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ON A LOCALISED OUTBREAK

OF

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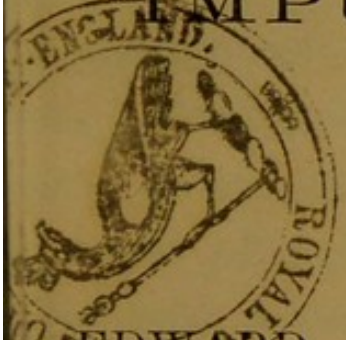
DURING THE MONTHS OF JULY AND AUGUST, 1870,

TRACED TO THE USE OF

IMPURE MILK.



BY

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MDCCCLXXI.

PREFACE.

The following paper from the pen of Dr. Edward Ballard, who holds the appointment of Medical Officer of Health to the Parish of Islington, was read before the Association of Medical Officers of Health at their ordinary meeting on November 19th. It was listened to with marked attention, and followed by an unanimous burst of approval, and by a resolution to ask Dr. Ballard's consent that it should be printed and circulated by the Association. The members present desired not only to express their own high sense of Dr. Ballard's labours, but to let the public see what untiring industry in collecting the minutest facts, what sagacity in linking together the chain of evidence, had at length driven him to the irresistible conclusion that the blandest and most unsuspicious article of food had been, and might be again made the vehicle of propagation of a most terrible and fatal disease. They hope that the public may be induced to lay aside their usual apathy, and see the duty of interesting themselves in the wholesomeness of the articles of food supplied to them, and of

supporting and encouraging the Medical Officers of Health, to whom the care of such matters is committed by the legislature.

The Association of Medical Officers of Health consists of members who hold or have held that office, and of other gentlemen, members of the medical profession, lawyers, chemists, and others, who are interested in sanitary science, and desire to watch and promote the operation of the laws for the protection of the public health. Public meetings, for the reading of papers and discussion, are held on the evenings of the third Saturday of every month, at a central spot — the Scottish Corporation Hall, Fleet Street (by the kind permission of the Corporation)—and gentlemen who desire to be present can easily obtain introduction as visitors.

R. DRUITT, *President*,
(*Late Medical Officer of Health to St. George's, Hanover Square.*)

J. NORTHCOTE VINEN, M.D.,
(*St. John's, Southwark.*)
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(*Guy's Hospital.*)
} *Hon. Secs.*

ON A LOCALISED OUTBREAK OF TYPHOID FEVER IN ISLINGTON.

The occurrence of a serious outbreak of typhoid fever in a district supposed to be under sanitary surveillance is to be regarded under most circumstances (some people would say under any circumstances) in the light of an opprobrium to sanitary administration. When, therefore, there happened in Islington, suddenly and without any premonition, such an outburst in a limited area as I am about to describe, it may readily be imagined that I was somewhat staggered. Isolated cases towards the end of the summer, dotted here and there, are what, I imagine, we all meet with, and Islington has in no year proved an exception in this respect to the rest of London. But such an outbreak as happened this year, confined nearly to one neighbourhood, I have never experienced during the fifteen years that the sanitary supervision of the parish has been in my hands. It was evident that something was seriously amiss. What was it? Was the fault mine? Had I failed to warn the local authority where warning was my duty? Had the local authority when warned neglected to interpose? These and similar questions naturally arose in my mind. An answer to them was imperative, if only for my own satisfaction. As it turns out, the inquiry which I instituted, and which from its extent and nature was surrounded with difficulties, has resulted in the discovery of a cause which it is important that the Association should be made acquainted with. The

facts elicited have a bearing upon our sanitary practice, and impart a warning to health officers and to the public alike.

I have placed upon the table one of the Ordnance maps, on which a circle has been described with a radius of a quarter of a mile, the centre of the circle being a spot about fifty yards to the north of the North London Railway. The line of the North London Railway cuts off to the north a little more than half this circle. It was almost entirely in this segment that the outbreak took place; indeed, I may say that nearly all the cases happened in families residing within a space which would be equivalent in extent to about a third part of such a segment. The subsoil of this part of the parish is mostly clay, in parts more or less mixed with sand. The elevation above the Ordnance datum is from about 106 to about 120 feet. The district is open, with wide roads and streets, and ample space between them. With some exceptions, the district is well sewered. About half the dwellings have been erected within the last twenty-five years, some even more recently. It includes some of the best houses in the parish of Islington. The water supply universally is from the mains of the New River Company. The railway-cutting, which crosses it and forms the base of the segment of the circle mentioned, is of a depth of about thirty feet. It has recently been widened, but long before the fever broke out the exposed surface had been covered by brickwork. On the south side of the cutting is a large yard, where several hundred horses are kept; the dung-shoot is situated within 100 yards of the cutting.

Between July 3 and September 10, I have ascertained that the occupants of sixty-seven houses in this district were invaded by typhoid fever, 168 individuals having been attacked with greater or less severity, of whom twenty-six died. With only nine or ten exceptions, the families invaded were those of independent persons or well-to-do shopkeepers, and were attended by private practitioners. Within the same period there occurred in the whole of the rest of the parish put together (the area of the parish being 3,127 acres) twenty fatal cases of the same disease. I have no means of knowing all the cases that happened in the parish which were not fatal, but I have a

record of attack of the occupants of forty-one houses and sixty individuals. The fatal cases are all I can enumerate with certainty. The reason of this is that, whereas, under the special circumstances of the inquiry, private practitioners kindly furnished me with lists of cases they attended in the district specially invaded, so generally that I believe there can have occurred but very few cases which have not been brought to my knowledge, I am under no such advantage as respects the rest of the parish.

But before these gross numbers can be accepted, some weeding of them is necessary. Thus, within the radius specially invaded there was one of the 168 individuals who came ill from the country, having certainly got her typhoid elsewhere, and came into the district to die, leaving 167 cases and twenty-five deaths to be accounted for.

Beyond the radius, in the rest of the parish, six of the twenty fatal cases certainly got their disease either in the country, in the City, or outside the parish of Islington. Subtracting these, we have left fourteen to account for. Of these fourteen, one, at least, a drain-cleaner, working in all parts of London for the General Omnibus Company, is just as likely to have got his disease out of Islington as in it. Thus we have twenty-five fatal cases within the radius to compare with thirteen fatal cases out of the radius—that is, nearly twice as many as in all the rest of the parish put together.

I have said that the cases which are referred to within the quarter-mile radius were, with few exceptions, in well-to-do families. They occurred at a season of the year when such families habitually take a holiday trip, and it so happened that in several instances the individuals were attacked and passed through their disease in some part of the country. Some of them left London feeling ill, others were seized with the initial symptoms a day or two after leaving home. One young man, attended by Dr. Pirrie, of Aberdeen, was attacked about five days after leaving home, others after an interval of several days or longer. By communication with their medical attendants in the country I have taken pains to verify the nature of the illness. Such cases are included in the enumeration wherever

I have been able to satisfy myself that, taking the period of incubation and all the circumstances into account, it was fair and right to do so.

As happens in all similar outbreaks, the disease presented varieties in the different individuals attacked. Some suffered from mild attacks, others from severe and fatal ones; different members of the same family suffered in different degrees. In some all the features of typical typhoid were presented; in others, one class of symptoms, such as diarrhœa, delirium, prostration, &c., predominated; in others, the disease was so mild as to have led to its designation as "febricula" rather than as typhoid, the occurrence of other severer and more typical cases in the same family alone enabling the practitioner to class it under its appropriate designation. I may state, however, that these very mild cases did not form more than a minority among the attacks. The fact that 15 per cent. of the attacks of persons dwelling within the radius were fatal, will show that the disease was tolerably severe on the whole, and that probably few mistakes in diagnosis were made.

