

**Report on an outbreak of enteric fever in the Malton Urban District / by
W.V. Shaw.**

Contributors

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No. 69

REPORT
On an Outbreak of Enteric Fever
in the Malton Urban District

BY

W. V. SHAW, O.B.E., M.D.

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MINISTRY OF HEALTH

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PREFATORY NOTE BY THE CHIEF MEDICAL OFFICER.

To the Right Hon. Sir E. HILTON YOUNG, G.B.E., D.S.O., M.P.,
Minister of Health.

SIR,

I beg to present the following report by Dr. W. Vernon Shaw, one of the Medical Officers of the Ministry, on the recent outbreak of Enteric Fever in the Malton Urban District in the North Riding of Yorkshire, after twenty years of comparative freedom from the disease.

The outbreak was due to pollution of the public water supply which is derived from a local well, a source which the District Council were urged by the Local Government Board to abandon forty years ago by reason of its liability to pollution and the associated high annual incidence of diseases of the enteric group. Looking back to 1872, over all our available records, the relation of this group to local pollution of the public water supply has been evident.

Unhappily also the River Derwent, which flows through the town, has for many years received the crude sewage from numerous local outfalls. In connection with another not dissimilar outbreak in Yorkshire in 1922, I pointed out that "the water of a village pump liable to pollution from its surroundings may be used by a community without any manifest disadvantage until it becomes contaminated through one channel or another with specific infection present in the population of the neighbourhood. When this occurs, local disaster may follow." On the present occasion the exciting factor was the access to the public water supply of infective excreta of an enteric fever patient who had been admitted to the Public Assistance Institution, and within two months 270 persons contracted the disease and 23 died.

The story is an old one, and in this particular area has been repeated during successive generations of the Malton Sanitary Authority. History records that it has been demonstrated also to many scores of Local Authorities throughout England and Wales, but speaking generally its grave lesson has been learned, with the result that, by the adoption of measures of preventive medicine, including the provision of wholesome public water supplies, the mortality from enteric fever has declined from 371 per million persons living in 1871-1875, to 7 per million in 1930.

The importance of early diagnosis, notification and the isolation in hospital of the first cases of enteric fever occurring in a district has long been recognised, and to this end your predecessors sanctioned the gratuitous provision by Local Authorities of certain facilities for

diagnostic purposes. It is to be borne in mind, however, that laboratory methods cannot replace clinical observation, and their results are to be interpreted in the light of what is learned at the bedside. In the peculiar circumstances set out in this Report some spread of infection may have been inevitable, but had the first patient been promptly removed to an isolation hospital the outbreak would in all human probability have been more circumscribed. That the outbreak was not larger must be attributed to the commendable emergency action of the Local Authority in respect of early diagnosis, prompt isolation, "sterilisation" of the water supply, and preventive inoculation.

I am glad to be able to add that the Local Authority is now earnestly engaged in devising schemes for improved sanitation, for the provision of available accommodation in isolation hospitals, and for a new and wholesome public water supply.

Under the provisions of the Local Government Act, 1929, it is the duty of the North Riding County Council to make a survey of the isolation hospital facilities in the Administrative County and to submit a scheme, for the Minister's approval, for the provision of "adequate hospital accommodation for the treatment of infectious disease in the whole County." A provisional scheme was prepared by the County Council but for various reasons it has not yet been put into operation.

I am, Sir,

Your obedient Servant,

GEORGE NEWMAN.

Whitehall, S.W.1.

December, 1932.

DR. W. VERNON SHAW'S REPORT ON AN OUTBREAK OF ENTERIC FEVER IN THE MALTON URBAN DISTRICT.

During the week ended 15th October the first case of enteric fever to occur in the Malton Urban District this year was notified. There was another case during the following week, but on the morning of 25th October the Ministry learned indirectly that many others had been reported, and inquiry of Dr. L. C. Walker, the Medical Officer of Health, who is also in general practice in the town, was made by telephone. Dr. Walker reported that 20 cases had been notified during the last three days, and that there were probably many others as he thought the disease was due to the pollution of the town well by washings from a heap of cattle manure which had been deposited close to it.

