

Dr. F. St. George Mivart's report to the Local Government Board on the general sanitary circumstances and administration of the Borough, and the Rural District, of Bridgnorth.

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REPORTS
TO THE
LOCAL GOVERNMENT BOARD
ON
**PUBLIC HEALTH AND MEDICAL
SUBJECTS.**

(NEW SERIES No. 25.)

Dr. F. St. George Mivart's Report to the Local Government Board on the General Sanitary Circumstances and Administration of the Borough, and the Rural District, of Bridgnorth.

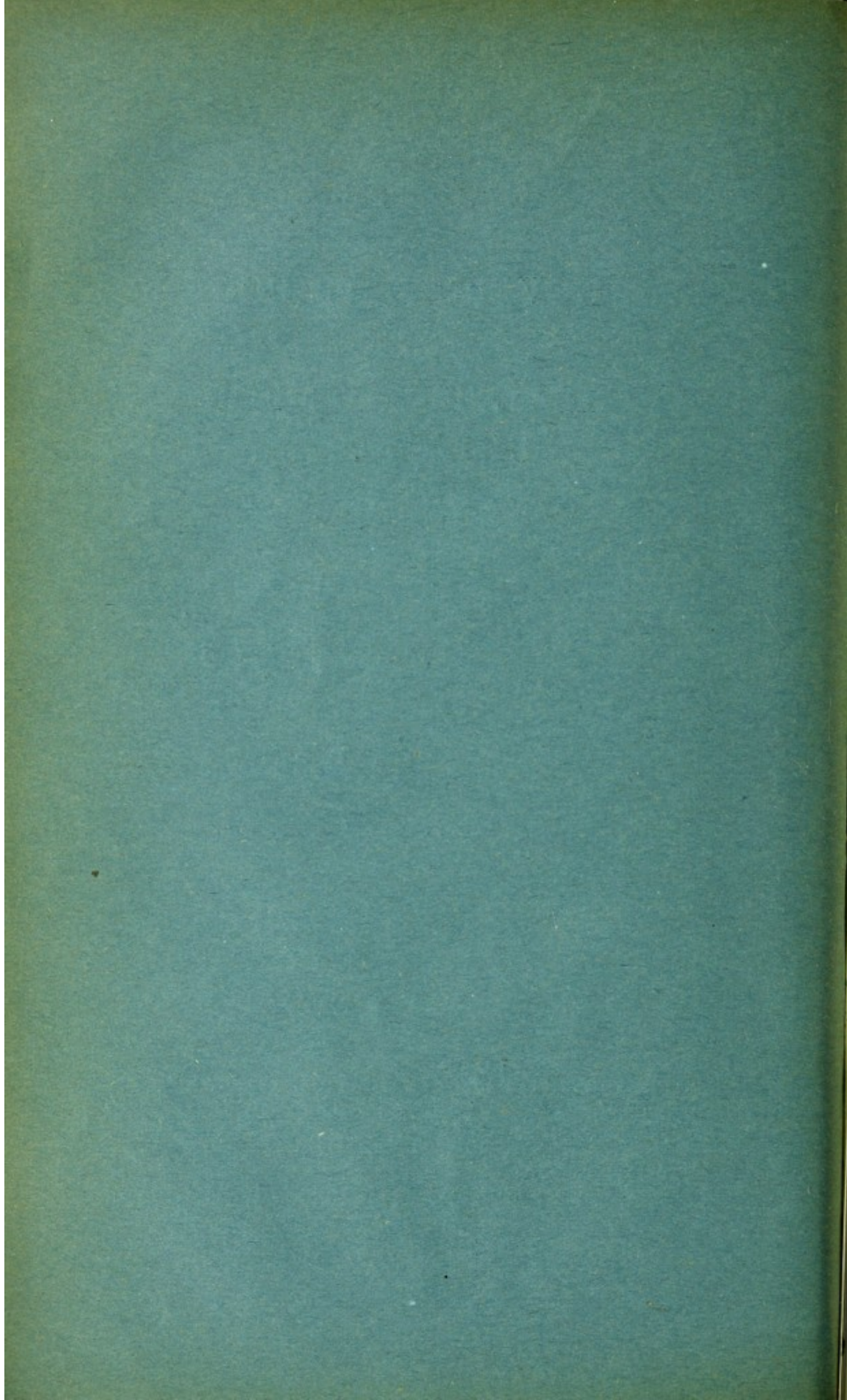


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Borough, and the Rural District, of
Bridgnorth.

ARTHUR NEWSHOLME,
MEDICAL OFFICER,
17th March, 1910.

BOROUGH OF BRIDGNORTH.

The Borough of Bridgnorth, near the eastern border of the County of Salop, is in the registration district and sub-district of Bridgnorth. Together with the Bridgnorth Rural District it forms the Bridgnorth Union.

The total area of the borough, 3,018 acres in extent, and wholly surrounded by the Rural District of Bridgnorth, comprises the parishes of St. Leonard, St. Mary Magdalen, Quatford, and Quatt Jarvis.

The two former parishes, constituting the part of the municipal borough wherein the bulk of the population is concentrated, have an area of 1,168 acres; the two latter, outlying and entirely agricultural, have an area of 1,850 acres and a population of 395 only, of whom upwards of 100 inhabit the union workhouse. The entire population, which was 6,052 at the Census of 1901, is now thought to be 6,020.

The borough itself consists of two portions, known, respectively, as "High Town" and "Low Town." The former, situated on the right bank of the Severn, is perched upon red sandstone cliffs rising nearly 120 feet above the river which, hereabouts, flows through a valley enclosed by steep and wood-crowned rocks. The latter, placed on the low-lying and flat portion of the left bank of the river, is connected with High Town by a fine bridge of seven arches.

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High Town, consisting of a broad main street running nearly north and south, from which three important thoroughfares diverge in a westerly direction, is closely built. In Low Town, save near the bridge, dwellings are more scattered. Heights above Ordnance Datum vary from about 225 feet in East Castle Street, High Town, to about 108 feet in Foundry Yard, Low Town. The populous portion of the borough stands wholly on the lower soft red sandstone which, along the river, is overlaid by alluvium. The conglomerate bed of this formation ends with a line following the ridge to the east of the town.

The principal industries of Bridgnorth, which is an important agricultural centre, comprise an extensive factory of carpets, textile dyeing and printing works, malting, brewing, tanning, and yarn milling. Two important fairs are held annually, in May and October respectively.

SANITARY CIRCUMSTANCES.

Roads.—There are 8 miles 3 furlongs of main, and 6 miles of other roads, paved or metalled. There are 2 miles of road not paved or metalled. On the whole, roads are fairly good. Some thoroughfares of very steep gradients, such as Cartway, demand much attention by reason of the downpour of water taking place there in rainy weather.

Dwellings.—At the Census of 1901 the borough of Bridgnorth contained 1,300 inhabited houses; there are now stated to be about 1,340. Very many of the older houses are built of local sandstone, soft and porous and not weathering well, but slowly becoming eroded and worn away. The sandstone is frequently cased with brick or plaster.

A considerable number of the poorer cottages constructed of sandstone, especially of those built into or close against the rock, are damp.

A striking feature of some of the older dwellings at Bridgnorth is the manner in which they are built into the rock or against the steep hill sides. Until quite recent years some dwellings actually cut in the sandstone were inhabited. These, however, have been condemned as unfit for human habitation and now serve as store-houses, poultry houses, and the like. But many dwellings are built against the rock so that the natural sandstone *in situ* forms part of the back or side wall. Likewise the rock is seen cut away here and there to form communicating passages and stairs leading from one house to another. Such passages are occasionally very narrow. Many of these dwellings have cellars which are "caves" in the rock, opening out of the dwelling room, and used as store places or sculleries. These caves derive light and air only through the living room. Some occupiers denied that their "caves" were damp; others owned to dampness and said that in wet weather there was occasional dripping of water from the ceiling of the cave.

Yards, generally, are without paving, and were frequently noticed in a dirty condition. In many situations upon the steep cliff slopes curtilages are cut in the rock, are narrow, and are in some cases paved with small cobble stones, quickly displaced and hindering proper surface drainage.

In general I heard but little complaint as to the condition of roofs. On the other hand, gutter-spouting is frequently lacking; in numerous instances I found down-pipes broken, displaced, or discharging upon the ground close to the walls. A frequent defect I found to be ill-fitting doors and windows, allowing rain to penetrate into rooms.

There is great need for cottages for the poorer labouring class in Bridgnorth, more especially for cottages with sufficient accommodation for such as have families. Instances were cited of persons who had desired to marry, but had been compelled to wait owing to the impossibility of finding a dwelling. Indeed, it appeared to me that the shortage of houses was not confined to dwellings of the poorer class alone. Rents are high; in some cases remarkably so, considering the accommodation afforded. This need for houses has been admitted for many years past by persons acquainted with the town.

In 1894 the Bridgnorth Town Council, under the Municipal Corporations Act, 1882, and the Housing of the Working Classes Act, 1890, applied to the Board for sanction to borrow £5,000 for the erection of dwellings for the working classes, and for approval of the appropriation to that object of certain corporate land and funds. A public inquiry was held with regard to this matter in January, 1895, by one of the Board's engineering inspectors. It was proposed to erect twenty cottages in blocks of eight and six, and also ten semi-detached cottages of a superior type. As result of this inquiry the Board informed the town council that they were not prepared to accede to that part of the scheme concerned with the erection of the twenty cottages first mentioned, inasmuch as they were of opinion that the site on which it was proposed to erect them could not be regarded as suitable for the purposes in view. As to the other part of the scheme, concerned with the erection of ten semi-detached cottages, the Board pointed out that it was proposed to discharge the sewage from these cottages in an unpurified condition into the Severn, and that they were not prepared to give their sanction to the construction of any works which would have the effect of causing unpurified sewage to be discharged into the river. The Board added that, before they could further consider this part of the town council's application, a proper scheme for the purification of the sewage from these cottages should be prepared and submitted to them. In reply to a subsequent communication from the Board, inquiring how the matter stood, the town council stated that they had determined for the present to abandon this application.

In view of the pressing need for dwellings in Bridgnorth, it is much to be regretted that the town council did not, by means of a suitable scheme, persevere in their praiseworthy intention to provide additional housing accommodation.

Water Supply.—Bridgnorth possesses a duplicate public water supply, consisting of (1) spring water intended for drinking purposes only, and laid on to public stand pipes; and (2) water from the Severn filtered and delivered at or into houses. The latter supply is, ostensibly, for purposes other than drinking. These two systems are said to supply in addition about 25 houses outside the borough,

but they do not supply the parishes of Quatford and Quatt Jarvis within the borough area.

The source of the supply of spring water has been thus described by Dr. Wheatley, the county medical officer, in a report made by him in 1905 to the county council on the water supplies of the Borough of Bridgnorth :—

“The spring water is piped from a well named ‘Oldbury Well,’ or ‘Conduit Well,’ situated to the west of the town. The water springs direct from the New Red Sandstone rock which forms the bottom and to some extent the walls of the well. The built sides are said to be formed of concrete, which is let into the rock so as to prevent the access of any unfiltered surface water. The water is above suspicion judged both by its surroundings and by the result of chemical and bacteriological examinations.

