artificially, and mustard was the sole or principal agent used. But it is difficult to decide for what reason the girl tried to sham illness, as she lost a comfortable situation, and had to return to a miserable home inhabited by a sick father and mother.

ON THE PROPAGATION OF ENTERIC FEVER.*

By T. CLIFFORD ALLBUTT, M.A., M.D.Cantab., F.L.S., etc.

THE great and inspiring advance of recent medical knowledge is nowhere better seen than in the department of infectious diseases. The distinction between typhus and enteric fever, and the wholly distinct causation of the two diseases, have, during the last few years, been clearly made out, and but few points remain to be investigated. Among questions which are still open are those which relate to the kind and the origin of the agent which produces the "enteric" state. The admirable investigations of W. Budd, Parkes, Murchison, and many others in England, and of men like Hirsch, Liebermeister, Pettenkofer, and others abroad, have done much to aid our investigations even in this direction also.

I think it is not yet clearly understood by the profession at large that enteric fever is a specific fever, and therefore must, in accordance with all analogy, depend upon a specific poison. We see many accounts of epidemics—accounts which are drawn up with industry and intelligence, but which fail to tell us the origin of the specific poison. The drinking of polluted water is shown, the entrance of drain-refuse into the wells is proved, but the farther problem is too often overlooked—the problem of the introduction of the peculiar poison. It is, however, quite certain that persons may drink faecal water for months or years, their cesspools may communicate with their wells, their drains may find a way into their water-pipes, and, in consequence, they may suffer from diarrhoea, from low forms of sore throat, from debility, languor, and from other evidences of low vitality, but they do not suffer from enteric fever, unless they drink the specific poison of that disease which may or may not be present in the cesspool or drain, and which certainly is not there unless it be introduced from without. Enteric fever is not caused by the drinking of faeces, whatever else this may produce, but by the drinking of a specific poison whose chief place of development is the infected human bowel, and which is, therefore, often found in human dejections. Unless that element be traced, the origin of the endemic is not discovered. Here, for example, is one of the difficulties which waits for settlement. Can the enteric poison which is known to be carried by water into the system be carried also by the atmosphere into the lungs and blood? Many writers hold that this latter is a means by which the endemic spreads. It is always hard to prove a negative, still more so to prove a negative in a question of such subtlety; the right course is rather to extend, as far as possible, the positive proof of that means which we know; viz., the introduction by water, and to find out whether it will cover all cases.

It seems to me very doubtful whether it will cover all cases. In large towns like Leeds, for instance, where the water-supply is uniform, continuous, and excellent, and where enteric fever is nevertheless prevalent, there would seem to be some farther means at work. For instance, I go frequently into infected houses where the water-supply is all that can be desired, but where there is a strong ventilation from the sewers. In such cases it would certainly seem as if the poison were light enough to be borne upon the wind and thence either breathed or caught in the food. Again, there seems to be some widely spread influence which determines the periods of the endemic. Individuals, or their excrement, must be moving from place to place and carrying infection all the year round; but yet we see endemic outbreaks chiefly in autumn, and their subsidence chiefly in spring. The ground-water levels seem to have much to do with this, probably in some mechanical way;† and it is certain that rains have much to do with it, as we see in one of the cases I shall now publish, as was seen in the Dundee outbreak so well described by Dr. MacLagan in the *Edinburgh Medical Journal* (October 1867, p. 297‡); and at Terling also, as was shown in the reports of Dr. Haviland in the *Medical Times and Gazette* for January 11th, 1868; and of Mr. Salter in the same journal for the 7th of March. The fall of rain acts, no doubt, by washing the infecting material into the springs and water-courses. That personal contagion has little or nothing

to do with the spread of the disease is now believed by all careful and instructed writers. That mere accumulation of dung and filth has no direct causative power is less clearly seized as a truth; and the hesitation which is felt on this point is now explained by the fact that the poison (whether parasite or not, as Fischer and Hallier have attempted to show,) certainly batters upon excrementitious filth and organic putrefactive matters.* In large towns, where many and complex agencies are at work, it is difficult or impossible to trace the beginning and causation of epidemics or epidemics, except it be under circumstances so crucial and peculiar as those of the Guildford outbreak. It is in small societies, the circumstances of which are simple, that such investigations are most likely to prove successful. In two such cases, I have been able to trace the origin of enteric fever, and these cases I have now to bring forward. The first case, in point of time, was that of a college belonging to the Society of Friends; it is called the Flounders Institute, and is situated at Ackworth, near Pontefract. The following is the report which I was enabled to make with the kind assistance of Dr. Wood.