I was directed to proceed to Malton forthwith to investigate the circumstances and to advise the District Council.

TOPOGRAPHY AND SANITARY CIRCUMSTANCES.

Malton is an old country market town in the North Riding of Yorkshire, situated on the River Derwent. It is divisible into two unequal parts, Old Malton with a population of nearly 1,000, and New Malton, lying about half a mile to the south-west and nearer to the railway station, with a population of approximately 3,500. In the last intercensal period there has been no increase in population. There are no prominent industries except brewing and such as serve the needs of a small agricultural community.

Malton is situated at the extreme eastern end of the Howardian Hills. The high ground to the west and north-west is composed of rocks of the upper division of the Middle Oolite which, as is clearly indicated by an examination of the railway cutting to the north-east, dip to the south-east. The oolitic limestone and calcareous grit forming the rocks are permeable and readily absorb the rainfall.

To the south of the town flows the River Derwent in a channel of clay which outcrops at its junction with the Middle Oolite on the north bank. The line of junction falls to the south-east and it is probable that this feature largely determines the source of the town water supply.

Water Supply.—The geological formation—the junction of permeable rocks and impermeable clay—is favourable to the supply of large quantities of water, and there are to the south-east within the district a number of pools and springs lying in the angle between

the River Derwent and the Gilling Branch of the L. & N.E. Railway. It is from these that the public water supply has been derived since 1868. According to tradition the present well—the Ladywell—occupies a site on or very near a well which existed at the time of the Roman occupation.

The Ladywell is held on lease by the District Council; it is a shallow well sunk on the oolite to a depth of 14 feet. The well is covered in and taps directly a number of springs. Surface washings are excluded, but there is some communication—probably through the wall—with the springs supplying the adjacent pools.

At a point some 200 yards to the west of the Ladywell is a pumping station with a gas engine and a three-throw pump which draws water from the well and raises it to a reservoir and a water tower of a total capacity of nearly 300,000 gallons, situated half a mile to the west. The rising main from the pumping station to the reservoir acts as a distributing main to the houses en route. Pumping is not continuous and when it ceases the flow in the main is reversed and it becomes a distributing main to the same houses; the rest of the town is supplied by gravitation from the reservoir direct. The apparent consumption has from time to time been regarded as excessive, and in 1931 the system was overhauled and a number of sources of leakage eliminated.

The water supply is constant and is delivered untreated within the limits of the District; the consumption is stated to be about 30 gallons per head per day. As it is situated in close proximity to the river, the Ladywell was subject to not infrequent pollution by inundation at times of flood, and in 1894 certain banks lying between the well and the river were re-made and raised in order to prevent this.

Sewerage and Sewage Disposal.—There are in the town 1,164 inhabited houses served by 898 cistern-flushed water closets, 611 pail privies and 10 midden privies. The sewers are not on the separate system and their contents discharge direct into the River Derwent without screening or other treatment. The two main outfalls serving Old and New Malton, respectively, are situated one to the east upstream from the Ladywell and the other to the west on which side also is a number of subsidiary outfalls. The number of conversions to the water carriage system in the years 1929 to 1931 was 14, 7 and 3, respectively. The pails are removed once a week by employees of the Council and are taken to a depot outside the town where their contents are tipped for the benefit of local farmers who buy them for manurial purposes, a proceeding which, should the material contain organisms of the enteric group, is not free from danger, as was illustrated at Bedlington in 1918 when 119 cases of enteric fever were traced to the drinking of river water infected by the surface washings of riparian land which had been manured with infected pail contents removed from the town.

Refuse Collection and Disposal.—House refuse is placed in covered galvanised iron bins and is collected once a week in covered horse-drawn carts. It is carted to the depot where, after screening, it is incinerated with the midden privy contents. Trade refuse is similarly disposed of but is collected in old boxes, pails and similar unsatisfactory receptacles which are placed in the street for the convenience of the scavengers.

PREVIOUS INCIDENCE OF DISEASES OF THE ENTERIC GROUP.

