Dr. H. F. Parson's report to the local government board on the general sanitary condition of Ince-in-Makerfield.

Dr. H. F. Parsons's Report to the Local Government Board on the General Sanitary Condition of Ince-in-Makerfield.

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Assistant Medical Officer,
December 22, 1879.

General Description.—Ince-in-Makerfield is an Urban Sanitary District in Lancashire conterminous with the township of the same name. It is bounded on the west by the borough of Wigan, of which it may be considered a suburb; on the south-east by the township of Hindley, and on the north by that of Aspull; the two latter being also Urban Sanitary Districts. It is in the Wigan Union and Registration District, and in the Hindley sub-district, which comprises the townships of Ince, Hindley, and Abram.

The township of Ince, which has an area of 2,320 acres, is of a somewhat triangular shape; the surface slopes gently from an elevation of 250 feet above ordnance datum on the N.E. to 100 feet on the S.W. The geological formation is the coal-measures, which are here exceedingly productive; the deepest collieries in Britain are situated in the township, and the aggregate thickness of the seams of coal worked amounts to 50 or 60 feet. Very little of the surface of the township is cultivated land or pasture; the ground, where not occupied by houses, railways, and collieries, being mostly waste, and often converted into a swamp or pool by the subsidence caused by the removal of the coal from beneath. This subsidence does not take place equally over the whole surface, for where the surface land belongs to the colliery proprietors all the coal is removed from beneath it, whereas under roads or buildings, for damage done to which the colliery proprietors are liable, pillars of coal are left to support the roof. The effects of the subsidence upon buildings are, however, sufficiently obvious in frequent cracks, and in walls and chimneys out of the perpendicular. Owing to the greater subsidence of the ground in the spaces between the streets, it is necessary, when a new street is constructed, to fill up the ground to the proper level. For this purpose shale from the spoil heaps of the collieries, or cinders, are generally used. The coal shale in this district contains less pyrites than is generally the case in other coalfields, it does not ignite spontaneously, and it was stated that offensive gases are not given off as the result of its decomposition. The Medical Officer of Health has on more than one occasion complained to the Local Board of the practice, on the part of the night-soil contractor, of depositing, at the request of the owners, privy refuse as filling-up material on ground intended for building. The Local Board have on each occasion, as I am informed, promptly put a stop to this disgusting practice, and insisted on the removal of that which had been deposited.

The population of Ince consists almost entirely of the labouring classes, and of the small shop-keepers who supply them with the necessaries of life.

Besides the collieries before mentioned, there are in the township extensive iron works belonging to the Wigan Coal and Iron Company, and other companies, and three cotton mills, and many of the inhabitants are employed in mills in Wigan. There are two or three larger houses, formerly gentlemen's residences, but these are now used as offices.

Owing to the commercial depression felt here as elsewhere, there are a good many houses now empty. Overcrowding is said to exist to a certain extent, owing to the bad times; the elder children of a family remaining at home, or two families occupying the same house, in order to save rent. There is a colony of Irish in one part of the township.

Streets and Dwellings.—Two main roads, the high roads from Wigan to Manchester and Warrington respectively, traverse Ince in a N.W. and S.E. direction, and are connected by a third road, Ince Green Lane. These, with a street called Belle Green Lane, lately taken over by the Urban Sanitary Authority, are all the roads in Ince repairable at the public expense. The houses grouped along the Manchester Road are called Upper Ince; those along the Warrington Road, Lower Ince.

The greater part of the houses in Ince are cottages, in continuous rows either along the main highways, or in streets leading out of them at right angles. These streets are 30 to 36 feet wide, and open at both ends; there are few closed courts, and those only in the oldest part of the town. There are about 100 back-to-back

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houses in the older parts of the town, but the erection of dwellings of this class is now forbidden by the byelaws, which require 150 square feet of open space at the rear or side of each house; and the houses are, as a general rule, provided with doors and windows at both front and back. There are no cellar dwellings. Hence, as regards facilities for ventilation in and around dwellings, Ince is better off than many towns of a similar character. Brick is the usual building material. The cottages have back yards in common; these are not paved, and their surface consists of ashes or bare earth, often uneven and in holes, which serve for the lodgment of filth and stagnant water. Such a surface can never be properly cleansed, and many of the yards were in a very filthy state. The streets not repairable by the Local Board are not metalled or channelled, the surface being formed merely of ashes. Some of them, *e.g.*, Forge Street, Broom Street, and Victoria Street, are in a filthy condition, deep in mud and pools of stagnant water, and with refuse matters of all kinds, including human excreta, lying about. The condition of the private streets has been several times brought before the Board by the Medical Officer of Health. In a special report to the Local Board on the sanitary condition of streets (dated January 24, 1877), he says:—

