Dr. Reginald Farrar's report to the Local Government Board on the circumstances associated with the prevalence of enteric fever in the Ashington Urban District in Northumberland.

FOR OFFICIAL USE.

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TO THE

LOCAL GOVERNMENT BOARD

ON

PUBLIC HEALTH AND MEDICAL SUBJECTS.

(NEW SERIES No. 87.)

Dr. Reginald Farrar's Report to the Local Government Board on the Circumstances associated with the prevalence of Enteric Fever in the Ashington Urban District, in Northumberland.

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Dr. Reginald Farrar's Report to the Local Government Board on the Circumstances associated with the prevalence of Enteric Fever in the Ashington Urban District, in Northumberland.

ARTHUR NEWSHOLME,
Medical Officer,
9th December, 1913.

There has been for several years past, and particularly during the summer of 1911, an undue prevalence of enteric fever in the Ashington Urban District, and the Board, consequently, directed an inquiry into the sanitary circumstances of the district, with especial reference to this prevalence. The duty was allotted to me.

Previously, in 1903, the late Dr. L. W. Darra Mair had reported to the Board on the occurrence of enteric fever in the district during the year 1901.* To this report by Dr. Darra Mair frequent reference is made in the present report.

POPULATION AND INDUSTRY OF THE DISTRICT.

The Ashington Urban District was formed in March, 1896, from a portion of the Morpeth Rural District by combining the civil parishes of Ashington and Hirst. Its boundaries were extended in 1900, and again in 1909, when a part of the North Seaton Civil Parish was included. The present area of the district is 3,041 acres.

The population at the 1911 Census was 24,583 (13,226 males and 11,357 females). It was 13,972 in 1901, the inclusion of a part of North Seaton Civil Parish occurring during the inter-censal period.

The population is located in two district townships known as Ashington and Hirst, the one separated from the other by the line of the North Eastern Railway Company. The population of Ashington has increased from 6,284 in 1901 to 8,155 in 1911; while that of Hirst, which is a much newer place and is growing rapidly, has increased during the same inter-censal period from 7,688 to 16,428.

The male population of both townships is almost exclusively engaged in the coal-mining industry, working in one or other of the four mines belonging to the Ashington Colliery Company. The colliers of Ashington township work, with very few exceptions, in the Ashington Pit, which is situated in that township.

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* Dr. Darra Mair's Report to the Local Government Board on the Sanitary Circumstances of the Ashington Urban District and on recent Enteric Fever therein. 1903. No. 183.

(31738—21.) Wt. 21838—156. 500. 1/14. D & S.

A proportion of the Hirst colliers (probably about 2,000) work in the Ashington Mine, but the bulk of them work in one or other of the three smaller mines—Woodhorn, Linton, and Ellington—belonging to the same company.

Sanitary Circumstances.

Housing.—The number of families or separate occupiers was 4,740 at the Census of 1911, the total number of inhabited dwellings was returned as 4,027, of which 3,292 were "ordinary dwelling houses," occupied by 3,388 separate occupiers. Houses not in single occupation may, therefore, be termed relatively few; but a comparatively large number of young men are taken as lodgers, usually not more than one at a time, in miners' families. The average number of persons per inhabited building was 6·10; in 1901 it was 5·85. The average number of persons per family in ordinary dwelling houses was 5·58. I found no evidence of serious overcrowding, the bulk of the houses being fairly roomy structures, containing on the ground floor a sitting-room and kitchen with a small pantry and washhouse, and upstairs two fair-sized bedrooms.

About two-thirds of the houses in Ashington township are from 20 to 40 years old, while nearly the whole of the houses in Hirst have been built within the last 20 years.

As regards the accommodation afforded, structure, condition of repair, ventilation, and lighting, the housing conditions in the district are fairly good, and compare favourably with those in most northern colliery villages. In some of the houses in Ashington the lower portions of the sitting-room walls were damp, owing to garden-beds being laid in immediate contact with walls built without a vertical damp-proof course.*

In the older part of Ashington, known as "the Rows," about 750 houses, there is considerable space between the "rows," so that each house has a fair-sized garden at the back of it, the gardens of adjacent rows in some instances abutting on one another. The gardens are, in nearly all instances, planted with flowers or vegetables, prizes being given by the colliery company for the encouragement of horticulture. In most of these gardens pigeons or fowls, and in some instances pigs, are kept. In the newer parts of Ashington and in Hirst, though there is no extreme crowding of houses on area, the "rows" are much closer together, and the air-space about the houses is consequently more limited.

Excrement and Refuse Disposal.—The privy-midden system prevails both in Ashington and Hirst, the privies abutting on and being connected with large brick ash-pits. In "the Rows" at Ashington, the oldest part of the district, the privy-middens are of the extremely objectionable type that is so frequently met with in the northern colliery districts, *i.e.*, the ash-pits, which differ slightly in construction in different "rows," generally

* In certain instances to which I drew attention the condition has been remedied since this report was written.

serve four privies, two at either end, and are unduly large, generally measuring 12 by 6 feet. Most of them are roofed over, but some of them, *e.g.*, those in 4th, and 5th, and part of 3rd Rows, were unroofed at the time of my visit. The floor is generally at the level of the ground, and in some instances certainly is neither bricked nor cemented. When there is a roof, the wall on the side remote from the houses rises to the height of the roof, the ash-pits are closed in on three sides, and the fourth, which faces the dwelling served, has a containing wall rising to a height of about 4 feet. The privies are usually so constructed, with a floor either flat or inadequately sloped, that there is no admixture of fæces with the ashes thrown into the ash-pit. They thus fail in a particular which is usually considered to be the sole possible justification from the sanitary standpoint of the system of dry disposal. Refuse food is freely thrown into the ash-pits, which are consequently much visited by flies.