In 1892 the late Dr. Bruce Low, when he was investigating the incidence of enteric fever in the Kirkby Moorside and Malton Rural Sanitary Districts, which incidence proved to be due to the consumption of the water of the River Rye, received information from local sources that from time to time outbreaks of illness occurred in the town of Malton and were alleged to be due to pollution of the public water supply. Dr. Low was consequently instructed to extend his investigations to Malton. Dr. Low reported*, *inter alia*, that he had had an opportunity of examining the death records for the 20 years beginning 1873 and was "struck by the circumstances that enteric fever and also diarrhoea have persistently recurred in the town." Both diseases were prevalent from 1873 to 1877, while in the first 9 months of 1878 there were in the Urban District—which at that time included Norton and had a population of 8,168—315 cases of enteric fever. This outbreak was attributed locally to drainage defects as, with a modicum of truth, so might the present one, and "enteric fever" and "diarrhoea" are also to be found in the death records of Malton for 1879, 1880 and 1881. Furthermore, in 1884, 1885, 1886, 1887 and 1888, enteric fever occurred every year, and in October, 1889, there was a remarkable outbreak of diarrhoea which "seems to have affected every household in the town," one medical man testifying to having treated 90 cases in one day. In 1890 there was a similar but milder outbreak. Public attention meanwhile had been called to the fact that the outbreaks of "fever and diarrhoea" had followed seasons of floods of the Derwent and had been associated with the supply to the town of muddy water from the Ladywell, which, it was said, contained "the sewage of all the towns and villages situated near the Rye and its numerous tributaries." In 1889, yielding to the pressure of public opinion, the local Board of Health—the then Sanitary Authority—called in a firm of consulting engineers to examine the whole question and advise. In a report, dated 28th April, 1890, the engineers condemned the supply and recommended its abandonment in favour of an entirely new scheme whereby water was to be brought from Settrington Dale—a source which for similar reasons has since

* Dr. R. Bruce Low's Report to the Local Government Board on an Outbreak of Enteric Fever in certain villages situated on the River Rye in North Yorkshire, and on the Water Supply of the Malton Urban Sanitary District. No. 67, 1893.

been hypothecated by Settrington itself—but this was never proceeded with. It is noteworthy that Norton, which shortly after became a self-contained Urban Authority, adopted an entirely new water supply, and its residents, except such as were infected in Malton, entirely escaped in the recent outbreak.

In 1892 there were no deaths from enteric fever in Malton, but 12 non-fatal cases were reported and Dr. Bruce Low attributed the diminished incidence partly to the action of the then Borough Surveyor (who had been appointed about 2 years earlier) who, as soon as the flood water in the Derwent had reached a certain level and before any discolouration had taken place in the water of the Ladywell, had adopted the practice of ceasing to pump from the well to the reservoir and did not resume pumping until some time after all discolouration had disappeared from the water in the well. Dr. Bruce Low confirmed the observations of the townsfolk that the pollution was intermittent and was due to the periodical flooding of the Derwent, and he pointed out that the security of the inhabitants against delivery of polluted water rested entirely upon the vigilance of the Borough Surveyor. Finally he recommended that “the members of the Malton Urban Sanitary Authority should, therefore, without delay reconsider the question of obtaining for the town a sufficient and uniformly wholesome water supply.”

Dr. Bruce Low's report was sent to the Malton Sanitary Authority in August, 1893, but it was not acted upon. They procrastinated and instructed their Medical Officer of Health and Surveyor to prepare a report on “how to prevent discolouration of the water in time of flood.” In the following December the Authority informed the Local Government Board that they proposed to adopt the recommendation of their own officers, which was to the effect that the banks of the river abutting on the Ladywell should be raised so as to keep out the flood water. They added that they were satisfied that a “more adequate and pure supply could not be obtained elsewhere.” The banks were raised some time before March, 1895.

So far as I have been able to ascertain, no permanent steps to protect the water supply other than those set out above were taken, but constant watchfulness has been necessary and from time to time, when floods threatened, the water supply has been curtailed as in 1892, by a cessation of pumping until such time as the floods subsided. Only fourteen cases of enteric fever have been notified in the last 21 completed years, but as Dr. Low pointed out, should the Surveyor relax his vigilance and “should by chance excremental matters from cholera or enteric fever cases be amongst the impurities contained in the water, the result might be disastrous to the town.”