“The size of the well is about 7 feet by 6 feet, and it contained at the time of my visit about 3 feet of water. It is said to rise 5 feet higher after a spell of wet weather. The outlet, a 2-inch iron pipe, was lowered seven years ago, and is now said to be situated as near the bottom of the well as is practicable.

“Instead of entering into details as to the distribution of this water, it will be sufficient to say that it runs to a tank under the Town Hall steps, from which are supplied two other tanks for the lower town, and the various standpipes in the higher town. As to the sufficiency of the water for the purpose for which it is used, there can be little doubt, for even in the driest weather of last autumn and winter, overflow from the tanks took place through the night and until eight o'clock in the morning. If there had been any shortness it would only have been necessary to increase the storage accommodation. In the year 1898 there was some shortness of conduit water, but the alterations then made seem to have got over the difficulty and prevented a recurrence. But although this supply is sufficient for drinking purposes it would be quite insufficient as a sole supply.”

A copy of the only analysis of this water that I could hear of is given in Appendix A. I did not find that any shortage had occurred within recent years.

With regard to (2) the filtered water of the Severn, the water works date from 1854. The intake is about half-a-mile above the bridge, and, although on the opposite side of the river, is only about 50 yards below the point where the Cantern brook, recipient of the effluent from the borough sewage works and the washings and soakage of the town refuse “tip” flow out. This is not all; on the same side of the river as the intake, and about 400 yards above it, are the Pendleton yarn mills, where 80 hands are employed, in addition to the residents in the overseer's house. The water-closets there comprise one for the residents, one for the male and two for the female mill hands. The sewage from these closets passes to a settling tank, with overflow discharging into the river about 30 yards down stream from the mills, *i.e.*, only about 370 yards above the intake of the water works. At the mills themselves are also discharged into the river the water from the engine and the washings from the wool used in the process of manufacture. The river at the intake is 150 feet wide. The water abstracted from the river passes through a $\frac{1}{2}$ -inch mesh screen into the intake well and thence through a $\frac{1}{8}$ -inch mesh screen to the pumping well from which it is forced by means of a 40 h.p. engine* to an installation of

* In case of failure of this engine there is a 20 h.p. reserve engine drawing directly from the river just above the intake.

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 "Candy" pressure filters. Thence it is raised about 270 feet to the service reservoir (247,000 gallons capacity) on the top of Bromley Hill. On its way to the service reservoir, which is covered, the water passes through two wells, a receiving "well," and a clear "well." These "wells" have no special function now, and only remain as part of a former system of filtration by sand and gravel. From the service reservoir the water flows by gravitation to all parts of the borough.

I am informed that the use of these Candy filters is experimental. They have been supplied on hire for six months under an agreement. The cost of the hire will be deducted from the purchase price if they are bought. The two filter beds formerly employed are now disused, and the space occupied by them may be utilised for the construction of a large service reservoir if the scheme prove satisfactory. At the time of my visit the Candy filters had only been installed a few days and it was too early to speak of their efficiency. The water delivered in the borough was brownish and very slightly turbid, but this was believed to be due to the clearing out of the mains by water highly aerated. Before I left the town the appearance of the water had greatly improved. No analysis had been made since the new filtration system was adopted.

The waters of the Severn, at the intake of Bridgnorth water works, cannot be regarded as free from polluting matters of dangerous sort. Within a distance of ten miles above this point, the river has already received the sewage of Ironbridge, Coalbrookdale, Broseley, Jackfield, Coalport and Madeley. About three-quarters of a mile above the intake it has also received the Worfe-brook bringing down some portion of the drainage of the village of Worfield. Reference has already been made to the entry of the Canern brook into the river, only 50 yards above the intake of the water works, though on the opposite side. The brook water must be regarded as a highly dangerous adjunct if allowed to mingle with the water at the intake. It was asserted to me that no such mixture takes place, but that the brook water flows down close to the western shore. Though this may be so under normal circumstances and it was manifestly so on several occasions when I visited the spot, yet the possibility of admixture, when strong west winds are blowing, cannot be overlooked.

The Severn water supplied to Bridgnorth, though intended for purposes other than drinking, has undoubtedly been used to no inconsiderable extent, hitherto, for drinking, and is likely to be so used even more in the future. In view of this, and of doubt as to the degree in which the new filters may afford protection to the consumers of this water, this portion of the Bridgnorth supply must be held to constitute a danger to the community.

Sewerage.—During 1854-56 the populous part of the borough was provided with sewers, which, owing to the nature of the levels, had to be laid in three separate systems. The surveyor informs me that those sewers which he has had occasion to take up

* These filters were put up in October last. The Surveyor estimates their capacity of filtration as equal to 250,000 gallons in 10 hours.

have been found to be glazed pipes jointed with cement. Ventilation is afforded by pipes, carried up at any convenient point. The sewers of Low Town are flushed fortnightly from the water mains. The High Town sewers are similarly flushed, but only in dry weather, as owing to the steepness of the gradients and the storm water brought down, these sewers are considered to be practically self-cleansing. On special occasions, such as fair times, they are flushed with a hose.

The sewers of as much of the northern part of High Town as the levels allow drain to sewage disposal works completed and put in operation in 1901. These works are situated at the north end of the town upon a site nearly 4 acres in extent close to the south branch of the Cantern brook. I am informed that there would probably be no difficulty in getting another 10-15 acres if necessary. The surveyor calculates the dry weather flow to be about 26,000 gallons. The crude sewage enters a detritus chamber and thence passes to two septic tanks. After passing through four additional small settling tanks, added during the present year, it is distributed by automatic gear over four open contact beds, two of which are filled with blast furnace slags and two with fine clinker. The resulting effluent flows direct to the Cantern brook. There is a storm overflow which comes into action when the storm water reaches a given rate of flow. This surplus storm water sewage passes, untreated, into the brook at a point 100 feet nearer to the river than the outfall of the effluent from the contact beds. The length of the Cantern brook from the outfall of the sewage works effluent to the river is upwards of 700 yards. The volume of its flow varies considerably, but is always much larger than the flow of the effluent. On the occasions of my visits to the stream I could see but very little evidence of the deposit of sewage matter in the bed of the stream. The effluent from the beds was on one occasion slightly turbid but quite free from smell. In Appendix B. will be found a copy of a recent analysis by Dr. Wheatley of the effluent from the sewage works. The remainder of the houses in High Town, roughly estimated by Dr. Wheatley in 1905 to number upwards of 861, drain to a sewer which discharges its contents, in a crude condition, by a single outfall, called the western outfall, into the Severn about 600 yards below the bridge. That very serious nuisance is caused by this discharge of untreated sewage is not denied. At the time of my visit black and highly offensive sewage was flowing out, and the river bed showed a large accumulation of the same.

In the part of the borough known as Low Town it is somewhat difficult to provide sufficient fall for all the sewers in that locality. The sewer in St. John Street has a fall of 1 in 281 and in Severn Street of 1 in 468. The outfall sewer is a brick oval 24 inches by 16 inches with a fall of 1 in 219. This outfall, known as the eastern, creates a nuisance similar to that caused on the western side. The surveyor informs me that the approximate dry weather flow at the eastern outfall, which is about 65 yards below the bridge, is about 42,000 gallons per 24 hours. The approximate estimate of the outflow at the western outfall is 289,000 gallons per

24 hours, including 115,000 gallons from the dye house and condensers at the carpet works.

The river is undoubtedly contaminated for miles below these two outfalls. As Dr. Wheatley remarks in his report for the second quarter of 1907, the discharge of so large a volume of untreated sewage into the Severn should not be allowed to continue. I understand that the town council have under consideration a scheme for the disposal of the sewage.

Excrement disposal.—According to information given to me by the inspector of nuisances, the populous part of the borough is almost completely furnished with water-closets draining to the sewers. He knows of only 11 water-closets draining to cesspools; 3 water-closets draining directly into the river; 23 cesspit privies; and two houses possessing earth closets. In houses of the poorer class the water-closets are commonly of the short hopper type. Flushing is generally good. Nuisances in connection with water-closets are not conspicuous, but hardship is caused by the insufficient number of closets, as also by their being placed at points inconvenient of access. It is a common thing to find only a single water-closet for the use of three cottages. At certain back-to-back houses on Bernard Hill the passage leading to the water-closet (for the use of three dwellings) is barely 12 inches wide. In some parts of the borough below the levels of the sewers, vault privies are in use and certain filth nuisances were found. The worst conditions of excrement disposal were met with in Foundry Yard. Here two privies are only 22 inches wide and open at the back. The privy vault is uncovered, and there is danger of children falling into it. The insanitary condition of Foundry Yard has repeatedly been the subject of remark by the medical officer of health in his annual reports. Privy vaults are emptied by cottagers as they best can arrange.

Removal and disposal of house refuse.—I am informed that the use of large ash-pits is discouraged, and portable ash-bins recommended. Apparently, however, efforts in this direction have not been very successful. In various parts of the borough I saw a number of large open refuse pits, many of them full or nearly so. The ground around these receptacles is unpaved, and thus becomes seriously fouled. In not a few cases, too, refuse was found deposited in heaps in corners of yards.

Removal of refuse is carried out weekly by the town council, whose carts daily perambulate sections of the town, which are thus dealt with in turn. The large refuse pits are usually attended to on request. The refuse of the High Town is tipped at a spot close to the sewage works, as already mentioned. The refuse of Low Town is deposited in an old gravel pit beyond the town.

Nuisances.—A good deal of nuisance is caused, from time to time, in various parts of the town by the accumulation and storage of manure. But the most serious nuisance in the borough is that caused by the keeping of pigs, a practice which some time since became very considerable. In many instances the inspector of nuisances has been successful in prohibiting pig-keeping, but very much remains to be done, and I heard numerous complaints of the

stench, and also of the noise, caused by these animals, which often appear to be kept in a negligent manner. In one case I found a pig-sty placed upon an enormous accumulation of manure and filth. The smell at this spot was extremely offensive and there were swarms of flies about. Adjacent to the Post Office serious nuisance was being caused by the keeping of pigs, the foul liquid from this sty having, apparently, saturated the sustaining wall adjoining the side door of a chapel. In the same yard, which was in other respects dirty, I found other pigs being kept in a stable. In the centre of the town, in another unpaved yard in which there is a slaughter-house, I found pigs being kept, as also a large quantity of poultry. A quantity of pig manure was stored in an open pit.

There are four registered *common lodging-houses*, including one for the reception of men only. All these houses were fairly clean. At one of these, which is rather dilapidated, the stairs are very steep, with high "risers" and narrow "treads." At another house a room intended for two married couples has no dividing partition between the beds. The antiquated regulations still in force have no clause dealing with this point.

