ENTERIC FEVER, DIARRHŒA, DIPHTHERIA, AND SCARLATINA, ORIGINATING FROM DRINKING-WATER.*

By NORMAN KERR, M.D., F.L.S., London.

I. MRS. P., farmer's wife, aged 35, in June 1871, suffered from a typical attack of enteric fever, with hæmorrhage from the bowels, from which she made a perfect recovery. Diarrhœa had previously never been absent for more than a fortnight at a time from the house. Either the father or the mother, or one or other of the four children, or one of the servants, was the sufferer. Two children had been attacked with scarlatina, of which, and of the other ailments enumerated, there had been no case in the neighbourhood for more than two months previously. Nearly the whole household had also repeatedly suffered from more or less severe sore-throat, one child having diphtheritic patches on the tonsils on one occasion. By the method of exclusion, I arrived at the conviction, after the milk-supply had been changed with no benefit, that all these illnesses, to which the family were so prone, must arise from the water of the well used for drinking purposes. My opinion was not seriously listened to till the typhoid fever set in, when the alarming state of the patient secured me, at last, a favourable hearing. The water formerly in use was given up, and a new supply brought from another well about fifty yards off.

The unhealthy symptoms ceased from the day of the change. So marked was the improvement that, in a month, the farmer and the landlord (the latter's mansion being close by) at length consented to my long urged request to clear out and examine the old well in the yard, the water of which they had formerly drunk. An old drain, which carried the liquid refuse from the pigstye and cattle-sheds, was found opening into the well, about five feet from the surface.

After this outlet had been built up, and the drainage of the yard diverted into an adjoining water-course, the family once more resorted to the old well; and, during the three years they remained at the farm, there was no recurrence of any of the former symptoms.

I ought to add, that neither enteric fever nor any similar disease had affected the stock during the whole period of the illnesses referred to.

II. In the residence of the gentleman who owned the farm where so much illness arose from the use of contaminated water, and which was not more than one hundred and twenty yards from the farmhouse, sore-throats, twice accompanied by diphtheritic patches, were seldom absent. Diarrhœa was also a constant guest; but, though frequently of a typhoid type, it never passed into thoroughly developed enteric fever.

Every other source of poisoning having been eliminated by elaborate inquiry, I laid it down that the symptoms must arise from the pollution of the potable water. The aged head of the family, who, strange to say, was the only inmate who never suffered from any of the symptoms referred to, was of the old school, represented by a worthy and reverend friend of mine, who died from enteric fever, who did not believe in modern sanitation, and who was accustomed to boast that he had a cesspool so deep and so capacious that it needed cleaning out only once in every thirty years. My hale and venerable patient, firm in his belief that neither bad water nor bad smells ever hurt anyone, had always ridiculed my interpretation of the cause of the constant unhealthy state of the household, and would never accede to the well and drains being examined. But the result of the inquiry into the sanitary state of the farm so convinced the rest of the family, that a thorough inspection of the sanitary state of the house was instituted. The result was unmistakable. The well from which the supply of drinking-water had been taken was in the middle of the courtyard, which latter was traversed by four brick drains, one from each corner of the house, these drains converging into one large common drain at a point adjoining the well. Large leaks were found in all the drains, the leaks being caused by rats. The refuse from the drains had thus been freely soaking into the well. It only remains to add that, since the defects were made good and the drainage no longer allowed to pour into the well, the old diphtheritic and enteric symptoms have never reappeared.

III. Three sons of a gentleman farmer, aged respectively 13, 11, and 8 years, were simultaneously struck down by diphtheria. Notwithstanding the most watchful care and nursing, all three died within ten days. No other member of the numerous family was attacked. There had been no diphtheria in the neighbourhood, and none of the family had been where it was. The milk-supply was found blameless; so, unless it be contended that the poison was "in the air", there was no other

possible solution than that the drinking-water was at fault. The well lay in a hollow in the farmyard, and there was considerable leakage into it from the brick drains leading from the cowshed and pigstye, through the surrounding damp soil.