The important questions are: How did the typhoid originate? And how did it come to spread over so many families?

We may take the question of its diffusion first:—The outbreak created some excitement and a good deal of speculation as to its cause. In this the local practitioners, especially those who had the care of the sick on the spot, very naturally took part; and various suggestions were offered me, all of them valuable, as proceeding from thoughtful and experienced men, some of whom held their opinions strongly. The suggested causes of the outbreak, however, resolved themselves distinctly into four. I have been unable to add another. I will take them, therefore, in order.

1. It was suggested that the alterations made in the railway cutting were the cause of the outbreak. It was said that, in widening the way, not only had an extensive fresh surface of earth been exposed, but that old drains and sewers had been cut across, from the mouths of which miasmata had issued, which had poisoned the entire neighbourhood. By looking at the map, on which the invaded

houses are marked, you will see that there was some colour for this idea, since some of them are situated very near to the railway cutting, and it was a notion very likely indeed to arise in the mind of a medical man attending cases in these houses. But 1. However applicable such a theory may have appeared under such circumstances, it is manifestly inapplicable to explain the invasion of houses at a distance from the cutting. 2. The widening of the railway extended in both directions far beyond the boundaries of the invaded district, and yet no typhoid developed in the adjoining houses. 3. The houses first invaded —that is to say, in the first fortnight—were not specially those adjoining the cutting. The disease broke out almost simultaneously in houses distributed in various parts of the district. 4. As a matter of fact, for which I have the authority of our surveyor, there was but one sewer cut across anywhere. I have marked its situation on the map. It was an old brick barrel drain, which had long been disused, and, as it ran at the rear of the houses, had been broken up. It was only pervious for a short distance from the cutting; it was quite dry and free from deposit, and no bad smell at any time proceeded from it. This is the result of a special examination of it by our surveyor. It will be observed, however, on looking at the map that the neighbourhood of this open drain was not that where the disease was most prevalent. On these grounds I am bound to absolve the railway works.

2. Another suggestion was that the fever was due to the effluvia proceeding from the dung-shoot of the yard previously mentioned. No doubt this shoot is frequently a source of nuisance to the neighbourhood, this nuisance arising at the time when the dung is removed by the carts. It requires more constant watching than our sanitary staff, with the multifarious duties now imposed upon it, can exercise. But I cannot admit that it was the cause of the fever, for the following reasons: 1. That only two houses situated within fifty yards of the shoot were invaded, while the bulk of the invasions were of dwellings two hundred yards and upwards away from it. 2. That, under the worst circumstances, the

effluvia on removal of the dung are not perceptible to a distance of more than one hundred yards, and there only faintly and occasionally. 3. That on three sides the shoot is overhung by dwellings occupied by labourers or poor people, yet in these dwellings not a single case of fever occurred.

3. The third suggestion is not quite so easily disposed of—namely, that the several domestic invasions in the district were due to local sources of miasm developed in each dwelling attacked. Now, it so happened that the earliest cases occurred under circumstances which either did not exclude altogether the probability of the typhoid attack having been dependent either wholly or in part upon a local miasm, or in which there was a possibility that it might have thus originated. Thus, out of the first nine houses on my list of invasions, I found such conditions present in seven. I may quote them as instances. They were: Offensive effluvia in the living-room of the family, due to rat burrows communicating with an old brick drain of an adjoining house; a foul receiver at a gully in a cowyard; a dung-heap about twenty yards from the house; an offensive cess-pit and bar, used by a builder's labourers, about twenty yards from house; a broken drain within the house, emitting offensive effluvia; offensive accumulation of dust and refuse in back area, &c. So frequently were such or similar conditions met with in my first inspections that, as any one else probably would have done, I attributed the typhoid to the sources of miasm I discovered, and for a time was quite satisfied that I was correct. The outbreak was far advanced before I seriously entertained any doubt upon the subject; and the reason was, that inasmuch as the large majority of the outbreaks occurred in private families, I did not hear of more than a small number until this period, or until medical men in the district found, by talking together, that each had an unusual number of cases on his hands, and kindly furnished me with lists. But now that my own list is completed, I find that conditions such as I have referred to would, with the utmost stretch of probability, only explain, or assist in explaining, about 37 per cent. of the domestic invasions. The remainder would be inexplicable on such

grounds. It is true that in nearly every house inspected I found two unwholesome conditions present—viz., a communication of the waste-pipe of the cistern with the drain or water-closet or stack-pipe, and an imperfect trapping of the sink-pipe, in consequence of the want of a syphon trap at the bottom. But throughout the parish—I expect I may say throughout the metropolis—these faults are almost universal, and so they would not satisfactorily explain the selection of the district chiefly invaded, nor yet the selection of individual houses in the same streets, &c., leaving others untouched. Even now, with my present knowledge, I cannot altogether absolve the unwholesome conditions I have enumerated in the minority of houses from all share in the production of the typhoid attacks. Their true etiological relation to the attacks, as it appears to me, will be mentioned presently.

4. The fourth suggestion made to me proceeded primarily from a lady, secondarily from her medical attendant, to whom she expressed her idea. Fever occurred in this lady's family, and in four families of her acquaintance about the same time. She then called to mind that some little time previously she had changed her milkman, and, as ladies will do, had induced these friends of hers to adopt the same tradesman. *Ergo*, it was the milk. It happened that her medical attendant, during the months of July and August, had several families of his *clientèle* down with typhoid, and, among the rest, the family of the very milkman whose wares were suspected. He wisely made some cautious inquiries, and found that out of eleven such families there were ten who were supplied from this source; the exceptional family resided a mile and a half off. Comparing notes with other private practitioners, the reality of a serious outbreak became obvious. Till then I had only heard of fatal cases, but now these other gentlemen began to make a similar inquiry, and there was such uniformity in the result that one after another communicated with me upon the subject. Altogether, private lists of cases were furnished to me by nine private practitioners in the neighbourhood, marking the families supplied by this milkman—some spontaneously, others immediately on my request. At first I confess I was

sceptical; I thought I could satisfactorily account for the cases, without having recourse to what appeared a rather far-fetched theory; albeit, it became the favourite one with my medical friends, each, of course, guided by his individual experience. I thought, considering the limitation of the outbreak, and the probability that a milkman in the neighbourhood would supply a great part of it, that, after all, the association observed might be nothing more than a coincidence, strange and curious indeed, but of no scientific worth, and I did not hesitate to check gossip by saying so. When I add that now I not only believe that the distribution of milk from the dairy I have mentioned was the means of sowing typhoid in the district, but regard it as proved, it may be readily conceived that the evidence I have gathered is tolerably convincing.

The general result of an inquiry into the milk-supply of the families within the quarter-mile radius into which I ascertained that typhoid fever had entered was this, viz.:—

That it occurred in the house of the milk vendor, where the business was carried on. He died; and seven other persons, members of his family, or boys employed and living on the premises, had typhoid, and one of the latter died.

That it occurred in the family of a person who dwelt in a small cottage in the cowyard, distant about 100 yards from the last-mentioned house and dairy, three persons having fever here. The first case here was in a girl, who, a fortnight before she actually fell ill, had left a situation at a public-house supplied with milk from this dairy, and since then had been residing at home. This family, the mother of the girl told me, rarely took milk, except on Sundays, being poor; but when the girl was ill, milk was given to them from the dairy. The mother herself, and subsequently a little boy, had typhoid when the girl was convalescent.