There are nine registered *slaughter-houses* all of which I visited. In most instances serious nuisance is caused, in the urban portion of the borough, by these slaughter-houses, which are generally surrounded by, or much too near to, dwellings, and complaints are made of foul smells, of soakage of filthy liquids, and of the presence of flies. Many of the slaughter-house structures are old and dilapidated sheds unsuited to their purpose. Floors of slaughter-houses are mostly of open brick or rough stone, broken and displaced.

There are 23 registered *milk vendors* in the borough area; of these, five are only occasional sellers of small quantities, and in one other case milk is disposed of privately. Milk is taken round in, and sold direct from, the carts; there are no milkshops properly so-called. There are a few dairies where a small quantity of milk is kept stored for sale; these are generally small, close, dark, and unsuited to the purpose.

As regards cowsheds the chief defect is the storage of manure, which had accumulated in enormous and offensive degree at one fold-yard, where 20 cows are milked. As a rule, cubic space and ventilation are fairly good, but lighting is often inadequate and cleanliness lacking. In one cowshed which was cleanly kept, I found a cow suffering from diarrhoea after calving. I was told that the calf took most of this cow's milk, but that a little of it was added to the milk sent out for sale. I remarked upon the filthy condition of the hindquarters and udders of this cow, and was informed that the owner had been advised that udder cleaning is apt to cause cold.

There are 15 registered *bakehouses*, most of which seemed in fair, and some, indeed, in excellent order. In one bakehouse, however, the walls were filthily dirty, as also was the floor which was of open brick, displaced and broken. At the door of the bakehouse was an open ashpit full to the brim of foul refuse. Close, also, to the door was a sty of four pigs.

SANITARY ADMINISTRATION.

The town council consists of 17 members who meet ten times annually, and there are eleven committees. By arrangement with the mayor, who is *ex officio* its chairman, the sanitary committee seems to be called together as required.

It is very difficult to estimate the value of the work done by the sanitary committee as no minutes are kept. Moreover, though the inspector of nuisances keeps a diary in which he enters in brief and general terms the nature of the work done by him day by day, it does not show the nature of his report to the committee, or the action ordered by the council after the committee have dealt with the facts reported by the inspector, who, as a rule, does not attend the council meetings. As a matter of fact the inspector informs me that his notices to defaulters are largely verbal. Likewise he has not had to resort to police court proceedings. Undoubtedly some good work has been accomplished, but it would seem that there is need for a closer grip of recurring nuisances. As regards the absence of minutes, I fail to see reason why the established custom of keeping minutes should be departed from, or, indeed, how it can possibly be dispensed with.

The only byelaws in force in the borough are with respect to slaughter-houses. These byelaws were made by the Local Board of Health for the Borough of Bridgnorth, and were allowed by the Secretary of State for the Home Department on the 29th April, 1854.

Regulations with respect to dairies, cowsheds, and milkshops have been in force since 1st March, 1908.

I was also shown a copy of the regulations respecting common lodging-houses. These regulations bear date 1852.

No part of any adoptive Act of Parliament is in force in the borough.

The *medical officer of health* is Mr. J. C. Padwick, M.R.C.S. (Eng.), and L.R.C.P. (Lond.), who was appointed in 1902. He is engaged in private practice and is also medical officer of health for Bridgnorth Rural District. As medical officer of health for the borough, Mr. Padwick receives an annual salary of £30, no part of which is repaid from county funds, the town council having declined to accept such repayment. Mr. Padwick has a fair knowledge of his district.

The *inspector of nuisances* is Mr. Enoch Williams, who was appointed in November, 1893. He is also inspector of water fittings, collector of rates, and captain of the fire brigade. For these various offices he receives a total salary of £125 together with a residence, rent and rate free. The total salary is thus apportioned:—Inspector of nuisances and water fittings £60; collector of borough rates £40; captain of fire brigade £25. No part of his remuneration as inspector of nuisances is repaid from county funds, the town council having, as in the case of their medical officer of health, declined to receive such repayment. Mr. Williams holds no certificate in sanitary science, but he was trained as a mechanical engineer and was for ten years engineer on the Witley Court estate. Undoubtedly his mechanical knowledge is of much use to him in his present appointment. As already mentioned he keeps a diary but

no journal and report book in the customary form. This I have advised that he shall keep in future. He has kept considerable records of house-to-house visitations in various localities, and has measurements of the cowsheds in the borough. Mr. Williams has a good knowledge of his district and of the insanitary conditions existing in it. Mr. Williams's work as collector gives him a busy period during about fourteen days twice a year, viz., in July and December. He is able to give to sanitary inspection, with which he combines inspection of water fittings, two or three days a week at least.

The borough surveyor is Mr. Ernest Trevor, who receives a salary of £150 per annum and the use of offices. He is not a "whole time" officer but is permitted to engage in private practice.

For the reception of cases of infectious disease other than small-pox there is an *isolation hospital* constructed of corrugated iron, match boarded internally, which was erected in 1894 at a cost of about £950, upon Corporation freehold land in Low Town. Of this land about $1\frac{1}{3}$ acres have been enclosed on the north and west sides by a 6 foot corrugated iron fence. The eastern boundary is a hedge, and the west a steep slope to the Stourbridge road. The town water supply is laid on to the hospital. Earth closets are in use. Slops are drained to a "soak-away" tank in a corner of the site. The hospital consists of a ward block and a block of outbuildings. The wards are arranged (four in a north and four in a south wing respectively) on either side of a lobby which also connects them with a kitchen and nurses' room. The large wards are 24 feet 6 inches by 9 feet 6 inches, and contain 3,026 cubic feet; the small wards are 14 feet 6 inches by 7 feet 6 inches, and contain 1,414 cubic feet. The wards are narrow and rather gloomy, being lighted on one side only. As not only the four wards in either wing but also the two wings and the nurses' room are all in direct communication, the building could properly be used for only one disease at the same time. If all the eight wards were in use at once the nursing staff accommodation, consisting of one bedroom 11 feet by 11 feet 6 inches, would be insufficient. The hospital is warmed and lighted by gas. Ventilation is effected by the upper sashes of windows, and by outlets in the roof. The latter at the time of my visit seemed to act as inlets quite as much as outlets.

The outbuilding block comprises a wash-house, a laundry, a coal store, a mortuary, a coach-house containing an iron tyred wood lined ambulance, and a disinfecting room containing an apparatus designed by Mr. Enoch Williams for *disinfection* by saturated steam. In this apparatus the live steam is turned straight into the chamber (measuring 6 feet by 4 feet 6 inches) at a pressure of about 23 lbs to the square inch. The apparatus cost about £70 and is thought to be effective.

Upon receiving notice of an infectious case the medical officer of health telephones to the inspector of nuisances, who visits the house. If the case requires removal to hospital, the inspector of nuisances procures a horse from an adjacent stable and himself accompanies the ambulance to the patient's house, and thence to the hospital. The ambulance is subsequently disinfected with formaldehyde gas, which is likewise employed for the disinfection of the patient's room

or rooms. I am assured that every effort is used to get the walls of the infected rooms cleansed as thoroughly as possible, and that stripping of wall paper is secured whenever practicable.

RECOMMENDATIONS.

1. The town council should again consider the desirability of erecting dwellings for the poorer working class.
2. The town council should satisfy themselves whether that part of the town water supply derived from the River Severn can be safeguarded against dangerous pollution, or effectually purified before delivery, in view of the fact that this supply, though not intended for drinking purposes, is, in fact, so used. If it be found that this water cannot be rendered wholesome, the source of supply should be abandoned.
3. The town council should make every effort to hasten the adoption of a scheme of treatment for the sewage of Low Town and for that part of the sewage of High Town at present discharged in a crude condition into the Severn at the eastern and western outfalls respectively.
4. The provisions of the Public Health Act, 1875, for the repression of nuisances, and more particularly of nuisances likely to recur, should be systematically enforced.
5. The town council should adopt byelaws dealing with (1) nuisances, including those arising from the keeping of animals; (2) common lodging-houses; (3) slaughter-houses and (4) new buildings.
6. The town council should increase the amount and improve the quality of the accommodation at the isolation hospital.

In this connection the town council would do well to consider the advisability of combining with the Bridgnorth Rural District Council for the provision of suitable hospital accommodation in common.

My thanks are due to Mr. J. H. Cooksey, town clerk, as also to Mr. J. C. Padwick, medical officer of health, Mr. Ernest Trevor, borough engineer, and Mr. Enoch Williams, inspector of nuisances, for their assistance in my inquiry.

APPENDIX A.

NOVEMBER 1909.

BRIDGNORTH SEWAGE WORKS.

Results of Analyses in Parts per 100,000.

Samples.	Oxygen absorbed in 4 hours at 80° F.	Oxygen absorbed in 3 minutes.	Oxygen absorbed in 3 minutes after 5 days' in- cubation.	Chlorine.	Nitrogen as ni- trates.	Odour.	Depth in inches of column that just obscures opacity lines.
Sewage	18.44	—	—	12.45	—	—	—
Tank effluent ...	5.93	—	—	8.55	—	—	1 inch.
Contact bed—first flow.	2.88	.935	.921	8.25	1.5	None	2½ inches.
Contact bed flow after 5–10 minutes flow.	—	—	—	8.05	1.5	None	2 inches.

APPENDIX B.

BOROUGH OF BRIDGNORTH.

ANALYSIS of SPRING WATER in 1898 (as supplied by PUBLIC
CONDUITS or STAND PIPES in the STREETS); by T. P.
BLUNT, County Analyst.

Grains per gallon.

Hardness 16°.	
Solids in solution, dried at 140° C. ...	23
Oxygen absorbed in 4 hours at 15° C. ...	0.01
Saline ammonia	0.001
Albuminoid ammonia	0.002
Nitrogen as nitrates	0.13
Nitrites	None.
Chlorine as chlorides	0.7
Poisonous metals	None.

The analysis shows the water to be a pure and excellent one for
drinking purposes, of moderate hardness, and capable of softening
to the extent of nearly three-fourths by boiling.

BRIDGNORTH RURAL DISTRICT.

The rural district of Bridgnorth which, as already mentioned, wholly encloses the borough of that name, has from north to south an extreme length of, approximately, 11 miles, and from east to west an extreme breadth of 16 miles.

The district has an area of 70,521 acres, and had at the census of 1901 a population of 8,573, dwelling in 1,886 houses. The present population must, the clerk says, be regarded as about the same. It would, however, appear probable that there has been some decrease, seeing that in 1891 the population was 9,185.

The only places at all describable as villages are Claverley, Alveley, and Worfield, the rest of the population living in small hamlets consisting each of a dozen or more scattered houses.

The rateable value of the district is £74,847. Its assessable value is £52,966, a rate of 1*d.* in the £ being estimated to yield £220. The last general district rate was at 5*d.* in the £, and has at no time exceeded 6*d.* The balance of outstanding public debt, which was incurred for the Alveley water supply, is £53 6*s.* 8*d.*

Save for a small colliery at Billingsley, employing some twenty men, the district is wholly agricultural, the principal industry being stock-raising. There is another colliery at Highley, just beyond the southern border of the district.