"In my report for December I called the attention of the Board to the large number of deaths among children under five years of age from chest diseases, and ventured to suggest that the unpaved and wet state of the streets had a great deal to do with the cause of so great a mortality. I feel certain, if the members of your honourable 'Board' will examine the state of the following streets, they will agree with me; viz., Stopford Street, Bird Street, Anderton Street, Bridgewater Street, Big Broom Street, Albert Street, Little Broom Street, Morris Street, alias Slack Row, Brook Street, Lord Street, Pickup Street, Caroline Street, Ashton Street, Edward Street, John Street, Keble Street, and Holt Street. I consider Anderton Street the worst; down this street all the night-soil is carried to the depôt; next Lord Street; then Brook Street. If any case of zymotic disease occurs in any of these streets, the evacuations, &c., of the patient are thrown into the street, percolate into the ground, and there remain a source of infection. If these streets were paved, channelled and sewered, it would not only improve immensely the sanitary condition of the parish, but would add greatly to its appearance, and enhance very much the value of the property in the neighbourhood of those streets."

It would appear that a good deal has been done since the date of this report to remedy the condition of matters therein complained of. All the streets mentioned have been sewered, and some of them repaired with ashes. The Local Board, however, have not put in force the 150th section of the Public Health Act, 1875, considering that as the streets in question were not thoroughfares, they were sufficient for the traffic going through them.

The interiors of a good many of the cottages were in a filthy state, a point to which the attention of the Inspector of Nuisances did not seem to have been directed. It must be admitted that with mud all around, and brought into the house by every incomer, it is difficult for the housewife to keep her abode in a cleanly condition.

Sewerage and Drainage.—The sewers which drain Ince have all been constructed by the Local Board since its formation in 1866, with the exception of one in the Warrington Road, which was constructed previously by the surveyors of highways. The latter is a brick culvert, and is said to act efficiently. The sewers laid by the Local Board are of glazed socket pipes with clayed joints from 12 to 24 inches diameter; they are laid for the most part in straight lines from man-hole to man-hole. The bottoms of the man-holes are two feet deeper than those of the sewer pipes, forming catch-pits in which the heavier sediment lodges, and is removed from time to time. I saw several man-holes opened. The sewer pipes were free from sediment and appeared to be working well; there was no offensive smell perceptible. The sewers are ventilated, every 50 to 60 yards, by shafts formed of 9-inch or 12-inch pipes opening in the middle of the roadway. At the upper end of these shafts is an arrangement for deodorizing the sewer air by charcoal, which must seriously interfere with their efficiency as ventilators. Not only is there a basket of charcoal six inches deep through which any sewer air that can escape must force its way, but the top of the shaft is closed with a lid to prevent road dirt falling upon the charcoal, and the current of gas can only escape by passing through 12 oblique lateral holes, each one inch in diameter. There are also a few ventilating shafts up buildings, and some of the street gullies are left untrapped. The sewers are flushed from the water-mains through a 2½-inch hose pipe, and in one case a brook can be turned through the sewer. The sewers are said to have been laid with a fall nowhere less than 1 in 250.

The Manchester Road is divided into two parts by the Leeds and Liverpool Canal, which crosses under it; from this point, Rose Bridge, the sewers fall either way; that on the west side runs westward along the Manchester Road, then turns to the south down Forge Street, and discharges into the Clarington Brook, a tributary of the River Douglas, forming the boundary between Ince and Wigan. At the outfall of the sewer are some tanks for clarifying the sewage by straining and subsidence. These tanks are two in number, 35 feet long by 10 feet broad, and holding about 7,000 gallons each. Each tank has two upright screens which consist of a bed of small stones contained between perforated boards; each bed is 2 feet 6 inches in thickness. A considerable amount of clarification of the sewage is effected by this arrangement. The sediment is removed from the tanks every six weeks or so by men in the service of the Sanitary Authority, and is allowed to remain in heaps, sprinkled with disinfectants, until taken away by farmers or by the night-soil men. There are no houses very near. The sewer running east from Rose Bridge under the Manchester Road has a similar arrangement, but the tanks are smaller and act less efficiently. The outfall is into another brook which also joins the River Douglas. The gradient of this sewer has been affected by the subsidence of the ground; the pipes were several inches deep in water at one of the man-holes which I saw opened, but there was a good current through it. The occupiers, however, of some shops in the Manchester Road near the upper end of this sewer complained that in wet weather the sewer failed to carry off its contents, which in consequence backed up the cellar drains and flooded their cellars. The marks left by the sewage were to be seen on the cellar walls. These cellars have been constructed since the sewer was laid.

