

# REPORTS

TO THE

## LOCAL GOVERNMENT BOARD

ON

## PUBLIC HEALTH AND MEDICAL SUBJECTS.

(NEW SERIES No. 22.)

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Dr. R. W. Johnstone's Report upon the repeated occurrence of Enteric Fever, from year to year, at Jennet Hill and Stanford Dingley, in the Rural District of Bradfield.

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By DARLING & SON, LTD., 34-40, BACON STREET, E.

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1910.

*Price Fourpence.*



# Dr. R. W. Johnstone's Report upon the repeated occurrence of Enteric Fever, from year to year, at Jennet Hill and Stanford Dingley, in the Rural District of Bradfield.

ARTHUR NEWSHOLME,  
Medical Officer,  
25 January, 1910.

In April, 1908, the Rural District Council of Bradfield wrote to the Board stating that the locality of Jennet Hill and Stanford Dingley had been subject to repeated outbreaks of enteric fever, and that the Council had endeavoured in vain to find any cause for the excessive incidence of the fever on this part of the district. They requested that the Board would allow one of their Medical Inspectors to undertake an investigation of the question. This duty was allotted to me, with directions to confine myself to making inquiry into the cause of enteric fever in this particular locality.

I visited the district in June and on several subsequent occasions.

My inquiries led me, at an early stage, to the conclusion that Stanford Dingley was not materially implicated in the spread of enteric fever in the locality. Almost all the cases had a more or less direct connection with Jennet Hill.

*Description of Jennet Hill.* — On the road between Stanford Dingley and Clay Cross, about quarter of a mile south-east of the former, there is a collection of cottages known as Jennet Hill. It is hardly of sufficient importance to be styled a hamlet. It consists of a row of ten dwellings, known as Lailey's Row, facing upon a *cul-de-sac* off the road referred to above, and of nine other dwellings scattered irregularly along the same road in the direction of Clay Cross, and also in the direction of Stanford Dingley.

Jennet Hill is situated near the centre of the rural district of Bradfield. There is no large town in the vicinity, Reading lying seven miles to the east, and Newbury seven miles to the west.

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Clay Cross village, quarter of a mile south of Jennet Hill, is on higher ground. Stanford Dingley is on the River Pang. The surrounding country is purely agricultural.

*Geology.*—Stanford Dingley is on the Chalk, and Jennet Hill on the Reading Beds, while Clay Hill and Bucklebury Common, which lies to the south of Clay Cross, are upon London Clay covered with gravel.

*Enteric Fever in the neighbourhood of Jennet Hill.*—At the outset of my inquiry I was supplied with a list of cases compiled by the late Dr. Woodforde during his term of office as medical officer of health to the district. I have interpolated in this list certain other cases which came to my knowledge in the course of my investigations, and I have omitted from it a case notified as enteric fever which was afterwards proved by post-mortem examination not to have been such.

The following table gives, in chronological order, the number of the cases thus ascertained, and also the date of notification, and the place of residence in each instance :—

TABLE I.

—	Date of Notification or attack ; dates of attack being in italics.	Residence at time of infection.
*1	22 Sept., 1893	Clay Hill.
2	8 July, 1896	Jennet Hill.
3	" "	" " Lailey's Row, No. 6.†
4	2 Aug., "	Jennet Hill.
5	" "	" " Lailey's Row, No. 4.
6	1 Apr., 1897	" " " " 5.
(a) 7	20 " "	Bucklebury Lower Common.
8	1 May, "	" " "
9	" "	" " "
10	1 June, "	" " "
11	" "	" Common.
12	1 Nov., "	Jennet Hill. Lailey's Row, No. 10.
(b) 13	30 Nov. 1897	Stanford Dingley.
14	11 Mar., 1898	Jennet Hill. Lailey's Row, No. 5.
15	1 Oct., "	" " "
16	17 " 1899	" " Lailey's Row, No. 3.
17	17 Aug., "	" " " " 10.
(c) 18	25 Aug. 1899	" " " " 10.
19	27 Aug. 1899	" " " " 10.
20	23 Aug. 1899	" " " " 5.