IV. In an old county family, the father, aged 35, was seized with diphtheritic sore-throat and typhoid diarrhœa; and the son, aged 5, with similar throat-symptoms and extreme weakness. Both had suffered previously from repeated, though less severe, attacks of sore-throat and diarrhœa respectively. The milk was minutely examined, and found pure; but, opening into the well (behind the immense pile of buildings), from which the drinking-water for the establishment was drawn, were found leakages from seven different drains emerging from the house. As soon as proper sanitary measures were completed, the family, who had all left, returned; the old well was used as before; and no ill consequences of the nature to which the father and son had formerly been subject thereafter overtook them.

REMARKS.—These are but a few cases, selected from a large number, where contaminated water seemed to be the originating cause of enteric fever, diarrhœa, diphtheria, or scarlatina. I have seen, in one family at the same time, one member struck down by scarlatina, a second by diphtheria, a third by diarrhœa, a fourth and a fifth by slight sore-throat, and a sixth by erysipelas. In more than one instance of this kind, the varied diseased conditions were all traced to the impure drinking-water.*

I have long been driven to the conclusion that the same contaminated drinking-water may, without the presence of specific germs, give rise to different diseases, the poison making itself manifest in the shape of erysipelas, scarlatina, diphtheria, diarrhœa, or enteric fever. The source is the same, the poison is the same, but the physical state of the individual constitution, or some idiosyncrasy of susceptibility, or some differential surrounding condition, is the factor in determining the special form of ailment which the poison may assume in any particular case.

FACTS ILLUSTRATIVE OF THE SPREAD OF ENTERIC FEVER AND DIARRHŒA, BY THE AGENCY OF POLLUTED DRINKING-WATER.†

By R. S. HUDSON, M.D., Redruth.

THE distribution of enteric fever in the central mining district of West Cornwall is so peculiar as to be worthy of record; and, as we ascribe this peculiarity to the varying nature of the water-supply, a short account may not prove uninteresting to those who take part in this discussion.

The district presents an area of about 40,000 acres, and a population of about 50,000 persons. The occupation of the working-classes is, to a small extent, agricultural; but the great industry is tin and copper mining, with its subsidiary employments. The density of population varies very much, some of the courts in Redruth and Camborne being as overcrowded as similar arrangements in large cities; while, in other parts, the district is so purely agricultural as to have a very thinly scattered population. The towns of Redruth and Camborne have each a population of about 8,000; but the distance (three miles) between these towns is occupied by three villages and their offshoots, so that the roadway is almost a continuous street. These towns are only three miles and a half from the north coast of Cornwall, and the whole district is daily swept by Atlantic breezes. No sewage-works have as yet been completed for this district. In Camborne, the pipes are being laid down; in Redruth, the engineers' plans have not yet been sanctioned by the Local Government Board. Redruth dates its water-supply from 1854. Camborne received its boon of a bountiful supply of pure water from a public company in 1870. The milk-supply of the two towns and the many villages is not carried out on any largely organised plan, many of the small farmers keeping a few cows, and disposing of the milk and cream to their immediate neighbours.

It will be seen that the conditions are favourable for the study of the etiology and spread of any zymotic disease, as the factors of sewer-gas and polluted milk-supply, which frequently give trouble in large towns, are at once eliminated from the inquiry by their non-existence. The seaboard also effectually guards against the admission of any infectious disease from without, except at certain ports; and almost invariably infectious diseases may be traced along the lines of traffic from one

* It should be understood that in these remarks I refer only to the apparent origination of disease. Instances of propagation, through water infected with excretions from previous cases of disease, are continually confronting me.

† Read in the Section of Medicine at the Annual Meeting of the British Medical Association in Cork, August 1879.

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of these ports, or by the rail which runs from east to west through the district.