In most of the streets trolley-lines are laid down, and scavenging is effected by means of trolleys which are run alongside the ash-pits. As was pointed out by Dr. Darra Mair, the trolley when in position alongside the ash-pit is not quite close to the wall, and, consequently, in the process of removing the material from ash-pit to trolley some of it falls to the ground between the two. Moreover, in the careless emptying of liquid food, and sometimes of slops, into the ash-pit, much contamination of the soil occurs, particularly in those streets which are only made up of cinders and small coal.

In several cases I observed cats or domestic fowls searching for food in these ash-pits.

Conditions such as these must in many ways favour the dissemination of infection from infectious matter cast into the ash-pits.

In Hirst generally and in the newer parts of Ashington the privy-middens, though not free from objectionable features, are of better construction, the ash-pits being of more moderate size, more completely enclosed, and so constructed as to allow a better admixture of ashes with the excrement. They are generally placed in the back-yards of the houses, and so contrived as each to serve two houses. In the case of the newer houses the floors of the privies are of tiles or cement, and the fronts of the seat of porcelain, whereas in the case of the older houses these parts are of wood. The back-yards also of the newer houses are paved with cement, and can, therefore, be better cleaned, whereas in some of the older houses in Hirst they lack paving.

The inspector of nuisances has produced a design* for remodelling the privies in the Rows at Ashington, which he hoped to induce his council to adopt, at all events, gradually. Privy-middens of more moderate size and better construction are, doubtless, in themselves to be preferred to those of the type which now prevails in the older parts of Ashington; nevertheless, reconstruction on the lines proposed is strongly to be deprecated as

* One ash-pit in 9th Row has been remodelled on the said design since this report was written.

tending to postpone indefinitely the change from a dry disposal system to one of water carriage, which is urgently required in the district. Defective privy-middens should not be remodelled, but should be converted into water-closets, and satisfactory ash-bins provided for domestic refuse.

Scavenging is carried out by men employed by the Ashington Colliery Company, in most streets by means of trolleys run on rails, as above described. (These same rails are employed for the carriage of coal to the houses.) After the ash-pits are emptied they are sprayed with lime by means of a sprayer. Down to the time of the outbreak in 1911 the middens had been emptied at fortnightly intervals.

Drainage and sewerage.—In the older parts of Ashington drainage is provided for by large trapped gullies, about one for every two houses, placed at intervals along the streets. In the more modern houses in Hirst each house is provided with its own gully. Of the sewers in Ashington there is apparently no plan extant; they run in most instances down the length of the streets, but I was unable to obtain information as to the junctions and direction of flow of several of the branches. They are constructed—I was informed—for the most part of socketted stone-ware pipes, clay-jointed, and laid in earth, not bedded in concrete. It is believed that a large proportion of them have undergone serious "buckling." The sewers in Hirst, which were laid down by the Ashington Colliery Company, are more modern and better laid, but frequent complaints have been received of effluvia from the manholes due to defective ventilation and flushing. Vent-shafts should be provided at the heads of the sewers in Hirst.

The district council have recently made application for sanction to a loan of £2,000 for provision of new sewers at Hirst.

The main sewer from Ashington discharges its contents untreated, by a 27-inch pipe, in a northerly direction into a sluggish brook, known as Haydon Latch, which eventually flows into the River Lyne. This main sewer is kept flushed at its further end (near the outfall) by the intermittent discharge into it of water pumped up from the Ashington Pit and condensing water from the engines, the water from these two sources being estimated as amounting to from 5,000 to 10,000 gallons daily. The heads of the sewers in Ashington are frequently flushed at three points by means of hydrants. A short distance beyond the discharge of the sewer into the Haydon Latch the stream is reinforced by a quantity of water drained from the pyrites works which are connected with the pit.

The gradients in Ashington are very flat and the sewers are old. For these reasons, as well as on account of the alleged defects above referred to, it is considered locally probable that the sewers will have, before long, to be relaid, a matter of special importance if a system of water carriage were adopted. Disposal works would probably also be necessary and pumping might be required.

The sewers of Hirst discharge in a southerly direction towards the Wansbeck, which is a tidal stream. The fall is good and the

gradients are more favourable for water carriage than in Ashington. As already stated, better flushing and ventilation of the sewers is required.

Streets.—The main streets in Ashington and Hirst, and a few of the side streets, are macadamized, kerbed, and channelled, but many of the streets between the "rows," particularly in the older parts of Ashington, are in a very bad condition. 4th Row and part of 5th Row have kerbed, channelled, and asphalted side-walks running along the houses; but in the streets running between most of the "rows," which form the usual access to the houses, both roadway and footpath are commonly made up of cinders and small coal, and their surfaces are covered with black mud or black dust, according as wet or dry weather prevails. It is impossible to keep such streets properly clean, and the very faulty conditions of excrement and refuse disposal described above conduce to a dangerous degree of organic pollution of the soil. Under such circumstances mud is necessarily carried into the houses in large quantities on the boots of their occupants in wet weather; it is quite common to see young children making "mud-pies" in these streets; while the prevalence of dust in dry weather is not only disagreeable but dangerous from a sanitary standpoint. In 9th Row, Ashington, which witnessed the greatest diffusion of enteric fever during the recent epidemic, the condition of the street was particularly bad.