\* Said to have contracted enteric fever at Oxford.

† Lailey's Row is not numbered, but for convenience in reference fictitious numbers are given.

(a) Cases 7, 8, 9 and 10, all living at the same cottage with their mother, were brothers and sisters of the husband of case 6. Case 6 was partly nursed by the mother of these four subsequent cases, and infected clothing from case 6 was washed at the mother's house. Case 11 constantly visited case 7 when the latter was ill.

(b) Case 13 was admitted to the Royal Berkshire Hospital with "appendicitis and peritonitis" on November 30, 1897. He died without operation on December 16, 1897. He was a grandson of the occupier of Lailey's Row, No. 10, and constantly visited there.

(c) Cases 18 and 19 slept in the bed with case 17 until a week before their attack. They were not notified in Bradfield, but in London. Both are grandsons of the occupier of Lailey's Row, No. 10.

—	Date of Notification or attack ; dates of attack being in italics.	Residence at time of infection.
21	22 Jan., 1900	Jennet Hill. Lailey's Row, No. 6.
22	6 Aug., 1902	" " "
23	21 Nov., "	" " Lailey's Row, No. 6.
24	24 Sept., 1904	Bradfield. Near Traveller's Rest.
(a) 25	<i>24 Sept., 1904</i>	Jennet Hill. Lailey's Row, No. 10.
(b) 26	25 Oct., 1904	Bradfield. Near Traveller's Rest.
27	31 " 1906	Jennet Hill. Lailey's Row, No. 8.
(c) 28	28 Aug., 1907	Stanford Dingley.
(d) 29	<i>28 Aug., 1907</i>	" "
30	22 Sept., "	" "
31	15 " "	Jennet Hill. " Lailey's Row, No. 8.

(a) Case 25 was not notified in Bradfield Rural District. He fell ill with enteric fever in London about a week after his return from a visit to his grandmother, the occupant of 10, Lailey's Row, Jennet Hill.

(b) Mother of case 24, whom she visited in hospital.

(c) Grandson of the occupant of 10, Lailey's Row, Jennet Hill, and visited there regularly.

(d) Not notified as enteric fever. Sister of case 28, and visited at 10, Lailey's Row. Had headache and sickness for some days at the same time that her brother was ill. This may have been a case of mild enteric fever.

It will be seen that thirty of the cases set out in the above table have occurred since July 8th, 1896. Sixteen of these were notified from Jennet Hill, five from Bucklebury Common, three from places in London, two from Bradfield, two from Stanford Dingley. Two other probable cases of enteric fever which were not notified have been added. They came from Stanford Dingley.

All the Bucklebury Common cases beyond reasonable doubt were consequent upon infection carried from Jennet Hill. The three London cases were infected at Jennet Hill, and it is possible that three of the Stanford Dingley cases (Nos. 13, 28, and 29) were infected from the same locality. In all, 27 of the 30 cases that occurred during the period 1896 to 1907 inclusive are traceable with more or less certainty to 10 out of the 19 houses of which Jennet Hill consists. In comparison with the remainder of the rural district of Bradfield this is an extraordinarily heavy incidence of enteric fever. The population of Jennet Hill itself is not more than 80 persons, and if Stanford Dingley, Clay Hill and Bucklebury Common be added the population of Jennet Hill and its vicinity probably does not amount to 400. During the period 1893-1907 inclusive 36 cases of enteric fever were notified from the rural district outside the vicinity of Jennet Hill, with a population of about 15,000,\* while 26 cases were notified from Jennet Hill and its vicinity, with a population of less than 400. During the period 1896-1907 inclusive 25 cases were notified from Jennet Hill and its vicinity, and 24 cases from the remainder of the rural district. The incidence of the fever is even more notable in the case of Jennet Hill itself where 16 cases were notified from a population of under 80 during the period 1896-1907. Moreover, the circumstances recounted above point to Jennet Hill as the source of infection of 11 other persons who contracted enteric fever during the same period.

\* The rural district had a population of 15,260 at the Census of 1901.