That, in addition to the two boys who had lived in the house for a longer or shorter time, two men engaged in the business, who did not live in the house, had typhoid. One of these was the cowman, engaged after the master was taken ill; the other was a young man who worked at the cowyard and carried out milk, and who took all his meals at a coffee shop

supplied from the dairy, and where two families, also supplied from the dairy, had fever.

That a fifth man employed at the cowyard, and residing at home, had fever. He also occasionally had his meals at the above-mentioned coffee shop, and his tea at his mother's, who was supplied from the dairy. His family being poor, he bought no milk for them anywhere, and he was the only member of it attacked.

That another single man, residing within the radius in a wholesome house, and engaged as a coachman outside the radius, who habitually took his meals at this same coffee-house, had an attack of typhoid.

That (omitting the girl who came ill from the country), out of sixty-two other families within the district which are known to have suffered from typhoid, fifty-four, or fully 87 per cent., were constantly supplied from the dairy with the milk they required, two were occasional customers, and five only stated that they did not deal there at all. I am not quite sure that complete reliance can be placed on this last statement; certainly I doubt it in one case of the five. All five resided close to the dairy, and it is very probable obtained there, as the most convenient place, any extra milk their families required. In another instance, a girl was attacked in a family not supplied by the dairy, but it appeared that, on two consecutive days in the beginning of July, she had taken tea with a schoolfellow, who, with her mother, had typhoid a few days later, this family being supplied from the dairy. No one else in this girl's family had fever.

Confining myself now to the *fatal* cases happening in families who resided within the quarter-mile radius (some of which individuals, however, were taken ill or died in the country), but excluding the girl who came ill from the country and died within the radius, I find that the total of such cases was twenty-five. Every one of the families in which these deaths occurred dealt for milk with the dairyman in question—[I include here the deaths in his own household]—only one of them was an occasional customer.

Outside the radius, in the rest of the parish, I said I had

fourteen fatal cases to account for. Five of these fourteen occurred in families supplied by this dairy—that is, more than a third of them. With such facts as these before me, I had a strong *primâ facie* case against the milk; but, strong as it was, it did not absolutely exclude the idea of mere coincidence. I did not know how far the dairyman's connection extended. I learned, however, that customers of his outside the radius, some at the distance of a mile or more, had been attacked with typhoid, and that several of them had died. What I had now to do, therefore, was to ascertain what families he actually did supply; with this information I should be able to determine the question decisively. Accordingly, I communicated to the father of the deceased dairyman the rumour which was freely canvassed both in the profession and in the neighbourhood, and suggested that it would assist in settling the question if he would consent to furnish me with a list of his son's customers. It redounds greatly to his honour that he at once complied with my request, and expressed his desire to do everything in his power to assist in unravelling the mystery of the outbreak. I may say here, as the proper place for saying it, that he fully carried out his promise, and in doing so has earned not only my personal respect, but the sympathy and respect of every right-minded person.

The result of my inquiry in this direction is that the members of 142 families were supplied with milk from the dairy in question. The district within the quarter-mile radius alone must contain over 2,000 families. So, after all, no very considerable proportion got their supply from this source. Out of these 142 families (which include the dairyman's household), I have ascertained that seventy were invaded by typhoid within the ten weeks during which the outbreak extended—that is to say, half of them were invaded. This includes all the families which had deaths from typhoid. I did not go from house to house to inquire among all the customers, so that it is quite possible that other non-fatal cases may have occurred in other families whose medical attendants have not communicated with me. But this is enough for us. Inquiring as to the source of milk-supply in all the other instances of typhoid in the parish,

during the same period, that came to my knowledge, I scarcely ever heard the name of any one milkman mentioned twice.

In these seventy families there happened altogether 175 cases, of which thirty were fatal—that is, the fatality was 17·1 per cent.

Again, taking the list of customers, I have gone through my mortuary records with it house by house, and I find that, besides the thirty deaths from typhoid which I knew of, there were altogether but three other deaths in these families—one was of an infant born prematurely (from what cause I could not ascertain), one was of a person who died suddenly with fatty degeneration of the heart, and the third was of an old lady, whose death is attributed on the certificate to "choleraic diarrhœa."

Probably, enough has been stated to satisfy you, as I am satisfied, that the distribution of the typhoid was connected with the distribution of the milk from the particular dairy referred to. But, at the risk of being charged with heaping Ossa upon Pelion, I shall mention some other observations which add confirmation to the inference. They are interesting apart from this use of them.

1st. It is remarkable how the typhoid picked out, as it were, the customers of this dairy in particular streets and rows of houses. Thus, in one long road, and a street issuing from it, at a distance of a mile or more from the dairy, it supplied three families; of these, two had typhoid. It supplied two families in a street with about thirty houses; one suffered from typhoid; in the other died the old lady already mentioned from "choleraic diarrhœa." It supplied four families in a new neighbourhood with about seventy houses; three of these families had typhoid. It supplied four families in a crescent with twenty-five houses; all four had typhoid (in one only a single mild case occurred). It supplied four families in a row of nine houses; typhoid occurred in two of them, and in the other two, cases of a mild febrile character (not enumerated) occurred. It supplied four families in two opposite rows of houses, altogether about sixty-seven; three of them had typhoid happen in them. It supplied four families in a square with

fifty-nine houses; all four had cases of typhoid happen in them, &c. And these were, so far as I can ascertain, the only cases in these several localities.

2nd. It is to be observed that there were comparatively few solitary cases in the seventy families. Solitary attacks only happened in twenty-two of them; and these twenty-two include the three individuals who alone, of all the inhabitants of the same house, had the opportunity of getting their disease from the use of this particular milk. Of the sixty-seven invaded families in which several members were exposed to the same risk, there were, then, only seventeen in which solitary cases occurred. The attacks were multiple, then, in 75 per cent. In these families, the number of cases varied from two to eight in a family, the average being a little over three cases per family. All will agree with me that this highly multiple character of the attacks in families is a feature not commonly met with except under circumstances where all the members of a family have been exposed to a common cause.

Still, it does not follow that where multiple attacks thus occurred every case in a family was due to the use of the milk, and that alone. Probably, in some instances, the disease, being once introduced into the house, and implanting there the contagion through the discharges, spread in the family and household, as it often does under such circumstances. This was very likely the case in some of those instances where an interval of two or three weeks elapsed between the first seizure in a house and the subsequent ones. In favour of this view, I may state that in one instance in which typhoid contracted from this milk was developed in the country, it spread in the family and house to which the patient had migrated. In one instance a servant went to her home in Islington ill, and her father there was attacked. I have not been able to ascertain, although I have inquired, that a similar event happened in any other instance. But if this explanation held good to any great extent, we should have expected that the multiple character would have been as strongly marked in the domestic invasions occurring late in the outbreak as in those occurring early in it. On the contrary, however, as the invasions of houses supplied with

this milk became delayed, so the multiple character of the domestic attacks became less marked. Thus—

					Total cases at intervals.
In the	1st week	9	houses were invaded	32 or 3·5	per house.
,,	2nd ,,	16	,, ,,	52 or 3·2	,,
,,	3rd ,,	13	,, ,,	36 or 2·7	,,
,,	4th ,,	6	,, ,,	17 or 2·8	,,
,,	5th ,,	6	,, ,,	9 or 1·5	,,
In subsequent weeks		18	,, ,,	29 or 1·5	,,
		68		175	

There was, moreover, no instance within the quarter-mile radius in which two families were attacked in the same house, except where both families used the same milk. On the other hand, there were several instances in which, more than one family residing in a house (the different families using milk from different purveyors), that using the milk from the dairy in question alone suffered.

