**Dr. S.W. Wheaton's preliminary report on enteric fever in the County of Durham.**

FOR OFFICIAL USE.

# REPORTS

TO THE

# LOCAL GOVERNMENT BOARD

ON

# PUBLIC HEALTH AND MEDICAL SUBJECTS.

(NEW SERIES No. 35.)

---

## Dr. S. W. Wheaton's Preliminary Report on Enteric Fever in the County of Durham.

---

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
OLIVER & BOYD, TWEEDDALE COURT, EDINBURGH; or
E. PONSONBY, LTD., 116, GRAFTON STREET, DUBLIN.

1910.

*Price Ninepence.*

To the Right Honourable John Burns, M.P., President of the Local Government Board.

Sir,

Although Dr. Wheaton's report on the prevalence of enteric fever in the County of Durham, now submitted, is preliminary in character, and although it cannot be completed in the near future in view of the defects of information which will hereafter appear, its publication should not, I think, be delayed; for it displays deplorably insanitary conditions urgently calling for reform, and the facts set out amply suffice to enable reform to be directed along the right lines.

For many years past Durham has had the highest death-rate from enteric fever of any county in England and Wales. Attention has been repeatedly drawn to its position in the annual reports of the Registrar-General of Births and Deaths; and in these reports the spots of special blackness in the county have been indicated. The Board's medical inspectors at various times have similarly emphasised the same facts, and have not failed to associate this excessive incidence of disease with the unwholesome conditions rife in the county; and the sanitary authorities in the county cannot excuse themselves by the lack of faithful counsel from the medical officer of health of the county and from a considerable number of its district medical officers of health. Knowledge the sanitary authorities have possessed, but this knowledge in many instances has not passed into duty. Ignorance of the facts now set out plainly in Dr. Wheaton's report, when knowledge is obtainable, cannot be regarded as much less culpable than is the failure of other authorities to utilise their knowledge. It will be convenient to postpone until after my review of Dr. Wheaton's report any attempt to estimate the suffering and economic loss which have followed from the gross neglect by a large number of sanitary authorities in this county of their statutory duties.

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
OLIVER & BOYD, Tweeddale Court, Edinburgh; or
E. PONSONBY, Ltd., 116, Grafton Street, Dublin.

1910.

*Price Ninepence.*

**No. 35.**

(15702—21.) Wt. 32817—370. 625. 7/10. D & S.

Dr. Wheaton reviews in detail the local circumstances associated with the excess of enteric fever in the county. The most important negative fact which emerges is the failure of evidence to implicate the water supplies of the county in the prevalence of enteric fever. As many as eight chief sources of supply serve its population of about $1\frac{1}{5}$ million persons, and in connection with each of these supplies heavy and light incidences of enteric fever are found. The evidence on this point is summarised in diagrams II. and III. It points to the conclusion that during the six years reviewed in this report enteric fever was not spread to a recognisable extent by these main sources of water-supply, though there is evidence that in the past such water-borne epidemics have occurred in the county. The possibility of their recurrence needs to be borne in mind as a practical danger, in view of the circumstances under which some of these supplies of water are collected, and of the risks of contamination during their distribution.

Dr. Wheaton, in Table IV. on page 18 of his report, shows how, contrary to the general experience in England and Wales, enteric fever prevails more largely in rural than in urban Durham. This is to some extent, however, a question of names rather than of facts, for "the population of the rural districts is principally collected in a number of villages where dwellings are closely aggregated so that they resemble small towns" (p. 8). In the aggregate of the so-called rural units of local self-government in Durham there are for equal populations two cases of enteric fever to every one case experienced in the county and municipal boroughs in the same county. There can be no hesitation in associating this difference with the fact that in these towns privies are less commonly in use and scavenging is more efficient than in the rest of the county.

Much domestic overcrowding of persons prevails in many parts of the county. This must increase the spread of enteric fever by personal infection, but as the information under this heading cannot be checked by correlative information as to the degree of use of hospital provision by patients in the different sanitary areas, investigation on this point cannot at present be carried further.

Next to water supply, infection by means of food comes under suspicion. Occasional outbreaks have been traced to milk-borne infection, and there is—though, unfortunately, the evidence obtainable lacks exactitude and completeness—much information rendering it likely that consumption of shell-fish and particularly of mussels is a frequent source of

enteric fever in the county. In this connection Dr. Wheaton attaches importance to the habits of the miners as to holiday-making and eating shell-fish while away from home. It may be hoped that an exact investigation will be made of each future case of enteric fever in the county and a record kept by medical officers of health of the facts thus collected for future reference.

In the county of Durham one man of every 22 of its total population (men, women, and children) is a miner, and the portions of the county having a large proportion of miners among their inhabitants have the heaviest incidence of enteric fever. These facts suggest that infection may have been acquired in connection with mining. They are, however, explicable on the supposition that in the mining villages and towns domestic or other conditions apart from the mines are such as specially favour the prevalence of this disease ; and although Dr. Wheaton defers his final conclusions on this point until more exact information can be obtained from the reports of the local medical officers of health, the evidence adduced by him does not favour the conclusion that infection is acquired in the mines of Durham to a great extent.

We come finally to the conditions with which the excess of enteric fever in the county of Durham can in a large measure be causally associated. These are the extremely filthy domestic arrangements by which excremental matters are retained in the immediate vicinity of dwellings.

The use of the privy is still almost universal in the county, although so-called ash-closets, which, unlike the ordinary midden privies, serve only one house, are now provided in most of the new houses of the industrial classes. As shewn graphically in diagram IV., the proportion of privies, including so-called ash-closets, is so great that, except in the borough of Hartlepool, they still enormously exceed in number any other form of sanitary convenience in nearly all the sanitary districts of the county. With such a state of matters it is difficult to compare among themselves the different parts of the county in respect of the relation between the character of the privy accommodation and the incidence of enteric fever. This difficulty is increased by the close relationship which Dr. Wheaton's facts appear to indicate between efficient scavenging of these privies and diminished enteric fever.

During the six years 1903–08, the experience of which has been investigated in Dr. Wheaton's report, some districts have suffered heavily and some only lightly from enteric fever, privies being common to all. This is explicable in part by varying degrees of efficiency of scavenging ; in part by the accident of introduction of specific infective material from without.

The importance of careful and frequent scavenging may be gathered from the repulsive details which it has been Dr. Wheaton's duty to place on record (*see* pp. 28 *et seq.*). It is especially among the rural and smaller urban authorities that there has been this double failure to provide for or insist on the execution of continuously efficient scavenging, and to cause the abolition of the worst forms of privies. With this gross failure to discharge the most elementary duty of a sanitary authority must be associated the fact that in the large towns (county and municipal boroughs) of the county having an aggregate estimated population for 1905 of 625,693, the total number of cases of enteric fever during the six years 1903–08 was 326, while in the smaller urban districts having an aggregate population of 295,520, the number was 686, and in the rural districts of the county having an aggregate population of 346,324, the number was 649 per 100,000 of population in each instance respectively.

When thus stated, the aggregate result on a large scale of sanitary default is unmistakable ; but a study of diagram IV. shows that in individual districts there is no closely consistent relation between the proportion of privies and the amount of enteric fever. Nor can this reasonably be expected. The infective material must be introduced before the excremental matter stored around dwellings can favour its multiplication and dissemination. This cannot be better illustrated than in the following quotation from page 18 of Dr. Wm. Budd's classical work on enteric fever (1873).

"Scattered over the country-side there were some twenty or thirty other hamlets. . . In each of these there were the usual manure-yard and the inevitable pig-sty ; in each there was the same primitive accommodation for human needs. The same sun shone upon all alike. . . From the soil of all, human and other exuviæ exhaled into the air the same putrescent compounds. . . And yet, while at Loosebeare a large proportion of the inhabitants were lying prostrate with fever, in not one of the twenty or thirty exactly similar places was there a single case.

To explain a contrast so signal there was but one fact to appeal to—the arrival from Chaffcombe, where the fever was already raging, of Mary G. with the disease actually upon her. Before that event in spite of manure heaps, pig-styes, and the like, Loosebeare, too, was free from the malady."

There has been no such accurate record in most of the districts of Durham of the circumstances of importation and of spread of the infection of enteric fever as that of Dr. Budd; but there is much evidence to the effect that infection has been brought home by miners, &c., and has subsequently spread; and there is reason to believe that contaminated shell-fish have borne a part in thus setting up new foci of disease. The statistics given in table V. on page 20 of Dr. Wheaton's report appear also to illustrate the fact that typhoid infection in the smaller districts recurs at irregular intervals, and this fits in better with the conception of importations of infection and subsequent spread, than of infection endemically present. In the large towns a difference of only 48 per cent. is shewn between the highest and lowest of the six years of enteric fever; in the aggregate urban districts the difference amounts to 181 per cent.; and in the aggregate rural districts to 227 per cent. An extreme instance of the same lesson is supplied by Consett. During the six years under investigation this district, notwithstanding its midden privies, experienced very little enteric fever; but a few years earlier it had more of this disease than any of the 47 sanitary districts of the county during 1903–08 (*see* page 32).

The general position as regards the relation between conservancy methods and enteric fever may be stated thus:

Throughout England and Wales counties persisting in the use of conservancy methods of dealing with excremental matters and not having adopted the water-carriage system have excessive enteric fever, in all instances in which industrial conditions imply considerable aggregations of population.

This rule holds good to a pre-eminent extent in the County of Durham; though owing to the varying degrees of efficiency of scavenging, and the varying number of opportunities for the introduction of specific infection from without in different districts, no consistent correlation can be traced in individual districts between the number of cases of enteric fever and the number of privies.

Reference has been made to the gradual substitution of so-called "ash-closets" for the old privy-middens. Although this represents some measure of improvement, the change cannot be regarded as altogether satisfactory. It is certain that in all districts in which a considerable number of houses are closely aggregated the change is only intermediate to the provision of water-closets; and experience in other parts of England has shewn diminution of enteric fever whenever water-closets have replaced either midden privies

or any form of pail closet or "ash-closet." The experience of Nottingham and Leicester quoted in my annual report for 1908–09 (page xxv) is most instructive in this respect.

An attempt to illustrate the economic loss inflicted on the population of Durham by its heavy sickness-rate and death-rate from enteric fever may possibly accelerate the administrative reform which the conditions revealed in Dr. Wheaton's report demand.

Dr. Farr in the 39th Annual Report of the Registrar-General of Births and Deaths (1876, pp. vi.–x.) estimated the mean net economic value of each male member of the population as £150, his estimate being based on the low standard of the agricultural labourer of that period. He concluded that if this estimate were extended to the whole population, including females, the standard might be lowered from £150 to £110 per head. At the age of 25 years the net value of a man (*i.e.*, the present value represented by the excess of his future earnings over cost of maintenance) on the same basis was estimated by him at £246. Recently Professor Irving Fisher, of Yale University, has estimated the minimum worth of the average American life as 4,000 dollars at the age of 20 years. These estimates when applied to a disease like enteric fever make no allowance for the cost of nursing and medical attendance, for the loss of wages during the protracted illness ; nor can one easily estimate the cost of future maintenance of families left destitute by the loss of the wage-earner.

During the six years 1903–08, the deaths from enteric fever in the County of Durham numbered 1,052. Of this number probably about 600 were deaths of males, and the majority of these deaths occurred during the working years of life. During the same period 6,315 cases of this disease occurred.

If it be assumed that each death represented a net financial value of £300, a direct loss of £315,600 was incurred by the county of Durham during the six years under consideration, from this disease alone.

Such incomplete financial considerations should lead the sanitary authorities of the County of Durham, who at present are incurring a most unenviable responsibility, to insist on the rapid abolition of the privy system and on efficient scavenging under the direct control of the staff of each sanitary authority.

I am, Sir,

Your obedient Servant,

ARTHUR NEWSHOLME.

May 12th, 1910.

100

# Dr. S. W. Wheaton's Preliminary Report on Enteric Fever in the County of Durham.

---

CONTENTS OF REPORT.



---

## CHIEF FACTS AS TO THE POPULATION OF THE COUNTY OF DURHAM.

The Administrative County of Durham together with the four County Boroughs of Gateshead, South Shields, Sunderland, and West Hartlepool contains an area of 649,244 acres, and had in 1901 a population of 1,187,474, against 1,016,562 in 1891, an increase of 16·8 per cent. in the intercensal period. The population of the Registration County in 1901 was 1,194,590. In 1901 there were in the Administrative County 200,441 inhabited houses, as against 168,565 in 1891, an increase of 18·9 per cent.

The population living in urban districts, including county boroughs, was 854,372, that living in rural districts 333,102. The population of urban districts had increased 18·5 per cent. since 1891, that of rural districts 12·7 per cent. This increase of population in rural districts, so contrary to the usual experience in England, is due to the large proportion of the mining population living in them. Of the entire population of the county 28·1 per cent. lived in rural districts, including the majority of the males engaged in connection with mines and quarries, 58,746 males so engaged lived in rural districts, as compared with 48,872 living in urban districts including county boroughs. The population of the rural districts is principally collected in a number of villages where dwellings are closely aggregated so that they resemble small towns. In 1901 males exceeded females in the county by 17,348.

## Relative Position of the County of Durham in respect of Mortality from Enteric Fever.

For a long time past the County of Durham, when compared with the other counties of England and Wales, has occupied a very bad position as regards prevalence of enteric fever. This is seen in the official statistics of the Registrar General.

Thus in the decennium 1871-80 the average crude death-rate from enteric fever in the Registration County of Durham was 559 per million persons living, as compared with an average rate for England and Wales of 322 per million. The registration counties, or divisions, standing next were the West Riding of Yorks, South Wales, North Riding of Yorks, and Nottingham, with rates of 452, 451, 444, and 430 respectively.

If the decennium 1881-90 be compared with 1871-80 the death-rate from enteric fever in the Registration County of Durham had fallen to 273 per million or 51 per cent., while that of England and Wales had fallen to 196 per million or 39 per cent.

Durham, however, still maintained its bad pre-eminence. During 1881-90 the registration counties or divisions which were nearest to Durham in respect of high enteric fever death-rate were Nottinghamshire, Lancashire, South Wales, and the North Riding of Yorkshire, with rates per million of 268, 265, 264, and 260 respectively.

In the decennium 1891-1900 Durham again stood in the worst position, with a death-rate per million from enteric fever of 302, as compared with a death-rate of 174 for England and Wales. The registration counties which were nearest to it in respect of enteric fever deaths were Nottinghamshire, Lancashire, East Riding of Yorks, Staffordshire, North Riding of Yorks, and West Riding of Yorks, with death-rates of 265, 256, 236, 220, 218, and 211 respectively. Thus in this decennial period the death-rate from enteric fever had increased 11 per cent. in the County of Durham as compared with 1881-90, whilst in England and Wales as a whole it had declined 11 per cent. Dr. Tatham in his letter to the Registrar-General, contained in the Supplement to the Sixty-fifth Annual Report of the Registrar-General, referring to enteric fever says, "in each of the last three decennia the

County of Durham suffered the highest mortality from enteric fever; the mortality there in 1891-1900, although 46 per cent. below that of 1871-80, having exceeded the rate in 1881-90 by 11 per cent. Reference to the reports of the Registrar-General for each year of the decennium last ended shows that the mortality in the County of Durham exceeded that of England and Wales in every year of the ten, amounting, in the year 1893, to 565 per million; this was mainly due to excessive mortality in the Registration Districts of Stockton, Auckland, Easington, Houghton-le-Spring, Chester-le-Street, South Shields, and Sunderland. In the last named district the death-rates from this cause were very heavy in the two following years also."