HISTORY OF THE OUTBREAK.

On my arrival on 25th October, the number of notifications of enteric fever since and including 9th October was 30. The patients

represented both sexes, all ages and many occupations, and were scattered throughout the town, whereas the slightly more populous Urban District of Norton, which is contiguous to Malton, was practically free. It appeared therefore, that whatever the vehicle of infection, it had been operative very largely in Malton. Preliminary enquiries had excluded the possibility of milk and of other articles of food and drink save water only.

On 24th October, on the hypothesis that the infection was water-borne and due to pollution of the well by washings from an adjacent heap of cattle manure, the Council had ordered the removal of the manure and the circulation throughout the town of handbills advising householders to boil all water, and they directed that this warning should be announced by the Town Crier in the streets. They also acceded to Dr. Walker's suggestion that, in the absence of adequate isolation hospital accommodation, they should take over and assume responsibility for the local Cottage Hospital and use it temporarily as an isolation hospital, and by the evening of 25th October twenty-six patients had been admitted. No other action to deal with the situation had been taken before my arrival.

I was able to confirm the Medical Officer of Health's conclusion that the disease was enteric fever and was probably water-borne, and that the relative freedom of the Norton Urban District was due to the fact that it had a separate and distinct water supply. Moreover, the coincidence in point of time and place of the invaded houses with the distribution of the public water supply suggested that the infection was general and had taken place either at the pump or before the water reached that point. Samples of water from the well and from the adjoining pool, taken on 26th October, were examined by Dr. W. M. Scott of the Pathological Laboratory of the Ministry of Health, and found to contain organisms of excremental origin. The specific organism of enteric fever was not found. Subsequently other samples were examined with similar results and at one time there was evidence of pollution in as small a quantity as 1 c.c. ; later there was some improvement.

At a special meeting of the Council on 26th October I recommended certain emergency measures including (1) sterilisation by chlorination of the water, pending the resort to an alternative supply which was not immediately available ; (2) removal to hospital of all notified cases ; (3) the offer of protective inoculation with anti-typhoid vaccine by the Medical Officer of Health, or by private practitioners ; and (4) a further warning that all drinking water should be boiled pending such time as it could be sterilised in bulk.

The Council accepted the recommendations and forthwith gave the necessary instructions. Before the meeting I had conferred with the Chairman and Clerk and had urged that they should anticipate the resolution of the Council and forthwith get into touch with the Engineering Department of the Ministry of Health and with a firm supplying the necessary appliances for sterilising the

water. This was done and a chlorinating apparatus adjusted to deliver and mix 2.5 parts of chlorine per million of water was installed at the pumping station by midnight on 27th October.

With the emergency measures in course of fulfilment, attention was directed to a search for the source of pollution. A potential source, of which the Council have long been aware, is flood water from the River Derwent, but the month of September had been remarkably dry in North Yorkshire and there had been no floods. Provisionally, therefore, the River Derwent could be excluded.

Enquiry as to the houses in the neighbourhood in which any cases of enteric fever had been known to occur recently elicited the information that the patient notified on 9th October—the first known case this year—was in the Public Assistance Institution (Spring Hall) which is situated 300 yards to the west of the Ladywell and at a higher level. I visited the Institution with Dr. Walker on 26th October and saw the patient (X), a young man of 23, who was in the male sick block; he presented the appearance of a patient in the fourth week of an attack of enteric fever. For three weeks before his admission on 23rd September this man had been employed as a harvester at a farm some miles away, where he lived in. On or about 20th September he complained of headache and loss of appetite and went to see the local doctor, when he was found to be feverish with no definite physical signs. As on 23rd September the fever persisted, he was sent by the doctor in a taxicab to the Institution accompanied by the Relieving Officer, and arrived about 4 o'clock. He was not bathed but was at once put to bed in the lower ward of the male sick block, which is separated from the female sick block by the "house," and there he remained until 26th October when I saw him. On the previous day a young woman inmate (Y) of about 30, who had been working in the Institution laundry for four months, had complained of being unwell and had been removed to the female sick block. I saw her with Dr. Walker; she had enteric fever and was the first of 7 inmates whose infection was water-borne. X and Y were forthwith removed at my suggestion, to the York Isolation Hospital. There were 6 beds in the lower ward of the male sick block of the Institution to which X had been admitted, and of these one was empty and 4 were occupied by chronic debilitated patients aged from 56–81 years. X was placed in Number 3 bed, which was immediately adjacent to the door of the water-closet which served the ward. The nursing staff consisted of a charge nurse and an assistant nurse; one lived in the male sick block and the other in the female, and ordinarily each had charge by day of 3 wards on the two floors of their respective blocks. There was no nurse on night duty, but on the male side a male inmate acted as attendant and there was a like arrangement on the female side. The nurse was at call if necessary. X had been received in the ward by the assistant nurse; he had a temperature of 101° and appeared "poorly";