3rd. The attacks in families appeared to have some relation to the quantity of milk consumed. It is a matter of common remark that milk is more largely consumed by females than by males, and by children than by adults. Now, leaving out the young children attacked in the families supplied by the dairy, and taking those over ten years of age and the adults, I find that, while ninety-seven females had the fever, only forty-four males had it—that is, females formed nearly 69 per cent. of those attacked above ten years of age. I am not aware that, under ordinary circumstances, typhoid shows any such remarkable preference for the female sex. Again, out of forty-seven families in which multiple attacks were observed and the date of the *first* case was determined, it occurred—

In a woman over 20 years of age	20	times.
,, child under 10 years of age	12	,,
,, girl between 10 and 20 years of age	6	,,
,, man over 20 years of age	6	,,
,, lad between 10 and 20 years of age	3	,,

The first attack in the house only occurred in a man or youth nine times out of forty-seven. Some curious illustrations of

this relation came out under the inquiries instituted at individual houses. Thus, in the family living at the cowyard, the daughter, while engaged as a nurse in a situation, alone got the dairy milk with regularity, and she was the first attacked; the second case in this house (her mother) was a month later. In a family consisting of the father and mother, who never took any milk at any time, two servants and four children, all had typhoid, except the father and mother, the children commencing. In another family, consisting of mother, two servants, three girls, and a boy of seventeen, one of the girls and the boy took milk porridge daily at breakfast; the other girls, with the mother, took little milk comparatively. The servants, complaining that the beer was sour, asked permission to have milk instead of beer. The girl and boy who ate porridge and the two servants were alone attacked. In another family, where a daughter aged eighteen and a son aged five years were attacked, the daughter, I was told, was a great drinker of milk, and she was attacked a fortnight before the son. In a house occupied by several families, using one privy, and where the drain-smells from an over-filled cesspool were very offensive, only one elderly man and woman were attacked. They alone drank milk from the dairy; the other families, being poor, had never any milk at all, and altogether escaped. In another family, the only person attacked was a young girl, who, being in delicate health, took more milk than all the rest of the family. Mr. Clifton also told me of a case of typhoid, which is not enumerated here, in the person of a young lady whose family was supplied by some other purveyor, but who fancied to drink daily a glass of milk from the dairy in question. No one else in the house ever took this milk, and she alone suffered.

I have very little more to add about the cause of the distribution of the disease. I have stated that miasmata of local origin played a part in the etiology of the outbreak. Such local miasmatic conditions were discovered in or about twenty-three out of sixty-eight houses in which fever occurred in connection with the use of this particular milk. This number is equivalent to 33 per cent. Now, it is well worthy of remark that the houses thus conditioned were, on the whole, those

attacked earliest in the outbreak among the customers of the dairy. Thus, of the twenty-five houses invaded in the first fortnight, fifteen were thus circumstanced; of the nineteen in the second fortnight, seven; of the sixteen in the third fortnight, one was dirty and unwholesome; of the eight at later periods, all were free from local miasm.

There can be little doubt that although these unwholesome conditions proved of themselves insufficient to produce typhoid in the persons exposed to them, yet that such exposure imparted a disposition to suffer from the contagium introduced into the system by the stomach.

These twenty-three houses had eighty-three cases amongst them; in only two of them were there solitary cases of fever. The average in the twenty-one multiple invasions is, then, 3·8 cases per house instead of three cases, as was averaged in the multiple invasions generally. And the fatal cases were twelve—that is to say, the fatality under the combined influence of the milk and miasm was at the rate of 14·4 per cent—which is lower than the average fatality. The inference being, that although the combination forced, as it were, an attack of typhoid on some individuals who probably would not have suffered from the milk alone, the attacks such individuals underwent were comparatively mild.

How did the typhoid contagium get into the milk? In considering this question we shall be considering the origin of the outbreak.

1. It is clear that it must have got into it either before it was sent out from the dairy or subsequently. The only probable way in which it could have got into the milk in its passage from the dairy to the customers is by the addition of foul water by the milk-carriers, in pursuance of a fraud upon their master. But against this supposition we have the fact that the young man who managed the dairy business—the master, indeed (who was one of the first fatally attacked)—himself carried out a great part of the milk in a cart, and also the fact that the disease, even in the first week of the outbreak, was so widely known as to preclude the idea of such a fraud having been

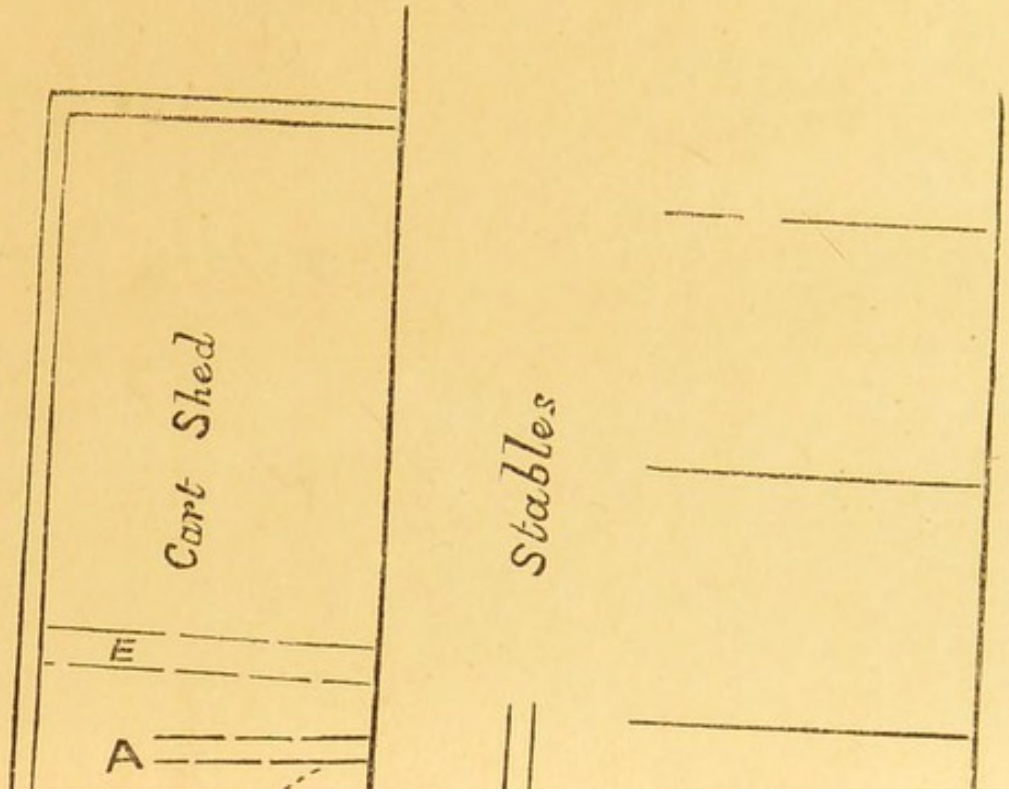
perpetrated unless by general concert between the master and the men. Neither will it serve to explain the fact that the family of the dairyman was itself attacked very early in the outbreak. The milk that they got is not to be supposed thus fraudulently contaminated by a milk-carrier outside the premises.

2. But besides sending out the milk furnished by his own cows, this dairyman often bought milk for sale from other sources. Sometimes, when the demand was greater than his supply, or when two or three of his cows ran dry, he bought considerably. Was this milk that he bought and served out to his customers, together with his own, that which contained the contagium? I inquired where the milk, under such circumstances, was obtained, and the answer was, from neighbouring cowkeepers, and several that I know were mentioned to me. This was quite sufficient to clear the purchased milk from suspicion; because, if that supplied from any one of these dairies had been the dangerous milk, I should have found the principal cases of typhoid in families supplied by that dairy. Now, as a matter of fact, in my inquiries throughout the parish into cases occurring during the whole ten weeks, I scarcely heard the name of any other dairyman mentioned twice.