Geology.—The western half of the district stands upon the old red sandstone, a small outlier of the coal measures occupying the summit of Brown Clee Hill on its western border. A narrow belt of coal measures, little worked, also traverses the centre of the district from north to south, to the west of and parallel to the River Severn; a band of Permian strata, sandstone, marl, and conglomerate, and one of new red sandstone usually intervening. In the south-eastern portion of the district the Permian beds occupy a considerable area east of the river. The portion of the district north and east of Bridgnorth rests on the sandstone and conglomerate beds of the Triassic (new red) series. Much of the eastern part of the district is covered with gravelly and sandy drift.

• SANITARY CIRCUMSTANCES.

Roads.—I am informed that there are 46 miles of main roads and 230 miles of district roads. Except those maintained by the county council, roads are generally in indifferent or, even, in some localities, in bad condition.

In the neighbourhood of Chelmarsh Common roads or at least passable footpaths are needed. The inhabitants of cottages here must suffer hardship owing to the absence of any decent roads or paths across the common, which is largely a swamp.

Housing.—Dwellings are generally detached, or in little rows of three or four. I did not find the number of eight in a row exceeded. Speaking generally, the condition of cottage property in this district compares not unfavourably with that of the average rural district. Gardens are commonly of fair or even of good extent. Most cottages are of brick or local sandstone, which in some cases is faced with plaster or cement, and have slated or tiled roofs. Eaves-spouting is generally provided, but down pipes are often broken away and discharge

water close to walls. Many cottages are without through ventilation of any kind, or rely for such on a single small window, which is usually fixed and therefore useless for the purpose. A few houses are damp by reason of their being built with part of the back or sidewalls in contact with the soil. Occasionally, as was seen at Chelmarsh, the flooring of ground floor rooms is broken and defective. In some of the above respects three cottages at Daddlebrook, in Alveley parish, were perhaps the worst met with.

In such localities as Chelmarsh, Deuxhill, Billingsley, and other places within reach of the Highley collieries the difficulty, already considerable, in getting cottage accommodation for the poorer working class is likely to increase. It is stated that the colliers have found out that, hereabouts, cottages are obtainable at a lower rent than that charged by the Highley Colliery Company. There is little or no paving around houses.

Water supplies.—For the most part these are fairly satisfactory considering the extremely scattered population. The village of Alveley has a public supply from a constant spring, the water of which is forced by means of a ram to a storage reservoir whence it flows to stand pipes. The ram has given trouble in the past, but now appears to be working well. The storage reservoir might, with advantage, be larger. The hamlet of Colmore Green, in the parish of Astley Abbots, has also been furnished with a good water supply by the local landowner. Aston Eyres, Worfield, Burwarton, Cleobury North, and Ditton Priors are other places to which water is conveyed from storage reservoirs. At Hampton Loade, in the parish of Quatt Malvern, the inhabitants of a row of cottages have at present to fetch water from a source nearly 200 yards distant. There is a stand pipe delivering for their use water derived from a brook. At the time of my visit, however, this water was unfit for use by reason, apparently, of inadequate filtration. In several other localities water is piped from springs and appears to be generally good and sufficient. In some villages and hamlets there are public pumps drawing water from closed wells, said in all cases to be dry steined. The water thus obtained is usually sufficient in quantity, but, in view of the porous nature of the strata and the doubtful surroundings, such water cannot be regarded as free from risk of contamination. I heard of no recent analyses of water, nor did I see any copies of such. In several places where public water supplies are unsatisfactory alterations and repairs were about to be put in hand, as, for instance, at Broughton, in Claverley parish, where a public dip well, the property of the district council, is below the level of a muddy lane.

It is desirable that a public water supply should be provided for the village of Claverley (population about 160). With the exception of Worfield this is the most populous parish of the district, and the most considerable village. There is only one public well, the depth of which I could not ascertain. According to a report made by Dr. Wheatley in 1905 the water was then found to be grossly contaminated with sewage matter. The well is said to have been subsequently cleaned out and to yield water of good quality. But this must be regarded as doubtful. The rest of the village depends upon private dry steined wells, mostly sunk in

garden or other ground exposed to pollution. One such well is admittedly contaminated and its water is not used.

As regards isolated cottages and small groups of dwellings, there is, in many cases, difficulty in obtaining wholesome water, as, for instance, at the hamlet of Lightwood, in Ditton Priors parish, and at some cottages at Ackleton, in Worfield Parish, and in the neighbourhood of Chelmarsh Common. Wells are usually covered and fitted with pumps. Such private open wells as I saw contained water which was evidently contaminated by foul soakage or by the entrance of polluting matters from the ground surface.

These questions, however, are receiving due attention from the inspector of nuisances and are being reported to the district council. Improvement of water supplies seems to be steadily, if somewhat slowly, going on in the district. For the most part there should be no special difficulty in securing reasonable supplies of wholesome water for groups of cottages. The district appears to be well furnished with springs.

Drainage.—House drainage, for the most part, finds its way to ditches, streams, or, occasionally, to tanks with overflow upon fields. At Alveley I found a 4-inch land drain (blocked at the time of my visit) conveying slops from five houses and a public house urinal to a ditch less than fifteen yards from two cottages, and causing nuisance there. Occasionally drainage runs into roadways, as at Claverley, where nuisance has for a long time been caused by the flow of filthy liquids down the village street. A scheme of drainage for some eight or ten houses in this place is under consideration. At Worfield a number of open drain channels pass to a 9-inch sewer, apparently of cement jointed pipes, which discharges among the reeds and rank growth in a mill bay communicating with the Worfe brook. The water in the mill bay is now stagnant as the mill is disused. The outfall is only fourteen yards from the infant school playground, where the smell from this at times causes nuisance. In some instances, owing to the leaking of drainage pipes, contamination of water in wells is to be apprehended.

Excrement and refuse disposal.—With comparatively few exceptions cesspit privies are in use. The contents of these are from time to time disposed of upon gardens. Many of these privy structures are out of repair, and in many cases the pit is situated beneath the floor. At some groups of cottages the number of privies is insufficient. An exceptional instance of this is seen at the "Poor Houses" at Alveley, which have only one privy for the use of eight dwellings.

In some instances nuisance was being caused by over-full cesspits. At Claverley an open cesspit was found adjoining, and overflowing into, a large open ashpit.

There is no collection of house refuse in any part of the district. For the most part there is ample space for the disposal of house refuse upon garden ground.

There are no *common lodging-houses* in the district. There are seven registered *slaughter-houses*. Though these structures are not adapted to their purpose, they are on the whole clean and well kept.

There are 21 registered *milk vendors*, nearly all of whose premises I visited. Bridgnorth Rural District cannot be termed a dairying

district. The inspector of nuisances estimated that about 270 gallons of milk are daily sent out of the district, to the borough of Bridgnorth, to Kidderminster, Brierley Hill, Birmingham, and Wolverhampton. Milk is not regularly stored for sale. Butter is made only in limited quantities. There is very little cooling of milk.

Taken as a whole the condition of *cowsheds* is very fairly satisfactory, and it was evident that the sanitary circumstances of these places receive attention from the inspector of nuisances. Cubic space, ventilation, and, for the most part, lighting are good. Floors, however, are in some instances defective, nor is daily cleansing always performed. Ceilings need stricter attention. But in this, as in so many other rural districts, the chief defect and the one apparently most difficult to remove is the accumulation of enormous masses of dung and filth, solid and liquid, in a central foldyard, or a yard with which cowhouses, in one way or another, communicate. In one yard I found a morass of considerable depth receiving constant accretion by the drainage of a pigsty. At this and at another foldyard an unusual number of flies were noticed in the cowhouses.

There are nine registered *bakehouses*, the condition of which calls for no remark.

Keeping of Animals.—Generally speaking, I observed little or no nuisances arising from the keeping of animals. In some places pigs are kept too near to houses, and at Colmore Green a pigsty abuts upon the wall of a dwelling. Exceptionally filthy conditions were found in a yard behind a small general shop at Claverley, wherein upwards of a hundred chickens were being kept. There was also a leaking pigsty and a mass of pig manure, the drainage from which pollutes a neighbouring stream which is a feeder of the Worfe brook, referred to in my report on the borough of Bridgnorth.

SANITARY ADMINISTRATION.

There are no byelaws or regulations, nor any adoptive Acts dealing with sanitary matters, in force in the district.

The *medical officer of health* is Mr. J. C. Padwick, already referred to in connection with the borough of Bridgnorth. He was appointed in 1901 at a salary of £60 half repaid from county funds. The Board have been repeatedly dissatisfied with the character of his annual reports, which they have had to note as meagre and perfunctory. I have conferred with Mr. Padwick on the subject of his annual reports. He has undertaken that these shall in future be fuller. It appears that he does not make systematic inspections, but visits localities as opportunity serves in the course of his medical practice.

The *inspector of nuisances* is Mr. F. H. Williams, certificated by the Royal Sanitary Institute, who was appointed in 1907 at a salary of £120 half repaid from county funds. I have previously had to consider the work of this officer in 1906, when he was inspector of nuisances to the Thingoe Rural District of Suffolk. It will suffice to say that the favourable opinion I then expressed has been justified by the evidence he shows of excellent work already accomplished in his present office. Considering the recent

date of his appointment and the difficulties of locomotion due to the hilly nature of the country hereabouts, he has a remarkably good knowledge of his district. His books are regularly and clearly kept. He has complete records of all cowsheds, with measurements and details of space, condition of flooring, drainage, &c. He is also well advanced with a house-to-house inspection, the records of which will be of value. Each parish has a separate book provided with an observanda sheet.

There is no *isolation hospital* for the reception of cases of infectious disease, nor is there any disinfecter. Upon being apprised of a case of infectious illness by the medical officer of health, the inspector of nuisances attends at the infected house leaving disinfectants, with verbal instructions, together with a printed notice as to precautions to be taken. On the death or recovery of the patient he disinfects the premises with formaldehyde gas, to the action of which the clothing and bedding are spread out and exposed as much as possible. For the additional cleansing and disinfection of walls an Equifex patent spray apparatus is used.