In the Annual Reports of the Registrar-General, Dr. Tatham has similarly drawn repeated attention to the high death-rate from enteric fever in certain districts in the County of Durham. Thus in the Registrar-General's Annual Report for 1904, in which year the corrected death-rate for enteric fever in England and Wales was 93 per million, the following statement is made: "The County of Durham contains 15 registration districts, in eight of which enteric fever mortality exceeded that of England and Wales as a whole. Among these districts the rate was equal to 247 per million living in Easington, 248 in Auckland, and 399 in Houghton-le-Spring. All these eight districts are included in the group of northern registration districts specified in previous reports as suffering excessively from enteric fever."*

Again in the Registrar-General's Annual Report for 1906 it is stated that "in the County of Durham enteric fever mortality was generally high in the year under notice, being above that in the country generally in eleven out of the fifteen registration districts therein comprised. In the following districts the rate exceeded 200 per million of the population: Stockton, Sedgefield, Auckland, Durham, Easington, and Houghton-le-Spring. In the "northern area of high enteric fever mortality" mentioned in several previous reports the mean death-rate from this disease in the year under notice was 196 per million. As compared with their several averages nine of the districts in this northern area showed improvement on the rates of the previous decennium, and five showed the opposite. Among the districts last alluded to the highest rates in the year under notice were 439 in Auckland and 970 in Sedgefield." Both these districts are in County Durham.

In the Registrar-General's Report for 1908 it is noted that "in the County of Durham mortality was excessive in the districts of Sedgefield, Auckland, Lanchester, Easington, Houghton-le-Spring, and Chester-le-Street." In Auckland, Easington, and Houghton-le-Spring, the rates in 1908 exceeded

---

* The registration districts comprising this area are :—Middlesbrough in the North Riding of Yorkshire, Stockton, Sedgefield, Auckland, Lanchester, Durham, Easington, Houghton-le-Spring, Chester-le-Street, Sunderland, and South Shields in the County of Durham, and Tynemouth, Castle Ward, and Morpeth in Northumberland

300 per million, the death-rate for England and Wales being 75 per million.

The following table shows the position of the Registration County of Durham in respect of enteric fever mortality as compared with England and Wales.

TABLE I.

| | *Death-rate from enteric fever per million of population for the Registration County of Durham.* | *Death-rate from enteric fever per million of population in England and Wales.* |
|---|---|---|
| 1871–1880 ... | 559 | 322 |
| 1881–1890 ... | 273 | 196 |
| 1891–1900 ... | 302 | 174 |
| 1901 ... ... | 250 | 155 |
| 1902 ... ... | 141 | 126 |
| 1903 ... ... | 113 | 100 |
| 1904 ... ... | 137 | 93 |
| 1905 ... ... | 179 | 89 |
| 1906 ... ... | 181 | 92 |
| 1907 ... ... | 86 | 67 |
| 1908 ... ... | 146 | 75 |

TABLE II.

*Enteric Fever cases and deaths in the Administrative County of Durham, together with the four County Boroughs, for the period* 1903-8.

| Year. | Number of Cases. | Number of Deaths. | Case mortality per cent. | Death-rate per 1,000 of estimated population. |
|---|---|---|---|---|
| 1903 ... ... | 775 | 136 | 17·5 | 0·14 |
| 1904 ... ... | 1,049 | 170 | 16·2 | 0·14 |
| 1905 ... ... | 1,295 | 223 | 17·2 | 0·19 |
| 1906 ... ... | 1,346 | 231 | 17·1 | 0·19 |
| 1907 ... ... | 611 | 106 | 17·3 | 0·08 |
| 1908 ... ... | 1,239 | 186 | 15·0 | 0·16 |

HISTORY OF FORMER INVESTIGATIONS INTO THE PREVALENCE OF ENTERIC FEVER IN THE COUNTY OF DURHAM.

During many years past this undue prevalence of enteric fever in the County of Durham has at intervals engaged the attention of the Board. A number of inquiries have been made by the Board's medical inspectors into local outbreaks of enteric fever, and a more general inquiry was made on this prevalence in certain areas in the county by the late Mr. T. W. Thompson in 1894.

The year 1893 was one of high enteric fever mortality in the county, 572 per million, and Mr. Thompson prepared a table

showing for that year the number of deaths from enteric fever and the mortality per million in all the sanitary districts of the county, together with their water supplies; also a diagram map showing the mortality from enteric fever in the various sanitary districts. He also prepared a table showing for the various sanitary districts in 1891, 1892, and 1893, the number of deaths from enteric fever and from diarrhœa. Also a table giving as far as could be ascertained, the actual number of known cases of enteric fever in the various sanitary districts from October, 1892, to April, 1894. These tables and the diagram enable one to ascertain the very important fact that enteric fever, with very few exceptions, especially prevailed in the same districts at that period as during the period 1903-8. Mr. Thompson drew attention to the close relation between mortality from enteric fever and from diarrhœa, and he devoted special attention to the relation of enteric fever prevalence to water supplies, especially to water supplies derived from the magnesian limestone. Of these the chief is that of the Sunderland and South Shields Water Company. He stated: "further inquiry might of course largely modify the aspect of the matter as I have presented it, but so far as the evidence goes, water (speaking here of water supplies generally) is not excluded from having perhaps had considerable concern in the dissemination of enteric fever over the large area in question; at least there is reason, I think, for watching the future behaviour of enteric fever in this region from this as well as from other points of view. At the same time it is clear that some of the facts I have quoted as consistent with water causation of fever in the County of Durham, are capable of other interpretation, and that there are many gaps in the evidence which further inquiry might fill up in the sense of either supporting or discrediting a water hypothesis. In any case the facts and statistics I have put forward do not seem to me to point to water as likely to afford a sufficient explanation of the prevalence of fever in the region in question. The vastness of the area involved, and the sustained character of the fever prevalence, tell, in my opinion, against such a view, and having regard especially to the number of different water supplies to be taken into account, suggest rather, that, although water may, by reason of independent contamination of multiple supplies, have played no small part in the epidemic spread of enteric fever at different times and in different parts of that region, yet that other important factors have contributed, and perhaps largely contributed, to the endemic prevalence of the disease."

A portion of the County of Durham was also dealt with by the late Dr. F. W. Barry in his Report to the Local Government Board on the Epidemic Prevalence of Enteric Fever during 1890-1 in certain sanitary districts situate in the valley of the River Tees in South Durham and North Yorkshire. Dr. Barry's report related to ten registration districts in which 1,463 cases of enteric fever occurred in two six-week periods from 7th September to 18th October, 1890, and from December 28th, 1890, to 7th February, 1891. Of these 1,463 cases 91 per

cent. occurred in three of these registration districts, *i.e.*, Darlington, Stockton, and Middlesbrough, portions of the first two of which are in the Registration County of Durham. The conclusions of this report may be summarised in the words of the late Sir Richard Thorne in his introduction to the Report of the Medical Officer to the Local Government Board for 1891 as follows: "Over a wide area covering 706,020 acres or 1,103 square miles, and containing 503,616 inhabitants, enteric fever has for years past been unduly prevalent. Within this area, where the infective material is thus constantly ready to hand, there occur in ten sanitary districts, covering 117,404 acres, and containing a population of 217,363, two marked and sudden outbursts of enteric fever, each of large amount, the remaining area meanwhile exhibiting as regards its constituent sanitary districts comparatively insignificant "fever" rates. Within the sanitary districts invaded by the two epidemic prevalences, some localities suffer heavily, whilst others escape exceptional incidence to the disease. One factor alone is found to be common to the places thus suffering exceptionally from enteric fever, and this is the use of water pumped from the River Tees." Of the ten sanitary districts here mentioned four of those in which exceptional incidence of enteric fever occurred are in the County of Durham, namely, Darlington Borough, Darlington Rural District, the Borough of Stockton-on-Tees, and Stockton Rural District. Dr. Barry did not deal in this report with the causation of what may be termed the "endemic prevalence" of enteric fever in these districts. It may be added here that although these districts are still supplied with water from the Tees or its tributaries, no similar epidemics, *i.e.*, beginning in September or in December, have occurred in them during 1903-8.

In 1896 Dr. Bruce Low reporting on the continued prevalence of enteric fever in Middlesbrough County Borough stated that since Dr. Barry's inquiry in no instance had there occurred in Middlesbrough any sudden and generally diffused outbreaks of enteric fever such as were manifested under the particular conditions to which Dr. Barry referred the exceptional fever epidemics of 1890-1. Dr. Bruce Low regarded the fever which he was inquiring into as "in the main indigenous and fostered by unwholesome conditions pertaining to the town itself. The principal of these were defective midden privies and pan privies, with faulty methods of scavenging." He reported that it was hoped that soon the Tees would be altogether given up as a source, and that all the water would be taken from its tributary, the Balder Brook, at Hury.

In 1889 the late Dr. Page reported to the Board upon an outbreak of enteric fever in the Houghton-le-Spring Rural District. Here 275 cases of enteric fever occurred between April 1st and June 7th, when the epidemic ended. Dr. Page attributed the outbreak to the pollution of the water supply, which was derived from a well sunk in the coal measures to a depth of 330 feet, but was contaminated by a feeder entering the well 45 feet from the surface. The above-mentioned reports, together with other reports on enteric fever in County Durham, made by the Board's inspectors, may be tabulated as follows:—

*Tabular Statement of Reports on Enteric Fever in County Durham, made by the Board's Medical Inspectors since* 1889.

| Date of Report. | Inspector. | Locality. | Character of Outbreak. | Causation of Outbreak. |
|---|---|---|---|---|
| 1889 ... ... | D. Page ... ... ... | Houghton-le-Spring R.D. | Outburst from April 1st to June 7th. | Polluted water supply from well. |
| 1890–91 ... ... | F. W. Barry ... ... | Darlington and Stockton-on-Tees Boroughs; Darlington and Stockton R.Ds. | Epidemic outbursts from September 7th, 1890, to October 18th, 1890, and from December 28th, 1890, to February 7th, 1891. | Water from the river Tees. |
| 1893 ... ... | H. M. Wilson ... ... | Chester-le-Street R.D. ... | Epidemic outbreak in two periods, November, 1892, to January, 1893, and February to March, 1893; 58 attacks, 4 deaths. | Polluted water supply from Stanley Burn, since discontinued. |
| 1894 ... ... | R. Bruce Low ... ... | Shildon and East Thickley U.D. | April to November, 1893; 224 attacks, 41 deaths. | Defective midden privies, and milk infection. |
| 1895 ... ... | T. W. Thompson ... | Whole County ... ... | October, 1892, to April, 1894; nearly all in the last two quarters of each year. | Doubtful; probably not water; possible influence of occupation through coal mines. |
| 1895 ... ... | T. W. Thompson ... | Sunderland Borough ... | Epidemic outburst in September 1895. | Milk infection. |
| 1901 ... ... | S. W. Wheaton ... ... | Bishop Auckland U.D.... | Prevalence in last two quarters of year. | Defects of excrement disposal, and polluted water supply from river Wear. |
| 1907 ... ... | W. W. E. Fletcher ... | Brandon and Byshottles U.D. | Autumn and winter of 1904, 1905, 1906. | Defects of excrement disposal and of sewerage, considerable personal infection; possible in-infection through coal mines. |

The reports of the medical officer of health of the County of Durham, Dr. T. Eustace Hill, have contained frequent references to the prevalence of enteric fever in the county. He has generally attributed the fever to faulty conditions of excrement disposal, to consumption of infected shellfish, or to conveyance of infection by flies or in dust; but he considers that water supplies are not free from suspicion of causing enteric fever in, at any rate, certain areas.

The annual reports of the local medical officers of health have in some instances attributed the enteric fever outbreaks to pollution of water supplies; others, of late, have laid stress upon infection from the consumption of shellfish from sewage-polluted layings. The majority, however, have laid principal blame upon the prevalence of unwholesome conditions in connection with the disposal of excrement and scavenging of privies.

In some instances medical officers of health have written special reports on enteric fever outbreaks, notably Dr. J. Taylor, on an outbreak of enteric fever in Chester-le-Street Rural District in 1908, and Dr. D. S. Park on outbreaks in Houghton-le-Spring Rural and Urban Districts in the same year.* These three districts are contiguous. Dr. Taylor regarded the outbreak, which occurred in the last two quarters of 1908, as being due to pollution of the water supply, although no definite source of its contamination was suggested. Dr. Park, on the other hand, regarded the outbreak in his districts as not being due to the use of water. Although the water supply in use in Chester-le-Street Rural District was also supplied to parts of his districts, yet some populous areas in these districts, using the suspected water, were free from the disease. He attributed the fever to defective excrement disposal, combined with unusually high temperature in September and October. He also attributed a number of attacks to the eating of infected mussels, the first notified case being of this nature.

In 1906 two sharp outbreaks of enteric fever occurred in the Rural Districts of Durham and Sedgefield (which are adjacent). By the medical officers of health these outbreaks were attributed, at any rate in their inception, to the use of a certain milk supply which was infected through the use of water derived from a polluted shallow well.† In Durham Rural District 24 attacks were notified between September 8th and 15th, all in households having milk from this source, and 72 cases in all occurred in the district during the year. In Sedgefield Rural District, from August to December, 117 attacks occurred, of which 78 were in households consuming the suspected milk supply.

In Durham Rural District nuisances from defective excrement disposal are most pronounced, and general sanitary work much

* Dr. Taylor's report is included in his Annual Report to the Chester-le-Street Rural District Council for 1908. Dr. Park's Report, which was made at the request of the Local Government Board, is included in his Annual Report to the Houghton-le-Spring Rural District Council for 1908.

† *See* Annual Reports of the Medical Officers of Health of the Durham and Sedgefield Rural Districts respectively for 1906.

neglected. On this account the district has twice recently been inspected (by Drs. Farrar and Bulstrode) on behalf of the Board. Similar conditions prevail in Sedgefield Rural District also. The incidence of these outbreaks is well shown on Diagram III. A very pronounced outbreak occurred in Shildon Urban District also in 1906, *see* Diagram III. The medical officer of health attributed this to gross defects of excrement disposal and removal, together with hot, dry weather. One hundred and thirty-four cases occurred in the district in this year.

### Relative position of the Sanitary Districts of the County of Durham as regards Enteric Fever prevalence.

The position of the County of Durham in respect of mortality from enteric fever having been set out, and the history of previous investigations on the subject having been summarised, it will now be convenient to study the relative position of the various sanitary areas of the county in regard to mortality and attack-rates from enteric fever. The sanitary districts are arranged in their order of prevalence of enteric fever as shown by the annual average attack-rates from 1903-8 in Diagram I. Their relative positions for the period 1903-8 can also be seen in Diagram II., where the annual average attack-rates and the annual average death-rates per 1,000 from enteric fever in the various sanitary districts during this period are set out. These average rates need to be checked by the data contained in Diagram III., in which are given the attack-rates per 1,000 for each year 1903-8 in the various sanitary districts.

Table III. below also shows the estimated populations of the various sanitary districts for 1908, together with the number of cases of enteric fever, and of deaths from this cause, per 1,000 of the population for each of the years 1903-8. In this table the various districts are arranged in the order of prevalence of enteric fever in them for the period 1903-8, as in Diagram 1, beginning with the district in which this disease was least prevalent.

Reference to the preceding diagrams, especially Diagram I., and to Tables III. and IV., will show that enteric fever has prevailed in rural districts in this county to a greater extent than in urban districts. With one exception, that of Sunderland, the four county boroughs, which have the largest populations concentrated on the smaller areas, have relatively less of this disease than most of the other sanitary districts, Gateshead and West Hartlepool being 7th and 8th on the list of fever prevalence, South Shields 15th, and Sunderland 25th. Of the 47 sanitary areas included in the county there are only two rural districts, Hartlepool and Barnard Castle, in front of the first two county boroughs. The five municipal boroughs of Hartlepool, Durham, Jarrow, Darlington, and Stockton also occupy a position superior to that of most of the rural and urban districts.