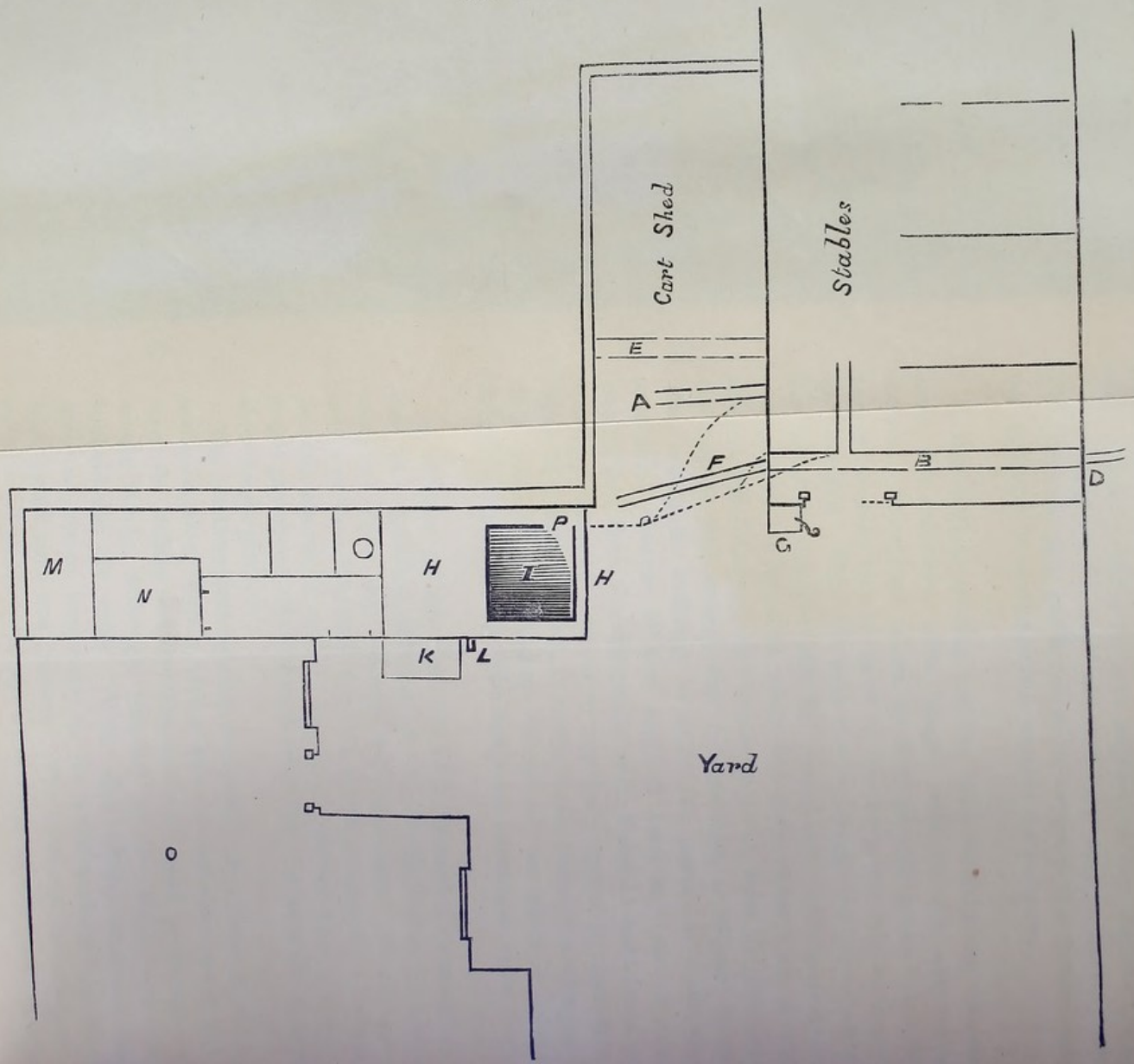
3. If, then, we ask *where* the milk obtained the contagium it held, as a question preliminary to *how* it obtained it, the answer must be—Upon the premises of the dairyman. My investigation was now localized, and the question came to be—What possible sources of typhoid contagion existed upon the dairyman's premises? And now I must tell you something about their geography.

The cowhouse was situated on one side of a large open yard, communicating with a narrow lane, at the entrance of which were the stables and dwelling-house of a cab proprietor, into whose family, although supplied by the dairy with milk, typhoid did not enter. With this trifling exception there were no houses very near it; its neighbourhood was mostly unoccupied land and gardens. The cowhouse formed part of a range of stable-buildings on one side of the yard. On the

e Dairyman's Premises, drawn by the Surveyor of the Parish of Islington, on Scale of One-eighth Inch to One Foot.



Plan of the Dairyman's Premises, drawn by the Surveyor of the Parish of Islington, on Scale of One-eighth Inch to One Foot.



A. Old 6-inch disused brick drain, containing slush. B. Stable brick drain, old. D. 6-inch pipe to sewer. E. 12-inch old, disused, dry, brick drain. F. Pipe from closet to B. G. Pump. HH. Office. I. Underground tank. K. Flap-table. L. Tap from cistern. M. Cistern. N. Open back yard. O. Part of dwelling house. P. Situation of gap in tank, and hole at bottom of which rat burrow began. *Dotted Lines.* Rat burrows.

adjoining side was a row of buildings used as warehouses. The cowhouse was well paved and always kept clean. There was no drain but the surface one, which conducted liquid matters along a channel to the centre of the yard, where they entered a gully opening, and passed away into the drains. The stables were drained by pipes towards the same gully, the pipe being continued into a small sewer in the lane. The dung was stored against the wall of the stable. I have no record of any complaint being made at any time against these premises on the score of uncleanliness. They were always clean when I have seen them. Ten or eleven cows were kept here. At the time of the outbreak, and for a long time before, there had been no disease among them—they were a fine and valuable lot of cows. The young man who carried on the business up to the time of his illness milked them himself, and saw to their being properly kept. In the centre of the yard, the paving of which had, from the heavy traffic upon it, got a good deal out of repair, was a large heavy gully grating, which it was always believed was properly trapped, but which, on examination in the course of the inquiry, was found not to be so. Beneath it was a receiver about three feet deep, from which the drain passed. I perceived no offensive smell from it, nor can I hear of any one who ever noticed any; but on gauging it with a fork, a violent gush of offensive gas was evolved, almost explosively. On the side of the yard opposite the warehouses was a cottage of two rooms, occupied by one of the workmen, his wife, daughter, and little son. All but the man had fever. The daughter was taken ill the same day as the dairyman—namely, on July 9. This was the girl I have mentioned who had left a situation as nurse, where the milk in question was supplied, a fortnight before her illness. Above the cottage was a large open iron tank of New River water. When I saw it, it was foul. It had no waste-pipe. It was used for the cows and horses, for washing vans, and for all domestic purposes by the occupants of the cottage.

The milk business, however, was not carried on here, but at premises about a hundred yards off, to which the milk was carried in the cans prior to distribution. I am assured that

none of the water from the tank over the cottage was ever added to it.