this was reported to the Master, who at 4.15 p.m. sent a note to Dr. Walker, who visited at 7.30 p.m. On X's record card, which was kept not in the ward but in the Master's office, is a note under date 23rd September in Dr. Walker's writing—"Hyperpyrexia? from diarrhœa, some pain in epigastrium, nothing abnormal found." X was ordered No. 10 diet which consists of tea and bread and milk; an extra pint of milk was ordered four days later. The condition described is borne out by the evidence of the assistant nurse, who alleges that X had several loose stools on the day of admission and that he got out of bed and used either the commode or the adjoining water-closet. It is immaterial, however, inasmuch as the contents of the commode, as also those of the bed slipper, were habitually emptied into the ward water-closet pan. Dr. Walker did not again visit the Institution until 26th September, when the entry on the card reads—"To be treated as typhoid. Still complaining of fixed pain over epigastrium, no cough, no signs of pneumonia or pleurisy." There are no other clinical notes and the temperature charts which I saw in the ward on the occasion of my first visit were subsequently missing and could not be found. The only other entries on the record card are dated 8th, 11th and 21st October, and relate to certain additions to the diet.

Dr. Walker's entries were made in the Master's office, the record card was never in the ward and the nurses aver that not only did they never see it but they knew nothing of the suspected nature of the illness until told by his deputy, Dr. Parkin, on 28th September, to treat the "case as one of infectious disease." No suggestion of the patient's removal to the York Isolation Hospital, as provided for by an existing agreement, was made nor were the other patients in the ward placed elsewhere. The only change in procedure after the 28th September was that X was given verbal orders, which he disregarded, to stay in bed and to use a bed slipper and urine bottle. It is stated that these utensils were used but not exclusively, and that they were disinfected by the addition of a proprietary disinfectant fluid which was allowed to remain in contact with their contents until such time as the nurse had finished the patient's toilet. The contents were then emptied into the ward water-closet pan. Following his visit on the 28th September, Dr. Parkin visited for Dr. Walker on 1st, 2nd, 3rd, 5th, 7th, 10th and 12th October, and on the 2nd he had taken a specimen of X's blood for the agglutination reaction. The result was negative, but as the clinical condition continued indefinite a second sample was examined later and a positive result reported on 9th October. On that date the notification of "enteric fever" was signed by Dr. Walker, and on 10th October Dr. Parkin is reported to have told the charge nurse that X had enteric fever and was to be treated accordingly. He was not, however, removed from the common ward and the situation remained as before. X was a difficult patient and there is no doubt that he was in the habit of getting

out of bed and going to the water-closet. There is evidence that one of the two nurses, who alternately shared day duty for the six weeks X was in the ward, had occasion to attend to his toilet once only. The risks of infection incurred by the nurses and the attendant appear to have been much less than they would have been with a docile and tractable patient. According to the records, on 14th October Dr. Walker resumed his visits to the Institution and attended on the 17th, 21st and 24th. In the meantime he had received from addresses in the town two further notifications on the 22nd, one on the 32rd and 15 on the 24th. On the last date he concluded tentatively on the reports of the Sanitary Inspector that the infection was water-borne and that there would probably be many more cases. He thereupon communicated by telephone with Dr. Mason, the County Medical Officer of Health, who visited Malton on 24th October, saw X, and appears to have concurred in Dr. Walker's diagnosis and also in the suggestion that the subsequent cases were infected by water.