TABLE II.

*Showing the age incidence of enteric fever in the vicinity of Jennet Hill, during the period 1893–1907 inclusive, compared with that in the remainder of the rural district during the same period :—*

	0–5	–10	–15	–20	–30	–40	+40	Total
Number of cases notified in other parts of the district during the period 1893–1907.	1	4	4	8	6	6	7	36
Number of cases in the vicinity of Jennet Hill.*	1	3	9	7	4	3	3	30

From this table it will be seen that the incidence of the fever was heavier on the age group 10–15 in the Jennet Hill neighbourhood than in the rest of the district, while relatively fewer Jennet Hill cases were over the age of 30. But the figures are too small to warrant any definite deduction.

Thirteen of those attacked in the vicinity of Jennet Hill were females and 18 were males. Two of the latter were under ten years of age.

TABLE III.

*Showing the seasonal incidence of enteric fever in the vicinity of Jennet Hill during the period 1893–1907 inclusive, compared with that in other parts of the rural district of Bradfield during the same period :—*

	Number of cases in Jennet Hill and vicinity during period 1893–1907.			Number of cases in other parts of Rural District of Bradfield during same period.		
January	...	1	...	...	...	1
February	...	—	...	...	...	3
March	...	1	...	...	...	2
April	...	2	...	...	...	3
May	...	2	...	...	...	5
June	...	2	...	...	...	2
July	...	2	...	...	...	1
August	...	9	...	...	...	1
September	...	5	...	...	...	5
October	...	4	...	...	...	7
November	...	3	...	...	...	3
December	...	—	...	...	...	3
		—				—
		31				36

In the Jennet Hill cases the maximum occurs in August, and is very marked, while very few cases occur in December, January, February, or March. In the remainder of the district the usual October maximum is shown, but the usual minimum in May is not apparent. It is to be borne in mind, however, that in dealing with so limited a number of cases no great reliance can be placed

\* The age of case 13 (not included in this table), was not accurately ascertained. He was a young adult.

upon the deductions made. So far as they go, the data point to the operation in Jennet Hill of some factor not at work, or at work in less degree, in the rest of the rural district, which would account for the marked maximum incidence in Jennet Hill during the month of August. In this connection, however, it is noteworthy that the excessive incidence during the month of August is partly due to the three cases which occurred at 10, Lailey's Row, among persons visiting there during that month (cases 17, 18 and 19). Probably also cases 28 and 29 (who were children of school age) visited their grandmother more frequently during the summer holidays than at any other time. If allowance is made for these five cases, and for the case No. 25, which was notified in September after a brief stay at 10, Lailey's Row, and for case No. 1, which is said by the late Dr. Woodforde to have been infected at Oxford, there is very little seasonal variation apparent, except the absence of cases in December, January and February.

If the incidence of enteric fever year by year, in the vicinity of Jennet Hill and in the remainder of the rural district be compared, lack of correspondence becomes apparent, as is shown by the following table :—

TABLE IV.

*Showing the number of cases of enteric fever, year by year, in the vicinity of Jennet Hill, and in the remainder of the Rural District of Bradfield respectively, during the period 1893-1907 :—*

				Rest of						Rest of	
		Jennet Hill.		R. D.				Jennet Hill.		R. D.	
1893	...	1	...	1	...	1901	...	—	...	6	...
1894	...	—	...	4	...	1902	...	2	...	2	...
1895	...	—	...	7	...	1903	...	—	...	—	...
1896	...	4	...	1	...	1904	...	3	...	—	...
1897	...	8	...	2	...	1905	...	—	...	3	...
1898	...	2	...	3	...	1906	...	1	...	1	...
1899	...	5	...	2	...	1907	...	4	...	2	...
1900	...	1	...	2	...						

There is, in most years, a marked lack of correspondence between the two parts of the rural district. It is especially noteworthy that in the three years 1894, 1895 and 1901, in which the greatest number of cases occurred in the rest of the rural district, no cases at all occurred in the vicinity of Jennet Hill, while in 1897, when eight cases occurred in the vicinity of Jennet Hill, only two cases occurred in the rest of the district. Subject to the caution to be observed in inference from a small number of cases, this discrepancy again suggests the existence of some influence more particularly affecting the Jennet Hill neighbourhood.