Water Supplies.

The water supplies of Ashington Urban District were fully described by Dr. Darra Mair in his report, from which I have borrowed several of the following details.

There is a public service of water throughout the whole urban district. Two water supplies, one for domestic purposes, the other for the public service, such as street watering, sewer flushing, &c., are obtained by pumping from the Ashington Colliery, both these supplies being in the hands of the Ashington Colliery Company. A portion of Hirst derives its supply from the North Seaton Colliery. This third supply will be later described.

(1.) *Principal Domestic Supply.*—The main supply for drinking and domestic purposes is conveyed over the whole of Ashington and about three-fourths of the township of Hirst.

This water is derived from the drainage of a large area of worked-out coal in the Ashington Pit, the water-bearing strata being seams of white sandstone, locally known as "white post," intervening between the worked-out coal seams. It is stated that these sandstone strata outcrop on the surface at Widdrington.

The colliery officials maintain that the area from which the drinking supply is derived is quite cut off from any part of the mine now being worked, and that there is no possibility of drainage into it from any of the workings. It is situated upon the fifth or lowest seam. All supports have been removed and the roof allowed to fall in. The passages which led to this area are now blocked up with brickwork, so as to cut off all access to it from other workings of the mine, except through a door which is kept locked.

The water is received in a channel, or conduit, about 7 feet wide, which was originally cut through the coal for drainage purposes, when this area was being worked. At intervals along this channel are inspection doors, which are kept locked, the key being in the possession of the man in charge. From the channel, which terminates in a brick dam, the water is pumped into a storage reservoir, and thence lifted by another pump to storage tanks at the surface. The water is delivered in pipes, unfiltered, to various parts of the mine, for the use of the miners.

By the courtesy of the colliery managers I was enabled to descend the mine and inspect the arrangements above described. So far as I could ascertain, the officials had good grounds for their belief that no drainage takes place into this supply from other parts of the mine.

Storage and filtration of water.—At the surface, the water is first received in a disused boiler placed in a brick tower. Thence it is passed through two "Torrent" filters of sand and gravel, each of 4,000 gallons capacity, which are used simultaneously. These are supplied by the Pulsometer Engineering Company. The filters are agitated every 24 hours by passing a steam jet through them. The sand and gravel is renewed annually.

Thus, all drinking water which is delivered from the surface is subjected to filtration, but, as I have already pointed out, that which is delivered by taps to various parts of the mine is not filtered.

I was also informed, but I found it difficult to obtain positive evidence as to this, that miners will frequently drink from streams or pools in the working parts of the mine.

From the filters the water passes to two sets of cylindrical tanks or "boilers" at a height of about 152 feet above O.D. The first set of four tanks supplies Old Ashington by a single 3-inch main; the second set of seven tanks supplies East Ashington and the north and east portions of Hirst by 3-inch and 4-inch mains, respectively. The water is pumped on to Hirst by means of a donkey engine. The tanks in each case are placed upon brick piers, built upon heaps of mining refuse. The tanks, the Hirst set especially, are some little distance from the filters, and the pipes leading to them from the filters pass through ground which is said to be liable to subsidences.

The mains are stated to be laid at an average depth of 2 feet.

The general means of distribution is by means of standpipes, one standpipe usually serving about 12 houses. In some of the newer parts of Hirst water is laid on into the houses, but the pressure is usually barely sufficient to reach the first floor.

It is possible that some leakage may take place in the distributing pipes or at their connections, and having regard to the contamination of the soil, incidental to the methods of excrement and refuse disposal as described above, insuction of polluting matter into the branch supply pipes running down the "rows" may be liable to take place when such leakage occurs.

The supply is in the hands of the Ashington Colliery Company, and the urban district council have no control over it. The company charge the district council a rate of 6*d.* per 1,000

gallons for this water, and a rent of £150 per annum for the use of service pipes and tanks.

The amount of water used for domestic purposes is stated to be from five to six gallons per head. The present supply is certainly inadequate in amount, particularly as regards Hirst.

The colliery company have offered to supply an additional 100,000 gallons per diem, to be pumped from their Woodhorn Pit, in order to bring water to the eastern boundary of the district. It is proposed that the tanks for this service should be 10 feet above the level of the present tanks. The probable cost of this scheme is estimated at £750, for which rent would be charged.

Alternatively, it is suggested that water could be obtained from the Tynemouth public supply at a cost of 8*d*. per 1,000 gallons. The county council have had under consideration the desirability of a Joint Water Board being constituted for the eastern part of Northumberland.

(2.) "*Slop*" *Water Supply*.—This is the name given to a supply of waste water which is pumped up from the colliery workings in Ashington pit, separately from the domestic service supply above described. No care is exercised in its collection, and the greater part of it is pumped to waste, but a part is stored in old boilers from which it is pumped by 3-inch and 4-inch mains to Ashington and Hirst respectively.

This water is used for watering the streets, flushing the sewers, and for fire brigade purposes. There are a large number of flushing valves at the head of branch sewers, and of hydrants for street watering. Screw-down valves are provided at certain points for cutting off water from other parts of the town if a maximum pressure is required in any particular section.