The premises where the milk business was conducted consisted of a dwelling-house, covered yard, stable, and offices. The arrangement of these is shown upon the accompanying plan. With respect to the stable, I must say that it was large, airy, admirably paved with iron bricks, and always very clean. It was provided with pipe drainage beneath the channel, entering an old brick drain (B), and with patent stable traps. Prior to the outbreak in these premises I am informed that some of these traps were broken, and that the smell was very offensive, and diffused into the yard beyond, especially when a closet, used by the workmen on the premises, which communicated with this drain at the further end of the stable, was flushed. During the illness of the dairyman at this house, the new traps were put in, and I am informed there was no accumulation in the pipes. At the side of the stable was a cart-shed, and near its entrance a wooden and glass office, attached to which, on the outside, was a flap-table, and above this, on the woodwork of the office, the cans used in the business were hung up. The kitchen of the dwelling-house, projecting backwards, had a window looking upon this table. The water-closet was situated in a narrow strip of yard at the rear of the kitchen. There were two receptacles for water on these premises. One was a cistern situated in the back yard. It was closely and well covered, and when examined found to be scrupulously clean. The waste-pipe did not pass into a drain, but discharged upon the surface of the paved yard. From this cistern a pipe proceeded to a tap at the side and a little below the level of the flap-table mentioned. The other was an underground tank, situated beneath the flagstone paving of the office against which the flap-table was erected. The water was drawn from it by means of a pump situated at the entrance of the stable from the yard. I may mention for what the fact is worth, that this pump, although in view from the office, was not in view from the window of the kitchen looking upon the flap-table. This tank, like he cistern, was supplied from the mains of the New River

Company. It was constructed about sixteen years ago, and during that time no examination had been made of it. It had, however, been opened occasionally when it became dry from fixing of the ball-cock. But the time had now arrived for a thorough examination of it to be made. This examination, however, from the absence of the occupier of the premises during the convalescence from his attack of fever, had to be delayed, and it was not thoroughly examined until the beginning of November. There was no objection to this delay, inasmuch as the death of the young man who carried on the business led to the trade being given up, the cows being sold off very shortly after his death, which took place on August 12. I may mention here, again, for what it is worth, that only eight fresh houses amongst the customers of the dairy were invaded after this date, six of them in the fifteen days between the 12th and the 27th, and only two later.

We may ask, then, which of these two sets of premises—the cowhouse and yard, or the business premises where the milk was sold—furnished the contagium to the milk? To take the cowyard first, there were present as possible sources of typhoid effluvia the foul receiver in the centre of the open yard, and the foul water-tank over the cottage. I think we may absolve the latter at once, inasmuch as it is improbable that water would have been added to the milk here while there was plenty at the place of business whither the milk was to be carried. With respect to the foul receiver in the yard, I should place little value on any objection to it as a probable source of contagium on the mere ground of offensive effluvia not being noticed, so long as it could be shown on independent grounds that typhoid fever had actually been contracted by any person or number of persons from exposure to its emanations, or that it was probable that the milk had been sufficiently exposed to the chance of absorbing the contagium proceeding from it. It seems to me that any emanations from the gully would, before reaching the cowhouse, have been too diluted to produce mischief in this way; while it is understood that the only other possible exposure it could have, would have been during the carriage of the milk through

the open air near it. Was there, then, any independent evidence of the gully or receiver actually giving off typhoid contagium into the atmosphere of the yard? It was a yard in which a good deal of business was carried on. Horses were stabled there, vans were washed near the gully, &c. As a fact, people employed about this yard were attacked with fever. Thus, 1st, one of the earliest, if not the very earliest case, happened in the person of a boy who was a "useful" boy about both premises—in the stables and at the cowhouse and yard. He was so ill on July 3 that he was sent home to his mother, at Finchley, where he died of typhoid on July 25. 2nd. The dairyman himself, who personally milked and managed the cows, spending much of his time in the yard, was attacked early—namely, on July 9. 3rd. The young woman at the cottage in the yard was attacked the very same day. 4th. A man who worked in the yard habitually, chiefly about the stables there and on the business premises, washing vans in the yard, &c., but who had nothing to do with the cows or dairy business, was attacked with fever early—viz., on July 7. 5th. Another young man, similarly occupied, was attacked on August 10. 6th, and lastly, a cowman, who came newly to work at the yard, and to take the place of the master, who was ill, in milking and managing the cows, about the beginning of August, was taken ill with typhoid on August 27. But in none of these cases was the certainty or probability of the dairy milk having been taken excluded. It cannot be asserted with certainty that they got their fever from a contagium evolved into the atmosphere at the cowyard. In the first instance the boy lived on the business premises, and had his meals there, including breakfast and tea. In the second case the same observation holds good. In the third case the girl had certainly taken the milk habitually up to a period within that of the incubation of typhoid. In the fourth instance the man told me that he occasionally took his meals at the coffee house, or his tea at his mother's house, both supplied from the dairy. In the fifth case the young man habitually took his meals at the above-named coffee shop, and also sometimes carried out the milk. The sixth case alone can

be supposed to have probably originated in the effluvia of the yard. This was the cowman, who boasted that he always got his milk pure, for that he drank half a pint every morning early while milking the cows, and that what he used at home with his family was taken from the cowhouse direct in a bottle. I may observe here that in this case the disease was confined to himself, no one else of his family or in the house getting typhoid. But, then, as he also carried out milk from the dairy he had the opportunity of quenching his thirst from the cans, whether he availed himself of it or not. He says he never drank any water on either of the premises, as "he does not like water." Throughout my inquiry I have met with no other case of typhoid among men engaged at the yard than those I have mentioned. It appears, therefore, to me that the evidence of typhoid emanations into the atmosphere of the yard fails to be satisfactory.

This being so, we fall back upon the business premises. Here I found two possible sources of typhoid contagium—viz., the offensive emanations from the stable drains, and the underground water-tank which supplied the pump. The evidence of mischief from the former is as deficient as it was in the case of the emanations in the cowyard; none of the men exposed to them having had fever except those who had been in the way of drinking the milk. And there is this additional fact, that the family most constantly and thoroughly exposed to these emanations escaped—namely, that of the horse-keeper, who actually lived over the stable, and the staircase leading to whose rooms was erected over a closet (not supplied with water) used by the workmen on the premises.

It will be observed that, step by step, my inquiry has become narrowed by the process of exclusion—the only one, as it appears to me, applicable in such an investigation as this. And so I have arrived at the *underground tank*. About this for some weeks I could learn nothing but that it was a wooden tank, constructed sixteen years ago, of three-inch pine bound with iron, and puddled at the bottom with about nine inches of clay. Awaiting the time when the tank could be opened for inspection, I forwarded samples of the water for analysis to Dr.

Bernays. I did not expect much to come of this, since the outbreak was nearly over, and an analysis made in September of water which was daily undergoing replenishment would probably give very different results from an analysis made in June or July, when it might have been somehow contaminated; and the result of the analysis confirmed my expectation. It was in all respects similar to the results of analyses of the New River Company's water, as published by the Registrar-General and by Dr. Letheby—that is to say, it exhibited no special character that would indicate an unusual departure from the average purity of that water.