In considering the various circumstances to which the exceptional incidence of enteric fever on the neighbourhood of Jennet Hill might be attributed, it must be premised that my inquiries were hampered by the length of time which had elapsed since many of the cases occurred, with the consequent absence of some of the patients through death or removal, and difficulty of obtaining accurate details from those who remained.

*Consideration of the cause of the special incidence of enteric fever on  
Jennet Hill.*

*Water Supply.*—In 1893 the sole water supply of Jennet Hill was a dip hole at the roadside about 100 yards south of Lailey's Row. It was the property of Thomas Davis, who lives in the house adjoining it where case No. 2 occurred. The dip hole was quite unprotected from surface washings, and was said to be fed by a spring. In April, 1897, Mr. Davis filled up the dip hole, but it was reopened by some of his neighbours in the following year, at what exact date I have been unable to ascertain. It was finally filled in, after closure by a magistrate's order, in December, 1903.

In April, 1897, the parish council dug a shallow well a few yards above the dip hole, and erected a pump in connection with it. This water was the sole supply of Jennet Hill until the dip hole was reopened in 1898. The parish council well water proved to have an unpleasant smell, and was much disliked by the people in the neighbourhood, hence it is practically certain that the pump was not used after the reopening of the dip hole in 1898, and as a matter of fact it soon fell into disuse and disrepair. It has now disappeared. In November, 1900, the district council sank a tube well, 91 feet deep, by the roadside opposite Lailey's Row. This boring reached the Chalk, and provided a supply of water which, after the analysis of samples, has been pronounced pure both chemically and bacteriologically. Since December, 1903, the tube well has been the only supply.

The closure of the dip hole in April, 1897, did not prevent the occurrence of a case of enteric fever at 10, Lailey's Row, Jennet Hill, which was notified on November 1st of the same year (case 12), nor a further case (case 13), occurring on November 30th, the relationship of which with the same house has already been indicated. On March 11th, 1898, a further case was notified at Lailey's Row (case 14), but in spite of many inquiries I have been able to get no definite information as to whether the dip hole was open or closed at this date. In any case it was closed finally in December, 1903, but enteric fever again occurred at Lailey's Row (case 25) in September, 1904, in October, 1906 (case 27), and in September, 1907 (case 31), while cases 28 and 29 were possibly infected at the same locality.

Without doubt the water of the dip hole was exposed to danger of contamination both by surface water and through the dipping of buckets from infected houses, and if the infective material of enteric fever had gained access to it in either of these ways, might well have contributed to the spread of the disease. Nor need such spread have taken the form of a simultaneous and widely disseminated outbreak among the consumers, as is commonly the case when this fever is water-borne, inasmuch as the water was that of a spring flowing away from a shallow basin, which would not be likely, therefore, to retain infection long. Nevertheless, in view of the persistence of enteric fever during the temporary closure of the dip hole, and after its permanent closure, I do not think that it can be regarded as having played a material part in spreading the disease in Jennet Hill.



*Milk.*—The milk supply was inquired into in 23 instances. In four of these no milk was taken, and in the other 19 instances milk was obtained from nine different sources, and the incidence on each supply was roughly in proportion to the number of customers served in the neighbourhood. The same supplies were distributed in Stanford Dingley and elsewhere without any evil consequences. The prolonged incidence extending over a series of years is additional reason for excluding milk. There was no evidence therefore to incriminate the milk supply.

*Uncooked Foods and Mineral Waters.*—Inquiries were made particularly as to shell fish, cress, and mineral waters, and also in the cases I was able to personally interview, as to fruits, lettuces and onions. It was found that practically no shell fish was eaten, cress was partaken of by one or two people only, and vegetables and fruit were not consumed save by persons who grew them in their own gardens or allotments. Mineral waters were practically never used. It was in my inquiries about foods that the lapse of time proved the greatest impediment to obtaining reliable information. People could hardly be expected to remember what they ate or drank ten years ago. On the other hand in an agricultural neighbourhood there is little variety of diet, and present habits with regard to food are probably also those of ten years ago. There are no shops in the neighbourhood of Jennet Hill, supplies being obtained from tradesmen's carts, which come from Reading and Newbury.