This supply could not ordinarily be used for drinking purposes, but I found that in parts of Hirst where the colliery company are erecting new houses, water for building purposes was being taken from temporary taps on the "slop" water mains (though I had been informed that this practice was no longer allowed), and might exceptionally be used for drinking. This circumstance could not be regarded as a contributory factor in the enteric fever outbreak.

There appears to be reason for doubting whether there is sufficient pressure on the "slop" water service to be effective in the event of a fire.

(3.) *North Seaton Supply*.—About one-fourth of the population of Hirst, in the southern portion of the township, as far as the lowest block of Pont Street, is supplied with unfiltered water pumped up from the North Seaton Colliery. This water is pumped up to four boiler tanks, each of 6,500 gallons capacity, from which it is delivered by 3-inch mains to the houses on this supply. These tanks are, I am informed, generally full in the early morning, but owing to deficient head and to friction in the pipes consequent on the number of branches, the supply at its further end is practically an intermittent one, and residents in this part of Hirst are often short of water, those in Pont Street, in particular, being often obliged to borrow from taps in the next block, which is on the

Ashington supply. I was informed that the fever hospital, which is on the North Seaton supply, has often been short of water.

Some of the residents in the area supplied with this water complained that at times it had a nasty taste, looked brown, and contained worms. This complaint was made by the parent of a child who contracted enteric fever, who had noticed these conditions about three weeks before she was attacked.

During the recent outbreak only two cases of enteric fever occurred in the area of this supply. One of these was the schoolmaster in Hirst school, the other the child referred to above who, so far as I could ascertain, had not taken water from the Ashington supply.

On the whole, the water supply of this urban district cannot be regarded as satisfactory; it is deficient in amount and open to considerable suspicion as regards its quality. Dr. Darra Mair recommended, and I endorse his recommendation, that the duplicate supply of drinking and "slop" water should be abandoned. The urban district council should take into serious consideration the question of obtaining a better supply either by their individual action, or by co-operating in the formation of a Joint Water Board which has been projected for this part of the county.

Prevalence of Enteric Fever in the Urban District.

Between September 1st, 1903 and October 31st, 1910, 157 cases of enteric fever were notified in the Ashington Urban District, viz.:—

In 1903	... ...	7 Cases.
,, 1904	... ...	14 ,,
,, 1905	... ...	52 ,,
,, 1906	... ...	19 ,,
,, 1907	... ...	10 ,,
,, 1908	... ...	23 ,,
,, 1909	... ...	21 ,,
,, 1910	... ...	11 ,,
Total	...	157

These cases in respect of age and sex were divided as follows:—

Males over 15 and under 65 years	... ...	72 or 46·2 per cent.
Females over 15 years	... ...	25 or 16·0 ,,
Children under 15 years	... ...	59 or 37·8 ,,
Total	...	156

In one case (male) the age was not ascertained. Of the children three were boys of 14, of an age, that is, eligible for employment in the mines.

Of the 72 cases of enteric fever in males over 15 and under 65 years of age, 63, or 40·1 per cent. of all the cases that occurred, were known to be employed in the mines, seven were engaged in occupations other than mining, the occupation of the two remaining cases could not be definitely ascertained.

During the more recent prevalence from April 1st, 1911, to June 7th, 1912, 89 cases were notified, viz.:—

Males over 15 and under 65 years	54 or 60·7	per cent.
Females over 15 years	21 or 23·6	,,
Children under 15 years	14 or 15·7	,,
Total ...	89	

Fourteen deaths occurred among these cases, a fatality rate of 15·7 per cent.

The latter cases as regards the dates of onset were distributed as follows:—

—	Males over 15.	Females over 15.	Children under 15.
April, 1911	—	2	—
August, ,, ...	6	3	1
September, ,, ...	28	7	9
October, ,, ...	11	4	3
November, ,, ...	—	1	—
December, ,, ...	2	1	1
January, 1912	—	1	—
February, ,, ...	1	1	—
March, ,, ...	4	—	—
April, ,, ...	2	—	—
June, ,, ...	—	1	—
	54	21	14

NOTE.—Since the 1911–12 prevalence, to which this report principally relates, 26 further cases of enteric fever have occurred in the urban district. In point of time these cases were distributed as follows:—

—	Males over 15.	Females over 15.	Children under 15.
June 1912	—	—	1
July ,, ...	—	1	—
September ,, ...	—	1	5
October ,, ...	—	1	—
December ,, ...	1	—	—
January 1913	1	—	—
April ,, ...	1	1	1
July ,, ...	—	2	—
August ,, ...	1	—	1
September ,, ...	2	2	4
	6	8	12

Of the above, 12 resided at Ashington (3 adult males, 9 women and children) and 14 at Hirst (3 adult males, 11 women and children). Multiple cases occurred in three houses, viz., 13, Eleventh Row, 4 cases; 35, Richardson Street, 3 cases; and 15, Morvern Terrace, 2 cases. There were 4 fatal cases.

Of the 54 males over 15 and under 65 years, 49 were engaged at one or other of the Ashington Colliery Company's pits, working either at the pit-head or below ground. The remaining five persons were a scavenger, a schoolmaster, a saddler, a co-operative warehouseman, and a joiner. Of the 14 children, two were boys of 14 years old, employed in the Ashington mine, one above ground and one below. Including these two boys, 51 persons, or 57·3 of the total cases, were employed in mining.