The facts are briefly these.

1. Long before the labours of Stewart and Jenner had proved that typhus and enteric fevers were distinct diseases, differing in their origin, symptoms, spread, duration, and complications, the medical practitioners of this district were familiar with certain local types of fever, which they designated by such terms as "Brea fever", "Trelowarren Street fever", etc.; "Brea fever" being a form with troublesome bowel-complications and usually extensive hæmorrhage. Year after year, it cropped up in Brea village, and, when a case appeared in other parts of the country with like symptoms, it was called "Brea fever". At this period, the highly infectious typhus was not uncommon; so the difference between the forms was very marked, and apparent even to superficial observers.

2. Although the practitioners of to-day cannot observe the broad distinctions which were readily recognised forty years ago between these local forms, the death-register and the reports of the Robartes Convalescent Hospital plainly indicate that enteric, or typhoid, or gastric fever still clings to certain districts; whereas, in others, there is scarcely ever a case. For example: in Redruth, there has not been a single sufferer from typhoid fever originating in the town itself for many years. True, there have been a few imported cases, who came with the disease on them, but in no instance did the disease spread.

It is to be hoped that the new drainage-works will be so efficiently devised as to preserve for us a like immunity in the future.

Such being the facts regarding this fever, what is the explanation?

I have no hesitation in saying that infected evacuations polluting the water-supply have been the prime agents in disseminating the disease; and, in proof of this, I make the following statements.

a. Enteric fever was common to the whole district, including Redruth and Camborne, when pumps, deep-wells, and open streams formed the only water-supply.

b. Fortunately for Redruth, Pednandrea mine, in its work of shaft-sinking, tapped the underground streams which supplied the pumps and wells, and people could not obtain the contaminated water, even if they desired it. In connection with this, I may be excused a digression, which points forcibly to either some careful superintendence on the part of a central authority, or to better education in sanitary matters, as a necessary qualification for the members of local authorities. Pednandrea mine has lately been abandoned; pumping operations have ceased; the water has risen to its former level; pumps and wells, during the late wet season, have been full. For many years, some of the former pumps have been utilised as convenient cesspits, and privies have been built over them; so that, not only are these old pumps indirectly contaminated by being sunk in a sewage-laden soil, but excrementitious matter has direct admission. The water must, therefore, have its fair proportion of sewage; yet, it has been gravely urged in a local newspaper that the town need not trouble itself in going to further expense regarding water, a supply being brought back again to their own doors, and, as it suited their fathers, it may do for them. "It's an ill wind that blows nobody good."

c. Camborne has also had much less fever since the excellent house-to-house supply was laid on; and the Medical Officer of Health, Mr. Angove, tells me that, without much trouble, he can trace the importation of nearly every case.

d. Those localities where the fever still exists have, in every instance, a polluted well- or pump-supply, into which excremental and slop nuisances have ready access.

The germ and pythogenic theories do not come within the scheme of this discussion; but I cannot help remarking that the germ-theory fully explains these local outbreaks, and their being confined to certain spots where previous infected evacuations have been deposited; whereas, if the pythogenic theory were true, how is it that similar conditions regarding water-supply and proximity to cesspits do not invariably produce it? Only last week, I examined water from a pump three yards from an old manure-heap. Percolation is evident; the water contains ammonia and nitrites; it is clear and sparkling, and much valued; but those who drink it do not suffer. I have, however, no doubt that, if the specific poison were once introduced, typhoid cases would be an annual occurrence in the hamlet where it is situated. Diarrhoea is the resultant of a filthy water-supply, and not enteric fever, if the specific poison be absent. The common septic poison may also produce a low form of continued fever or septiciæmia. The only instance I bring forward has been already mentioned by Dr. Blaxall, in his report to the Local Government Board, and I can vouch for its truth. Certain families, who suffered severely from scarlet fever in the epidemic of 1876—two, three, and even four in a family having been carried away after a few hours' illness—"were in the habit of getting their water

from an obviously polluted source, to wit, an open stream, which in its course to the locality in question, passes through a farmyard. I observed two dead dogs in it, also ducks paddling about."