X had been in the Institution for 33 days from 23rd September. The notifications of enteric fever received on 24th, 25th and 26th October numbered 15, 11 and 17, respectively. If due allowance is made for the incubation period and the insidious onset peculiar to enteric fever, it is necessary to allow about 21 days, or possibly longer, from the date of infection to that of notification. The infection of the patients notified on 24th-26th October therefore, must have occurred on or about 3rd-5th October. It was on 26th September that Dr. Walker had written "treat as typhoid fever" on X's record card. X must have been infected early in September and was a potential source of infection from 23rd September, the date of admission to the Institution. If X, however, was the cause of the outbreak it is necessary to bridge the gap between 23rd September and 3rd October or thereabouts and to establish a connection between his infective discharges and the water distributed throughout the town.

The water closets in the male sick block are connected to a drain running in a south-westerly direction under the boundary wall of the institution, and on reaching the road beyond, this drain enters an inspection chamber as do two others from different parts of the Institution. The combined drain from the chamber runs along under the road westwards where it is joined by another from other properties; it then turns south through Metcalfe's Yard and discharges its contents direct into the River Derwent. No water for drinking purposes is taken from the river below Malton.

At my direction excavations were made in the road outside the Institution to see whether there was any break in continuity of the combined drain, and to ascertain its relation to the water main from the pumping station to the reservoir which runs parallel to it. No fracture or leak in either the combined drain or the water main was found.

The drain from the male sick block was then plugged at the inspection chamber and all water taps in the block were turned on. After some hours there was no sign of overflow at the yard gullies or of back pressure in the drain, and when the plug was removed only a small quantity of water escaped. It was obvious, therefore, that there was considerable leakage somewhere in the course of the drain.

Accordingly the whole length of the drain from the inspection chamber to the male sick block was laid bare. It was found to consist of 6 in. glazed earthenware spigot and socketted pipes with cemented joints, and there was a broken socket with resulting disconnection of the pipe and the discharge of the bulk of the sewage into the surrounding soil. The break was found some 12 feet from the inspection chamber and at a point where about 18 months previously a trench had been dug to a depth of 4 ft. 6 ins. in order to accommodate an electric power cable which passes obliquely under the drain. The break was old and apparently due to superincumbent pressure at the point where the trench had been dug. There were minor leakages along the whole length of the drain, but below the break was a large empty cavity into which the water I had caused to be run into the drain had flowed and disappeared. Thus there can be no doubt that typhoid infected sewage had been escaping from the drain into the soil ever since X's admission to the male sick block on the 23rd September.

The site of the break was a short distance from the pumping station, between which and the Ladywell is a pipe line of cast iron connected directly with the pump. There is a lift, from 10-12 feet, from the end of the suction pipe in the well to the pump. Pumping is not continuous and it was stated by the engineer in charge that when the pump is stopped there is no leakage of air into the suction pipe; it holds its vacuum, and priming of the pump is not necessary on restarting after an interval. It did not seem likely, therefore, that the water was polluted after leaving the Ladywell. Moreover, between the site of the breakage and the pump the oolite rock dips down and is replaced by a bed of Oxford clay. The bed of clay appears at Musley Bank to the west of Malton, and runs in an easterly direction along the north bank of the River Derwent right up to the springs at Ladywell. Indeed, it is the junction of the clay and oolite rock which determines the appearance of water as springs in this situation. It is from this occurrence that the Institution has been named Spring Hall.

It is probable that the bed of clay adjoining the oolite rock forms a channel along which sewage from the broken drain might find its way into the Ladywell. Excavations were made down to the rock on the immediate western side of Ladywell, and also some 20 feet further west in the direction of the Institution. No definite indication of the precise course taken by sewage from the Institution to the well was discovered. Bacteriological examination of

(a) surface soil, (b) oolite rock, and (c) water at the bottom of one of the excavations showed, however, that the rock in this situation was, and had been, sewage polluted. The pollution at the bottom of an excavation some 20 feet from the well was of a higher degree than that found in the water of the Ladywell.