The Registrar-General's enquiries show that enteric fever is especially a disease of urban areas. Thus, in the Supplement to the Sixty-fifth Annual Report of the Registrar-General for 1891-1900, Table 6, the mortality from enteric fever in certain

## Table III.

*Showing estimated population of each sanitary district in the death-rates for the years* 1903–1908 *per* 1,000 *of population, and the* 1903–1908.

| Sanitary District. | Population estimated for 1908. | Enteric Fever 1903–08. Average Annual | | 1903. | |
|---|---|---|---|---|---|
| | | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. |
| 1. Consett U.D. ... ... ... | 10,969 | ·09 | Nil | ·09 | — |
| 2. **Hartlepool Boro'** ... | 23,823 | ·13 | ·05 | ·13 | ·04 |
| 3. Hartlepool R.D. ... ... | 3,167 | ·16 | ·05 | — | — |
| 4. Whickham U.D. ... ... | 16,195 | ·18 | ·05 | — | — |
| 5. Barnard Castle U.D.... ... | 4,479 | ·22 | ·07 | ·22 | — |
| 6. Barnard Castle R.D.... ... | 10,999 | ·22 | ·04 | **·63** | — |
| 7. **Gateshead C. Boro'** ... | 128,393 | ·26 | ·05 | ·22 | ·04 |
| 8. **W. Hartlepool C. Boro'** | 77,573 | ·26 | ·04 | **·35** | ·04 |
| 9. Tow Law U.D. ... ... | 4,243 | ·31 | — | ·22 | — |
| 10. Weardale R.D. ... ... | 9,651 | ·34 | ·07 | **82** | ·10 |
| 11. Felling U.D. ... ... ... | 26,940 | ·44 | ·09 | ·50 | ·07 |
| 12. **Durham Boro'** ... ... | 16,894 | ·46 | ·07 | ·32 | ·06 |
| 13. **Jarrow Boro'** ... ... | 34,752 | ·50 | ·13 | ·56 | ·05 |
| 14. Seaham Harbour U.D. ... | 11,060 | ·51 | ·17 | ·80 | ·38 |
| 15. **S. Shields C. Boro'** ... | 115,535 | ·52 | ·09 | ·56 | ·09 |
| 16. Lanchester R.D. ... ... | 30,920 | ·54 | ·12 | ·42 | ·17 |
| 17. Hebburn U.D. ... ... | 24,652 | ·58 | ·13 | ·40 | ·12 |
| 18. Benfieldside U.D. ... ... | 8,456 | ·64 | ·10 | ·64 | — |
| 19. Stockton R.D. ... ... | 17,279 | ·65 | ·13 | ·74 | ·20 |
| 20. Stanhope U.D. ... ... | 2,040 | ·66 | ·08 | **1·40** | — |
| 21. Willington U.D. ... ... | 7,948 | ·71 | ·10 | ·38 | ·12 |
| 22. Tanfield U.D.... ... ... | 9,523 | ·74 | ·09 | ·57 | — |
| 23. Crook U.D. ... ... ... | 11,500 | ·75 | ·19 | ·17 | — |
| 24. **Darlington Boro'** ... | 49,861 | ·78 | ·11 | ·43 | ·10 |
| 25. **Sunderland C. Boro'** ... | 157,693 | ·80 | ·14 | ·81 | ·14 |
| 26. Leadgate U.D. ... ... | 4,808 | ·80 | ·10 | — | — |
| 27. Darlington R.D. ... ... | 9,723 | ·81 | ·12 | 1·10 | ·10 |
| 28. **Stockton Boro'** ... ... | 52,800 | ·85 | ·13 | **1·0** | ·15 |
| 29. Chester-le-Street R.D. ... | 70,019 | ·90 | ·13 | ·50 | ·07 |
| 30. Annfield Plain U.D. ... ... | 14,479 | ·95 | ·18 | ·60 | — |
| 31. Stanley U.D. ... ... ... | 20,085 | ·97 | ·18 | ·51 | ·06 |
| 32. Durham R.D.... ... ... | 28,932 | 1·01 | ·20 | ·55 | ·10 |
| 33. Easington R.D. ... ... | 43,544 | 1·10 | ·21 | ·84 | ·19 |
| 34. Spennymoor U.D. ... ... | 16,872 | 1·13 | ·21 | ·71 | ·18 |
| 35. Sunderland R.D. ... ... | 28,321 | 1·18 | ·18 | 1·60 | ·90 |
| 36. Blaydon U.D.... ... ... | 26,199 | 1·22 | ·11 | ·79 | ·13 |
| 37. South Shields R.D. ... ... | 11,944 | 1·39 | ·23 | 1·20 | ·09 |
| 38. Auckland R.D. ... ... | 52,771 | 1·45 | ·21 | ·88 | ·13 |
| 39. Southwick-on-Wear U.D. ... | 14,745 | 1·51 | ·26 | 1·10 | — |
| 40. Hetton-le-Hole U.D.... ... | 14,403 | 1·52 | ·16 | ·81 | — |
| 41. Sedgefield R.D. ... ... | 21,794 | 1·70 | ·29 | ·53 | ·14 |
| 42. Houghton-le-Spring R.D. ... | 19,909 | 1·73 | ·28 | 1·40 | ·20 |
| 43. Bishop Auckland U.D. ... | 13,136 | 1·87 | ·23 | ·65 | — |
| 44. Houghton-le-Spring U.D. ... | 9,041 | 2·07 | ·31 | 1·20 | ·24 |
| 45. Ryton U.D. ... ... ... | 11,461 | 2·14 | ·21 | ·85 | ·21 |
| 46. Brandon and Byshottles U.D. | 16,617 | 2·73 | ·39 | ·62 | ·19 |
| 47. Shildon U.D. ... ... ... | 13,687 | 3·39 | ·54 | 1·30 | ·56 |
| **Administrative County together with County Boroughs ...** | 1,329,835 | ·85 | ·14 | ·70 | ·14 |

## TABLE III.

*County of Durham in* 1908, *the annual average attack-rates and attack-rates and death-rates per* 1,000 *of population for each year*

| 1904. | | 1905. | | 1906. | | 1907. | | 1908. | |
|---|---|---|---|---|---|---|---|---|---|
| Attack-rate. | Death-rate. | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. |
| ·09 | — | — | — | — | — | ·09 | — | ·27 | — |
| ·13 | ·04 | **·17** | ·04 | ·12 | ·12 | ·08 | — | ·16 | ·04 |
| — | — | — | — | — | — | ·31 | ·31 | **·63** | — |
| ·07 | — | **·35** | ·14 | **·35** | ·14 | ·20 | — | ·12 | ·06 |
| — | — | ·40 | — | — | ·22 | — | — | **·67** | ·22 |
| ·09 | ·09 | ·36 | ·18 | — | — | ·17 | — | ·09 | — |
| ·32 | ·07 | ·20 | ·04 | **·39** | ·08 | ·16 | ·04 | ·20 | ·02 |
| ·20 | ·02 | ·25 | ·08 | ·34 | ·08 | ·20 | ·02 | ·21 | ·02 |
| ·22 | — | ·22 | — | — | — | ·47 | — | **·70** | — |
| ·10 | — | ·31 | ·10 | ·50 | ·10 | ·20 | ·10 | ·10 | — |
| **·60** | ·12 | ·35 | ·16 | ·50 | — | ·34 | ·11 | ·30 | ·07 |
| ·19 | — | **1·00** | ·12 | ·30 | — | ·18 | — | ·52 | ·18 |
| ·50 | ·11 | **·90** | ·11 | ·50 | ·22 | ·25 | ·17 | ·23 | ·05 |
| ·18 | ·09 | ·09 | — | ·18 | — | ·09 | ·29 | **1·90** | ·45 |
| ·56 | ·07 | **·78** | ·21 | ·48 | ·08 | ·44 | ·03 | ·33 | ·07 |
| ·31 | — | ·52 | ·06 | ·45 | ·10 | ·40 | ·06 | **1·0** | ·29 |
| ·44 | ·13 | **1·10** | ·12 | ·58 | ·08 | ·53 | ·12 | ·32 | ·04 |
| ·25 | ·12 | ·62 | ·24 | **1·30** | ·23 | ·36 | — | ·59 | — |
| ·56 | ·19 | ·43 | — | **1·0** | ·42 | ·59 | — | ·57 | — |
| ·50 | ·50 | ·50 | — | ·50 | — | — | — | ·98 | — |
| ·62 | — | ·10 | ·12 | ·75 | ·12 | ·25 | — | **1·20** | ·12 |
| ·56 | — | **1·0** | ·44 | ·32 | — | ·53 | — | ·84 | ·10 |
| ·43 | ·17 | ·69 | ·17 | ·81 | ·34 | ·26 | ·09 | **2·0** | ·34 |
| **1·70** | ·10 | 1·0 | ·14 | ·80 | ·16 | ·34 | ·10 | ·41 | ·04 |
| ·84 | ·21 | **·91** | ·20 | ·86 | ·12 | ·59 | ·05 | ·79 | ·08 |
| ·12 | ·21 | **2·90** | ·42 | 1·0 | — | ·20 | — | 2·41 | — |
| **1·20** | ·20 | ·41 | ·10 | ·82 | ·20 | ·70 | ·10 | ·51 | — |
| ·84 | ·13 | ·59 | ·09 | ·99 | ·17 | ·99 | ·15 | ·64 | ·09 |
| ·74 | ·09 | 1·10 | ·21 | ·96 | ·08 | ·33 | ·04 | **1·60** | ·24 |
| ·22 | ·06 | **1·40** | ·21 | 1·10 | ·29 | 1·0 | ·28 | ·96 | ·20 |
| ·79 | ·12 | ·63 | ·05 | ·98 | ·16 | **1·50** | ·20 | ·99 | ·39 |
| ·83 | ·03 | ·76 | ·59 | **2·60** | ·27 | ·48 | ·13 | 1·0 | ·13 |
| ·90 | ·28 | 1·60 | — | 1·10 | ·28 | ·53 | ·09 | **2·60** | ·39 |
| ·89 | ·23 | ·89 | ·11 | ·77 | ·11 | 1·0 | — | **2·40** | ·29 |
| **2·10** | ·15 | 1·0 | ·23 | 1 30 | ·22 | ·39 | ·07 | 1·30 | ·21 |
| ·75 | ·07 | **2·0** | ·07 | 1·0 | ·17 | ·78 | ·07 | 1·80 | ·11 |
| 1·40 | ·17 | **1·80** | ·08 | 1·30 | ·34 | ·83 | ·25 | 1·50 | ·25 |
| 1·30 | ·19 | 1·80 | ·28 | 1·90 | ·19 | ·64 | ·05 | **2·10** | ·41 |
| 1·60 | ·29 | 1·10 | ·36 | **3·30** | ·63 | ·69 | ·20 | ·95 | ·06 |
| 2·10 | ·36 | ·79 | ·14 | **2·40** | ·28 | ·91 | ·21 | 2·0 | — |
| ·43 | — | 1·0 | ·14 | **5·40** | ·98 | ·64 | ·23 | 1·90 | ·22 |
| 1·30 | ·20 | 2·20 | ·40 | ·70 | ·25 | ·69 | ·05 | **3·90** | ·50 |
| 2·0 | ·24 | **3·40** | ·47 | 2·30 | ·62 | ·54 | — | 1·10 | ·07 |
| 3·80 | ·59 | 1·70 | ·35 | 1·0 | ·11 | ·56 | — | **4·90** | ·55 |
| ·61 | — | **8·80** | ·88 | ·47 | ·09 | ·36 | ·09 | 1·30 | — |
| 4·90 | ·74 | **6·10** | ·74 | 2·90 | ·42 | ·42 | ·06 | 1·20 | ·18 |
| 3·50 | ·47 | 2·40 | ·15 | **10·20** | 1·44 | ·59 | ·29 | 1·90 | ·29 |
| ·83 | ·14 | 1·19 | ·19 | 1·04 | ·19 | ·46 | ·08 | ·90 | ·16 |

groups of urban counties from 1891-1900 per million living, at all ages, was 198; in certain groups of rural counties, 116; in England and Wales, 174. The average corrected rates for 1899-1903 were, per million, urban counties, 174; rural, 93; England and Wales, 150. In the period 1903-7 the corresponding rates were, urban counties, 99; rural, 68; England and Wales, 88. For the year 1908, urban, 84; rural, 56; England and Wales, 75.

In the County of Durham the average crude death-rates from enteric fever for the period 1903-8, calculated on the estimated population for 1905, were 116 per million in urban districts, including county boroughs, 180 in rural districts. In county boroughs alone the death-rate was 78 per million only, in municipal boroughs 97 per million, in other urban districts 175 per million; so that when the county boroughs and municipal boroughs are excluded, there is little difference in the mortality in urban and rural districts in the county. The rural districts in Durham are all of large area and, excepting those of Weardale, Barnard Castle, Darlington, Stockton, and Hartlepool, they contain collections of dwellings of an urban character, for the most part clustered around coalpits. The designation "rural," therefore in this county does not usually correspond to the actual conditions of a district.

In the administrative county, including county boroughs, in 1901 there were 11,674 male persons engaged in agriculture, aged 10 years and upwards, as compared with 107,618 engaged in mines and quarries. Of this latter number, 58,746 lived in so-called rural districts. There was a total of occupied males, at these ages, of 380,640.

TABLE IV.

*Showing attack-rates and death-rates per million of estimated population for* 1905 *in four groups of districts in County of Durham in the six years* 1903-8.

| Year. | 1. Urban Districts including County and Municipal Boroughs. | | 2. Urban Districts only. | | 3. Rural Districts only. | | 4. County and Municipal Boroughs only. | | 5. England and Wales. |
|---|---|---|---|---|---|---|---|---|---|
| | Attack-rate. | Death rate. | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. | Attack-rate. | Death-rate. | Death-rate. |
| 1903 ... | 548 | 97 | 575 | 108 | 824 | 133 | 535 | 91 | 100 |
| 1904 ... | 798 | 136 | 1,181 | 189 | 923 | 130 | 616 | 111 | 93 |
| 1905 ... | 819 | 126 | 1,685 | 230 | 1,126 | 203 | 406 | 77 | 89 |
| 1906 ... | 904 | 159 | 1,529 | 250 | 1,649 | 246 | 606 | 116 | 92 |
| 1907 ... | 475 | 84 | 599 | 125 | 511 | 81 | 416 | 64 | 67 |
| 1908 ... | 723 | 99 | 1,289 | 165 | 1,669 | 275 | 453 | 67 | 75 |

If the death and attack-rates for urban districts, including the four county boroughs and the five municipal boroughs, given in Table IV., are compared with the corresponding rates for rural districts only, the excess in rural districts in respect of attack-rates is marked and also the excess in respect of death-rates,

with the exception of two years 1904 and 1907, in which the death-rates in rural districts were slightly lower than in all urban districts, including municipal and county boroughs. If, however, the county and municipal boroughs be excluded from the comparison, the attack and death-rates in urban and rural districts, Columns 2 and 3, are seen very closely to approximate with the exception of the low mortality in 1907 in rural districts. When the rates in county and municipal boroughs are taken separately (Column 4) and compared with the rates of Columns 1, 2, and 3, they are seen to be relatively low in each year without exception. Especial attention may be paid to the relatively low death-rates in county and municipal boroughs. Among these there are two, Sunderland County Borough and Stockton Municipal Borough, whose mortality and attack-rates exceed the rates shown in the others. These occupy the 25th and 28th places in the list of enteric fever prevalence, *see* Table III. and Diagram 1.

If the factor or factors which lead to this diminished incidence of enteric fever in many of the more populous towns in the county, and to the less favourable experience of Sunderland County Borough and Stockton Municipal Borough could be ascertained, we should have gone far towards determining the cause of the excessive prevalence of enteric fever in the County of Durham.