*Infection in relation with disposal of excrement.*— All the dwellings in the neighbourhood of Jennet Hill dispose of excrement by means of pail closets. The contents of the pails are emptied on to heaps in the gardens, and covered with a little soil. At convenient intervals of time the heaps are conveyed to the fields and spread there. Formerly they were dug into gardens and allotments, but this has not been the case for the last two years.

Lailey's Row contains ten semi-detached cottages of four rooms each, rented at about 1s. 8d. a week. Each cottage has its own garden, about 30 yards in length, with the pail closet at the further end. The gardens are separated only by slight hedges two or three feet high.

There are no drains at Lailey's Row except a surface water drain in front of the houses discharging into an open ditch. Slops are thrown on the gardens.

Disinfection in Bradfield Rural District is carried out by a specially employed expert. His method with regard to "closets, drains and cesspits" is that they "are thoroughly coarse sprayed with 7½ to 10 per cent. carbolic acid (invoiced to me as 97 per cent. strength), and if excreta of the patient has not been buried, but is of surface disposal, such surfaces are coarse sprayed as above." The woodwork and boxed-in seats are treated in the same manner, and the brickwork underneath. Special attention was paid to garden heaps where excreta of patients had been turned out. Disinfection of closets, however, is never carried out until the removal or recovery of the patient.

There is no experimental justification for supposing it possible that the specific bacillus of enteric fever is capable of surviving

from year to year in the soil of the gardens.\* It is true that so long ago as 1898 the medical officer of health of the Borough of Eccles reported that Professor S. Delépine had isolated this bacillus from the scrapings of bricks forming the sides or bottom of a privy midden, into which infected discharges had been thrown 13 months before the examination was made. In this case, too, the midden had been disinfected more than once between the time of examination and the presumed time of infection. Efforts were made at the time to exclude the possibility of the midden having been re-infected by mild or unrecognised cases of enteric fever, but the possibility of infection by "carriers" had not then been discovered and could not therefore be excluded. In any case the disinfection carried out at Jennet Hill, as reported to me, was so thorough as to render it very unlikely that infection survived in the privy pails, much less persisted in them from year to year.

When cases were nursed at home in the locality of Jennet Hill the excreta were generally dug into the gardens, and the closets were not disinfected until after the patient's recovery. In the meantime they were liable to spread the infection either by contact, by flies, or by dust, and it is possible that cases may have been infected in this way.

*Infection by bacillus carrier.*—In view of the failure to account for the excessive amount of enteric fever at Jennet Hill in one or other of the ways already discussed, question arose whether, among its inhabitants, there might not be a "carrier"† of the fever, who could have served as the agency of its dissemination from time to time, either by personal contact or through less direct channels.

There had been three cases (13, 28 and 29) in a house at Stanford Dingley who had been constantly visiting 10, Lailey's Row, where five other cases occurred (12, 17, 18, 19 and 25). On inquiry it was found that the head of the Stanford Dingley household was a mineral water manufacturer on a small scale, and the owner of a cress bed. Twenty years ago he suffered from a severe illness attributed to influenza and phlebitis; since then he has been in good health with the exception of occasional attacks of sick headache. Particular inquiries were made at all the infected houses which were still inhabited by the patients or their friends, as to consumption of this person's mineral waters and cress, but the result was negative. For some reason he appears to have been regarded with suspicion in his own neighbourhood, and all those interrogated vigorously denied that they had ever partaken of either his cress or his mineral waters. It was ascertained that he made about eight dozen of mineral waters each fortnight, but they were not sold in the vicinity of Jennet Hill. They were mostly disposed of at Lidmarsh, where there was no special incidence of enteric fever.