The distance from the break in the drain to the Ladywell is about 250 yards. This probably accounts for the interval which elapsed between the date of admission of X to the Institution and the date of the first group of water-borne infections. Dr. Scott succeeded in isolating from the faeces of eleven of the patients a strain of the *B. typhosus* identical in cultural reactions with the strain recovered from X but markedly different from the strain responsible for a simultaneous outbreak elsewhere.

If X was responsible for the outbreak, then by his removal from the Institution on the 26th October it ought to have been stayed, and the notification of primary cases should have ceased some three weeks later. This is in fact what happened. After the middle of November the number of notifications fell rapidly and by the end of the month the primary cases ceased. On the other hand, sterilisation of the water, which might have been responsible for the same result, was enforced as from 27th October and it is not possible to dissociate the effect of these two measures. The circumstantial evidence, coupled with Dr. Scott's findings, is such as leaves no doubt in my mind that the outbreak was entirely due to the accidental contamination of the water supply with the specific organisms of enteric fever derived from the man X reaching the Ladywell from the broken drain.

The 17 patients notified on 26th October could not be accommodated at the Cottage Hospital, where all the beds were already occupied, and I arranged with the York City Council, through Dr. McNaught, the Medical Officer of Health, to admit up to 20 patients to their Isolation Hospital. The residents of Malton had by this time been consuming infected water for upwards of four weeks and it seemed expedient forthwith to secure further hospital accommodation. Subsequently, by the kind offices of the respective authorities, patients were admitted to the isolation hospitals of the Leeds, Scarborough and Darlington Town Councils, the Thirsk Rural District Council, and the Great Ouseburn, Northallerton, and East Riding of Yorkshire Joint Hospital Committees.

In the meantime, the cost of transport and the reluctance of parents to have their children taken away to distant hospitals had led the Council to seek other means of supplementing the accommodation locally, and a wooden hut of 60 feet by 20 feet was purchased and erected in the grounds of the Cottage Hospital. The hut was destitute of equipment except lighting and heating, but it served to accommodate convalescent patients whose beds were required for acute cases.

The emergency measures recommended to the District Council on 26th October were working satisfactorily. Bacteriological examination of the treated water early in November showed that it was sterile and samples taken from house taps in the town were found to contain free chlorine. Accordingly it was found possible gradually to reduce the amount of added chlorine to 0.7 parts per million.

Mr. McNaughton, of the Engineering Department of the Ministry, visited Malton on the 4th and 5th November and investigated the water supply. Mr. McNaughton, after full consideration, concurred in the recommendation that the Ladywell supply should be abandoned entirely as soon as possible and another supply provided, whereupon the Urban District Council called in a consulting engineer with this end in view.

Many residents desired anti-typhoid inoculation and approximately 1,600 were inoculated successfully at the expense of the District Council. No individual who was inoculated before infection developed the disease, but a number who were inoculated during the incubation period did. There was some indication that in these patients the attack ran a milder course; in particular the degree of pyrexia appeared to have been less.

The total number of primary cases was 235 and there have been at the time of writing (9th December) 35 secondary cases. The total includes 28 non-residents who were infected on visits to the town for business or pleasure and who took meals there.

The total number of invaded houses was 221. In the Public Assistance Institution there were 8 cases and in each of 8 private houses there were 3; in 26 instances there were 2; 186 cases occurred singly.

There were 127 males and 143 females infected and the age distribution is as follows:—

<i>Years.</i>	<i>0-10</i>	<i>11-20</i>	<i>21-30</i>	<i>31-40</i>	<i>41 years and over.</i>
Males	35	50	21	4	17
Females	24	49	35	19	16

The excess of females over males at ages over 31 is largely accounted for by secondary cases who had been engaged in nursing.

The attack rate was slightly in excess of 5 per cent. of the consumers of the water, as compared with 7 per cent. in the Borough of Worthing (Broadwater and Tarring) outbreak of 1893, 8 per cent. in Maidstone in 1897, 2 per cent. at Lincoln in 1904-5, 2 per cent. at Bolton on Dearne in 1921 and 0.4 per cent. at Bedlington in 1918. This attack rate, varying from 0.4 per cent. to 8 per cent.,

is very instructive and represents all the difference between sporadic and epidemic incidence.