## Yearly and Seasonal Incidence of Enteric Fever in the County of Durham.

### (a) *Yearly Incidence.*

A glance at Diagram III. will show that during the period 1903 to 1908 the prevalence of enteric fever was greatly reduced during the two years 1903 and 1907, especially in 1907. No marked outbreak occurred in either of these years, with the exception of Stanley Urban District, in which there was an exceptional attack-rate of 1·5 in 1907.*

This year, 1907, was noteworthy for the low rate of mortality from enteric fever, the rate for England and Wales being 67 per million, and the lowest recorded. For the County of Durham the rate was 86. The following year, 1908, had a death-rate of 75 per million for England and Wales, which is, with the exception of that of 1907, the lowest recorded. The rate for the County of Durham was 146. Table IV. also shows how marked were these two years of minimum prevalence, and especially how in these two years the rates in all the different classes of districts, *i.e.*, urban, including county boroughs and municipal boroughs, urban only, rural, and county and municipal boroughs, tended to approximate. It is in the years 1904-5-6-8, which may be called epidemic years, that these rates diverged and increased disproportionately in urban districts (exclusive of county and municipal boroughs) and in rural districts. This is brought

* This outbreak in Stanley Urban District was attributed by the medical officer of health to unusual personal infection in dwellings.

out more clearly in the following table, in which the attack-rate for enteric fever in the year 1907 is taken as 100:—

TABLE V.

| Year. | Urban districts, excluding county and municipal boroughs. | Rural districts. | County and municipal boroughs. |
|---|---|---|---|
| 1907 ... | 100 | 100 | 100 |
| 1903 ... | 96 | 161 | 128 |
| 1904 ... | 197 | 180 | 148 |
| 1905 ... | 281 | 220 | 97 |
| 1906 ... | 255 | 322 | 145 |
| 1907 ... | 100 | 100 | 100 |
| 1908 ... | 215 | 327 | 109 |

In the county and municipal boroughs the difference between the highest and lowest attack-rates, the lowest being taken as 100, is only 48. In urban districts, excluding county and municipal boroughs, the corresponding difference is 181. In the rural districts it is 227. The rule for the county and municipal boroughs applies to each individual borough as may be seen by reference to Diagram III. Even Sunderland County Borough and Stockton Municipal Borough, which have a sustained higher rate than the other seven county and other boroughs, are not subject to the great variations in single years shown in the rural and ordinary urban districts. We may conclude, therefore, that the urban districts of Durham (exclusive of county and municipal boroughs) and the rural districts not only have an endemic prevalence of enteric fever which in years of minimum prevalence is higher than that of municipal and county boroughs, but that in years of epidemic excess, such excess, owing to conditions which exist in these districts, is enormously greater than in the municipal and county boroughs.

(b) *Seasonal Incidence.*

An examination of the cases of enteric fever notified in each quarter of the years 1903-8 in each sanitary district of the county, showed that enteric fever prevalence in this county conforms to the well-known fact that enteric fever is a disease of the autumn months. There was no instance of an outbreak commencing in the first quarter of the year, and but few instances of an outbreak being continued through the winter into the following spring. Exceptions to this were noted in Sunderland County Borough in 1904, and in Stockton Municipal Borough in the same year.

INFLUENCE OF TEMPERATURE AND OF RAINFALL ON ENTERIC FEVER PREVALENCE IN THE COUNTY.

Observations of the ground temperature are not kept in the county, but records of the rainfall and temperature are available. When the monthly records of rainfall and temperature of a year of marked prevalence of enteric fever, *e.g.*, 1908, were compared with those of a year of minimum prevalence of enteric fever,

*e.g.*, 1907, it was seen that they differed greatly. In 1908 there was a marked *deficiency* of rainfall during July, August, and September, and *all through the fourth quarter* of the year, combined with a temperature above the average in the month of September, and markedly exceeding this average in the months of October and November. In 1907, the year of low prevalence, there was also *deficient* rainfall in July, August, and September, but a marked excess during October; with a very low temperature in July and August, of average height in September, somewhat above the average in October, and slightly above the average in November. If other two years were compared, *e.g.*, if 1903, a year of low enteric fever prevalence, both in County of Durham and in England and Wales, was compared with 1906, a year of low enteric fever prevalence in England and Wales but of marked prevalence in County Durham, as shown in Table I., the following facts were noted: In 1906 rainfall was deficient throughout July, August, and September, only slightly above the average in October, and deficient for the rest of the fourth quarter. This was combined with a temperature considerably above the average in August, September, October and November. In 1903, the year of low enteric prevalence, there was some excess of rainfall in July, August, and September, which excess was very great in October. The temperature was low throughout July, August, and September, slightly above the average in October, and low throughout the rest of the fourth quarter. It would thus appear that excessive temperature in August, September, and October, or September and October, *if combined with deficient rainfall* in August, September, and October, are conditions which foster enteric fever in the County of Durham. These conditions have been frequently noted as associated with prevalence of enteric fever in other parts of the country, but much more extended observations would require to be made to ascertain their relations with anything approaching certainty. It is possible that deficient rainfall in August, September, and October may be of much more importance than conditions of temperature. Of the causes of the well-known seasonal prevalence of enteric fever we know very little. In the County of Durham the year 1908 was remarkable for severe and late prevalence of enteric fever, the disease being continued into and prevailing much more extensively in the fourth quarter of the year than in any of the other years from 1903-8. This was a uniform feature in the sanitary districts in which the disease was prevalent. The fourth quarter of 1908 was remarkable on account of deficient rainfall throughout, and excess of temperature, in October and November. Nevertheless, in some districts of County Durham these unusual meteorological conditions had very little influence in increasing the prevalence of enteric fever, notably in the county and municipal boroughs, where the death-rate per million was 67 (*see* Table IV. and Diagram III.), and in the three purely rural areas of Hartlepool, Weardale, and Barnard Castle Rural Districts. Although similar meteorological conditions prevailed throughout England and Wales, yet here the death-rate from enteric fever was, with one exception, the lowest recorded (75), the lowest being 67 in the preceding

year, 1907. Thus the county and municipal boroughs of Durham, with a death-rate of 67, conformed to the rate for England and Wales, but the rates in the other urban districts and the rural districts greatly exceeded these, being 165 and 275, respectively.

### Comparison between Enteric Fever Prevalence and Mortality from Infantile Diarrhœa and Enteritis in Durham.

Diarrhœa, including enteritis, is a disease which accounts for a large proportion of infantile deaths, and has a marked seasonal prevalence.

In the two years 1903 and 1907, when the prevalence of enteric fever in County Durham was greatly reduced, the mortality from diarrhœa and enteritis was also most markedly reduced as compared with other years. In the year 1907, in which the death-rates from enteric fever in England and Wales and in the County of Durham were the lowest recorded, 67 and 86, respectively (*see* Table I.), the infantile mortality in Durham Registration County was also the lowest recorded, being 135 as compared with 118 for England and Wales. The deaths from diarrhœal diseases of children under one year of age per 1,000 births were in the County of Durham in this year 13, those for England and Wales being 14, 13 counties having higher rates than Durham. This exceptional low mortality from diarrhœal diseases in Durham during this year can hardly fail to be related to the unusually low temperature of July and August in this county in 1907.

Diarrhœa and enteritis prevalence, as shown by deaths, usually precedes the autumnal prevalence of enteric fever, and ceases almost entirely at the end of the third quarter of the year, whereas enteric fever prevalence commences later and continues far into the fourth quarter of the year. It is noted by the Registrar-General that the infantile mortality, which principally depends upon diarrhœal diseases, in England and Wales in the third quarter of 1907 was less than in any other quarter of the same year, and that in 40 years there had been only two years in which the infantile mortality in the third quarter was thus less than that of any other quarter of the respective years. This reduced prevalence of diarrhœal diseases in the third quarter of 1907 was noticeable in the County of Durham. In 1908 enteric fever prevalence in the County of Durham, as before noted, was exceptionally postponed and was prolonged through the fourth quarter. Similarly, prevalence of diarrhœa and enteritis, as shown by infantile deaths, was also postponed and continued into the fourth quarter of the year. In this year the prevalence of diarrhœal diseases, as indicated by infantile mortality, was similarly postponed over England and Wales, the infantile mortality for the fourth quarter of the year being greater than in any other quarter.* The true relations of the prevalence of diarrhœa and enteritis and of enteric fever are of interest in view of the "preliminary diarrhœa," which has been often referred to in the reports of the Board's inspectors, and by local medical officers of health, as preceding outbreaks of enteric fever in the County of Durham, as elsewhere.

---

* *See* Registrar General's Reports for 1907 and 1908.

The late Mr. T. W. Thompson, in his report on enteric fever in the county before mentioned, referred to the "practical disappearance of diarrhœa mortality at a time when fever mortality was at its maximum, suggesting that fatal diarrhœa might consist largely of unrecognised cases of enteric fever." After discussing the matter thoroughly, he arrived at the conclusion that there was little to support this belief. Diarrhœal diseases and enteric fever each follow independent courses of their own, diarrhœal diseases in a community preceding enteric fever in time, but occasionally overlapping the latter, the prevalence of both under favouring conditions depending to a great extent upon seasonal changes of temperature and moisture, and being influenced by any abnormal or exceptional features affecting these conditions such as occurred in the years 1907 and 1908. Furthermore, even after full allowance is made for non-fatal cases, epidemic diarrhœa is more especially a disease of infants, enteric fever of persons who have passed the age of infancy.

## Influence of Soil on Prevalence of Enteric Fever.

The greater part of the surface of the County of Durham is undulating or hilly. There are practically no low-lying parts liable to flooding, and nearly everywhere sufficient fall can be obtained for drainage. The county increases in elevation from the sea level on the east coast to a height of 2,000 feet on the moorlands of the western border. Many of the inhabited areas are situate at a considerable elevation. The deep underlying strata are in three bands running from north-east to south-west, each roughly occupying a third of the area of the county. On the east is the magnesian limestone of the permian formation, in the middle the coal measures, in the west carboniferous rocks, mainly millstone grit and carboniferous limestone. The whole of these rocks are covered more or less by glacial deposits—principally boulder clay, with sand and gravel. These deposits are thickest in the east, and thin out as one proceeds westward. On the east the boulder clay overlies the magnesian limestone, which, however, is uncovered in a few places, particularly near South Shields. The coal measures are to a large extent uncovered by the boulder clay, and the millstone grit and carboniferous limestone are uncovered to a still greater extent.

All these systems of rock are capable of furnishing water supplies, the magnesian limestone and coal measures from wells or deep borings, the millstone grit and carboniferous limestone from springs to a limited extent, but chiefly from surface-gathering grounds. The County Boroughs of West Hartlepool, South Shields, and Sunderland are situated on the coast, that of Gateshead is on the Tyneside. All are situate chiefly on the boulder clay, and with the exception of Sunderland have a low enteric fever incidence (*see* Diagram 1). Hartlepool Borough is the only large town in Durham situate directly upon the magnesian limestone. It adjoins the County Borough of West Hartlepool, and comes second in the order of freedom from enteric fever, the latter borough being 8th, on the Diagram 1.

The town of Darlington, Seaham Harbour Urban District, Ryton Urban District, and a large portion of Easington Rural District, Hartlepool Rural District, and Durham Rural District, are situate on glacial gravel. Seaham Harbour and Hartlepool Rural District have a low enteric fever prevalence, being 14th and 3rd on the list in Diagram 1, but Darlington Urban District has a rather high prevalence, being 24th, and Easington and Durham Rural Districts, with Ryton Urban District, have a high fever prevalence, especially Ryton, which is 45th on the list. The districts situate on the high-lying moors of the western part of the county, viz., Weardale Rural District, Barnard Castle Urban District and Rural District, are essentially rural in character, and have a low enteric fever prevalence. Consett Urban District is first on the list in Diagram 1, and is remarkable for the absence of deaths from enteric fever during the period 1903-8. It is situate directly on the coal measures at a high elevation, 500 feet above sea level. All other populous places are situate either on boulder clay or directly on the coal measures, which latter usually furnish a subsoil of clay or sand, differing little in its physical properties from boulder clay. There does not appear to be any difference in enteric fever prevalence which can be attributed to the influence of the soil underlying dwellings in the county.

### Relation of Water Supply to Enteric Fever Prevalence.

The greater part of the population of the County of Durham is supplied with water by three companies: (1) The Sunderland and South Shields Water Company; (2) The Newcastle and Gateshead Water Company; and (3) The Weardale and Consett Water Company. In addition, four sanitary districts are supplied from the River Tees or its affluents, source No. (4); one, Bishop Auckland, from the River Wear, source No. (5); two wholly, and three partly, from water pumped from or in connection with colliery workings, source No. (6); four from moorland springs, source No. (7); three from deep wells penetrating the permian sandstone, source No. (8); and one, Chester-le-Street Rural District, from, sources 1, 2, 3, and 6, source No. (9). *See* Diagrams II. and III. So far as I have information at the present time the source and extent of supply of these different waters are as follows:—

No. (1). The Sunderland and South Shields water is obtained from a number of wells sunk in the magnesian limestone, these wells in some instances having borings which penetrate the limestone to reach water-bearing strata of sandstone. This water supplies the north-eastern corner of the county. The possibility that pollution of this water takes place by reason of surface impurities reaching the water-bearing strata through the fissures which abound in the magnesian limestone has to be borne in mind. The surface of this limestone is for the most part covered by a very considerable thickness of boulder clay, which forms a more or less impermeable covering; but whether this covering is a sufficient protection could only be determined by a detailed investigation. The water is not filtered. The

water supplied in the town of Sunderland by this water company has been examined recently for presence of bacillus coli. Of 112 samples, 56·2 per cent. contained none in 100 c.c.; 29·4 per cent. gave a positive result in 100 c.c., but not in less; 10·7 per cent. gave a positive result in 10 c.c.; and 3·6 per cent. gave a positive result in 1 c.c.

No. (2). The Newcastle and Gateshead water is supplied to places on the Tyneside. It is derived from moorland gathering grounds and is said to be filtered.

No. (3). The Weardale and Consett water is also derived from moorland gathering grounds, and is said to be filtered always before passing into the supply pipes.

No. (4). I have no information as to whether the whole of the water of the Tees Valley Water Board, derived from the River Tees or its affluents, is at the present time filtered before delivery, or as to the efficiency of that process.

No. (5). Water from the River Wear is supplied to Bishop Auckland Urban District. From time to time this water has been supplied in an unfiltered condition, but I believe that the whole is filtered at the present time.

No. (6). No reliable information is available as to the waters coming under the heading of "Supplies from Coalpits." Some of these supplies are derived from the magnesian limestone, others from the coal measures, others partly from subsoil water, and they are generally hard waters.

No. (7). Moorland springs. These comprise a number of small supplies to places almost entirely rural in character, derived from springs issuing from the millstone grit or carboniferous limestone of the hillsides in moorland districts.

No. (8). No exact particulars are available as to the water supplied to the three Hartlepool sanitary districts from deep wells.

Diagram No. II. shows the annual average death-rates and the annual average attack-rates per 1,000 of population from enteric fever in the sanitary districts of Durham for the six years 1903-8, the districts being grouped according to their various water supplies. This diagram should also be compared with Diagram III., showing yearly attack-rates. Where one district is served by more than one water supply it is again inserted in the diagram (printed in italics) opposite the second water supply if the supply is considerable in extent; if small only and comparatively unimportant in quantity, the information is added in a note on the diagram only, *e.g.*, Easington Rural District, Blaydon Urban District, Whickham Urban District, Houghton-le-Spring Rural District. This diagram shows the remarkable freedom of some districts, *e.g.*, Consett Urban District and Whickham Urban District, from enteric fever, although sharing their water supply with other districts which have a marked incidence of enteric fever. I cannot ascertain that the water is supplied to these particular districts in any respect which differentiates them from the other districts having the same supply. The diagram also shows that the water supply No. (1), which is under the greatest

suspicion, has not produced during the period under consideration in this report any excess of enteric fever as compared with other water companies' supplies. This conclusion is not weakened when the rates for single years given in Diagram III. are examined. Where districts are supplied by more than one water supply, and where, therefore, if water supplies were a source of infection there would be a greater liability to unequally distributed outbreaks of enteric fever, no such incidence is recorded. It is noteworthy that the group of districts supplied with water from sources (7) and (8), moorland springs and deep wells, are very free from enteric fever. Certain places, *e.g.*, Consett Urban District, Whickham Urban District, Gateshead County Borough, supplied from sources (2) and (3), are also remarkably free from enteric fever prevalence.