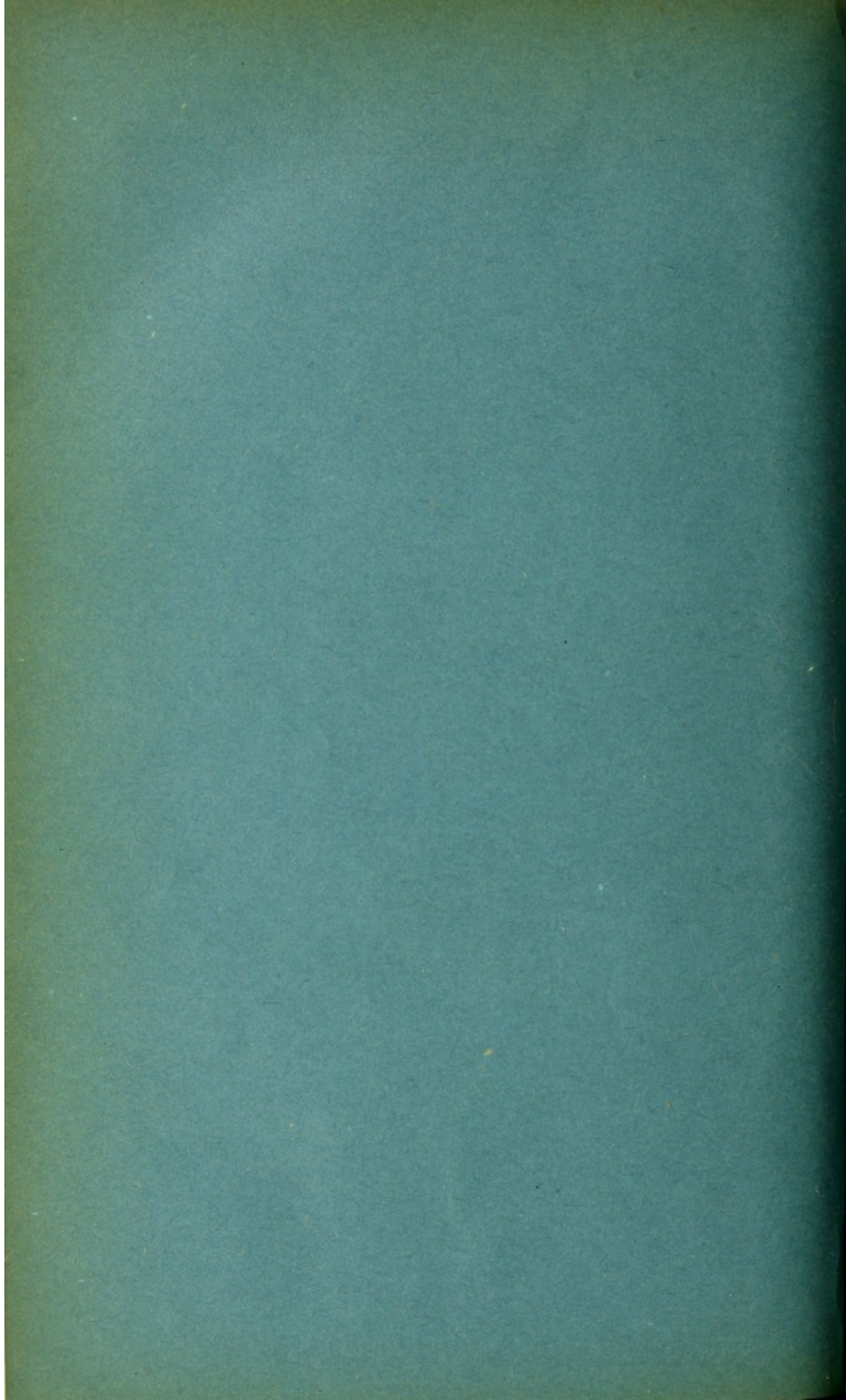
As regards diphtheria, the rural district council have an arrangement with the Salop County Council that any medical practitioner may send swabs to Mason's College, Birmingham, for examination. If the result be affirmative the practitioner is notified to that effect by telegram; if negative he receives a report by post; a report is also furnished to the county council. There is an understanding that the rural district council will pay for the use of antitoxin by medical practitioners if required.

RECOMMENDATIONS.

1. Attention should be given by the rural district council to the need for a road or path for the use of inhabitants of houses on Chelmarsh Common.
2. The rural district council should take steps to secure the provision of a sufficient supply of wholesome water for the village of Claverley.
3. Attention should be given to the abatement of drainage and other nuisances, and especially such as those existing in Claverley, Alveley, and Worfield.
4. Regulations framed under the Dairies, Cowsheds, and Milkshops Order should be adopted as soon as possible.
5. The rural district council should, either themselves or by arrangement with the town council of Bridgnorth, make suitable provision for the isolation and treatment of cases of infectious disease in hospital.

I have to express my thanks to Mr. W. Pitt, clerk to the rural district council, for his assistance in making my inquiry, and in a special manner to Mr. F. H. Williams, inspector of nuisances, for the time he has bestowed in accompanying me to the various localities visited.

F. ST. GEORGE MIVART.



FOR OFFICIAL USE.

REPORTS

TO THE

LOCAL GOVERNMENT BOARD

ON

PUBLIC HEALTH AND MEDICAL SUBJECTS.

(NEW SERIES No. 28.)

Dr. R. W. Johnstone's Report to the Local Government Board upon outbreaks of Enteric Fever in Conway Rural District, Conway Urban District, and Llandudno Urban District, during 1908 and 1909.

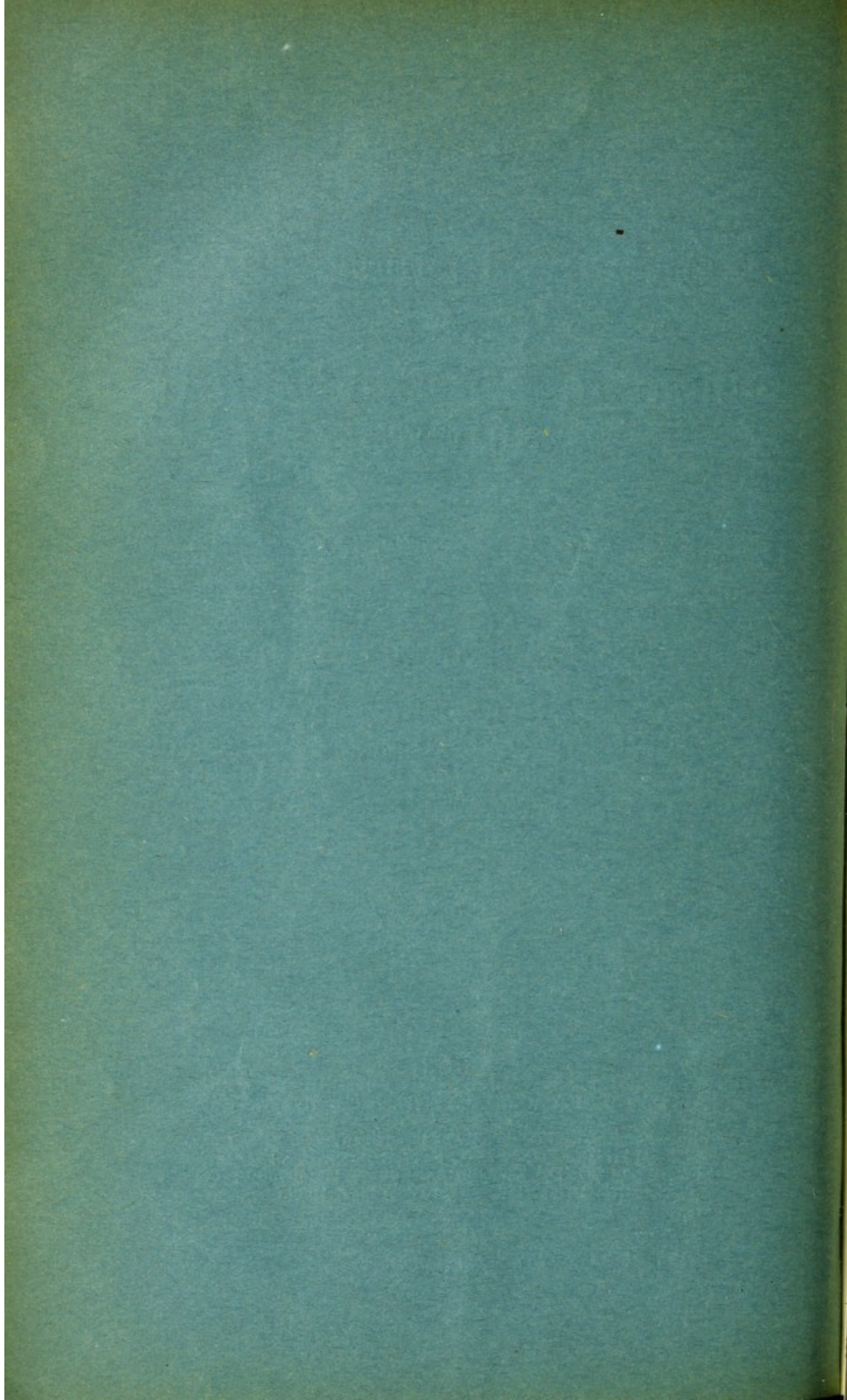


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Dr. R. W. Johnstone's Report to the Local
Government Board upon outbreaks of
Enteric Fever in Conway Rural District,
Conway Urban District, and Llandudno
Urban District, during 1908 and 1909.

ARTHUR NEWSHOLME,
Medical Officer,
28th April, 1910.

IN consequence of reports made by the medical officer of health of the North Carnarvon combined districts, with regard to outbreaks of enteric fever in the Conway rural district during the latter part of 1908, and the early part of 1909, and in the Conway urban district during 1909, I was instructed to make inquiry into the circumstances in which these outbreaks had occurred.

I visited the neighbourhood in June, 1909, and on subsequent occasions. Upon my arrival it appeared that there had been certain cases of enteric fever in the Llandudno urban district which could not be dissociated from those in the Conway rural district, and it was therefore deemed advisable to include the former in my inquiry.

Before dealing with the behaviour of the fever, I give a short account of each of the localities in which it occurred.

LLANDUDNO URBAN DISTRICT.

The urban district of Llandudno, with an area of 2,839 acres, had, at the Census of 1901, a population of 9,279, which is estimated to have increased to 11,328 in the middle of 1909. In summer the population is largely augmented by visitors, ranging, it is said, between 20,000 and 40,000 in the month of August. The number of inhabited houses is 2,053.

The district is bounded on the north and west by the Irish Sea, on the east by the Conway rural district, and on the south by the Conway urban district. The chief centre of population

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is the town of Llandudno. It is the terminus of a branch railway line from the Llandudno Junction, situated some three miles away in the Conway urban district.

The town of Llandudno with its environs, is a well known health and pleasure resort. It occupies the east shore of the peninsula that terminates in the Great Orme Head, a headland of considerable height and area which shelters the town completely on the northern side.

Water Supply.—This is derived from Lakes Dulyn and Melynlllyn, respectively 36 acres and 18 acres in area. These lakes are on the western side of the River Conway about 15½ miles distant from Llandudno. The surface of Dulyn is 1,747 feet above ordnance datum, and that of Melynlllyn 2,094 feet. There is no inhabited dwelling on the watershed of either lake. Analyses of samples of the water have shown it to be well adapted for drinking and domestic use.

Excrement Disposal in the urban district, is effected almost entirely by means of water closets. There are a few privy middens and pail closets; not more than a dozen of each.

House Refuse is collected by the council weekly from small houses and twice a week from larger premises. Galvanised iron bins are provided, and the refuse is incinerated in a destructor which is the property of the council.