The infectivity of the *B. typhosus* would appear to be markedly variable, or alternatively there are wide individual differences in susceptibility. In this connection it is noteworthy that in the last 21 completed years enteric fever has been practically unknown at Malton, and that of the 270 patients in 1932, 158 were below 20 years of age.

On my advice the water-closets of all invaded houses were treated with an emulsion of bleaching powder. Infected pails were removed forthwith, their contents tipped in a selected place and treated with bleaching powder. The used pails were washed out with a solution of bleaching powder before again passing into circulation. Infected privy middens were dealt with on similar lines, as were yards and gullies.

The disinfection of clothing and personal belongings of patients when the incidence of the disease was at its highest proved to be beyond the capacity of the one Thresh steam disinfector available, but fortunately Dr. Thornley, Medical Officer of Health of the East Riding, was able to arrange for the use of the high pressure steam disinfector at Great Driffield belonging to the East Riding Joint Hospital Committee.

SUMMARY AND CONCLUSIONS.

1. 235 persons, or approximately 5 per cent. of the population of Malton, contracted enteric fever in the six weeks ended mid-November, 1932. There were 35 secondary cases.

2. There was no case of enteric fever in the Urban District until the 23rd September, 1932, when a patient was admitted to the Public Assistance Institution. On 26th September he was found to be suffering from enteric fever but he was not notified until 9th October, nor was he removed to the York Isolation Hospital until 26th October, although an agreement was in existence between Malton Urban District Council and the Corporation of York for the admission of cases of infectious disease.

3. This man's infected excreta were drained into the River Derwent—the common sewer of the town—by a broken drain allowing part of the contents to soak into the surrounding soil, polluting it heavily with the specific infection which gained access to the water supply, either by drainage from the oolite or otherwise.

4. The infected sewage probably entered the public water supply from about the 30th September to 26th October, when the patient was removed to the York Isolation Hospital.

5. The town is sewered into the River Derwent and, apart altogether from the Public Assistance Institution, infected excreta from the water-borne cases of enteric fever had been entering the River Derwent for upwards of a month.

6. The exceptional incidence of enteric fever in Malton during the seventies, eighties and nineties of last century, recorded by the late Dr. Bruce Low in his report of 5th May, 1893, has unfortunately been repeated in the year 1932, and although the source of pollution differed the vehicle was the same. I cannot do better than repeat the conclusion of Dr. Bruce Low that "the members of the Malton Urban Sanitary Authority should, therefore, without delay, reconsider the question of obtaining for the town a sufficient and uniformly wholesome water supply."

In conclusion, I should like to thank the officers of the District Council for their willing co-operation. They all rendered admirable service in very anxious and trying circumstances. Particular mention should be made of the Clerk, Mr. J. L. Chapman, who could always rely on the support of Mr. C. C. Laverack, the Chairman, in overcoming the many difficulties incidental to the absence of isolation hospital facilities. Upon Mr. Jackson, Sanitary Inspector and Surveyor, the only whole-time officer of the Council, fell the formidable task of supervising the disinfection of infected premises and the removal and disposal of infected excreta, in which he never failed to maintain the rapid pace which was set. Mention should also be made of the help received from Dr. Walker, the Medical Officer of Health of Malton, his partner, the late Dr. Parkin, Dr. Thornley, the County Medical Officer of the East Riding, and the Medical Officers of other districts enumerated in this report who responded to my request for hospital accommodation and thereby materially assisted in bringing the outbreak to an end.

APPENDIX I.

MALTON URBAN DISTRICT.

NOTIFICATIONS OF ENTERIC FEVER TO THE REGISTRAR-GENERAL, 1932.

Week ended	15th	October	...	...	1 case.
"	22nd	"	...	...	1 "
"	29th	"	...	...	78 cases.
"	5th	November	...	...	64 "
"	12th	"	...	...	58 "
"	19th	"	...	...	26 "
"	26th	"	...	...	11 "
"	3rd	December	...	...	6 "
"	10th	"	...	...	2 "
"	17th	"	...	...	1 case.
"	24th	"	...	...	1 "
"	31st	"	...	...	Nil.