Diagram No. III. shows the attack-rate per 1,000 of population from enteric fever in the various sanitary districts in Durham for each of the years 1903-8, the districts being grouped in the same way in relation to their water supplies as in Diagram No. II. The facts set out in this diagram give little support to the inference that, excluding for the moment local contamination of water in water mains, water supplies were concerned to an important extent in producing enteric fever. Some of the districts suffered from extensive outbreaks of enteric fever, whilst others having the same water supply during the same period remained unaffected. Thus, in the year 1904 there was an extensive outbreak in Brandon and Byshottles Urban District, supplied from source No. (3), but Consett and Whickham Urban Districts, having the same supply, remained quite unaffected. In 1906 there was a serious outbreak at Southwick-on-Wear, but other places supplied from source No. (1), during the same period, including the adjoining and coterminous Borough of Sunderland, showed no corresponding enteric fever prevalence. Seaham Harbour Urban District in 1905 was almost quite free from enteric fever, whilst the other districts supplied from the same water company (source No. (1)) all suffered from a considerable amount of enteric fever. The diagram of yearly incidence of the disease also shows that districts in the two groups Nos. 7 and 8 may suffer from outbreaks, which are not of sufficient gravity to be shown in the diagram of average incidence during six years, although they are supplied from moorland springs, *e.g.*, Stanhope Urban District, in the year 1903. A district which is supplied from four different sources, *e.g.*, Chester-le-Street Rural District, from Nos. 1, 2, 3, and 6, does not show any excessive prevalence of enteric fever above that of many other districts, although if any one of these supplies had during the period been concerned in producing enteric fever, its influence would have been expected to have been shown by its producing a severe outbreak in that portion of this rural district which it supplied. It would also have been expected to produce an outbreak of enteric fever in Chester-le-Street Rural District at the same time as it might presumably have caused outbreaks in other districts, many of which during the period show a fever prevalence greatly in excess of that of the rural district; but I have not been able to find any instance in which this occurred.

A study of the weekly returns of notified attacks in each district for the period 1903-8 showed that, with the exception of an outbreak at Southwick-on-Wear, commencing in May, 1906, and which was clearly caused by the consumption of infected mussels, in no single instance has any outbreak of importance commenced in, or occurred during, the first and second quarters of the respective years, and there are no instances of explosive outbursts of enteric fever during the first half of any year. Had water supplies been capable of producing such outbreaks one or more instances might have been expected during this period; but all the outbreaks during these six years in the various sanitary districts in the county have occurred in the last half of the year. For instance, in the water-borne outbreak of enteric fever at Lincoln, the onset was sudden and intense; and occurred in the month of January. In the Worthing water-borne outbreak there was a sudden outburst in May followed by a cessation, and a second larger outburst in July. Outbreaks of enteric fever due to contamination of water supplies occur at all seasons, according to the date of introduction of the infection into the water. If water supplies in the county of Durham had been capable of causing outbreaks of enteric fever in this way it is altogether improbable that the first and second quarters of all the years 1903-8 would have shown such uniform exemption in all the sanitary districts of the county. Reference has been made on page 20 to the uniformity in the prevalence of enteric fever year by year in the county and municipal boroughs. These places are supplied with water from no less than five out of the eight sources supplying the county. If these water supplies had been producing enteric fever, their effect could hardly have been a uniform one throughout this period, and would have been expected when tested on such large populations to have shown marked epidemics in particular years, especially since some of these water supplies are also distributed to urban and rural districts in which most extensive epidemics occurred during this period.

No outbreaks have occurred which have been attributed to local contamination of water in particular water mains by insuction of infecting matter through fractures, or from valves, or defective water-closet fittings; and no evidence is extant that such outbreaks have occurred.

There are a number of small sources of water supply, in particular in the rural districts, which are liable to pollution, especially in connection with dairies and cowsheds. Through the medium of these supplies a few small outbreaks have occurred, especially when for some reason, such as alterations to wells or to mains, or temporary shortage, the public supply has been inadequate, and people have fallen back upon these local sources. Except, however, when such supplies infected milk, as occurred in the case of Durham and Sedgefield Rural Districts in 1906, *see* page 14, they have not produced outbreaks of serious extent. On the whole, therefore, it does not appear probable that water supplies during the period under consideration have played an important part in causing the prevalence of enteric fever in the county of Durham. This conclusion does not do away with the need for constant vigilance in order to protect the different

sources from risk of pollution, and for their frequent examination by chemical and bacteriological analyses. Some of the supplies are not beyond suspicion. Those from rivers are insufficiently treated by preliminary storage, and depend upon efficient filtration to render them at all safe, as for instance that from the River Wear, and at the earliest opportunity should be replaced by sources which are free from this objection.

## Relations of Excrement Disposal and Scavenging to Enteric Fever Prevalence.

### (1) *Excrement Disposal.*

In the County of Durham privies are almost universal. The midden privy is the form usually in use, but of late years a number of midden privies have been replaced by ash privies, usually styled "ash closets."

Many of the midden privies are very large with uncovered receptacles sunk below the ground level, not watertight, and serving for two, four, or a much larger number of houses. In some districts many of these privies are greatly dilapidated and without proper doors, so that their contents escape on the surface of the streets, or back streets, in which they are situated. The ash privy is an improvement upon the midden privy. It is from 8 to 20 cubic feet in capacity, entirely above the ground level, covered in, and its bottom is cemented. Ashes are thrown in from the front, so that the excrement is covered up, the contents being withdrawn through a door at the back. Unfortunately, in many instances the sill at the bottom of the door is on the floor level, so that liquid contents escape beneath the door into the street, or back street, especially if the privy become at all full. Nuisance from this cause is much aggravated by people in many districts throwing slop water in these privies, which, so long as these privies continue in use, can only be prevented by active co-operation between householders and sanitary authorities. In some districts, also, people neglect to place ashes in the privy, when similar nuisance arises. Of late, in newly constructed ash privies, the sill of the door in many districts has been raised so as to retain liquid material, but this, of course, renders the cleansing more difficult and not so complete. The contents of midden privies have to be thrown out on the ground in many districts, from which they are shovelled into a cart or basket. In some instances the contents have to be conveyed through the dwellings in baskets, to be emptied into the cart in the street. Under these circumstances the ground of the streets and back streets and in many instances also the interiors of the dwellings become fouled with excremental filth.

No returns as to the method of excrement disposal for each house in the various sanitary districts can be obtained, but only the actual number of conveniences of each kind. Since midden privies serve two or more dwellings, while ash privies and water closets usually serve one house only, the proportion of houses served by midden privies unfortunately cannot be accurately ascertained.

Diagram No. IV. shows for each district the percentage of water closets to all other sanitary conveniences, and the annual average

attack-rates from enteric fever in the same districts. Excepting a few districts where a limited number of pail closets are in use, the percentages of which are indicated, the blank part of the diagram shows the proportion of midden privies and ash privies combined. In this diagram no consistently definite relation between enteric fever prevalence and the extent of use of privies is visible. When it is remembered that midden privies nearly always serve two or more households, the disproportion of this method of excrement disposal is so great that, with the exception of the first six districts on the list, it can safely be stated that privies are in use in the majority of houses in all the sanitary areas of the county. Even in the case of the first six sanitary districts on the list the proportion of privies is so great that, allowing for the fact that midden privies frequently serve more than one house, except in the borough of Hartlepool where water closets are almost universal, nearly 50 per cent. of the dwellings must be provided with some form of privy. Hartlepool Borough is second on the list of freedom from enteric fever, but Consett Urban District, where, certainly, a majority of the houses are furnished with privies, is first on this list (Diagram 1).

The process of converting midden privies into ash privies has been going on for some time in certain districts, but I have no figures sufficient to give any detailed account, or tables to show exactly to what extent this has gone on during the period 1903-8. The yearly number of conversions of privies to water closets is very small in the county as a whole and in the different districts. In some districts little improvement has been effected in the matter of midden privies, and since these structures tend to become more insanitary with the progress of dilapidation, the risk of their becoming infected with enteric fever and acting as a permanent source of infection increases likewise.

### (2) *Scavenging.*

The question of excrement disposal cannot well be separated from that of scavenging.

In the greater part of the county this is very unsatisfactory, but in the county boroughs and municipal boroughs, as shown by the reports of the county medical officer and the local medical officers of health, it is more efficient and has become increasingly so of late years.

In most of the urban (excluding boroughs) and rural districts contracts for scavenging are given out by the district councils to various local contractors, who may be farmers, colliery proprietors, carters, and others who have carts and horses. In many parts a colliery company undertake the scavenging of all the houses belonging to them, which may form a large proportion of the total dwellings in some of the urban districts. The contractors are supervised by the inspectors of nuisances. From this it follows that in extensive districts, especially rural districts, where there are a number of different contractors, nearly the whole of the time of the inspector of nuisances may be taken

up in this manner, greatly to the detriment of his other duties. Naturally, a contractor prefers to do the work at a time when he has no other employment for his men and horses, hence there is often great irregularity in the periods between the visit of the scavenger, and contracts are frequently terminated, either by the contractor or the council, with a consequent interregnum in which the privies become overfull. The work is stated by several medical officers of health to be greatly interfered with also at the time of public holidays. An overfull privy, by allowing its contents to escape into the street or back street or on the privy floor, may act as a source of dissemination of the disease if it has become infected by receiving the excreta from a case of enteric fever. When the privies become overfull, also, the people in the colliery villages defœcate on the ground around the dwellings, so that other conditions tending to the spread of enteric fever are added. Probably many outbreaks are consequent on the neglect of scavenging at the time of the August Bank Holiday. The carts usually employed in scavenging are unfitted for the purpose and spill their contents, thus adding to the fouling of streets, which in some districts is caused by the filth from the privies being thrown on the ground before removal. This fouling of the streets by excremental filth has been frequently referred to by local medical officers of health as a source of spread of enteric fever. Not only may persons carry the infection on their footgear but the dried filth must be carried up in the dust storms, which are so marked in the colliery districts in dry weather, and conveyed into dwellings, thus contaminating food and drink.

Repeatedly, as shown by the reports of the medical officers of health, scavenging is neglected for long periods until accumulations become very great and the ground surface is fouled by the escaping filth from privies; then an outbreak of enteric fever occurs during the autumn months. A new contractor or contractors are appointed and the work is perhaps properly done for another period. When from various causes scavenging is again neglected, a fresh outbreak of fever follows. In some districts scavenging is left entirely to occupiers.

In a few districts special pails are provided to receive the excreta of cases of enteric fever under treatment at home. The pails are removed and the contents may be buried, thrown on a refuse tip, or burnt in a destructor. There is an increasing tendency to use these precautions, the medical officers of health realising the great importance in checking the spread of fever of keeping the infective excreta out of the privies.

Notable instances of outbreaks, due to defects of excrement disposal and neglect of scavenging, can be seen by reference to Diagram III. There are two urban districts, Ryton and Shildon, which, except for two serious outbreaks in the years 1905 and 1906, respectively, would have very low average attack-rates and rates of mortality. Both of these outbreaks commenced in the third quarter of the year, and were attributed by the medical officers of health to neglect of scavenging leading to overfull privies and consequent filthy conditions. In the case

of Shildon, hot dry weather was added as a contributing cause. In Shildon Urban District it is mentioned, both in the annual reports for 1906 and 1908, that many people have not sufficient ashes to cover the fœcal matter in the ash privies, which are very offensive in hot weather. The latter district suffered a severe epidemic in August to November, 1893, which was reported upon by Dr. Bruce Low (*see* page 13). Dr. Bruce Low attributed the outbreak primarily to defective midden privies and neglected scavenging, assisted, to a certain extent towards the end of the epidemic, by milk infection. Ryton, however, does not appear to have previously suffered a severe outbreak since 1877.

The following extracts from the reports of the medical officers of health show the frequency of defects of excrement disposal and of neglect of scavenging, also how often such neglect has been followed by outbreaks of enteric fever. The yearly reports for some districts unfortunately give no information on the matter, but in no less than 23 out of the 47 sanitary districts in the county the scavenging of privies is referred to as unsatisfactory, and in six districts the medical officer of health, in the year preceding that in which a severe outbreak occurred, had drawn special attention to the neglected scavenging of privies.

Reference to Diagram III. will assist in following these quotations from reports. In Annfield Plain Urban District the scavenging is said to be carried out by the Council's employees and to be satisfactory. Auckland Rural District in 1907 had little enteric fever, but scavenging of privies is referred to as "greatly neglected." In 1908 a very severe outbreak of enteric fever occurred, 113 attacks being notified, nearly all in September and October. In this year scavenging was referred to as unsatisfactory.

In Barnard Castle Rural District, in 1907, scavenging was referred to as bad, as the farmers would not empty the ash privies. At Benfieldside Urban District, in 1905, scavenging was referred to as irregular, the tenants cleansed the privies themselves. In Bishop Auckland Urban District in 1906 enteric fever is stated "mostly to have occurred in dwellings with midden privies or ash privies." In this urban district there was great neglect of scavenging in 1899, associated with an outbreak of enteric fever in the same year, reported on by myself.

In Blaydon Urban District in 1907, "scavenging bad, wants constant supervision, causes much waste of time of inspector of nuisances." Little enteric fever occurred in this year, but in 1908 an outbreak occurred. It is again stated "scavenging had got behind-hand, supervision takes much time, work done by contractor."

In Brandon and Byshottles Urban District the structure and condition of the privies has been often noted as very bad. Severe outbreaks of enteric fever occurred in 1904-5-6. Scavenging was repeatedly stated to be "unsatisfactory," and was done by contractors. My colleague, Dr. W. W. E. Fletcher, visited this district in 1906 in connection

with the outbreaks of enteric fever. He attributed the spread of fever to the blowing about of fæcal dust from midden privies and from the fouled streets, aided perhaps by flies. He also thought house-to-house infection had probably a considerable share in spreading the disease. The disease was almost confined to one village, Brandon Colliery, where, of 173 houses invaded, in the three years, 124 were situated. Even in 1906, when Dr. Fletcher visited this village after its three years' visitation by enteric fever, he found that the scavenging of the privies was neglected, and that scavenging was carried out in the district by no less than 13 contractors. The structure and condition of the privies also remained unsatisfactory.

In Chester-le-Street Rural District in 1907 it is stated that there are "many cases of neglected scavenging; worst-scavenged villages are Washington and Eighton Banks; varying degrees of carefulness and efficiency of the work of the different contractors. In parts of the district the work is still left to householders." In 1908 a very severe outbreak of enteric fever, like the severe outbreaks which occurred in the district in 1893 and 1890, occurred. This outbreak, which was regarded by the medical officer of health as due to possible pollution of water supplies, occurred in four townships of the rural district, of which Washington was one. In his report on the fever, the medical officer of health especially refers to the "hundreds of children who pollute the streets by their excreta, dropped wherever convenient," and to the universal fouling of the streets by "garbage" and refuse. In the adjoining urban and rural districts of Houghton-le-Spring, outbreaks occurred in 1908 at the same time. Reference to Diagram III. will show how much these outbreaks increased the average attack-rate in these districts, especially in the rural district, which had been comparatively free from enteric fever since 1900. The medical officer for these two districts excluded the water supplies from concern in the outbreak, which he attributed to the filthy condition of the privies combined with hot, dry weather. In his annual report for this year, 1908, he notes that the contract for scavenging in the Sunniside District, in which the outbreak commenced, had been cancelled owing to the irregular manner in which the work had been carried out.

Consett Urban District. This district has been very free from enteric fever during 1903-8, but in 1894 the medical officer of health referred to the large number of uncovered midden privies and to the "bad scavenging," and urged that this work should be no longer given to contractors but undertaken by the district council. No action was taken on his recommendation, and in the following year 143 attacks of enteric fever occurred, with 20 deaths; an attack-rate of 17·5 per 1,000. This is higher than in any district in the county in the period 1903-8. In his report for this year, 1895, the medical officer of health stated the scavenging was not effective, and would not be so until the council undertook the work. The water supply was exonerated from all suspicion of being concerned in the outbreak. At the present time the scavenging is carried out by the district council

and is said to be satisfactory. In Darlington Borough scavenging is said to be satisfactory.