Sewers and Disposal of Sewage.—The sewers are glazed and socketed sanitary pipes, jointed with cement; they are ventilated by open grids in the street, and in some instances by 6-inch ventilators carried up adjacent buildings. The sewers are flushed at regular intervals with fresh water drawn from the mains. The lower side of a manhole is closed by means of a flushing block and the manhole and the sewer behind it are filled with water from a hydrant, the block is pulled away and the water and sewage behind it are released in bulk. Sewage is discharged in a crude state, into the sea about a mile beyond high water mark. The sewers are tide-locked at high water and tank sewers are provided for the retention of sewage at such times, the discharge being, of course, intermittent.

Isolation Hospital.—The district council have an isolation hospital, for infectious diseases other than smallpox, about half a mile from the town of Llandudno. It has two ward blocks; one of 10 beds capacity used for scarlet fever cases, and one of 11 beds for diphtheria and enteric fever cases. There are also an administrative block, a laundry, a mortuary, an ambulance shed, and a caretaker's cottage.

Two wards are devoted to enteric fever, and the duty room between them is used as an observation, or private ward. A pail closet is used in connection with these wards, and the contents are buried in the earth. There is no proper hospital sink, the bedpans have to be cleansed at an ordinary sink, a procedure which increases the risk of infection for the nurses. The hospital is enclosed by a wall five feet high in its lowest part.

Patients are attended in hospital by their own medical men. There is no medical officer and no general medical supervision of the hospital. The medical officer of health has no duty or responsibility in connection with the admission or discharge of patients, their isolation while in hospital, or the disinfection of their belongings before discharge. There are rules with regard to the admission of visitors, but these rules are not observed.

The district council also possess a small-pox hospital, which is a corrugated iron building containing two wards, and separated only by a wall from the isolation hospital enclosure.

Disinfection.—The council have a steam disinfecter at the town yard. There is a special cart for the conveyance of clothing and other articles to the disinfecter. At the time of my visit the fixed observation window between the rooms for infected and disinfected articles respectively was broken.

CONWAY URBAN DISTRICT.

The area of the Conway urban district is 3,450 acres. The population was 4,681 at the Census of 1901, but is estimated to have been 6,559 in June, 1909. In summer the population is increased by visitors to about 9,000, and each Whitsuntide about 3,000 volunteers encamp within the district. The number of inhabited houses is 1,031.

The district lies along the estuary of the River Conway, embracing both banks. It is bounded on the north by the Llandudno urban district, and on the south and east by the Conway rural district. The chief centres of population are the town of Conway lying on the left bank of the River Conway, about three miles south of Llandudno, Deganwy about a mile north of Conway on the opposite bank of the river, and the houses around Llandudno Junction, close to the town of Conway, but on the other side of the river.

The Water Supply is derived from Llyn Cowlyd, a natural lake in the heart of the Carnarvonshire range of mountains. The area of the lake is about 200 acres, and its surface is 1,169 feet above ordnance datum. The watershed is of a mountainous character, free from human habitation or cultivated land. Analyses of samples of the water have shown it to be highly suitable for drinking and domestic purposes.

Excrement Disposal in the urban district is effected mainly by means of water-closets. There are said to be 12 pail-closets and only 3 privy middens in the whole district.

House Refuse is removed weekly by the district council's men.

Sewers and Disposal of Sewage.—The sewers are glazed and socketed sanitary pipes jointed with cement. They discharge their contents in a crude condition into the estuary of the River Conway by six different outfalls, which are carried down to low water mark.

Isolation Hospital.—There is no isolation hospital, but a site for one has lately been selected. There is no disinfecter.

CONWAY RURAL DISTRICT.

The Conway rural district, with an area of 26,135 acres, had, at the Census of 1901 a population of 6,364, which is estimated to have increased to 8,505 in the middle of 1909. The number of inhabited houses is 1,590.

The only portion of the rural district with which this report is concerned is the parish of Llangwstenin, which bounds the Conway urban district on the east. The population of this parish was 1,406 at the Census of 1901; it includes the eastern half of the group of houses around Llandudno Junction, and it has no other considerable aggregation of dwellings.

The Water Supply of the parish of Llangwstenin is derived from Cowlyd, which has already been described under Conway urban district.

House Refuse in Llangwstenin is removed once a week by persons who contract with the Conway rural district council.

Excrement Disposal in the parish is effected in the main by waterclosets. There are, however, about 150 pail closets and a few privy middens.

Sewers, and Disposal of Sewage.—The whole parish with the exception of some low-lying parts is sewered. The sewers are glazed and socketed stoneware pipes, jointed with cement; they discharge their contents in a crude state into the River Conway.

Hospital and Disinfectors.—The Conway rural district council possess neither an isolation hospital nor a disinfectors. A site has, however, lately been selected for an isolation hospital to be erected in conjunction with Conway urban district.

HISTORY OF ENTERIC FEVER IN THE THREE DISTRICTS DURING THE TEN YEARS PRECEDING 1909.

The following table shows, year by year, the number of notifications of enteric fever, and the number of deaths referred to this disease during the period 1899-1908 for each of the three districts, together with the mean annual death-rate per 10,000 inhabitants in each district from enteric fever.

TABLE I.

	1899.		1900.		1901.		1902.		1903.		1904.		1905.		1906.		1907.		1908.		Mean annual death-rate per 10,000 for the period 1899-1908.
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
Llandudno urban district.	6	1	5	1	6	1	7	2	4	-	4	-	4	1	2	1	1	-	1	-	0.70
Conway urban district.	2	-	-	-	1	-	1	-	-	-	1	-	5	1	-	-	3	-	-	-	0.19
Conway rural district	2	-	-	-	9	-	1	-	7	-	1	2	-	-	2	1	1	-	8	1	0.59

During the period covered by the above table the mean annual death-rate per 10,000 from enteric fever in England and Wales was 1.16. It is evident therefore that all three districts have

suffered much less from fatal enteric fever during the past ten years than the country in general.

ENTERIC FEVER IN THE THREE DISTRICTS DURING THE PERIOD
SEPTEMBER 1ST, 1908, TO JUNE 30TH, 1909.

During this period there were 55 known cases of enteric fever in the three districts. Six of these were not notified, but are included in the table below in view of their history, and the circumstances in which they occurred. Twenty-five houses were invaded, and there were ten deaths.

TABLE II.

*Showing the initials, age, sex, and date of attack of each case of enteric fever known to have occurred in the urban districts of Llandudno and Conway and the rural district of Conway during the period September 1st, 1908, to June 30th, 1909.**

Case No.	Initials.	Age.	Sex.	Date of Attack.	District in which the case occurred.	Remarks.
1	L. A. J.	9	F.	1908. Sept. 18	Conway rural district.	X. Farm.
2	K. W.	31	F.	Oct. 22	Conway urban district.	
3	P. J.	9	M.	" 22	Conway rural district.	
4	Mrs. J.	30	F.	" 23	Do. do.	
5	R. W.	6	M.	" 28	Do. do.	
6	J. J.	33	M.	" 28	Do. do.	
7	J. O.	7	F.	Nov. 1	Do. do.	
8	M. E.	16	F.	" 5	Do. do.	
9	G. W.	3	F.	" 8	Do. do.	
10	M. J.	40	F.	" 11	Do. do.	
11	R. E. R.	3	M.	" 11	Do. do.	
12	E. M. J.	14	F.	" 11	Do. do.	Same house as case 1.
13	L. M. G.	9	F.	" 20	Do. do.	
14	J. R.	34	F.	Dec. 1	Do. do.	Do. do. 11.
15	E. J. R.	10	M.	" 1	Do. do.	Do. do. 11.
16	S. W. R.	9	M.	" 1	Do. do.	Do. do. 11.
17	J. R.	4	M.	" 1	Do. do.	Do. do. 11.
18	A. L.	41	F.	" 7	Do. do.	Do. do. 3.
19	W. J.	4	M.	" 20	Do. do.	Do. do. 10.
20	W. R.	37	M.	" 21	Do. do.	Do. do. 11.
21	H. J.	6	M.	" 23	Do. do.	Do. do. 4.
22	J. J.	4	M.	" 23	Do. do.	Do. do. 4.
23	B. A. J.	12	F.	" 24	Do. do.	
24	S. J.	28	F.	" 29	Do. do.	
25	M. A. W.	1½	F.	1909. Jan. 4	Do. do.	Do. do. 9.
26	L. O.	14	F.	" 6	Do. do.	Do. do. 7.
27	M. J.	5	F.	" 9	Do. do.	Do. do. 24.
28	M. E.	17	F.	" 13	Do. do.	Do. do. 8.
29	E. T.	13	M.	" 20	Do. do.	
30	Mrs. T.	56	F.	Feb. 1	Do. do.	Nursed case 24. Subsequently went to Z. Farm.

* Cases in a house in which there had been previous occurrence of the fever during the period covered by the table, are indicated by italics.

Case No.	Initials.	Age.	Sex.	Date of Attack.	District in which the case occurred.	Remarks.
31	Mrs. C.	50	F.	1909. Feb. 26	Llandudno urban district.	Imported case.
32	M. B.	9	F.	Apr. 1	Do. do.	
33	G. F.	33	M.	" 1-8	Conway urban district.	
34	G. W.	11	M.	" 2	Do. do.	Same house as case 33.
35	N. F.	2	F.	" 4	Do. do.	Do. do. 33.
36	Mrs. F.	26	F.	" 8-12	Do. do.	Do. do. 33.
37	J. W.	38	M.	" 15	Conway rural district.	
38	B. S.	18	M.	" 16	Llandudno urban district.	
39	R. C.	70	M.	" 17	Do. do.	
40	J. P. B.	13	M.	" 18	Conway urban district.	Do. do. 33.
41	S. A. B.	11	M.	" 18	Do. do.	Do. do. 33.
42	T. M.	4	M.	" 22	Do. do.	Do. do. 33.
43	B. S.	8	F.	" 22	Llandudno urban district.	
44	J. V.	23	M.	" 26	Do. do.	Do. do. 38.
45	E. J.	69	M.	May 1-6	Conway urban district.	Do. do. 30.
46	L. C.	26	F.	" 9	Llandudno urban district.	Do. do. 38.
47	S. J.	23	M.	" 12	Conway urban district.	Do. do. 45.
48	M. H.	22	F.	" 14	Llandudno urban district.	Do. do. 38.
49	A. W.	18	F.	" 16	Do. do.	Do. do. 38.
50	M. A. W.	3½	F.	" 21	Conway rural district.	Do. do. 37.
51	A. E.	23	F.	—	Do. do.	Died May 25th, before notification.
52	A. W.	17	M.	" 26	Llandudno urban district.	Same house as case 38.
53	M. E. E.	8	F.	" 26	Conway rural district.	
54	L. W.	11	F.	June 4	Do. do.	Do. do. 37.
55	J. E.	16	F.	" 12	Conway urban district.	Do. do. 45.