Surely, we had here pythogenic conditions sufficient to develop fever; but no. For months the children suffered from chronic diarrhoea, and, when attacked with scarlatinal poison, they readily succumbed.

TYPHOID FEVER AND MILK.

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THE number of cases now on record in which typhoid fever has arisen from individuals partaking of milk, contaminated with poisonous matter, makes it desirable that all well-authenticated cases should be placed on record; so that, the subject being well ventilated, not only the profession but the public may be fully alive to the danger.

During the summer of 1876, a family—consisting of father, mother, and four children, with one male and three female servants—removed from a house in the borough into one in a neighbouring village. They were all in robust health, and anticipated much enjoyment in their new home. Things went on well for a while; they were all healthy, and the country lanes and fields and their health-giving breezes were much extolled; and their old town friends envied their freedom and the advantages they had gained both for their children and for themselves. After they had resided in their new home but three months, it was noticed that the eldest child, a fine well-developed girl of nine or ten, began to look pale and thin; the food was taken sparingly, and often refused. Languor superseded to such an extent, that lessons had to be abandoned. Shortly afterwards, a rash (but not typical of typhoid fever) appeared, showing itself chiefly on the arms, legs, and abdomen. Treatment had no effect, and the child remained in a typhoid condition for weeks. During her convalescence, a younger sister complained of feeling unwell, and she exhibited symptoms not unlike her sister, but the rash was less persistent and not so well defined. Convalescence was tardy, and came by fits and starts; one day the children assumed a cheerful demeanour, ran about, and joined the others in play; the next day, the lassitude supervened, and they passed their time on the sofa or in bed. Before they had fairly convalesced, their father complained of sickness, aversion to food, and fatigue after walking but a short distance; the skin became slightly jaundiced, and the liver congested and tender; the action of the bowels, which before was regular, became uncertain. At the end of the third week, an abscess formed in the right axilla, followed by another the week after in the same region on the left side. Although all the symptoms pointed to decided blood-poisoning, they were not sufficiently pronounced to make the patient uneasy as to the result, but were still most annoying, keeping him from business, and entailing considerable expense. When the blood-poisoning appeared to be on the decline, and the family were rejoicing in the belief that their troubles had almost ended, the coachman—a man who, during their lengthened illness, had proved himself a most valuable help to all from the ready manner in which he could nurse or perform other little offices about the sick-room—also sickened. The disease in this instance resembled in most of the symptoms that of his master, notably so concerning the amount of poison which settled in the liver, although he had not, so far as my memory serves me, any abscess externally. At one time, the region over the liver became suspiciously swollen and tender, and it appeared as if matter were forming.

So soon as the disease first made its appearance, the sanitary arrangements of the house and its surroundings were overhauled. Everything was perfect, as indeed I expected to find it; for, prior to its occupation, I had advised that all drains, water-closets, sinks, etc., should be looked to; this was done efficiently and to my satisfaction.

The drinking-water was obtained from a well conveniently sunk towards the rear of the house. Its surroundings were carefully examined. Nothing injurious could contaminate the water, as was proved from analysis by an expert. To what, then, could this long typhoid condition be due? It was impossible to say. When we were giving up the search for the cause in despair, I determined to make a final examination of the premises. I began by following the drain from the water-closet, which passed through the kitchen-garden and emptied its contents into a running stream in the field beyond. What was my surprise may be imagined, when passing through a door in the garden-wall into the field, to behold staring calmly at me a lean and hungry-looking cow. Up to that moment, I had not the least knowledge that a cow existed on the premises. In a joking way, I remarked to the gentleman that accompanied me: "Your cow also appears to be ill." "Yes," he replied, "for the past three or four months she has been ailing, getting