Respecting Durham Rural District, it is stated in 1908 that the scavenging was partly done by occupiers, and that the enteric fever outbreak in this year was due to the condition of the privies. The outbreak in 1906 was attributed to milk infection from the same source as that which was said to have caused the outbreak in the adjoining Sedgefield Rural District. In Darlington Rural District scavenging is done by contractors, and in parts of the district is unsatisfactory. In Easington Rural District a severe outbreak of enteric fever occurred in 1908, which was attributed to defects of excrement disposal, the "lack of scavenging" being mentioned as "most marked at Murton, where the greatest number of cases occurred." A contractor was fined for neglect in this year. At Felling Urban District, where enteric fever prevalence is unusually low, it is mentioned that scavenging is performed by the district council, that it is satisfactory, and that a refuse destructor is in use.

The medical officer of health of the Borough of Hartlepool, the only water-closet town in the county, and second on the list of freedom from enteric fever, in his annual report for 1908 states that since the removal of "ashpit," *i.e.*, midden privies, enteric fever has practically ceased. In the Borough of Jarrow scavenging is done by contractors, and is said to be satisfactory. For Hebburn Urban District, 17th on the list of freedom from enteric fever, mention is made that the scavenging is performed by the district council and is good.

In Lanchester Rural District scavenging is partly done by a contractor, by colliery owners, and by householders. At Leadgate Urban District an outbreak occurred in 1905, and it is stated that scavenging is done by houseowners, and that there is no regular period for removing the refuse. The fever was attributed to the turning up of the polluted soil whilst laying new drains.

At Ryton Urban District a very severe outbreak occurred in August and September of 1905. The medical officer of health, in his special report, attributes the outbreak to neglected scavenging and "accumulations of excreta uncovered by ashes," together with a period of hot weather. Scavenging was left to tenants of houses. Reference to Diagrams II. and III. will show how greatly this outbreak increased the average prevalence of fever in this district. There had been no severe outbreak since 1877. At Seaham Harbour Urban District, a district fairly free from enteric fever, an outbreak occurred in 1908, connected with defective excrement disposal. Pail privies were neglected and used as midden privies, the filth from which flowed on the footpaths.

In Sedgefield Rural District a severe outbreak in 1906 was connected with milk infection from the same source as that which caused an outbreak in Durham Rural District. In 1908 an outbreak occurred again, in connection with which the defective scavenging of the district is referred to. Scavenging was

stated to be very difficult owing to the bad state of the roads, which were unmade, rendering it impossible to do the work except in the daytime. The fever is said to have existed in all parts of the district, the "so-called streets are a collection of 'cesspools,'" no doubt meaning by "cesspools," collections of liquid filth escaping from privies. In Southwick-on-Wear Urban District scavenging is carried out by the council, and is said to be satisfactory.

In South Shields Rural District there is a considerable amount of yearly enteric fever prevalence, increased in 1905 and 1908. In his annual report for 1907 the medical officer of health states that the "scavenging is much neglected, the contractors, who are farmers, do it only when they have nothing else to do." In 1908, 26 notices were served on contractors for neglect. In Spennymoor Urban District an outbreak occurred in 1908. In his annual report for this year, the medical officer of health states, "the scavenging by contractors is badly done by some, two of them threw up their contracts when the winter was coming on. During the last year the work has not been carried out very satisfactorily." In another report it is stated that, "the filth is first raked into the street, much of it is dropped in the street from the carts."

Among the boroughs Stockton appears to be the worst off as regards privy accommodation, having many large midden privies used by several houses in common. In 1908, it is noted, 217 of these privies had to be emptied through the dwellings, and the filth during the process of removal is in many instances thrown on the ground of the streets; but no complaint is made of default in frequency of scavenging. This town is 28th on the list of enteric fever prevalence (*see* Diagram 1), but no special outbreak has occurred in the period 1903-8. In Stockton Rural District enteric fever in 1906 was attributed by the medical officer of health to long retention of filth in midden privies. In 1907 it is mentioned that the contents of privies emptied into the streets are left some time before removal.

In Sunderland County Borough, the worst of the county boroughs in respect of enteric fever prevalence, and 25th on the list in Diagram 1, a large number of water closets have been provided recently. In 1908 about 7,400 houses out of 23,899 were still supplied with "privies and ashpits." Scavenging is carried out by the borough council and appears to be efficient.

In Sunderland Rural District, 35th on list of prevalence, with a large persistent amount of fever, defects of privies and neglect of scavenging are several times referred to in the reports. The scavenging is said to be "let to contractors, and there are complaints of the way in which the work is done, but daily supervision of it is said to be impossible." Public holidays are said greatly to interfere with the work. In Tanfield and in Tow Law Urban Districts scavenging is said to be satisfactory, although done by contract.

At West Hartlepool County Borough, 8th on the list of freedom from enteric fever, where a large proportion of houses are supplied with water closets, the remaining

midden privies are said "probably to be responsible for the endemic presence of enteric fever." In Whickham Urban District, which is 4th on the list of freedom from enteric fever, scavenging is stated to be carried out weekly by the district council's own workmen in a satisfactory manner. Willington Urban District, 21st on the list, has a considerable yearly prevalence of enteric fever without marked outbreaks. References are made in the annual reports to deficiency of scavenging. In the report for 1908 it is stated that "scavenging was by contract, that it was remiss at times, and it was desirable that the ash privies should be emptied better." The actual structure of the privies was very unsatisfactory.

From these extracts from annual reports, especially if aided by reference to Diagrams II. and III., it will be seen how frequently the presence of and defective conditions of privies, especially if combined with neglect of their regular emptying, precede or accompany an outbreak of enteric fever in the various sanitary districts. It will also be seen that with one exception, Southwick Urban District, in no instance in which scavenging arrangements are said to be satisfactory has excessive prevalence of enteric fever occurred during the period 1903-8. Of these 11 districts, in which scavenging is said to be satisfactory, we know that in seven the work is carried out by the councils' own staff. The enteric fever at Southwick was undoubtedly due to consumption of mussels from the bottom of a ship in dock there. To the presence of these privies, in association with defective scavenging and consequent pollution of soil and other surroundings of dwellings, must be attributed a large portion of the spread of the fever when it is introduced into the various districts. There can be little doubt that if the outbreaks which have arisen under these circumstances could be excluded, the attack and death-rates for the county from enteric fever would be enormously reduced.

## Sewerage.

This is frequently unsatisfactory, particularly in the smaller urban and the rural districts. That of the colliery villages is frequently of very primitive construction. Many houses are not connected to any sewer. Roughly constructed open channels are often used as sewers. House gullies are sometimes not provided even where sewers exist. Where gullies are provided they are usually distant from the dwellings, and, speaking generally, there is small risk of emanations from the sewers directly entering dwellings. Since privies are almost universal, fæcal matter does not, as a rule, enter the sewers. Means for flushing and ventilating sewers are very often absent.

In but few outbreaks of enteric fever has it been even suggested that sewers were concerned. No clear instances of enteric fever following the course of any particular sewer have been observed.

There does not appear to be any reason to consider sewers as being directly concerned to an important extent in producing enteric fever in the county.

## Relation of Infection through the medium of Food to Enteric Fever Prevalence in County Durham.

*Milk.*—Very few outbreaks of fever in Durham have been attributed to milk-borne infection. I have only been able to find four instances in which this cause was said to be operative. These occurred (1) at Sunderland County Borough in 1895, when an epidemic outburst occurred which was attributed to this cause by the late Mr. T. W. Thompson.* (2) At Shildon Urban District in 1893, when an autumnal outbreak was attributed by Dr. Bruce Low partly to milk infection.* (3) In Durham, and (4) in Sedgefield Rural Districts, where simultaneous outbreaks occurred in both districts in 1906, which the evidence suggested were due to the consumption of milk from one and the same farm which was clearly subjected to specific contamination.

All these outbreaks occurred in the autumn when enteric fever is most prevalent and when, therefore, the chance of infection of all kinds of food is greatest.

The conditions under which the dairying industry is conducted in the County of Durham are often most unsatisfactory, and it is surprising that outbreaks from this cause are not more frequent. This cannot be explained by the fact that colliers and their families take but little uncooked milk or condensed milk only; for, as will be seen later, enteric fever is especially prevalent in the colliery districts. In a few instances the use of condensed milk has been said to favour the spread of enteric fever, owing to the tins being left uncovered and exposed to infection by dust from infected privies, from roads fouled with excreta, or by flies coming from privies containing infective material; in view of the conditions favouring fœcal contamination, which have been shown to prevail in such a large number of districts, this is not unlikely to be the case.

*Shellfish.*—Of late, several outbreaks of enteric fever in the County of Durham have been attributed to infection from eating mussels. Cockles and oysters are not mentioned in the reports of the medical officers of health as sources of infection, although large quantities of cockles are consumed in the towns and villages of Durham. As to mussels, in some instances it appears quite clear that their consumption has originated outbreaks. Thus at Southwick-on-Wear in 1906 a much greater number of cases of enteric fever occurred than in any other year from 1903 to 1908. The outbreak, which commenced early in May, was clearly started by cases of this disease following the consumption of mussels gathered from the bottom of a ship in dry dock. In the greater number of instances the incriminated mussels are said to have been gathered at Sunderland. This was the case in outbreaks in Chester-le-Street and Sunderland Rural Districts. It is quite possible, also, that the special incidence of enteric fever in the coal-mining districts is due to consumption of shellfish to a considerable extent. Colliers are very fond of shellfish, eat enormous quantities of them at times, and in connection with their roaming habits may partake of many different samples in a

---

* *See* Tabular Statement on p. 13.

short period, thus multiplying the risks of infection. At present, however, there is not sufficient information as to the source of the shellfish, particularly mussels, as to whether other classes of the population who do not consume shellfish escape enteric fever in the various sanitary districts, or as to seasonal use, if any, of mussels and other shellfish, to enable one to come to any exact decision on this point. The unusual endemic prevalence of enteric fever in Sunderland County Borough and in Stockton-on-Tees Borough, as compared with the other county and municipal boroughs, may with great probability be due to constant re-infection through the medium of mussels, since they are of all populous places in the county situate nearest to polluted mussels beds. The foreshore of Sunderland County Borough and the estuary of the River Tees below the Borough of Stockton-on-Tees have mussel beds which are well known to be polluted by sewage from these towns.

*List of Outbreaks of Enteric Fever which have been attributed in the Reports of the Local Medical Officers of Health to the Consumption of Mussels.*

| Name of District. | Year of Outbreak. | Particulars of occurrences of Enteric Fever. | Source of the Mussels. |
|---|---|---|---|
| Southwick on Wear U.D. | 1906 | Thirteen attacks in May ... | Bottom of a vessel in dock. |
| Chester le Street R.D. | 1908 | Five persons partook of mussels 14 days previous to onset of illness. The first case in the outbreak was due to this cause. | Sunderland foreshore. |
| Houghton le Spring R.D. | 1908 | Six persons contracted illness from eating mussels. | Not stated. |
| Jarrow M. Borough | 1908 | "Mussels explained some cases" | ,, |
| Hetton U.D. ... | 1908 | Five cases probably contracted fever from eating mussels. | ,, |
| Spennymoor U.D. | 1908 | Seventeen cases early in the year from eating mussels. | River Tees. |
| Sunderland R.D. ... | 1908 | Thirteen cases were due to eating mussels sold after dark. | Sunderland foreshore. |
| Sunderland County Borough. | 1908 | In 11 cases mussels had been ingested on a day sufficiently recent to point to this as the probable cause. | ,, |
| Stockton Borough | 1907–8 | Two cases in 1907 and seven in 1908, due to eating mussels. | Not stated. |

### Sex and Occupation in relation to Prevalence of Enteric Fever.

(1) *Sex.*—It has been stated that there was a great excess of enteric fever among adult males in various outbreaks in the County of Durham. Unfortunately, figures to show the relative proportions of the two sexes who were living in the affected areas

have, so far as I can ascertain, been given in one instance only. This was in Shildon Urban District, where in 1893 Dr. Bruce Low found that out of 224 cases of enteric fever a greater incidence of enteric fever on males occurred at all ages, and at each age period except 5-10 years. The following table is copied from his report:—

*Rates of Enteric Fever attack per* 1,000 *living of each Sex at different Age Periods in Shildon Urban District.*

| — | At all ages. | Under 5 years. | 5–10 | 10–15 | 15–25 | 25–40 | 40–60 | 60 and upwards. |
|---|---|---|---|---|---|---|---|---|
| Males ... | 27·6 | 15·2 | 33·0 | 50·6 | 39·0 | 25·3 | 13·5 | 4·3 |
| Females ... | 19·4 | 6·9 | 35·7 | 25·7 | 26·1 | 20·3 | 8·4 | 3·5 |

It must be remembered that judging from the death rates for England and Wales, the incidence of enteric fever is greater among males than females. In the Registrar-General's Annual Report for 1908 it is stated that the average rate of mortality from enteric fever per million living in England and Wales was, for the period 1903-7, for males 106, for females 72.

Males exceed females in the County of Durham by 17,348, there being only 971 females to 1,000 males. In many colliery villages the excess of adult males over adult females must be large, and, therefore, even on the assumption that infection is contracted in the dwelling, a larger number of adult males are exposed to infection. Returns as to the sex and ages of those attacked with enteric fever in the various sanitary districts cannot at present be obtained. If these important data were obtainable, it might possibly turn out that the sex and age incidence varied much in different districts in the county, and, perhaps, varied also with the source of infection.

(2) *Occupation.*—On the supposition that enteric fever in the County of Durham is more prevalent among adult males, has been superimposed the suggestion that the disease is spread through infection received in the underground workings of coal mines. Proof that enteric fever is actually more prevalent among colliers than in other occupations is, however, wanting. The occupations of the sufferers are not usually entered on the notification certificates, nor can I obtain particulars of them from the annual reports of the local medical officers of health. The occupations of those dying from this disease are also not given in the reports of the medical officers of health. Information on these two points is much to be desired. Reference to Diagram 1 shows that, speaking generally, sanitary districts with a large proportion of coal miners among their inhabitants have a much heavier attack-rate from enteric fever. Those at the head of the list of freedom from enteric fever are seen to be iron-working or manufacturing districts, with few, if any, colliers. Those at the bottom of the list will be seen to have a very large proportion of coal miners among their occupied males.

The spread of infection through underground workings was suggested in 1895 by the late Mr. T. W. Thompson in his report before mentioned; by Dr. Bruce Low in his report on Shildon Urban District; by Dr. Fletcher in his report on enteric fever in Brandon Urban District in 1904-6; by Dr. Eustace Hill in his quarterly report to the Durham County Council in 1908, his annual reports for 1895, 1900, 1901 and 1903; and by several medical officers of health in the county in their annual reports. Other medical officers of health have stated that there was nothing to suggest pit infection, or that it was not a likely cause of spread of enteric fever. In no instance was this method of spread proved. In no instance has it been reported that the first sufferers in an outbreak in a particular part of a district had been working at a particular pit, together with other early cases in other parts of the district. Nor have individual outbreaks been observed to commence with attacks among adult males who were colliers. No instance of a particular pit, or any "level" in a pit, which could be fixed upon as disseminating the infection has been found. In particular, no instance of any outbreak of enteric fever occurring at a time of the year apart from the time of the usual seasonal prevalence, which could be attributed to dissemination through working underground, has been observed. To prove that a certain amount of dissemination does not occur through the coal pits in a district in which there is an autumnal outbreak would be difficult, but that no such considerable outbreak has been observed renders it likely that this is a casual and limited source of enteric fever. No instance of infection of any water supply, which was consumed in a pit, has been reported. Colliers are very liable to fill their cans with water from odd sources when going to their work. Such sources if infected may explain outbreaks of fever among the men using them, as, for instance, occurred in the unusual incidence of enteric fever upon colliers in 1893 at Atherstone in Warwickshire. Here colliers, leaving early in the morning to go to work, drew off polluted water which had been turned into certain pipes at night time to keep them full in case of fire.*

The coal pits in Durham are generally admitted to be well ventilated and free from dust. Privies are not provided below ground. Fœcal matter in the workings, I am informed, is, as a rule, soon covered up with waste material thrown back in working the coal. It does not follow that the excess of enteric fever in many colliery districts must be regarded as necessarily due to infection received in the pits. As a rule, a man in the earlier stages of enteric fever will be unable to endure the hard, sustained labour of a collier, and will be incapable of returning to such work, whilst still infectious, after convalescence from enteric fever. Owing to the need for continuous work and shortened hours of such work, which is generally piece-work, I am informed that eating of food below ground is exceptional, and the collier only drinks what he has brought with him. For these reasons, therefore, the risk of spread of infection in

* Dr. S. W. Wheaton's Report to the Local Government Board on Enteric Fever at Atherstone, 1893.

the pits is diminished. When the coal trade is dull a man may be working only a portion of each week. During this spare time many colliers visit fairs and markets, eating ices, shellfish, and other articles which are often prepared under unwholesome conditions in districts where privies are almost universal, and where contamination of food with fæcal matter must be common. Outbreaks of enteric fever in the county have frequently been attributed by the local medical officers of health to infected food or drink consumed at fairs or markets, especially in the month of August, when many fairs are held.