Notes on Table II.—In dealing with the incidence of the fever in point of time, it was found that the dates of notification afforded little indication of the date of the actual commencement of the disease. Endeavour was therefore made, by seeking information from the patients themselves, and from their medical attendants, to fix in each instance the date of onset of the fever, and although it did not always prove possible to ascertain the precise day of onset, yet, in nearly all instances, this was determined with sufficient accuracy for practical purposes.

Case 1.—This child died at Brodnant farm, Llangwstenin, on October 30th, 1908, having been ill since September 18th of the same year. The cause of death was certified to be broncho-pneumonia, tubercular peritonitis and hæmorrhage. Shortly before death the case was seen by a second medical man who was of opinion that the disease was enteric fever.

Case 2.—This was the only case in the town of Conway.

Case 3.—This boy lived at a chip shop near Llandudno Junction. His symptoms were suggestive of enteric fever, and an application of Widal's test to a sample of his blood gave a positive reaction. He was not notified as enteric fever.

Case 4.—This woman was not notified as enteric fever; the symptoms of her ailment were obscure. She fell ill on October 23rd, and was first seen by the doctor on November 2nd. He continued in attendance until December 10th. On December 23rd her two children (Cases 21 and 22) fell ill with enteric fever.

Case 11.—This child was not notified as enteric fever, nor was there a positive reaction with a sample of his blood submitted to Widal's test. He suffered from diarrhoea and fever, and was under treatment up to the 24th of November, though the feverish symptoms ceased after November 16th. Five persons were subsequently attacked by enteric fever in this house, four of them on December 1st.

Case 12.—This was the first case notified from X farm. The onset of the illness was just 12 days after the death of Case 1.

Case 13 was living in quite a different locality from any of the others. No connection was established between her and any other case.

Case 18.—This woman was not notified as enteric fever. She lived in the same house as Case 3. She fell ill on December 7th, took to her bed on the 11th, suffering from headache and fever, got up on the 18th, but was unable to work, and retired to bed again on January 8th, remaining there until the 15th. A specimen of her blood gave a positive reaction with Widal's test.

Case 23 lived next door to the house inhabited by Cases 11, 14, 15, 16, 17 and 20.

Case 30 was housekeeper at Z farm, in Conway urban district, but when Case 24 (her daughter), who resided in Conway rural district, fell ill, she went to live with her, and nursed her.

Case 31 did not contract the fever locally. She arrived at Llandudno on February 27th, already ill.

Case 33.—The date of onset of this patient's illness was never accurately settled, because he had been under medical supervision for influenza for some weeks before he developed symptoms of enteric fever. The case was not notified until April 16th.

Case 37 was not notified as enteric fever. He fell ill on April 15th, and remained under medical treatment from April 16th to May 17th, returning to work on June 3rd. He suffered from muscular pains and fever, and he had hæmorrhage from the bowel, which was attributed to hæmorrhoids. Before this illness he had never had hæmorrhage, and after his recovery a specimen of his blood gave a positive reaction with Widal's test.

Case 45.—This person was the farmer of Z farm, in the Conway urban district.

Distribution of the Fever in Place and Time.—Upon study of the particulars recorded in Table II., and of those shown in diagrammatic form on the accompanying chart, it is evident that there were two outbreaks of the fever separated from one another by an interval of about two months. The first of these outbreaks may be regarded as having commenced on September the 18th, 1908, and as having ended on February the 1st, 1909, during which period there were 30 cases of enteric fever, all save one in the Conway rural district.

Subsequently to February the 1st there was no more fever, with the exception of one imported case on February 26th, until April 1st, when the second outbreak commenced. This outbreak continued until June 12th, covering a period of two and a half months, during which there were 24 cases of enteric fever. Of these 24 cases 9 occurred in the Conway urban district, 9 in the Llandudno urban district, and 6 in the Conway rural district; a distribution of the fever in place, it will be observed, entirely different from that characterising the first outbreak, which was almost wholly limited to the Conway rural district.

TABLE III.

Showing the incidence of enteric fever, in the three districts, upon certain age groups during the period September 1st, 1908, to June 30th, 1909.

Age	0-5	-10	-15	-20	-25	-30	-40	+40
Number of Cases ...	10	11	9	6	3	3	7	6

Sex and Age Incidence.—From the figures in the above table it appears that more than half the persons attacked by the fever were under the age of 15.

Twenty-four males and 31 females were attacked. Of the 24 males 9 were under the age of 10 years, and 15 were under the age of 15 years, while only 9 were over the age of 15. Of the 31 females attacked, 15 were under the age of 15, and 16 were over that age.

There was, therefore, special incidence of the fever on females, and as regards males, on those under 15 years of age.

CONSIDERATION OF THE FACTORS WHICH MAY HAVE BEEN CONCERNED IN THE SPREAD OF ENTERIC FEVER IN THE THREE DISTRICTS DURING THE PERIOD SEPTEMBER 1ST, 1908, TO JUNE 30TH, 1909.

Water Supply.—All houses invaded by the fever, with the exception of that of Case 13, were supplied with water from one or other of the public services in connection with Lake Dulyn or Lake Cowlyd. Both these supplies are of great purity, and are exceptionally free from risk of contamination at the source. There was no sudden and widespread occurrence of cases such as is characteristic of an outbreak of enteric fever due to contamination of a public water supply at its source.

Nor was the distribution of the fever coterminous with the area of supply from either source. In the first outbreak (September 18th, 1908, to February 1st, 1909) all the cases except one were in the rural district of Conway. The Conway urban district, which has the same water supply, was practically free from enteric fever.

In the second outbreak (April 1st to June 12th, 1909) 9 persons were attacked in Llandudno urban district, 9 in the Conway urban district, and 6 in the Conway rural district, although the water supply of the first-named district is quite distinct from that of the latter two.

No evidence was obtained to connect the outbreak with local contamination of the water supply, nor was the grouping of invaded houses of a nature to suggest such a source of infection, whether taken over the whole period or at any particular portion of it.

Uncooked vegetables, such as watercress, lettuce, onions, celery, and tomatoes. Inquiries were made in 42 of the cases attacked,

and the replies indicated that one person (Case 40) partook habitually of uncooked lettuce, onions, and tomatoes, while three persons (Cases 37, 50 and 54) had within the three weeks preceding their illness eaten watercress procured from a brook at Z. farm, where, at the time, a convalescent from enteric fever was residing. I examined the brook or field drain whence the watercress was said to have been obtained, but I saw no trace of cress within a quarter of a mile of the farm buildings. It is, however, possible that cress hidden by rank weeds and meadow grass may have escaped my notice. The brook runs close by the farmyard cesspool and manure heap, but does not pass near the dwelling-house. The house slops were at that time thrown on the fields, and it is possible that they reached the brook. It is conceivable, therefore, that these three persons may have contracted the fever through eating specifically polluted watercress; although personal infection may well have been in large part responsible, inasmuch as all three lived in the same house, and the dates of attack are consistent with Cases 50 and 54 having been infected by Case 37.

But however this may be, it is clear that the outbreak under consideration is not referable to infection conveyed by uncooked vegetables.

Shellfish.—The consumption of oysters, mussels, cockles, scallops, and periwinkles was inquired into in 53 of the enteric fever cases. Only two persons of those attacked had partaken of mussels,* and none of them had partaken of any other kind of shellfish during the month preceding the onset of their illness.

The evidence, therefore, is against any suggestion of causative relationship between consumption of shellfish and the outbreak of enteric fever.

Milk.—The age and sex incidence of the fever is favourable to the hypothesis that the agency of its dissemination may have been milk. For, as has already been pointed out, there was special incidence of the fever upon females, while of the 24 males who were attacked only 9 were over the age of 15, and more than half the total attacks of both sexes were under that age. The association of the fever with young males is especially notable as regards the first 23 cases, 11 of whom were males and 12 females, for of the 11 males only two were over the age of 15, and only three over the age of 10.

All these 23 persons, with one exception (Case 13) were supplied with milk from X. farm in the Conway rural district. A girl (Case 1) fell ill at this farm on or about the 18th of September, 1908, shortly after returning from a school-treat at Rhyl. She died on the 30th of the following month. On the 11th of November another girl (Case 12) was attacked with fever at X. farm, and was eventually notified as suffering from enteric fever. The farm was visited by Dr. Travis, the medical officer of health, on November 16th. He found a mattress lying in contact with the milk cans, and was informed that it had been there a fortnight. Orders, which were at once carried out, were given for the

* The mussels were said to have been well boiled.

destruction of the mattress and for the disinfection of the milk cans. On December 6th the second case, mentioned above (Case 12), was notified as enteric fever, and on the same day the farmer, under pressure from the medical officer of health, transferred his milk business to other hands, terminating all connection between X. farm and the milk supply.

Of the 23 cases referred to above, two lived at X. farm and the remainder, with the exception of Case 13, at 11 other houses, all of which had their milk from this farm. All these houses were invaded by the fever between October 21st and December 25th, dates of invasion which are consistent with the hypothesis that infection was carried by milk from X. farm, and that the milk became infective during the illness of Case 1, and remained so, at least at intervals, until the transfer of the milk business on December 6th. Subsequently to this date, there were seven other persons attacked, three of whom lived in three houses which had already been invaded by the fever, and were supplied with milk from X. farm, while the other four lived in three houses not previously invaded, and only one of which was supplied with milk from X. These cases will be referred to later.

The total number of houses supplied with milk from X. farm at the time of the outbreak was 52. They were scattered over an area, in the neighbourhood of Llandudno Junction, with an estimated population of 1,278 persons, living in 284 houses. Milk was distributed within this area from six other dairy farms. One of these, in a milk round of 48 houses, supplied milk to three invaded houses, but one of the three had milk from X. farm also. Another farm supplied milk to one invaded house in a milk round of 38 houses, but in this case the house had milk from X. farm as well. The remaining four farms had no invaded houses on their milk rounds. It appears, therefore, that the relative incidence of the fever was nearly four times greater on houses supplied by X. farm than on houses deriving their supply from any one other farm, and 12 times greater on houses supplied by X. farm than on houses supplied by the six other farms taken combined. These facts, taken together with the existence of enteric fever at the farm and the correspondence of the dates of onset of the fever among consumers of X. milk, with the period during which the milk was probably infective, leave no room for doubt that X. milk was the chief factor in the spread of the first outbreak of enteric fever. This first outbreak of the fever, which had been almost wholly confined to Conway rural district, terminated on February 1st, 1909, with the attack of Mrs. T. (Case 30). There was no further occurrence of the fever, with the exception of an imported case in Llandudno urban district on February 26th (Case 31), until April 1st, when the second outbreak began.