"At the request of Mr. Harvey and Mr. Brown, I visited the Flounders Institute on April the 16th, 1869, in order to ascertain the nature of the fever now prevalent at the Institute and in Ackworth, and in order to learn, if possible, the causes of its prevalence. I met your medical attendant, Dr. Wood, accordingly; we visited several patients at the Institute, and I ascertained that the disease from which they were suffering was enteric fever. That opinion you had already heard from Dr. Wood. We also visited several patients in Ackworth Moor Top, and ascertained they also were suffering in like manner from enteric fever. As is commonly the case, it had fallen chiefly and firstly upon young persons.

"As regards the Institute, I found your conditions as to site, and aspect, and internal comforts, to be most satisfactory. My survey ended, as is common in these cases, by my suspicions falling upon the drinking water. I found that your supply was from two sources. 1. From a well upon your own premises; 2. From a well in the village, to which I shall refer under the name of the watering troughs. First, as to your own well. It appears that this water has been little used for drinking purposes. You have not any cesspool in dangerous proximity to it, your drains are constructed with sanitary tubes, and I do not think it likely that the excreta from the fever-patients in your house have reached your well. I shall show reason for believing that they all derived their poison from one common source; viz., the watering troughs.

"The analysis of your well-water, made by Mr. Wilson of the Leeds School of Medicine, shows that it contains 1.82 grains of organic and volatile matter per gallon, and 4.9 grains of common salt. On the whole, though somewhat unsatisfactory, it may safely be used, provided it be exposed to the air so as to allow the sediment of oxide of iron in combination with organic matter to be fully formed, and that it be then filtered. Mr. Wilson holds the same opinion, and recommends the use of a carbon-filter.

"I now turn to the water at the watering troughs. It appears that this water, which is very bright and pleasant, has been chiefly or entirely used for table purposes in your household. As your Institution is conducted upon the principle of total abstinence, this village water has been largely consumed by your inmates. The watering troughs supply a favourite drinking water not only to yourselves but also to that part of the village of Ackworth called Ackworth Moor Top. It is a remarkable fact, which I hear from Dr. Wood, that those persons in the village who have suffered first and most severely are also total abstainers, and have drunk largely of the attractive water of the troughs. The watering troughs and the small well or drinking trough a little above them, are supplied from one stream, and the analysis of the water, as made by Mr. Wilson, is as follows: 'The water from the spring at the watering troughs is inodorous, very bright and clear, and has a scarcely perceptible saline taste; it forms no deposit on standing. An imperial gallon contains 5.04 grains of organic and volatile matters and 6.21 grains of common salt.' Nitric acid, which is a product of the decomposition of animal matter, is present in unusually large quantity. It will be clear to you from the above analysis that the water of the troughs is, in spite of its beautiful appearance, very impure. The area of the enteric fever is curiously conterminous with the area supplied by the troughs, only one case having occurred outside this area, and that one was a boy who passed by the impure well twice daily and frequently drank the water. On examining the troughs with Dr. Wood, I found below your gates and across the road two large troughs, and a short distance above these troughs another small trough. On inquiry, I found that a stream was known to cross the high road reaching the well-trough from a point about thirty yards higher up. We crossed

* Read in the Medical Section at the Annual Meeting of the British Medical Association in Leeds, July 1869.

† When I wrote this paper, I had not had the advantage of reading the admirable paper on the same subject by Dr. Buchanan, in the *Medical Times and Gazette* for March 12th, 1870. He shows very clearly the specific origin of an outbreak in an Essex village, and makes some remarkable observations on Pettenkofer's theory.