Reports of the local medical officers of health frequently mention that the early cases in an outbreak apparently were infected elsewhere than in their own sanitary district. I have referred to this in my report on the sanitary condition of Bishop Auckland Urban District, which has a large market twice weekly, and have shown in that report that in a town where the contents of infected privies are emptied on the road surfaces and allowed to lie, persons visiting the town may carry away infection with them.* When the material from privies is thrown into the streets, as was the case in this town, the risk of infection of food or drink exposed for sale or in process of preparation must be very great. The possibility of infection being contracted at the Bishop Auckland markets was also mentioned by Dr. Bruce Low in his report on Shildon Urban District. Colliers frequently sleep in common lodging-houses, or in other houses, under circumstances of overcrowding and unwholesomeness.

The only conclusion deducible from the statistics at present in my possession is that there is an excess of the disease in most sanitary districts in which colliers are numerous, as compared with districts occupied by ironworkers and others. It cannot at present be asserted that this excess is much greater among men than among women in these mining districts; and if such excess among men occurs, it has not hitherto been shown that infection occurs on a large scale in the mines. On each of these points further information requires to be carefully collected. The boroughs and county boroughs which have much smaller incidence of enteric fever than other districts in the county (Diagram 1), have also few colliers among their populations. Four of these, West Hartlepool County Borough, and Hartlepool, Darlington, and Stockton Boroughs, have no colliers among their populations, and of the remaining five, the highest proportion is one-ninth in the town of Durham, the lowest one-thirty-third in Sunderland County Borough.

### Overcrowding upon Area and in Dwellings in relation to Enteric Fever Prevalence.

Reference to Table IV. shows that in the county and municipal boroughs of Durham, where the number of dwellings upon area is greatest, the attack-rate and death-rate are least. In most of the rural and many of the urban districts there is abundant air

* Dr. S. W. Wheaton's Report to the Local Government Board on the Sanitary Condition of Bishop Auckland Urban District and on Sanitary Administration of the Urban District Council, 1901.

space around dwellings. In these districts enteric fever is excessively prevalent. Overcrowding upon area, therefore, has no connection with the prevalence of enteric fever in the County of Durham.

With respect of overcrowding of persons, Durham, together with the adjoining County of Northumberland, has much overcrowding and a high proportion of small tenements. At the last Census, 77·4 per cent. of tenements in the administrative county, including county boroughs, were "small," consisting of less than five rooms, whereas no other county, except Northumberland, had more than 70 per cent. of such tenements. Of each 1,000 tenements of all kinds, 262 were of two rooms only, and 29·6 of the population was "overcrowded," *i.e.*, living more than two in a room. No other county, except Northumberland, has anything approaching this proportion of domestic overcrowding, but four county boroughs exceed it, namely, Gateshead, South Shields, and Sunderland, which are in Durham, and Newcastle in Northumberland. In the aggregate of urban districts in Durham, 76·5 per cent. of tenements have less than five rooms; and in rural districts 79·8 per cent. This proportion varies greatly in the larger urban districts, from 52·3 in Stockton Municipal Borough and 56·6 in West Hartlepool County Borough, to 91·6 and 91·8 in Hebburn and Felling Urban Districts, respectively. Gateshead and South Shields County Boroughs occupy a high position in relation to freedom from enteric fever, being 7th and 15th on Diagram 1, and so do Felling and Hebburn Urban Districts, being 11th and 17th on the list, respectively. An examination of the Registrar-General's Tables 19 and 20, in the 1901 Census Report for Durham, shows, however, that of tenements of less than five rooms it is in those having two rooms only that the greater part of the overcrowding takes place. Houses of this class are more numerous in colliery villages than elsewhere in the county, especially in those villages which belong to the colliery companies.

Table 19 of the Census Report of County Durham for 1901 shows that the number of families of four persons and under living in two-roomed tenements has increased since the Census of 1891, and that a considerable number of families of 7, 8, 9, and 10 persons (4,618, 2,804, 1,328, 525) still live in two-roomed tenements. Reference to Table 20 of the same Report shows that in certain sanitary districts the proportion of families, of all sizes, from one to nine persons, living in two-roomed tenements is very much greater than in others. For instance, in Annfield Plain, Bishop Auckland, Blaydon, Consett, Crook, Felling, Hebburn, Leadgate, Ryton, Seaham Harbour, Shildon, Tanfield, Tow Law, and Willington Urban Districts; Auckland, Chester-le-Street, Easington, Lanchester, and South Shields, Rural Districts; South Shields County Borough; and Stockton, Durham, and Jarrow Municipal Boroughs, this is the case. In Houghton-le-Spring and Southwick-on-Wear Urban Districts; West Hartlepool, Gateshead, and Sunderland, County Boroughs; and Hartlepool Municipal Borough, unlike the districts enumerated above, more families

live in houses having more than two rooms than in two rooms, or this excess of families living in two-roomed tenements is only slightly marked. Some of the districts in the first group have high enteric fever rates, others of them are equally notable for freedom from this disease. On the contrary, Houghton-le-Spring Urban District, in the last group, has suffered greatly from enteric fever. There does not, therefore, appear to be any direct relation between overcrowding in houses and enteric fever prevalence.

The condition of the dwellings as to cleanliness, dilapidation, &c., varies much, and there is no information on this point which can be put into statistical form, but, as a rule, it is in colliery villages that the houses are most wanting in these respects.*

## Isolation Provision.

At the time of writing this report all the sanitary districts in the county, with two exceptions, Weardale Rural District and Stanhope Urban District, are provided with hospital accommodation. This accommodation has not always sufficed for the needs of the district, even when people could be persuaded to enter a hospital, or to allow their children to go to hospital, when attacked by enteric fever. In some outbreaks not more than 25 per cent. of the sufferers have been removed to hospital, in others 50 per cent., in others nearly all. Figures for each sanitary district, enabling a comparison to be made between the incidence of fever and the proportion of cases of enteric fever removed to hospital, are not available. Even in each of the county boroughs a considerable number of cases of enteric fever are treated at their own homes. In West Hartlepool County Borough, for instance, less than a quarter of the enteric fever cases were removed to hospital. This question of removal to hospital, in relation to enteric fever prevalence, besides being intimately concerned with overcrowding in houses, is also affected by methods of excrement disposal, and by measures taken for rendering excreta thrown to privies innocuous. Often the excreta from cases of enteric fever are thrown, without previous disinfection, on open uncovered middens, from which they escape to the ground, and may be conveyed on the feet or blown into the dwellings when dried with the dust from streets and middens, thus fouling food and drink.† Multiple attacks in households are in some outbreaks marked. Where a house consists of two rooms only, and is occupied by a number of persons at susceptible ages, direct personal infection must often occur when the sufferer is kept at home without skilled attendance. Experience shows that when

* For information as to the conditions of housing, and particularly as to "free houses," *see* Dr. R. J. Reece's Report to the Local Government Board on the Sanitary Circumstances of, and Administration in, the Hebburn Urban District, with special reference to its Housing Accommodation generally, 1908. Also Dr. L. W. Darra Mair's Report to the Local Government Board on the Sanitary Circumstances of the Whickham Urban District, with special reference to its housing accommodation generally, and to certain back-to-back houses at Marley Hill in particular. 1907.

† *See* Dr. Bruce Low's Report on Enteric Fever in the Urban District of Shildon. 1894.

enteric fever is treated at home, secondary infection is not infrequent even in larger houses than are common in most of the districts of the county. Instances of eight attacks in one household, of 7, 5, 6, 3, 3, 5, 6 attacks in households are mentioned in Stockton Borough, Annfield Plain Urban District, Chester-le-Street, and Houghton-le-Spring Rural Districts; Consett, Crook, Southwick, Urban Districts, respectively. In Sedgefield Rural District 23 cases in nine houses are noted. In Hetton Urban District multiple attacks are said to be frequent; in Stanley and Brandon Urban Districts the fever is said to have been largely spread by personal contact; in Tanfield Urban District eight persons are said to have been infected by one case; but, usually, particulars as to the date of onset of illness, enabling one to judge whether the other cases were infected from the first and were not due to a common source, are not given.

In districts in which at times dust, consisting partly of dried fœcal matter from privies which have received excreta from cases of enteric fever, is scattered about and enters dwellings in considerable quantities, it must always be difficult to apportion the relative importance of direct personal infection and of infection from the privies, through the scattering of dust, or possibly by the intermediation of flies.

### Summary of Report and Deductions therefrom.

Of the population of the county 28·1 per cent. live in rural districts. The majority of the coal miners live in rural districts.

The county holds an extremely bad position in respect of enteric fever as compared with England and Wales and with other counties.

Although in England and Wales enteric fever is mainly a disease of urban areas, it prevails to a greater extent in rural areas in Durham. The municipal and county boroughs of Durham as a rule show a relatively low prevalence of enteric fever.

During the period 1903-8, there were two years, 1903 and 1907, of minimum prevalence of enteric fever, in which the attack and death-rates were not only lower than in other years but also approximated to each other in the different parts of the county (urban and rural and in the boroughs). In the years of epidemic prevalence, 1904, 5, 6, 8, these rates diverged and increased to a very disproportionate extent in urban districts (excluding county and municipal boroughs) and in rural districts.

The epidemic years, as contrasted with the years of merely endemic prevalence, were characterised by deficiency of rainfall and by excess of temperature in the autumn months. These features had, therefore, a disproportionate influence in favouring enteric fever in the urban districts (excluding county and municipal boroughs) and the rural districts of Durham, as compared with their effect in England and Wales and in county and municipal boroughs in Durham. This was especially marked in 1908, when the great excess of fever in the County of Durham, as compared with England and Wales, was almost confined to the urban districts (excluding county and municipal boroughs) and to the rural districts; the county and municipal boroughs conforming in fever prevalence to England and Wales.

This peculiar liability of urban districts (exclusive of county and municipal boroughs) and of rural districts in Durham to excess of enteric fever in certain years requires explanation. There is no evidence that it has been connected, during the six years under investigation, to an important extent with water supplies, with differences of soil, defects of sewerage, conditions of milk supply, overcrowding on area or in dwellings; and the information available does not enable one to say whether any of this excess may be due to deficiency of isolation hospital provision and consequent spread of infection by personal contact.

From this preliminary inquiry two particulars emerge, in which the urban districts of Durham (excluding county and municipal boroughs) and the rural districts differ from England and Wales as a whole, and from the aggregate of the county and municipal boroughs in the county. These are:—(1) The almost universal prevalence of privies; (2) the presence of a large proportion of colliers among their population.

Several of the county and municipal boroughs have a large proportion of water closets, four of them have no miners in their population, and the remainder have a very small proportion of miners (*see* Diagram I.). These facts, relating to the county and municipal boroughs, are summarised in Table VI. below. Where privies exist in these county and municipal boroughs they nearly always serve one household only, not several, as is usually the case in other urban and in rural districts of the county.

TABLE VI.

| Position, out of the 47 sanitary districts of the County, in respect of freedom from Enteric Fever. | Name of Borough. | Proportion of Water Closets. | Proportion of Colliers. |
|---|---|---|---|
| | | Per cent. | |
| 2nd ... ... ... | Hartlepool Borough ... | 99 | Nil. |
| 7th ... ... ... | Gateshead County Borough | 17 | 1/14 |
| 8th ... ... ... | West Hartlepool County Borough. | 67 | Nil. |
| 12th ... ... ... | Durham Borough ... ... | 76 | 1/9 |
| 13th ... ... ... | Jarrow Borough ... ... | 10 | 1/17 |
| 15th ... ... ... | South Shields County Borough. | 20 | 1/16 |
| 24th ... ... .. | Darlington Borough ... | 27 | Nil. |
| 25th ... ... ... | Sunderland County Borough | 71 | 1/33 |
| 28th ... ... ... | Stockton-on-Tees Borough... | 33 | Nil. |
| | | 46·6 | — |

The influence of privies in favouring enteric fever is increased by neglect of scavenging. Where privies exist in the county and municipal boroughs of Durham they are much more efficiently and regularly scavenged than in most other urban and rural districts in the county. In all urban and rural districts in which there is evidence that scavenging is satisfactory there is shown a diminished prevalence of enteric fever as compared with districts in which scavenging is unsatisfactory.

The great prevalence of enteric fever in the County of Durham, and especially its excessive prevalence in colliery districts in that county, have been shown to be associated in a number of cases with the consumption of shellfish derived from polluted sources within the county.

The habits of the miners, especially their fondness for shellfish, must be held to give them increased opportunities for infection by enteric fever; and the almost universal use of privies in the districts in which they live, combined with defective scavenging, must favour the spread of infection when thus introduced. Although the fever may be introduced into the county and municipal boroughs, yet, owing to the much greater proportion of water-closets and the much more efficient scavenging of privies, where these exist, the disease has not the same opportunities of dissemination as in the rural and urban districts, exclusive of boroughs.

## Data needed for Further Investigation of Enteric Fever in the County of Durham.

The preceding summary evidently gives only preliminary conclusions, which require to be confirmed by further inquiry continued over a longer period, and to be supplemented by much fuller information, if the causes of enteric fever in the County of Durham are to be completely unravelled and prevented from continuing to operate.

Among the records which need to be kept by the medical officer of health of each district in the county the following may be mentioned as especially likely to be valuable in the pursuit of further investigations:—

1. Each case when notified requires to be carefully investigated by the medical officer of health, an exact record being kept of his enquiries into the antecedents of each case in such a manner as to be available in any future inquiry into the subject. The record should always give the approximate date of onset of the illness, and the relative dates of cases in the same household.

2. Statistics should be prepared for each sanitary district setting out the following particulars for each year:—
   (1.) The age and sex incidence of all cases of enteric fever.
   (2.) The occupation of all persons attacked.
   (3.) The number of cases treated at home and in hospitals, respectively.

3. For each sanitary district a statement should be prepared giving the method of excrement disposal for each tenement within the district.

4. A statement should be prepared of the numbers of midden privies converted into ash privies (so-called "ash closets") and of privies replaced by water closets in each sanitary district, year by year.

5. Exact information should similarly be recorded as to the method of scavenging employed in each sanitary district, as to

whether the work is done by contractors or by the council's own staff, as to the efficiency of the work, frequency of removal of contents of privies and ashpits, &c.

As these conditions are liable to change, the information should be recorded for each individual year.

Further information is also needed as to the sources of the shellfish consumed in the county, as to any special periods of the year for their consumption, and their relationships to the incidence of enteric fever.

For assistance in preparing this report I am especially indebted to Dr. Eustace Hill, the county medical officer of Durham, who has furnished me with a large amount of statistical and other information. To all the medical officers of health of the sanitary districts in the county I am indebted for returns of notifications of enteric fever and deaths from diarrhœa and enteritis, often prepared at considerable inconvenience and trouble.