If the whole period from September 1st, 1903, to June 7th, 1912, be taken together, it is found that out of 246 cases, 126 were males over 15 and under 65 years old, five were boys of 14 years, and the age of one male patient was not ascertained. Classifying the boys of 14 with the adult male patients, we have 131 persons, or 53·2 per cent. of all cases, eligible for employment in the mines, of whom 114, or 46·3 per cent. of all cases, were known to be so employed, 12 were engaged in occupations other than mining, while the occupations of the remaining five (including three boys) were not ascertained.

Seeing that coal-mining is the *raison d'être* of the whole population of Ashington, other occupations being merely ancillary to this industry, the preponderance of coal-miners among the male patients would need no comment, but for the fact that the incidence of enteric fever on males of mining age has been notably heavier than the ratio which these persons bear to the whole population.

At the census of 1901, males over 14 and under 65 years of age, whom we may call for convenience persons of "mining age" (since it is usual in this district for boys of 14 to be employed in the mines), formed 33·3 per cent. of the whole population. At the census of 1911 the proportion was 34·8 per cent.

It is noteworthy that in the enteric fever outbreak of 1901-1902, which was investigated by Dr. Darra Mair, a similar preponderance of males of mining age, as compared with females and children, was observed. Of 191 cases occurring in that epidemic, 89, or 46·6 per cent., were males over 15, and 102, or 53·4 per cent., females and children, whereas the percentage of males over 15 to all females and males under 15 in the general population was 32·9.*

I was unable to obtain any records giving details of cases of enteric fever occurring between January 13th, 1902, the date of the last cases recorded by Dr. Darra Mair, and September 1st, 1903, the first case of which I could obtain details from Dr. Mills,† but, taking all the cases for which records are available between January, 1901 and June 7th, 1912, we obtain a total of 436 cases, of which 215, or 49·3 per cent., were males of mining age, and 221, or 50·7 per cent., females and children. The marked prepondenance of the incidence of enteric fever on males

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* It may be noted that in calculating the persons of "mining age" I have included boys of 14 and excluded males over 65, whereas the figures given by Dr. Darra Mair only allow for the computation of all males over 15.

† The number of cases occurring between these two dates was given as 16, but I could obtain no particulars as to age and sex of the cases.

of mining age, as compared with females and children, thus holds good for the whole period 1901 to 1912. To this further reference will be made below.

Relative Incidence on the townships of Ashington and Hirst.—(*a*) 1901-2.—Dr Darra Mair found that in the outbreak of 1901-2 Hirst suffered at least twice as much as Ashington. He says in his report:—

> "Of the 187 cases notified in 1901, 135 occurred in Hirst and 52 in Ashington, so that the attack-rate was 18 and 8 per 1,000 of the population in these townships respectively. The fatal cases numbered 20 in Hirst and 8 in Ashington; the fatality-rate was thus 15 per cent. in each place, while the death-rate from enteric fever was 2·6 and 1·3 per 1,000 of the population respectively."

(*b*) 1903-10.—Analysis of the incidence of the notified cases of enteric fever during this period gives the following results:—

Of the 157 cases notified between September 1st, 1903, and October 31st, 1910, 89 occurred in Hirst (39 males over 15, 49 females and children, and one male of age unspecified) and 68 in Ashington (33 males over 15, and 35 females and children) so that the attack-rate, calculated on the 1901 census figures, was 11·6 and 10·8 per 1,000 of the population in Hirst and Ashington respectively. The fatal cases numbered 17 in Hirst and 7 in Ashington; the fatality-rate was thus 19 per cent. for the former and 10 per cent. for the latter township, while the death-rate from enteric fever was 2·2 and 1·1 per thousand of the population respectively.

It will be noted that for this period there is no striking disparity between the attack-rate for Hirst (11·6) and for Ashington (10·8) such as was observed in the outbreak of 1901.

(*c*) 1911-12.—Of the 89 cases occurring between April 1st, 1911, and June 7th, 1912, 46 (28 males over 15, and 18 females and children) occurred in Hirst and 42 (26 males over 15, and 16 females and children) in Ashington. In one instance, that of a nurse, the disease was obviously contracted in the isolation hospital.

During the recent outbreak, therefore, the incidence of enteric fever has, in proportion to the population, been relatively nearly twice as heavy on Ashington as on Hirst, and, having regard to the rapid growth of Hirst, already indicated on p. 1, it is probable that during the whole period since September, 1903, there has been relatively heavier incidence of the disease on Ashington.

Incidence on Ashington Colliery Workers in 1911-12.—I have already stated that of the 54 cases of enteric fever affecting males "of mining age" between April 1st, 1911, and June 7th, 1912, 49 occurred among men and boys engaged at one or other of the Ashington Colliery Company's pits.

Through the courtesy of the colliery manager I have obtained particulars of the persons employed at these pits at the time of my inquiry and of the distribution of enteric fever cases among them.