‡ In this interesting paper, Dr. MacLagan shows that cholera followed the same track as enteric fever; while typhus, on the contrary, took quite another course.

* Cf. Liebermeister's account of the outbreak at Basel, in the *Deutsche Klinik* for 1866, Nos. 6, 7, 9, 10.

the road and walked some yards up the road, where we found a clump of cottages. In the midst of them is an open space, and in this space is a pump which is never dry, and the water of which, we have no doubt, is a branch of the stream which supplies the troughs. Now the space occupied by these cottages is the site of an old stone-quarry, which has been filled up with loose earth and rubble. Some parts of this quarry, and, for example, a part now occupied by a privy, had been worked and filled up again within the last ten years. These cottages, therefore, stand in a sort of amphitheatre, sheltered behind by the walls of the quarry. At the back of these premises is a pool supplied constantly by running water; this is, we proved, the main source of the stream which supplies the troughs. This stream runs by several channels through this basin of excavation, the channels themselves then combining to form a main stream which supplies the watering troughs. The basin is filled with porous made earth, upon which again are placed six or eight dwellings, with foul privies, etc. To give some idea of the rapidity of percolation, I may say that on the day of my visit a heavy rain was falling. Surface-water, at the close of the shower, was standing in the hollows of the soil behind the cottages. In less than an hour nearly the whole of this rain-water had disappeared; and, I may add also, a certain sump-hole which receives the surface drainage, etc., was never emptied, for 'it emptied itself' by escape into the soil below. This sump-hole lies just above the calculated run of the stream going down to the troughs.

"It appears that the first case of typhoid fever in your district was that of a girl named Lee. She soon fell ill of fever after her return from a village near Wakefield. Lee lives in one of the cottages which are built in the stone-quarry. During the first day or two of her diarrhoea, the dejections were cast into the privies behind the cottages, and upon the made earth. After that time, the people buried these dejections in the loose earth which fills the old quarry, and below which the stream runs to the trough. This case occurred during the winter months, and at a time when much rain was falling. The rain, soaking through the loose ground in the way I myself witnessed, would enter the stream, and would carry with it the whole of the typhoid excreta. These excreta were then carried by the stream itself into the stomachs of the inmates of your household."

The next outbreak which I was called upon to investigate was with Mr. Ellerton of Aberford, and it occurred at Bramham College, a large school near Tadcaster, under the management of Dr. Haigh and his sons. This report is as follows.

"On the 10th of May, 1869, I was consulted by you concerning an outbreak of fever which had recently taken place in your establishment. From the evidence which I obtained from Mr. Ellerton, I was satisfied that the fever was of the kind known as enteric. I felt satisfied also that the appearance of enteric fever in the college was due to introduction from without. It appears that, in the latter half of the month of March, nineteen of your boys sickened at once with symptoms that afterwards developed into those of well-marked enteric fever.* It seemed clear, therefore, that these boys were subjected to some common cause of disease. My attention was at once directed to your water-supply. A suspicion of the water had already presented itself to Mr. Ellerton and yourselves; and you were exploring the state of your supply. I found that your drinking-water was taken from a surface-well on your premises. Having, then, a well liable to pollution, was any pollution by the specific excreta of enteric fever to be detected? I believe that, with your assistance and the assistance of Mr. Ellerton, I am enabled to answer both these questions in the affirmative. A specimen of the well-water, however pleasant for drinking purposes, was (as shown by analysis) contaminated by sewage-matter. It became important, then, to find the origin of this contamination. In close proximity to your well was a soft-water tank, cemented inside. The cement, however, was shelling off on the side next the well; and that there was soaking going on from the tank into the well was clear from the distinct discoloration which was found on the stonework of the well contiguous to the soft-water tank, and in no other part. It was discovered that the water in the tank was contaminated by sewage matter, by means of a drain formed of sanitary tubing which runs over the top of the soft-water tank on its way from a water-closet to the sewage-tank. At the spot where it passed over the tank, this tubing was broken (owing to its having been undermined by rats and so let down), and the whole ground above the arched roof of the tank was saturated with filth. Inside the soft-water tank at the spring of the arch, and just below the broken drain, were found two cracks, through which there were evident traces of the dripping of

sewage into the tank. Your well was, therefore, impregnated with sewage through the intermediation of the soft-water tank.