S. W. WHEATON.

# DIAGRAM I.

## ANITARY DISTRICTS OF DURHAM ARRANGED IN ORDER OF FREEDOM FROM ENTERIC FEVER DURING 1903-1908.

### VERAGE ANNUAL ATTACK RATE FROM ENTERIC FEVER PER 1000 OF POPULATION, 1903-1908.

| NITARY DISTRICTS OF DURHAM STIMATED POPULATIONS FOR 1908. | | | Proportion of occupied males above 10 years of age, engaged in Coal or Shale mining with remarks * |
|---|---|---|---|
| CONSETT. | U.D. | 10.969 | 1/12 An iron working town. |
| HARTLEPOOL. | BORO' | 23.823 | None. |
| WARTLEPOOL. | R.D.x | 3.167 | Very few |
| WHICKHAM. | U.D. | 16.195 | 1/3 |
| BARNARD CASTLE. | U.D.x | 4.479 | Very few |
| BARNARD CASTLE. | R.D.x | 10.999 | Very few |
| GATESHEAD. | C.BORO' | 128.393 | 1/4 A manufacturing town. |
| WEST HARTLEPOOL. | C.BORO' | 77.573 | None |
| TOW LAW. | U.D.x | 4.243 | 1/3 |
| WEARDALE. | R.D.x | 9.651 | Few |
| FELLING. | U.D. | 26.940 | 1/3 |
| DURHAM. | BORO' | 16.894 | 1/3 A residential town |
| JARROW. | BORO' | 34.752 | 1/7 A shipbuilding town |
| SEAHAM HARBOUR. | U.D. | 11.060 | 1/3 |
| SOUTH SHIELDS. | C.BORO' | 115.535 | 1/10 |
| LANCHESTER. | R.D. | 30.920 | Considerable, proportion not known |
| HEBBURN. | U.D. | 24.652 | 1/8 |
| BENFIELDSIDE. | U.D. | 8.456 | 1/8 Iron working district |
| STOCKTON. | R.D.x | 17.279 | Very few. |
| STANHOPE. | U.D.x | 2.040 | Very few, Small moorland town |
| WILLINGTON. | U.D | 7.948 | 1/2 |
| TANFIELD. | U.D | 9.523 | Nearly 2/3 |
| CROOK. | U.D. | 11.500 | 2/3 |
| DARLINGTON. | BORO' | 49.861 | None |
| SUNDERLAND. | C.BORO' | 157.693 | 1/13 Shipbuilding & engineering |
| LEADGATE. | U.D. | 4.808 | Probably quite 2/3 |
| DARLINGTON. | R.D.x | 9.723 | Few |
| STOCKTON. | BORO' | 52.800 | None |
| CHESTER-LE-STREET. | R.D. | 10.019 | Probably 2/3 |
| ANNFIELD PLAIN. | U.D. | 14.479 | 2/3 |
| STANLEY. | U.D. | 20.085 | 2/3 |
| DURHAM. | R.D.x | 28.932 | Quite 2/3 |
| EASINGTON. | R.D.x | 43.544 | Quite 2/3 |
| SPENNYMOOR. | U.D. | 16.872 | 1/3 |
| SUNDERLAND. | R.D.x | 28.321 | Probably 3/4 |
| BLAYDON. | U.D. | 26.199 | 1/2 |
| SOUTH SHIELDS. | R.D. | 11.944 | Probably 2/3 |
| AUCKLAND. | R.D | 52.771 | Probably 3/4 |
| SOUTHWICK ON WEAR. | U.D. | 14.745 | 1/8 A Shipbuilding town |
| HETTON-LE-HOLE. | U.D. | 14.403 | 2/3 |
| SEDGEFIELD. | R.D.x | 21.794 | Probably 2/3 |
| HOUGHTON-LE-SPRING. | R.D.x | 19.909 | Probably 2/3 |
| BISHOP AUCKLAND. | U.D. | 13.136 | 1/6 |
| HOUGHTON-LE-SPRING. | U.D. | 9.041 | 1/2 |
| RYTON. | U.D. | 11.461 | 2/3 |
| BRANDON & BYSHOTTLES. | U.D. | 16.617 | 2/3 |
| SHILDON. | U.D. | 13.687 | 1/2 |

.09 ... 3.39

* No official figures as to occupations available for rural districts or for urban districts below 5000 in population at the time of the census of 1901; an approximate estimate can only be made in these instances.

346.a Wt. 32817. 370.625. 2/10.

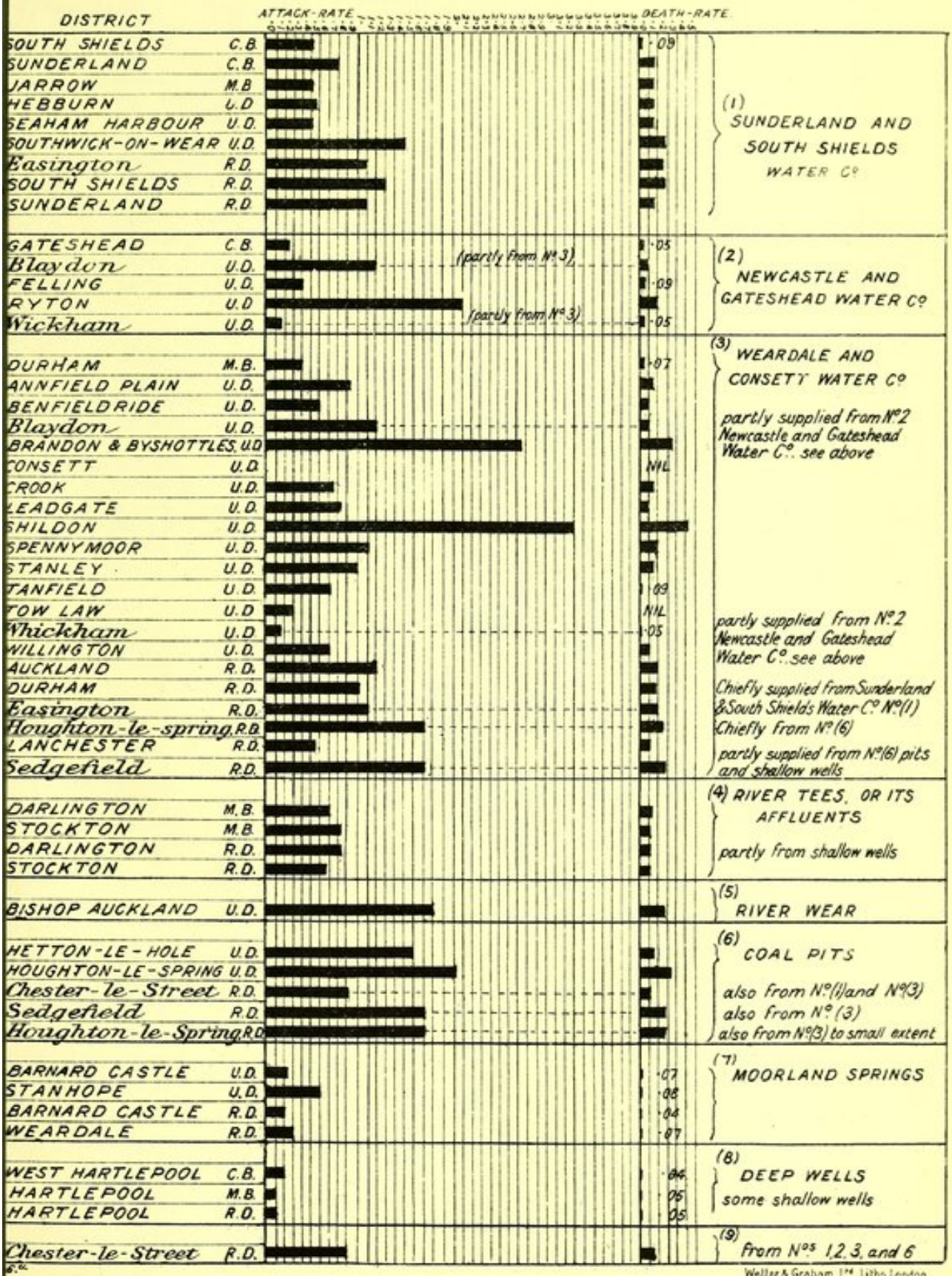
Waller & Graham Ltd Litho, London.

# DIAGRAM II

## NITARY DISTRICTS IN THE ADMINISTRATIVE COUNTY OF DURHAM

## NTERIC FEVER - AVERAGE ANNUAL ATTACK-RATES AND DEATH RATES PER 1000 OF POPULATION DURING 1903-08, IN RELATION TO WATER SUPPLIES.

EN A DISTRICT HAS MORE THAN ONE WATER SUPPLY TO AN IMPORTANT EXTENT, THE NAME IS PRINTED IN ITALICS)



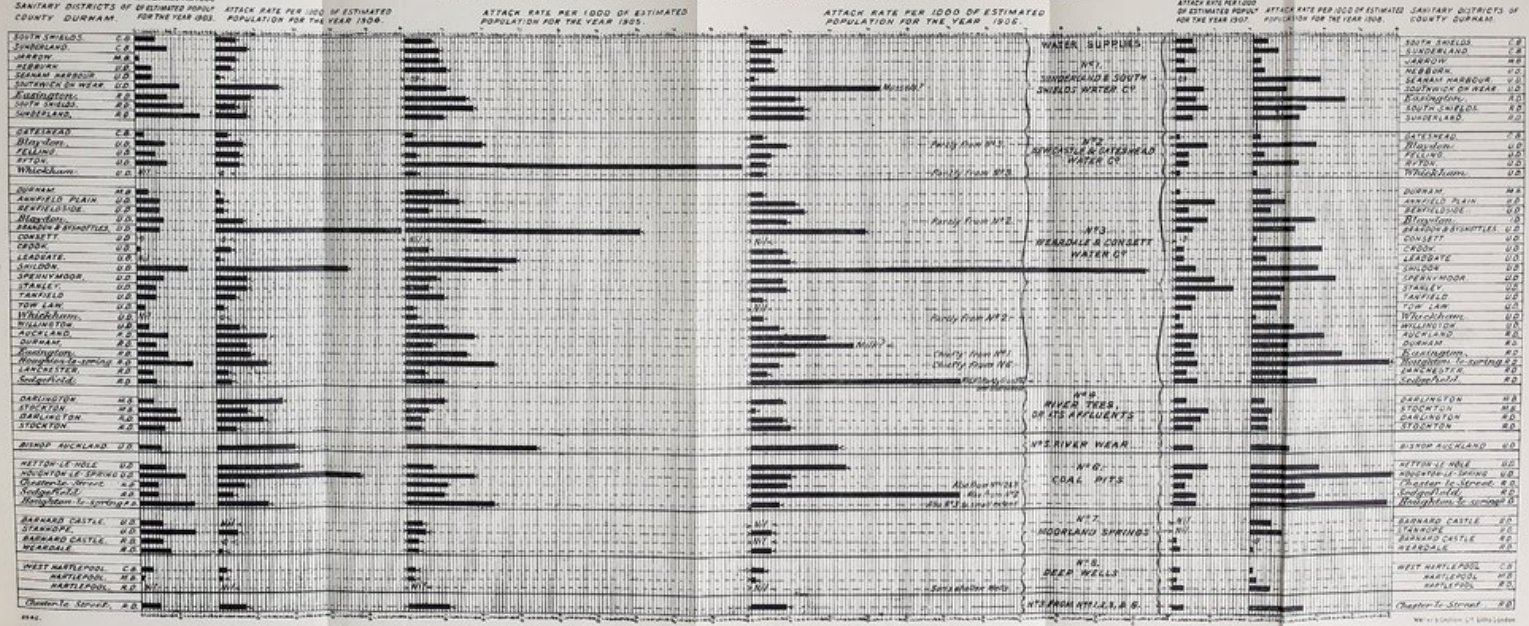

Weller & Graham, Ltd. Litho, London.

# Diagram III.

## Sanitary Districts of the Administrative County of Durham.

### Attack-rates from enteric fever in each year 1903-08. in relation to water supplies.

(When a district has more than one water supply to an important extent, the name is printed in italics.)

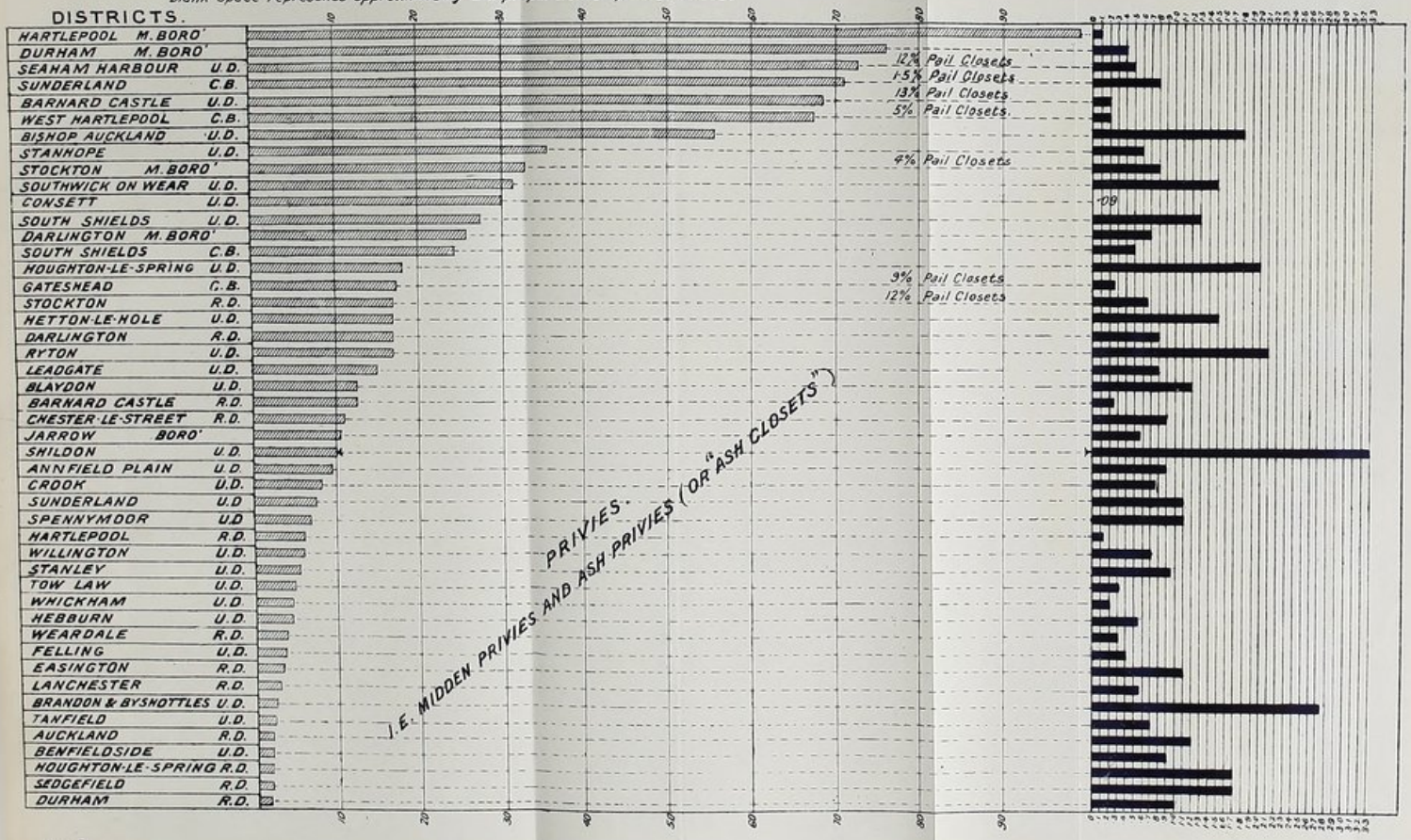


# DIAGRAM IV.

## SANITARY DISTRICTS OF THE ADMINISTRATIVE COUNTY OF DURHAM.

PROPORTION OF WATER-CLOSETS, (SHADED SOLUMNS) TO OTHER SANITARY CONVENIENCES IN EACH SANITARY DISTRICT IN RELATION TO THE AVERAGE ANNUAL ATTACK-RATE FROM ENTERIC FEVER PER 1000 OF POPULATION DURING THE SIX YEARS 1903-08. (BLACK COLUMNS)

*Except where, as stated on the chart, pail-closets are in use to a certain extent, the other sanitary conveniences are privies. Hence the blank space represents approximately the proportion of privies in use.*




3346.ª

Waller & Graham, Ltd. Lith. London