In the meantime an event took place which, as will appear later, constitutes a connecting link between the first and second outbreaks. This was the return of Mrs. T., who had been attacked by the fever on February 1st while staying with her daughter in Conway rural district, to Z. farm in Conway urban district on February 7th. She was then feeling ill, and on the

8th of February was notified as suffering from enteric fever. On the same day she was removed to Llandudno Isolation Hospital, where she remained until the 16th of March. The circumstances of her discharge from hospital were unusual. From the first she expressed great discontent with the hospital, and was anxious to leave it. After several attempts to persuade her medical attendant to consent to her discharge she was removed to Z. farm on the 16th of March, while still in a very weak condition, and before her evening temperature had become normal. In the circumstances it would not be surprising if she were still in an infective condition* after her removal to Z. farm; and, in view of the fact that this farm is a dairy farm, it is convenient at this stage to consider whether the precautionary measures adopted in relation with Mrs. T. at this time were such as could be trusted to safeguard the farm milk against danger of contamination by infective material derived from her.

In the first place, although Mrs. T. was accompanied from the hospital by a nurse, who remained with her until the 5th of April, the nurse was on duty at night only, and during the day the inmates of the farm and, in particular, the farmer himself frequently visited Mrs. T.'s room. Again, the milk cans were cleansed and the milk cooled at a shed in the farmyard about 50 yards from the house door, but at a much lower level. Abutting on the farmhouse beside the house door is another shed, which was used as a laundry for washing Mrs. T.'s soiled linen during her convalescence. This shed has no drainage, and any waste water emptied outside it would eventually reach the vicinity of the other shed where the milk cans were washed. No disinfectants were used at Z. farm after the return of Mrs. T. from hospital. At the time of my visit there were signs on the pavement outside the laundry shed that slop water had recently been emptied there, but I was told that during Mrs. T.'s convalescence all waste water after washing her linen had been carried to the fields and emptied there. This involved a walk of about 30 yards around the house, the ascent of a steep pathway and the passage of two gates. In view, therefore, of the possibility that infected slops were emptied in a place whence they could drain naturally to the washing shed for milk vessels, and of the fact that the farmer went direct from the sick room to his milk cans without using any disinfectant for his hands, it is obvious that, if Mrs. T. were still infective after March 16th, there was no lack of opportunity for the infection to gain access to the milk supply.

On April the 1st, just a fortnight after Mrs. T.'s return to Z. farm, a case of enteric fever occurred in Llandudno, in a house supplied with milk from this farm. Other houses on the same milk round were invaded by the fever, and early in May the farmer himself (Case 45) fell ill with enteric fever, and eventually died from it. Sale of milk from the farm was stopped on

* Efforts were made to obtain samples of her faeces for bacteriological examination, but she and her friends refused their consent to this procedure.

May 6th. Between April 1st and June 30th, 24 persons in the three districts were attacked by enteric fever, and 19 of them lived in houses supplied with milk from Z. farm. The number of houses invaded by the fever was 10, and six of them were on the Z. farm milk round. The last house to be invaded was Z. farm itself, and after May 6th no further houses on the Z. farm milk round were invaded.

The dates on which consumers of Z. farm milk were attacked by the fever are consistent with the hypothesis that infection was spread among them by this milk, and that the milk became infective on the return of Mrs. T. from hospital to the farm.

As nearly as could be ascertained, 22 houses were supplied with milk from Z. farm, and, as has been said, six of them were invaded by enteric fever between April 1st and June 30th, 1909. During the same period no other milk farm supplied more than one invaded house in the three districts.

In two instances milk from Z. farm was supplied to large establishments in which several cases occurred. The first of these was a school, where the schoolmaster (Case 33), his wife (Case 36), his child (Case 35), a child (Case 42), and three school-boys (Cases 34, 40, and 41) were attacked. The general sanitary condition of the school was excellent.* The incidence of enteric fever, in this house, upon those who drank fresh milk is remarkable. The schoolmaster drank a glass of fresh milk every morning. Three of the school boys had a glass every day at 11 o'clock; one of them left the school on March 20th, and therefore incurred risk of contracting the fever through drinking the presumably infected milk for only a few days; of the other two, one was attacked. Two school boys, and two only, were given a glass of milk each on April 8th, the day of their departure for home, both were attacked by enteric fever at their home on April 18th. The two children who were attacked (Cases 35 and 42) both drank milk unboiled, whereas two other children staying in the house, who did not take unboiled milk, escaped infection. The number of boys at the school was 16, and there was a staff of six other persons, besides a family of four children staying for a visit. As far as could be ascertained, no other person beyond those mentioned above took unboiled milk except in tea.

The other large establishment in which the fever occurred, although not wholly supplied with milk from Z. farm, took about 40 quarts a day from there. The Z. farm milk had a reputation for good quality, and was therefore supplied at the breakfast table and for drinking. The household, including visitors and staff, numbered about 155 persons. I was informed that two visitors had fallen ill with enteric fever after returning to their own homes, but beyond the fact that one of them left Llandudno on April 13th and fell ill on April 20th, I did not obtain details of their illness. Amongst the staff, who numbered 50, six per-

* The only fault found was an old drain, passing under the dining-room, which had been allowed to remain in connection with the house drain through a mistake of the contractor. But since this drain was embedded in concrete it is difficult to see how it could have any effect in spreading the fever, as was locally suggested.

sons were attacked. The first of these (Case 38) fell ill on April 16th. He was a waiter in the establishment, and he had his meals with another waiter in the pantry. The remainder of the staff, with the exception of two maids who worked in the still-room, had their meals in the servants hall. The waiters in the pantry, the stillroom maids, and the nurse to the manager's children, were the only servants who had free access to the milk. After meals the milk was brought from the dining room to the pantry, and passed thence through a hatch to the stillroom. The waiter, who first fell ill (Case 38), drank milk freely; the other waiter, who escaped the infection, drank it only in tea or coffee. The next person to be attacked was a porter (Case 44), who was attacked on the 26th of April. This man worked in the plate-room* and had his meals in the servants' hall. He never took milk except in his tea, he ate no food of a suspicious kind, he had not been away from Llandudno, and, as far as is known, he had not been specially brought in contact with any previous case of the fever. On the 9th of May a maid (Case 46) was attacked. She had worked in the stillroom for three weeks before her illness. She drank milk freely, whereas the other stillroom maid, who escaped infection, took milk only with her tea. On May 14th a laundry maid (Case 48) was attacked. She had her meals in the servants' hall. She took milk only in her tea, she had not eaten any food of a suspicious kind, and had not been away from Llandudno. She slept in the same room as Case 46, and may possibly owe her illness to direct personal infection, although five days is an unusually short period of incubation for enteric fever. On May 16th the nurse to the manager's children (Case 49) was attacked. I was unable to interview this girl, but she was said to have taken milk freely, and she would have had charge of the children's milk. The milk, it is stated, was always boiled before it was given to the children. On May 26th the page and lift boy (Case 52) fell ill. He slept in the room with Case 38, but the latter was removed to hospital on April 23rd, so that it is not likely that the page was a victim of personal infection. He was fond of milk, but he could not obtain it as a rule. About a week before his illness, however, he had a cup full of milk from the stillroom. He said he had no other milk except in tea or coffee.

It appears then, that at the school nearly all those persons who had special opportunities of contracting infection by way of milk were attacked by the fever, while at the other establishment three out of the five persons on the staff, who had free access to milk, were attacked, and the other two who escaped did not drink milk except in tea or coffee.

Taking into account the remarkable way in which the dates of occurrence of the fever fit in with the return of Case 30 to

* I was informed that at the time of his illness there was an untrapped drain in the plate-room, which communicated with the house drain. It was said in addition that the house drains were laid open for repair about the time of the outbreak. It is possible, that if the house drains were infected by an early case, danger of infection might have existed, but the persons most likely to be infected would be the workmen employed in the repairs, and no case of this sort is known to have occurred.

Z. farm, the opportunities for infection of the milk supply which existed there, the severe proportional incidence of the fever upon houses supplied with its milk, and the disproportionate incidence of the fever upon raw-milk drinkers at the two large establishments in which cases occurred, the evidence incriminating the Z. milk supply as a principal factor in the spread of the disease, may be regarded as conclusive.

Personal Infection.—As usual in outbreaks of enteric fever, personal infection was in a certain measure responsible for the spread of the disease. None of the earlier cases were removed to hospital, and Case 30 was discharged from hospital too soon for the safety of the district. The latter occurrence is the more reprehensible, in view of the fact that it was known she was to be removed to a milk farm. Only seven cases in all were isolated in hospital, so that it is no wonder that even after the suspected milk supplies were discontinued, cases continued to occur in houses already invaded by the fever.

During the whole period, September 1st, 1908, to June 30th, 1909, only 25 houses were invaded by the fever, although 55 persons were attacked. A certain number of these repeated appearances of the disease in the same house were probably due to personal infection. Cases 25, 26, and 28 occurred in houses that had already been invaded by the fever, and though these houses ordinarily took their milk from X. farm, the persons in question did not fall ill until a month or more after the X. milk supply had been discontinued. Case 29 lived in a house which had not previously been invaded by the fever. The house was supplied with milk from X. farm, but Case 29 was not attacked by the fever until more than a month after the supply was discontinued. It was ascertained, however, that he visited the farm frequently, and that the farm washing was done at the house in which he lived. This may have been a case of direct personal infection, or infection may have been conveyed by the soiled clothes from X. farm.

Case 24 was probably a victim of personal infection. She visited the house where Cases 3 and 18 were ill, and was herself visited by the ambulant Case 4. There is no doubt that Case 30 was infected at the house of her daughter (Case 24). Case 30 nursed her daughter and slept in the same bed as her granddaughter (Case 27) during the latter's illness. Case 36 was, perhaps, personally infected while nursing her husband (Case 33). Case 48 has already been referred to under the heading of *Milk*.

Summary and Conclusion.—The first outbreak of enteric fever commenced with an unrecognised case at a milk farm, and the fever was subsequently spread mainly by infected milk from this farm. As soon as the disease was recognised, prompt measures were taken, the milk trade was removed from the farm and the outbreak came to an end. In the meantime, however, the housekeeper at another milk farm had contracted the fever from her daughter whom she had nursed. The housekeeper was immediately removed to hospital, but was unfortunately allowed, after five weeks stay there, to return to the farm while probably still in an infective condition. Within two weeks of her return

the second outbreak of enteric fever commenced, the fever occurring mostly among persons supplied with milk from this farm.

Fifty-five cases occurred in all, and 25 houses were invaded. There is little or no evidence to point to any factor in the spread of the disease other than milk and, in a much smaller degree, personal infection. The evidence incriminating the milk is conclusive.

I have to express my thanks to the Clerks of the three district councils for facilities afforded me during my inquiry; to Dr. Travis, the medical officer of health of the North Carnarvon combined districts, for guidance during my visit to his district, and for facts and figures concerning it. My thanks are due also to Mr. Wm. Little, Mr. F. A. Delamotte, and Mr. Levi John, inspector of nuisances, respectively, to the urban district councils of Llandudno and Conway, and the rural district council of Conway, for work done at my request.

In addition, I have to express my acknowledgment of the courtesy extended to me by my medical brethren in the three districts, in affording me every possible information with regard to their cases.

R. W. JOHNSTONE.