It was not until the return of the family from the country that I could get the tank exposed; and what I found was this:—The description given me of the tank was correct; but the woodwork had become rotten, and at one corner towards the cart-shed, had broken down to the depth, from the edge, of about eight to ten inches, forming a considerable gap in that side of the tank.* Between the part of the tank where this gap existed and the adjoining wall (distant about twelve inches), the earth, present everywhere else between them, was wanting, a conical hole being formed to the depth of about two feet. At the bottom of this hole, on letting down a candle, I noticed a rounded, smooth shoot with a wet clay bottom, inclining towards the cart-shed, and, on introducing my hand, I was convinced that it was a rat-burrow. A stone was raised in the direction of the cart-shed, a hole dug, and the burrow was again reached, and found to cross above a stoneware pipe leading from the water-closet towards the stable. Fortunately, at this moment the water was turned on from the main. It rapidly filled the tank, which overflowed at the gap; the water ran into the hole dug outside, and filled it to the level of about four inches above the burrow. It then ceased to rise any more, and on carrying my hand round this level, I found another

* I was not present at the moment the stone covering the tank was raised, and I was told that this piece of the woodwork broke down during the act of raising the stone. I merely describe what I saw. From the very damp condition of the wall opposite the gap, I am satisfied that this explanation is not to be trusted. Water had certainly run out of the tank at this spot for a considerable time.

burrow, by which, evidently, the water was running off. On the flow by the supply-pipe ceasing, the water sank rapidly to the level of the lower burrow, and was seen running away by that also. It sank no lower for a long time. The inference I drew was that by these burrows the water was very freely conducted away into some drain or cesspool. On taking up the paving of the yard and exploring, three old and imperfect brick drains of various sizes were discovered, into one of which the pipe from the water-closet had been carried. The other two were disused, but one of them contained some wet slush; the other, containing only a quantity of dry deposit, could not have been the conduit for the overflowing water. In making these excavations, the burrows were necessarily trodden in, but the soil was found saturated with wet up to the brick drain in the stable that the water-closet pipe ran into, and up to the old drain at a lower level that contained the wet slush. With the exception of the drain which received the water-closet pipe drain, these old drains were disused, and evidently had been disused for many years. I have marked the situation of all three upon the plan. From the appearance of the soil in the course indicated by the dotted lines on the plan, there is every reason to believe that it was in their direction, or by some diverging burrows, that the water ran away into the two drains marked A and B. With respect to the old drain, A, it is believed that it was once an overflow drain running into an old cesspool or ditch which is known to have once existed outside these premises, and the remains of which, beneath a collection of old oyster-shells, were discovered about June last in laying down a pipe-drain, D, for the drainage of some neighbouring houses. Prior to the laying down of this drain, the stable brick drain, B, ran straight along into an old sewer; but when, D, a six-inch pipe was laid in, it was thought right to connect the brick drain, B, with it, the owner intending at some future time to do away with B, and carry the pipe from the water-closet into D.

This being the condition of affairs, it is evident that the underground tank was, by these rat-burrows, in communication with two old drains; and it is scarcely necessary to point out that, where rats could pass and water rapidly flow away, foul

gases from the drains could pass, and must have passed, to the tank. Moreover, any accidental or temporary arrest of the flow of sewage from the brick drain, B,—such, for instance, as may have occurred at the time of the alterations of the drainage of the adjoining houses—must, at the time the water flowed from the main into the tank, have filled up the drains and rat-burrows and the hole between the tank and the wall, and have caused an overflow of sewage into the tank at the gap. Either such an accident, or the completion of the burrows to the tank, or the incursion of a rat carrying foul matters with him, might serve to account for the suddenness of the outbreak, supposing this water to have been used habitually for addition to the milk. However this may have been, we have here a fouled water-tank, the addition of the contents of which to milk distributed in the neighbourhood would be sufficient to account for the communication of typhoid fever to those who used it.

Is there, then, any reason to believe that this water was ever added to the milk, or that the water alone ever produced typhoid? I was assured by the men about the premises that none of them ever drank this water; it was understood generally on the establishment that it was provided for the horses, for washing the cans, and for cleaning purposes generally. I only met with one boy who drank of it, and he used it at his dinner, and whenever he was thirsty. He had fever; but then at that time he was living upon the premises, and had his meals there, with the usual quantity of milk at his breakfast and tea. He was there for a week at the beginning of August, and was taken ill on or about August 14, after he had returned to his mother's house. This boy agreed with the other men in saying that he had never seen anybody else drink from the pump. The family of the deceased dairyman also informed me that at no time was the pump used for the addition of water to the milk; "if ever any was added, it was from the tap." Certainly the tap was the more conveniently situated for this purpose, close on the right side, and a little below the flap-table. So far as their knowledge extended, I have every reason to give credit to this statement, which, moreover, has been confirmed to me independently by several

of the men employed. But then it was added that those of the family I inquired of had little or nothing to do with the milk business, which was entirely under the management of the young man who died; and it is to be recollected that persons in this trade are very much dependent upon the honesty of their servants, and that the pump, although in full view of the office when occupied, was not in full view of the window in the house which looked upon this part of the yard. And in connection with the hypothesis that contaminated water had on some occasions been added to the milk by some one is a fact communicated to me, that one family while suffering from typhoid discontinued the use of the milk "because it had a bad taste, and was disagreeable;" and another person asserts that "she had several times complained to the dairyman himself that the milk when kept became stinking, not (as she said) merely sour; and also of its poorness." This, if true, must have been prior to July 9. We are dealing now with probabilities, and one point to be weighed in estimating them is the fact that the dairyman and his household were among the very first attacked with the fever. Did they use milk diluted with this water in their family? Probably they were not very particular. But, supposing that it is absolutely true that no water from the pump was purposely added by any one to the milk, we have yet left the admitted fact that the cans were washed at the pump. Is it probable that the small quantity of foul water left in them after this process would suffice to contaminate the whole bulk of milk subsequently introduced? I confess that, to my mind, this is not an impossibility. We all know how small, almost infinitesimal, an admixture of sewage will poison a well or running stream; nor is the idea of reproduction of the typhoid contagium out of, within, or in the presence of an appropriate organic material at all foreign to the prevailing opinions upon the subject. Future experience may show that milk, which has remarkable relations to chemical ferments, is a substance peculiarly adapted also to the reproduction of morbid contagia, or to the contagium of typhoid in particular. Nor do we know even now how minute a quantity of contagium is sufficient to introduce the disease into any individual. Scarlet

fever has recently been shown by Dr. Bell, of St. Andrews, to have been conveyed by milk to the customers of a cowkeeper in that place, the cows having been milked by persons convalescent from the disease. I claim now to have shown, what I have long suspected to be probable, that typhoid fever may be similarly conveyed by milk. Whether I have also correctly referred the contamination of the milk in this case to its source in contaminated water, others are better judges than myself. At all events, I have spared myself no labour in the investigation, which, if it has resulted in nothing else, has demonstrated one of the dangers connected with the mode in which the trade in milk is conducted in this metropolis.

APPENDIX.

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A.

The case of the boy who left the dairy premises ill on July 3 is remarkable. No medical man saw him in Islington, but on the 4th he was seen by Mr. Hochee, of Finchley. He writes: "When I first saw him, he complained of pains in his limbs and throughout the body, but more intense about the region of the kidneys and knee-joints, which were much swollen. He thought he had taken cold; he was very weak and could scarcely stand. The bowels were apparently in a healthy state; the urine scanty, with slight sediment. I at first thought it a case of acute rheumatism, and commenced with the alkaline treatment, and until July 7 he seemed to be doing well; the urine was loaded with lithates, and became abundant, the pains were less severe, and the body had the peculiar acid smell which accompanies the rheumatic attack, with profuse perspiration. The bowels were moved once a day slightly, and the motions were rather dark." Mr. Hochee tells me that the boy got so much better from these symptoms that he allowed him to go out for a walk, and that he did walk out a considerable distance.