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\* At the instance of the district council bacteriological examination of six samples of soil from various gardens in Lailey's Row was made, but in no instance was the bacillus of enteric fever isolated. *Bacillus coli communis* was reported to be present in three instances.

† A "carrier" of enteric fever is a person who, although he or she may be in good health, carries the infective material of the fever in his or her body, from which it may be given off in either the stools or the urine.

Attention was then directed to Lailey's Row. Of the 10 houses it comprises only four had escaped the fever, and three of these four houses had but few inhabitants, who were, moreover, of an age which would render them less susceptible to enteric fever. Two of these three houses were occupied by one old woman only, while a man of 53 and his father resided in the third.

Special inquiries were made as to the degree of intimacy prevailing amongst the inhabitants of Lailey's Row, with a view to ascertaining possible ways of extension of the fever from one house to another, whatever might have been the original source of infection. The information gained was singularly negative; the inhabitants never frequented each other's houses, never borrowed\* or lent cookery or eating utensils, never had fruit or vegetables from each other's gardens, never smoked each other's pipes, and never shook hands with each other. Nevertheless, having seen some of the inhabitants in their neighbours' houses, I am not disposed to place great reliance on the answers I received.

The house which presented most grounds for suspicion of harbouring a carrier case was without doubt No. 10. This house was repeatedly invaded by enteric fever, and several persons of susceptible age who resided there for only a short time were attacked. Moreover, the only relatives of the family who resided within visiting distance were attacked (cases 13, 28 and 29). The person most to be suspected would be one of two who prepared the food.

Specimens were secured of the blood of the father and mother of the Stanford Dingley household, also of one of the two persons who prepared the food at 10, Lailey's Row, and her father, but all proved negative with Widal's test. The other person who prepared the food at 10, Lailey's Row died in November, 1908. Her blood was not tested.

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When, early in 1909, the stage of my investigations, indicated in the foregoing account, was reached, the causation of enteric fever in the Jennet Hill neighbourhood still remained obscure. The evidence available did not point to the water, the milk, or the foods, as supplied to the community, having been responsible for the fever. Moreover there had never been a definite outbreak of the fever at Jennet Hill; instead of this, cases had kept occurring, one or two at a time, over a long period of years. These facts suggested the continued existence of some condition at Jennet Hill, sooner or later affecting susceptible persons coming within the range of its influence. The presence of an enteric fever "carrier" in the community would constitute such a condition.

But the occurrences of the fever up to this time, and the deductions that could properly be drawn from them, did not indicate, with sufficient conclusiveness, any particular member of the community to be the carrier, if carrier there were. The evidence, it is true, suggested that the carrier was most likely to be found among the inhabitants of 10, Lailey's Row; but, at the best, it afforded no

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\* The one admitted exception was some plates, knives, and forks borrowed from No. 8, Lailey's Row, by the inhabitants of No. 10 in 1907.

more than grounds for suspicion, and certainly did not exclude the possibility of there being a carrier in some other household at Jennet Hill.

The occurrence, however, in 1909, of further cases of the fever at Lailey's Row and also in connection with a family that had until recently resided there, cast a fresh light on the causation of the disease.

On March 27th, 1909, a boy aged 6 years, living at No. 8, Lailey's Row sickened with enteric fever. This boy came to No. 8, Lailey's Row with his family in October, 1908, the former occupants of No. 8 having removed a few miles away to another village. The family consisted of father, mother, the patient and another son aged 14, together with the patient's uncle who arrived on March 28th for a month's visit. The boy attacked had not been away from home except to go to school at Stanford Dingley. He had not been in contact with any known case of enteric fever, and he had partaken of no suspicious food or drink.

In May I heard, through the inspector of nuisances, that two cases of enteric fever had been reported to the medical officer of health from Newbury rural district, and that both had been attacked shortly after their return from a stay at the house now inhabited by the former occupants of No. 8, Lailey's Row. The following facts were ascertained: The patients, a mother aged 27 and her daughter aged 4, went to stay in the house on February 25th, 1909, and returned to their home on March 15th. The mother was first seen by a medical man about March 27th, but she had been ailing since March 7th. The little girl sickened about March 17th.