The Ashington Colliery Company were working at the time of my inquiry four pits known as the Ashington, Linton, Woodhorn, and Ellington Pits, the numbers of men and lads employed at each of these being as follows:—

Ashington	...	Underground ...	3.705	4,619
		Surface	914	
Linton ...	...	Underground ...	1,078	1,232
		Surface	154	
Woodhorn	...	Underground ...	1,773	2,093
		Surface	320	
Ellington...	...	Underground ...	387	509
		Surface	122	
			Total	8,453

The 49 enteric fever cases occurring among the employés of the Ashington Colliery Company were distributed as follows:—

Ashington	...	Underground ...	32	40
		Surface	8	
Linton ...	...	Underground ...		1
Woodhorn	...	Underground ...	5	7
		Surface	2	
Ellington...	...	Underground ...		1
			Total	49

Thus it appears that, whereas of the company's employés 54·6 per cent. were employed at the Ashington Pit, 81·6 per cent. of the enteric fever cases occurring among these workers were assignable to the Ashington Pit, and 18·4 per cent. to the other pits. In other words, the incidence of enteric fever was 8·7 per 1,000 on workers at the Ashington Pit as against 2·3 per 1,000 on workers at the other three pits, or nearly four times as heavy in the former cases as in the latter.

This circumstance corresponds with the relatively heavier incidence of the recent outbreak on Ashington as compared with Hirst, for the Ashington Pit is situate in the Ashington portion of the urban district, and practically all the workers resident in Ashington are employed in this pit, while the workers resident in Hirst include the remainder of those employed in the Ashington Pit and practically all the employés of the other three pits. Of the 40 cases occurring among workers at the Ashington Pit 27 resided at Ashington and 13 at Hirst, while of the 9 cases occurring among residents who worked at the other three pits 8 resided at Hirst and only 1 at Ashington.

Comparison of incidence on Colliery Workers and the rest of the population.—The incidence of enteric fever on the colliery workers and on the general population of the whole district may now be further considered. Leaving out of consideration 2 cases (sisters) that occurred in Hirst in April, 1911, there remain 87 cases that occurred between August 7th, 1911, and June 7th,

1912 (I give the dates assigned as the beginning of the illness not the date of notification).

During the months of August and September 34 males over 15 and 20 females and children were attacked. Of the males, 31 were miners, of whom 24 worked in the Ashington Pit, 7 in one of the other three pits, 3 were persons other than miners, 1 residing at Ashington, 2 at Hirst. Of the females and children 10 resided at Ashington, of whom 5 might be fairly regarded as "secondary" cases, and 10 at Hirst.

During the months October, 1911, to June, 1912, 20 males over 15 and 13 females and children were attacked. All the males were miners, 16 working in the Ashington Pit, and 4 in the other pits. Of the 13 females and children two were boys of 14 employed in the Ashington Pit, 1 was a hospital nurse, 3 resided at Ashington, and 7 (of whom 4 might be regarded as "secondary" cases) at Hirst.

It must be concluded that the incidence of enteric fever in the Ashington Urban District has, not only during the recent outbreak, but during the whole period since 1901, been markedly heavier in proportion to their numbers on working miners, who constitute probably at least 90 per cent. of the male population over 15 years of age, than on the females and children of the community; and that during the 1911-12 outbreak the incidence of the disease has been distinctly heavier on men employed in the Ashington Pit than on those working in the other pits belonging to the same company.

Had the primary cause of the disease been one affecting impartially all sections of the community we should have expected to find women attacked in proportion to their numbers in an equal ratio with men. Indeed, seeing that in a mining community the washing of household linen and utensils, and the tendance of the sick, in the earlier stages, at least, of their disease, devolves upon women, they are exposed in a higher degree than men to chances of secondary infection. Moreover, as being more at home in the daytime they are exposed in a higher degree than men to chances of infection, through the medium of flies or otherwise, originating in the proximity of privy-middens or ash-closets to the dwellings.

Possible causes of excessive incidence on the Colliery Workers.—It is not easy to find a complete explanation of the excessive incidence of the disease on the colliery workers, but the following circumstances should be considered:—

1. Miners probably drink more unboiled water than other classes of the community. It is the custom for every miner to take a tin water-bottle, of about a quart capacity, with him when he goes to work. This bottle he generally fills with water before leaving home. If, therefore, the general supply be specifically infected the infection is more likely to affect miners than females or children.

2. As I have pointed out, the domestic supply is not filtered till it reaches the surface, and taps on this supply are provided at different points at the bottom of the mine from which miners may drink, or replenish their bottles. If the supply be infected

at its source, the fact that miners can, while females and children cannot, drink it in an unfiltered condition may be of importance.

3. A few pail privies of a primitive type are provided at the bottom of the mines; but I was informed that miners generally relieve themselves, when the need arises, in any convenient place near their work. It is possible that specific infection may reside in the dirt with which the floors of the workings are covered. Streams and pools of water, the drainage of the workings, as already mentioned, occur in several places, and I was informed, on good authority, that thirsty miners will not unfrequently drink from them.

If some source of infection mainly or solely affecting miners has been in operation during the recent outbreak, and in previous years, it was only to be expected that some degree of secondary diffusion among females and children should occur.

Inquiries which I made among infected houses led me to conclude that there were at least ten cases of secondary infection, among the 89 cases that occurred between April 1st, 1911, and June 7th, 1912, and that certainly in six of these instances adult females had contracted the disease in the course of attendance on patients. In one instance, that of a nurse, who contracted the disease while on duty in the fever hospital, this was the obvious source of infection.

Insanitary conditions about dwellings contributory to local spread of infection.—The sanitary circumstances of the district, particularly in respect of the defective methods of excrement and refuse disposal above described, are such as to conduce to diffusion of the disease.

They also serve to explain the concentration of cases in particular areas of the district, especially in 9th Row (Ashington), where secondary cases occurred in five houses in 1911-12.