"It only remains now to discover the source of the specific infection. You tell me that at the end of last January you received two boys, who sickened about nine days after their arrival and developed all the symptoms of enteric fever. It is in accordance with the time of the incubation of enteric fever (which is seldom or never less than ten days, and generally more,) that these boys should have received the poison into their systems before coming to you, for fever was prevalent in the localities from which these boys respectively came; in fact, enteric fever was present in the home of one of the boys. These boys had the diarrhoea characteristic of enteric fever; and I find that their excreta were thrown down the water-closet generally used in cases of sickness. The broken drain found above the soft-water tank was the drain from the water-closet. The whole case is therefore singularly clear, and the remedy as clear as the causes."

Both these cases tend, I think, to prove with unusual clearness that water charged with sewage-matter had long been drunk daily with impunity, so far as enteric fever was concerned, until the moment when the dejections of an enteric patient passed into it. At Terling the people had long been drinking water horribly charged with organic matter and bowel-dejections, and without the fever as a consequence, until one young girl commenced the specific process; her dejections were washed by heavy rains into the wells, and then only did the endemic spread among the people.

REPORTS

OF

MEDICAL AND SURGICAL PRACTICE IN THE HOSPITALS OF GREAT BRITAIN.

THE MARGATE SEA-BATHING INFIRMARY.

[BY THE EDITOR.]

[Concluded from page 285 of last number.]

Mortality, etc.—There is no museum at this Hospital, a circumstance which is to be regretted. We believe that not a few interesting specimens are obtained from time to time, especially those illustrating processes of repair after excisions of joints, etc. The mortality is not large; but, of the few *post mortem* examinations obtained, some are of unusual value. Mr. Clouting, who has been in the Institution nine months, told us that he could remember only two deaths—one from tubercular meningitis, the other from disease of the lungs. The mortality of 1868 was 18 out of a total of 909 admissions.

Treatment of Disease of the Hip-joint.—The admirable plan of extending the limb in cases of disease of the hip, by means of a weight attached to the foot and passing over a pulley at the bottom of the bed, is extensively employed here. This plan was imported, we believe, from America, and is now in very general use in the London Hospitals; but it is not so widely known as it deserves to be. It is both more comfortable to the patient and vastly more convenient to the nurse than the long splint. Its more general employment in private practice would save many a patient from the deformity which often results when recovery takes place. Sometimes it is necessary to use counterfixation; and we observed that Mr. Clouting had devised a sort of laced jacket, padded under the armpits, by straps from which the patient's body might be secured to the top of the bed. It seemed to act very efficiently. In some cases, counterextension by a perineal band may be better. Mr. Clouting mentioned to us that he had recently had several cases in which the habit of wetting the bed in children in cases of disease of the hip-joint had ceased when the limb was extended. No excisions of the head of the femur for disease of the hip have been recently performed. There were no patients in at the time of our visit, in whom this operation had been performed at other hospitals.

Successful Case of Excision of the Knee.—A boy named Hall, aged 11, was the only instance of excision of the knee-joint performed elsewhere under care at the time of our visit. This boy's knee had been excised by Mr. Langstaff at Southampton ten months before admission. The patella had been left. The limb is now straight, but with a little twisting outwards of the tibia. The sinuses are almost healed.

We mentioned last week two cases in which excision of the knee had been performed in the hospital.

Cases of Syphilis.—There was one patient under care whose disease was clearly acquired syphilis, and not scrofula in any sense. We mentioned last week that we were able to identify only one patient (out of one hundred and thirty-five) as being undoubtedly the subject of in-

* It is interesting to know that these nineteen boys are total abstainers, or nearly so, and were, as the Messrs. Haigh found out in reply to my questions, the only or the chief abstainers in the school. This was noticed at Ackworth, and it was noticed at Terling. The fact is curiously in accordance with our views of the propagation by water.