About May 13th a child aged 1 year, at No. 9, Lailey's Row, sickened. This child had been at No. 9 since October 18th, 1908. She was ill for about three weeks, the symptoms being obscure, but not inconsistent with a diagnosis of enteric fever, though a bacteriological examination of the stools made in the third week after the onset of the disease, proved negative.

In the meantime endeavours were being made to obtain specimens of the blood, fæces, and urine of the inhabitants of Jennet Hill and more particularly of those living in Lailey's Row. In spite, however, of the tact of the inspector of nuisances, the aid of the local nurse, and all the influence that could be brought to bear, including pecuniary inducement, only a small number would permit samples to be taken. Unfortunately some of the dwellers in Lailey's Row are not of a high type of intelligence, and soon became suspicious of our motives. Some pleaded outraged modesty, others had religious scruples, and argument and persuasion only made them more obstinate. Eventually samples of both fæces and urine were obtained from 18 persons,\* fourteen of whom resided in Lailey's Row, and a sample of fæces alone from one person. Samples of blood were obtained from 15 persons all residing in Lailey's Row. The bacteriological examination of these samples was made by Dr. J. C. G. Ledingham of the Lister Institute. Of the blood samples, 6 gave a positive reaction with Widal's test, and one gave a partial reaction. Blood samples were not taken from

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\* Only one of these was known to have had enteric fever.

any persons known to have had enteric fever, and in these circumstances the number of positive reactions must be regarded as remarkable. The *bacillus typhosus* was not recovered from any of the samples of urine, but four of the samples of fæces contained *bacillus typhosus* in large quantities. That is to say, four persons out of the 19 who supplied samples of fæces, were enteric fever "carriers." The results obtained from examination of the stools of these four cases were as follows. A.'s stools were examined on May 13th, June 18th, and July 3rd, with positive results on each occasion; on June 4th and July 16th, with negative results. B.'s stools were examined on June 4th and July 16th, with positive results. C.'s were also examined on June 4th and July 16th, with positive results. D.'s were examined on May 18th, June 2nd, and July 9th with positive results, and on June 24th, with negative results. The blood of A., B., and D. gave no reaction with Widal's test; the blood of C. gave a positive reaction.

A., B., and C. inhabit No. 9, Lailey's Row; D. is the person who formerly lived at No. 8, Lailey's Row, but removed in 1908 to a village three miles away.

In the cases of A. and D. no doubt arises, but in the cases of B. and C. I am not satisfied that the samples of fæces supplied for examination were really samples of the fæces of those persons.

Both of the latter refused flatly to furnish samples, but subsequently samples of fæces were procured, which were said to be those of B. and C., though this point cannot be regarded as altogether free from doubt. Endeavours are now being made to induce A. to enter a hospital for treatment, and to obtain samples from B. and C. through a reliable agent.

A. had been an inmate of a public institution for six months in 1872, three months in 1873, and for a short period in 1874. She had also been an in-patient at a public hospital in 1901, and again in 1905. There were no known cases of enteric fever at the public institution while A. was an inmate, and a scrutiny of the notifications of enteric fever from the public hospital during 1901 and 1905 does not suggest that enteric fever had been spread there by A. She has no history of enteric fever, or of any illness bearing suspicious resemblance to enteric fever. In or about the year 1888 A. and her family came to reside at Clay Hill next door to the house in which case No. 1 occurred. She states that while at Clay Hill her husband (B.) and her two sons (one of whom was C.) had enteric fever in April, 1891. C. was by her account removed to hospital suffering from enteric fever. None of these cases were notified as enteric fever, and the hospital books show that C. was not admitted until September 6th, 1892, and was discharged 11 days later. He is entered on the books as suffering from tuberculosis and was discharged relieved. This may possibly have been an unrecognised case of enteric fever, and it may be that A. became infected at the same time and commenced her career as a carrier in 1892. The following year her next-door neighbour (Case 1) had enteric fever, and immediately afterwards A. removed to No. 9, Lailey's Row (October 16th, 1893). No cases were notified from Jennet Hill until July, 1896. It is to be borne in mind, however, that there may have been unrecognised cases, and indeed the

remarkably high proportion of positive Widal reactions amongst the inhabitants of Lailey's Row rather points in this direction. From 1896 onward cases of enteric fever continued to crop up in Lailey's Row and its neighbourhood, as many as seven of them occurring in the houses next door to A.