It is noteworthy that of the 42 cases notified from Ashington township 41 occurred in that part of Ashington known as "the Rows." This area, which is the oldest part of the township, comprises long rows of miners' cottages in the immediate vicinity of the colliery. It is divided by a broad macadamized road running northward to the pit, the rows to the west of this road, numbered 1 to 6, and comprising 320 houses, being from 30 to 40 years old, while those to the east, numbered 7 to 11, and comprising 425 houses, have been erected at different dates since 1885. All these blocks have large privy-middens of the old-fashioned type between them, and in the majority of instances the intervening streets are only made up with cinders and soft coal.

Six cases occurred in the rows numbered 1 to 6, while 35 cases occurred in those numbered 7 to 11. Of these 35 cases—

2	occurred	in	7th Row.
2	,,	,,	8th ,,
23	,,	,,	9th ,,
5	,,	,,	10th ,,
3	,,	,,	11th ,,
35			

There was, thus, a notable concentration of cases in 9th Row, and those cases occurred for the most part in houses towards the centre of the row which comprises 94 houses, arranged in three blocks.

The cases in 9th Row were distributed as follows:—

No. of House.	Cases.
7	1
21	4
22	1
23	1
29	2
32	1
40	1
41	2
49	3
58	1
59	2
60	1
64	1
65	1
66	1
	23

Multiple infection occurred in five houses, viz., in Nos. 21 (four cases), 49 (three cases), 29, 41, 59 (two cases in each).

A spot-map which I have had made shows that, as regards the whole area of houses comprised in Rows 7 to 11, the 35 cases occurring in this area were concentrated about its centre, the peripheral houses escaping infection. It is also to be noted that, whereas the centre of 9th Row was the part of the area most heavily infected, cases in the other rows occurred in houses closely adjoining the alley which connects them with the central block of 9th Row.

This distribution of cases is compatible with a theory that infection resulting from defective methods of excrement disposal may have been conveyed in some instances by the agency of flies, and it was observed that there was an unusual prevalence of flies in the district during the summer of 1911, the beginning of the period of exceptional prevalence. The first case* that occurred during the outbreak was that of a miner residing in 29, 9th Row, who was taken ill about August 7th, and removed to hospital on August 22nd. This man was ill for a fortnight before he was taken to the hospital. While in bed at home his stools were received into a chamber-pot, and deposited on the ash-midden facing the house, though some attempt seems to have been made to disinfect them by the addition of a disinfectant ("Keral"). It is, at least, possible that the deposition of this man's stools on the ash-midden may have constituted a focus of infection

* Again excluding 2 cases (sisters) that occurred in Hirst, in April of this year, and which appear to have no connection with the outbreak.

which was disseminated by the agency of flies or otherwise. It is a significant fact that a case of the disease occurred in a scavenger employed in emptying the privy-middens.

I have analysed the cases occurring in Ashington township between 1903 and 1910. Of the 68 cases notified in the township 54 occurred in the Rows, distributed as follows:—

Row.	Cases.	Row.	Cases.
1	1	7	3
2	1	8	8
3	4	9	16
4	2	10	7
5	8	11	2
6	2		—
		Total ...	54
			—

Of the 95 cases occurring in the Rows since 1903, 39 occurred in 9th Row.

It appears that not only during the recent outbreak but in previous years also, 9th Row suffered at least twice as severely as any of the other rows; also that of the 54 cases occurring between 1903 and 1910, only 18 occurred in the rows to the west as against 36 in the rows to the east of the central road which divides the rows into areas. Three of the houses in 9th Row which were infected during the recent outbreak, had been invaded during previous years; viz., Nos. 49 and 21 in which multiple cases occurred in 1911, and No. 32.

As regards the township of Hirst, the concentration of cases was not so striking as in the Rows at Ashington, but it is to be observed that the cases in this township were mainly confined during the recent outbreak to the three northern avenues, the area lying between Chestnut Street and Myrtle Street being the most severely invaded.

Milk Supply.—I obtained particulars of the milk supply in all the invaded houses and considered the possibility of infection having been conveyed by means of milk. It is not quite certain how many separate supplies were included in the returns received, as in some cases the same farm may have been indicated under different names, but the returns comprised at least ten quite independent supplies, and I found no evidence tending to implicate any of those supplies as being responsible for the spread of the disease. I also visited eight farms in the urban district, and its neighbourhood, including all those from which milk is habitually purveyed into Ashington. The cowsheds and dairies on these farms were fairly satisfactory, and call for no special remark. I could obtain no evidence that would lead me to suppose that a "carrier" might be included among any of the milkers or farm hands. An investigation of the milk supply was also made independently by Dr. Hembrough, the county medical officer of health, who could find no reason for implicating any of the milk supplies.

Shell fish.—I also considered the possibility of the disease having been due to the consumption of shell-fish. In one case

only did I obtain any history of shell-fish having been recently eaten. There does not appear to be much consumption of shell-fish in the district.

Summary.

The conclusions that seem to be warranted by a consideration of the facts of enteric fever prevalence in this district during the recent outbreak, and in preceding years since 1901, are as follows:—

There has been an undue prevalence of enteric fever in the district since 1901, and a marked epidemic prevalence during the summer and autumn of 1911.