"On July 7 diarrhœa commenced. I thought that the colchicum which he was taking, in combination with bicarbonate of potash, might have brought it on, so left out the colchicum and put in a little morphia instead. On the 8th, the bowels were more relaxed, and the motions began to assume the character of the stools in enteric fever. The pains which he had first complained of had ceased, the swelling of the knees had subsided; but there was tenderness over the abdomen, with considerable heat of skin. About the umbilicus there were a few pink spots; there was tympanitis, but no hæmorrhage that I heard of. I soon changed my treatment to astringents and chlorate of potash with ammonia, and plenty of food and nourishing

diet, and the lad seemed to improve but slowly until the 20th, when the diarrhœa, which had almost subsided, recommenced. He became delirious, and after four days died on July 25. There were no cases in the vicinity of his mother's house." If it be considered that the typhoid was only incubating up to July 7 or 8, and that the fever is be dated from one of these days, then this was not the first case among the consumers of the milk. The first case in the series would then be that of a young woman, aged twenty-one, who lived one hundred yards from the dairy, who had nothing to take her to either of the dairy premises, but who habitually got the milk. She was taken ill on July 3, and died on July 19. Three other families at least, customers of the dairy, would thus also have been invaded prior to the dairyman's household. This would again tend to strengthen the views I have adopted.

B.

The following notes, kindly furnished me by Dr. Moxon, of the cases in a family he attended, will illustrate some of the varieties observed. "The first was —— (a young lady), æt. about twenty-two, taken ill July 19–20 (ailing on 19th, ill on 20th); delirious on 24th, maniacally delirious on 25th; a very copious rose-spot eruption on 25th–26th; mental oddness throughout, with refusal of food and drink for many days. Pulse up to 138, and at times reaching 148 (she has severe mitral regurgitation); a decided change for the better on 15th day, and then a slow but unbroken convalescence, now complete. During the illness, the bowels were generally costive or natural; two loose motions on one day (the 12th). From the 4th to the 15th day she passed everything under her. No meteorism or abdominal tenderness or pain; no thoracic symptoms. Prevailing temperature moderate.

"2nd. —— (a young lady), æt. nineteen. Was low and fretful for five days; then on July 31 decidedly ill and took to her bed, with pyrexia (foul tongue marked, among the other factors of this state, more than the rest). The nervous system is naturally first-rate; she never showed the least delirium, but was otherwise as ill as her sister. She was annoyed with vomiting, which was severe on 7th, 8th, and 9th days. On 7th day, a dull, measly, clouded state of the surface appeared, which passed off on the 8th, and then there were eight rose spots, which had gone on 10th, and no more came. Abdomen perfectly natural in character throughout; but costiveness prevailed,

and on 11th day a large black stool was passed. On 11th day, she had severe epistaxis, without relief of the symptoms. The pulse never went above 126; chest natural. About 19th day, the pulse and temperature began gradually to fall. Convalescence moderately rapid.

"3rd. A female servant, æt. about twenty-three. Taken ill August 3, and next day transferred to Guy's, under my care. Her case was exceedingly like No. 2, except that no rose spots or other eruption ever appeared, and no abdominal disturbance of any sort. Her case was prolonged in its course. She left Guy's on September 24. She was carefully watched, and we have a chart of morning and evening temperature, &c."

C.

The following case illustrates the kind of particulars which were courteously sent me by the practitioners who were in attendance upon individuals who passed through their attack in the country.

Dr. Pirrie, of Aberdeen, thus writes of one of them, a young man:—"On August 12, at one o'clock in the morning, I was sent for in great haste to see Mr. ——, at one of the best hotels in Aberdeen, or in Scotland. He had come from London by the London steamboat, and on my arrival I found that he had lost a large quantity of blood, which I saw, in consequence of hæmorrhage from the nose, which was going on most profusely. I plugged both the posterior and anterior nares on each side by one very long bit of lint, and from the moment I did so he did not lose one drop of blood. On examining him after the hæmorrhage had ceased, I felt convinced he was labouring under the early symptoms of severe disease, and after some days I felt certain it would be found to be a case of typhoid fever. I then sent him to our hospital, where he was well cared for; and although I could not prescribe for him there, I being one of the surgeons, I saw him daily until he was convalescent, except on two days when I was from home. The rash and all the symptoms were as well marked, I think, as they possibly could be. I paid particular attention to the rash and to every symptom, so that regarding the diagnosis you need have no doubt."

Besides Dr. Pirrie and Mr. Hochee, I am under obligations, for information as to cases they attended in the country, to Mr. J. C. Proctor, of Lydd; Mr. Agar, of Ponders End; Dr. Fleury, of Croydon; Dr. Armstrong, of Gravesend; Dr. Warwick, of Southend; Mr. H. G. Philpott, of Brighton; Mr. T. W. Benfield, of Leicester; and Mr. Tomlinson, of Oundle.

D.

The difficulties experienced in discovering cases in private families were sometimes considerable. Some, as in the following instance, were discovered almost by chance. Looking through my mortuary records, my eye was arrested by a return of a death in one of the best houses in Islington of a servant certified as having died from "meningitis." My experience not assisting me in respect of acute idiopathic meningitis in the adult, I suspected that this might turn out to have been a case of typhoid, and as the house was found on the dairy list of customers, I made inquiries. I could gain no information from the medical gentleman who attended the woman, for he declined to accede to my request for information as to his private cases. On applying at the house, however, and explaining my mission, I was courteously informed that two cases of typhoid (one fatal) had occurred a day or two after the family had gone to Southend, and was referred to Dr. Warwick for details; that the illness of the servant, who was attacked a few days later, had been attributed to sunstroke; and that a niece of the servant, who nursed her partially, and was much at the house during her illness, had been since ill. I had already this niece's name on a list of typhoid cases which I had been kindly supplied with from the Fever Hospital. The house she came from (she was a servant) was irreproachable in all sanitary respects, no other case of fever had occurred there, and I had been puzzled to account for the illness.

E.

Since this Paper was read, the occurrence of typhoid in three other families, customers of the dairy, has been brought to my knowledge. Several members in each family were attacked. One of these invasions is particularly interesting. In a street of about fifty villa residences, two of the houses only were supplied from the dairy. In only one of these did typhoid occur. The family consisted of the father and mother; three boys, aged two, four, and five years; a baby, aged ten months; two servants and a governess. Two kinds of milk were supplied to the house from the dairy—namely, ordinary milk at fourpence per quart, and "babies' milk" at fivepence. Only the baby got the latter. It was better than the ordinary milk, as "it threw up more cream." It kept well. The master of the house on one occasion before the outbreak had the curiosity to examine the

ordinary milk with the sp. gr. galactometer, and following the directions accompanying the instrument, inferred that one-fourth of the bulk was added water. The youngest boy took most milk, but all three boys had bread and milk for breakfast. The boys and the mother were ill in the country, whither the family had gone for their summer trip. The youngest boy was the first attacked, on July 17, and was taken out of town the next day. The baby remained well, as also did the father, the governess, and one servant. Of all the family, one servant only remained at home and continued to use the milk. She was taken ill about August 1, and had a sharp attack of typhoid. At the other house in this street the part of the family at home during June, July, and August was the father, mother, and one servant. At this house nothing but "babies' milk" was taken in, the extra price being habitually paid. No fever occurred at this house.

F.

Results of Dr. Bernays' examination of the water of the underground tank :—

Total solids at 130 C., 17·8 grs. per imperial gallon, of which 1·7 grs. are lost at a red heat.
Hardness before boiling, 13·75.
Hardness after boiling, 6·12.
Chlorine as sodium chloride, 1·46 grs. per gall.
Ammonia, none.
Oxygen required by oxidizable organic matter, &c., 0·025 grs. per gall.
Nitrogen, 0·151 grs. per gall.
Nitrates, but little—a mere trace.

G.

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