B., husband of A., and C. her son, were both extremely difficult persons to deal with. No accurate details could be obtained from them. So far as is known, however, no cases of enteric fever have been associated with them at the places where they have worked. B. was in hospital with peritonitis and phlebitis in April, 1904.

D., a married woman who came to Lailey's Row in September, 1903, has no history of enteric fever nor of any illness at all resembling it, nor is there any history of enteric fever in families with which she had lived as a domestic servant. No case of enteric fever is known to have occurred in her own family until October, 1906, when her husband (Case 27) was attacked. Two cases, referred to above, have occurred in connection with the house which she has occupied since she left Lailey's Row.

*Conclusion.*—The account which has been given of enteric fever at Jennet Hill, and of the circumstances associated with its continued prevalence, points to the conclusion that certain members of the community, who proved to be "carriers" of the disease, were, at least in large degree, the sources of infection.

The beginning of the excessive incidence of the fever which has for so many years characterised this locality did not, it is true, coincide with the arrival of the carrier A. in the neighbourhood. No case of the disease is known to have occurred at Jennet Hill until nearly three years after she took up her residence there. It is, however, as has been pointed out, not improbable that unrecognised cases may have occurred at Jennet Hill during this period; moreover, even were this not so, such knowledge of the history of carriers of enteric fever as we possess suggests that considerable periods may elapse during which, for reasons not always apparent, they may not infect others. The facts that her next-door neighbour at Clay Hill was attacked by enteric fever, that the fever began to occur in serious amount at Jennet Hill within three years of her arrival at that place, that its further prevalence coincided with her continued residence there, and that none of the usual factors in the spread of the fever could be implicated, are indicative of causal relationship between her presence and occurrences of the disease.

Such connection as may have existed between the spread of fever at Jennet Hill and the presence of the carrier D. there may be presumed to have been less than in the case of A., since D. did not take up her residence at Jennet Hill until 1903. The history of D., however, in relation with the fever is of particular interest because of the disease, which had already attacked her husband while she was at Jennet Hill, having reappeared in connection with the house she subsequently occupied in a locality three miles away.

In view of the known potentiality of the carrier as an agent in the dissemination of enteric fever, the presence of A. and D. at Jennet Hill may have afforded sufficient opportunity for the

spread of the disease in this way without postulating the existence of other carriers in the neighbourhood. Nevertheless the marked association of the fever with No. 10, Lailey's Row, already discussed, is suggestive of the presence of a carrier in that household also; and it may be that the member of this family who died in 1908, was in fact a carrier. Nor indeed, in view of the limited number of instances in which the stools and urine of the inhabitants of Jennet Hill were bacteriologically examined, can the possibility of there being other carriers in the neighbourhood be excluded; although the detection of two undoubted carriers as well as of two persons in whom the presence of this condition is not yet free from doubt, together with the suspicion of the former existence of yet another carrier, is, perhaps, in itself sufficiently remarkable in so small a community.

The conveyance of the infective material of enteric fever from the carrier to his victims is usually effected directly, as the result of personal contact, or indirectly by means of food or drink or other articles contaminated by him. In what proportion the propagation of the fever at Jennet Hill was shared among those transmitting agencies could not be ascertained.

I have to acknowledge assistance received during this inquiry from the clerk to the rural district council. Mr. Windle, the inspector of nuisances, was most helpful not only by reason of his knowledge of the district, but also through his keen interest in the inquiry, and his untiring efforts to secure materials for investigation. My acknowledgments are due to Dr. A. Ashby for information as to the notifications of enteric fever in his district.

R. W. JOHNSTONE.

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