house can be obtained.

* The first case in this group occurred on August 1st, and was not notified until August 16th, so that there was no doubt that the midden was contaminated repeatedly before disinfection.

TABLE V.

Showing the number of houses invaded by enteric fever in Ormesby Urban District during each year of the period 1898-1907 inclusive, distinguishing invaded houses with privy middens from invaded houses with pail closets: also the approximate number of houses using each of these methods in each year.

—				No. of houses with privy middens invaded by enteric fever.	No. of houses with pail closets invaded by enteric fever.	No. of houses with privy middens in the district.	No. of houses with pail closets in the district.
1898	...	...	...	37	4	1,482	452
1899	...	...	...	18	—	1,472	490
1900	...	...	...	3	1	1,462	569
1901	...	...	...	8	4	1,452	687
1902	...	...	...	5	1	1,442	770
1903	...	...	...	7	1	1,432	884
1904	...	...	...	8	4	1,422	1,038
1905	...	...	...	—	3	1,412	1,170
1906	...	...	...	8	2	1,402	1,381
1907	...	...	...	6	12	1,392	1,531

It will be seen from this table that in every year except three the incidence of enteric fever upon houses with privy middens was proportionally greater than upon houses with pail closets. Thus in 1898 when the privy midden houses were between three and four times as numerous as the pail closet houses, the notifications from the former were more than nine times as numerous as those from the latter. In 1907, 1905, and 1901 the pail closet houses suffered in greater proportion than did the others.

It is to be noted, however, that in 1901 the relative incidence of the fever on pail closet houses was but little in excess of that on privy midden houses; while in 1905, the number of notifications of the fever in the district was too small to afford means of properly making comparison of this sort. In 1907, the markedly heavier incidence of the fever on pail closet houses may conceivably have been due to other influences than those habitually operating in relation with methods of excrement disposal, a hypothesis which receives some encouragement from the unusual seasonal prevalence of the disease in this year to which attention has been drawn on p. 4. But, however this may be, occasional variations such as those observed in 1901, 1905, and 1907, do not seriously affect the weight of evidence afforded by considerable data extending over a period of years.

During the whole 10-year period the average proportion of pail closet houses per 100 houses existing was 38·4, and the average number of privy midden houses per 100 houses existing was 61·6. Thus it would be expected, in the absence of special predilection of enteric fever for either class of houses, that the proportion of invaded houses of each class per 100 houses invaded, would be approximately 38·4 and 61·6. This is not the case, the proportion of invaded pail closet houses per 100 houses invaded is only 24·2 for the whole period instead of 38·4, while that of the privy midden houses is 75·8 instead of 61·6, clearly showing that during the 10-year period, houses with privy middens were invaded by enteric

fever more frequently, in proportion to their number, than houses with pail closets.

In Cargo Fleet, where there are hardly any privy middens, only nine houses were invaded by enteric fever during the 10-year period, and two of these were privy midden houses. In 1908 only two houses in Cargo Fleet were invaded.

It is not, however, to be inferred from these data that pail closets, although associated in Ormesby with occurrences of enteric fever in smaller proportion than privy middens, are themselves to be exonerated from the possibility of having contributed towards the dissemination of the disease. The pail closet is open to objection in that it leads to retention near the dwelling of matters which need immediate removal, although in smaller amount and for a shorter time than in the case of the privy midden. Immediate removal of excremental matter from the neighbourhood of the dwelling, and with it, the avoidance of some obvious risks of transmission of infection, can be secured only by means of the water carriage system.

Conclusion.

From the foregoing account of investigations made as to enteric fever in the Urban District of Ormesby, it is apparent that the excessive prevalence of the disease in North Ormesby in 1908 was due to the operation of more than one agency. The evidence obtained goes to show that privy middens were responsible, perhaps in no small degree, for dissemination of the fever, whether by transmission of the infection by house flies or in other ways. Shell-fish when obtained from so polluted a source as the Tees below Middlesbrough must always be a danger to health, and the evidence obtained in this outbreak allows of little doubt that they played a part in the spread of the fever. Direct personal infection, as is usual in outbreaks of enteric fever, contributed to the dissemination of the disease.

RECOMMENDATIONS.

1. The Council should adopt measures to hasten the conversion of privy middens into pail closets, or preferably into water-closets where the sewers are suitable for the reception of their contents.
2. The removal of stable manure and the emptying of privy middens should be undertaken at intervals of less than a fortnight, if possible not longer than every week in order to limit the breeding grounds for flies. Precautions should be adopted to avoid fouling the back streets during removal.
3. Measures should be taken to prevent the sale of sewage polluted shell-fish.
4. Early removal of cases of enteric fever to hospital should be secured.

I have to acknowledge assistance received from Dr. H. W. Jackson, Medical Officer of Health, and from Mr. A. H. Sill, Clerk to the Urban District Council. Mr. W. G. Harrison, the Surveyor and Inspector of Nuisances, was of great service to me throughout the whole of my inquiry, both on account of his knowledge of the district, and also on account of his energy and intelligence in procuring necessary information for me.

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