Study of the 89 cases in the 1911-12 period of prevalence has not brought proof that all or the majority of cases were to be attributed to the operation of a single cause of infection. It is possible that several conditions may have been at work, though the extent to which one may have operated more than another cannot be stated. The considerations in question are:—

(1.) *Water Supply.*—Suspicion fell, in 1901, on the general water supply (the reasons are given in Dr. Darra Mair's report), though the exact way in which water pollution could have taken place was not evident. The facts as regards the 1911-12 cases do not point with the same clearness to the probability of water causation, but it would be unwise wholly to exclude the possibility that a limited infection of the water supply of Ashington and Hirst, similar to that formerly suspected to have occurred, may have taken place. The double supply of "slop" water and drinking water can hardly be without risk.

(2.) *Infection contracted in the mines.*—There has been evidence of excessive incidence of the disease on miners engaged in the Ashington Pit. It is difficult to say whether this may have been due to infection in the mine, or is attributable to the majority of the workers in this pit living in Ashington and becoming infected at their houses. To the extent that mine infection operated, it is to be referred either to the many opportunities of infection in the pits from the absence of proper methods of disposal of excreta, or possibly to the fact that in the pits the miners had access to contaminated water.

(3.) *Localised infection.*—There was evidence of attacks of enteric fever being grouped in neighbouring houses; a grouping which may well have been associated with the numerous opportunities of infection afforded by the local deposit of infectious matter in the privy-middens of the place. The grouping of cases in No. 9 Row, Ashington, during 1911-12, when taken with the excessive occurrence of enteric fever in this row in previous years, suggests the possible existence of a typhoid carrier in that locality.*

(4.) *Secondary cases in invaded houses.*—Some of the cases in the 1911-12 period were secondary to others in the same dwelling,

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* The stools of two or three suspected "carriers" have been examined at the instance of the medical officer of health but with negative results.

notwithstanding that the persons attacked had been removed from their homes to the isolation hospital. This, again, may be connected with local conditions of excrement disposal and soil pollution which favour infection.

Generally speaking, the study of the incidence of enteric fever in the years antecedent to 1911-12, shows that this prevalence might also be consistent with the operation of any or all of the causes above named.

Diarrhœa and Enteritis.—It may be noted here that these diseases occasioned 64 deaths of infants under one year old during 1911, as against 28 in the previous year. The medical officer of health points out in his annual report for 1911, that in 1901 epidemic diarrhœa and enteric fever were also simultaneously prevalent.

Isolation Hospital.—All the enteric fever cases occurring during the recent outbreak were treated in the isolation hospital belonging to the urban district council. This hospital, which was erected out of current rates, in 1902, was designed by a former inspector of nuisances. It comprises one brick building and one corrugated iron block.

The brick block is built in two storeys. On the ground floor are two wards each 30 by 14 feet, and 13 feet 3 inches high, built side to side, and separated by a party-wall. There is no through ventilation in these wards, nor is there even roof ventilation. The windows open by a falling sash at the top and are not made to open at the bottom. There are 11 beds in each of these wards, and during the recent outbreak, two children have sometimes been placed in one bed.

The water closet and bathroom are separated from the wards by a corridor which is unventilated, except when the intervening door is opened.

There is a bedroom for ward-maids on the ground floor. On the upper floor are a bedroom for the caretaker and his wife, and a bedroom for two nurses, the one opening through the other, with a bathroom and lavatory communicating with both.

During the outbreak, seven nurses were employed, of whom six slept " turn and turn about " in three beds.

The iron block comprises two main wards each 28 feet by 18 feet 4 inches, and 8 feet 6 inches to the eaves. In each of these 14 patients were accommodated during the outbreak. There are two smaller wards, one 14 feet 9 inches by 8 feet 10 inches, the other 9 feet by 9 feet, in each of which two patients were lodged.

At one time, 52 patients were under treatment in this hospital.

The design of the hospital, particularly of the brick block, is most unsatisfactory, the provision for ventilation being quite inadequate. The accommodation for nurses is insufficient. The hospital was grossly overcrowded during the outbreak. This overcrowding combined with the absence of proper ventilation, cannot but have been prejudicial to the convalescence of patients.*

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* *Note.*—Whilst this report is in the press I learn that it has been found impossible to deal adequately with a local outbreak of diphtheria by reason of the insufficiency of this hospital.

Recommendations.

1. The urban district council should take all practicable steps to obtain a water supply satisfactory in quantity and quality for the needs of the district.

2. They should adopt a water-carriage system for the disposal of sewage in their district. The existing privy-middens should be abolished, and replaced by water-closets, and satisfactory ash-bins should be provided for domestic refuse. Any reconstruction of the sewers in Ashington township that may be rendered necessary by the adoption of a water-carriage system should be considered, and a competent engineer should be engaged to advise on this point.

3. The infectious diseases hospital should be rebuilt, or remodelled so as to secure (1) proper ventilation of the wards; (2) adequate accommodation for the nursing staff.

In conclusion, it is my pleasant duty to thank the clerk to the urban district council, Dr. Mills, the medical officer of health, and Mr. Beatty, the inspector of nuisances, for assistance afforded me during my inquiry. I desire also to thank the officials of the Ashington Colliery Company, who gave me full information concerning the water-supply and other matters, Dr. Hembrough, the county medical officer of health for Northumberland, and Dr. Stevenson, of the General Register office, who supplied me with certain statistics relating to the age and sex distribution of the population of the district.

Reginald Farrar.