The old sewer in the Warrington Road is not provided at its outfall with any arrangement for clarifying the sewage.

No water-closets are connected with the sewers. With the exception of the cellar drains above-mentioned, there appear to be no connections between the sewers and the interior of the houses. The pipes from the slopstones in the scullories are carried through the walls, so as to discharge in the open air over a trapped earthenware gully. In some cases, however, as in George Street, this arrangement has not been carried out in a workmanlike manner; the brickwork around the gullies has been badly laid, so that the slop-water lodges in pools in the joints, giving off effluvia which must be sometimes drawn up through the untrapped sink-pipes into the houses.

Water-supply.—Ince is provided with a public water-supply, which is in the hands of the Local Board. The water is procured from wells in the new red sandstone at Golborne, five miles south of Ince. There are two wells, 150 feet deep, connected by a tunnel which is driven some distance into the rock at the side, its total length being 120 feet. The upper part of the wells is lined with brickwork laid in cement and puddled, and the nearest inhabited house is 500 yards distant, so that the water appears free from any chance of pollution from surface soakings. The water is pumped from the wells into two open reservoirs containing together 700,000 gallons and is then forced to Ince through 12-inch cast-iron pipes enamelled by Dr. Angus Smith's process. The main gives off branches to supply the town, and at its farther end, where it is reduced in size to 8 inches, is connected with a cast-iron tank situated at the highest part of Ince, 100 feet in diameter and 15 feet high, containing over 700,000 gallons, and sufficient for three days' supply. The water is supplied on the constant system, and the daily supply is 180,000 to 200,000 gallons, or about 13 gallons per diem for each of the population. Little is used for trade purposes, and none for water-closets. Each house has, as a rule, its own tap in the scullery.

The water seems free from any risk of pollution, and its physical characters are all that can be desired, but its hardness, though not excessive, renders it less fitted for washing, and even less agreeable to the taste of persons accustomed to soft water, than the moorland waters with which the neighbouring towns are supplied. The appended analysis by Mr. E. Davies, F.C.S., of Liverpool, shows its general character as regards mineral ingredients.

The town's water was first supplied to Ince in 1872. Before that there were only a few wells, and those of doubtful purity, and the people had to draw water for drinking and domestic use from ponds and ditches.

I have no data to show whether the health of the population was favourably affected by the introduction of a purer supply.

Excrement Disposal.—There are no water-closets in Ince—none at any rate connected with either the public sewers or water supply. The old-fashioned midden privy is

practically the only method of excrement disposal. In the older parts of Ince the middens are of the worst type, very large—one measured inside 10 feet 6 inches by 6 feet,—very deep, (usually sunk 4 feet below the surface of the ground,) often receiving the drip off the roofs of the privies on either side, and as a natural consequence wet and offensive. Some were leaking over the yard, and few were so contrived that the ashes thrown into the ashpit could mingle with the excreta.

In the case of houses of more recent date the ashpit is of smaller dimensions and provided with door and roof, but in some cases without any opening for ventilation. The privies, too, are as a general rule without a sufficient opening for light and ventilation.

In his reports to the Local Board for April 3rd and May 1st, 1878, the Medical Officer of Health called attention to the state of the yards, privies, and ashpits in the streets leading out of the Manchester Road. He says, "All the ashpits, with the "exception of those newly erected, were very large, uncovered, and in a very dilapi-"dated state, and creating a nuisance. I should advise the Board, before the warm "weather sets in, to insist upon the ashpits in the district being reconstructed and "covered in, or we may expect a continuance of typhoid fever and diarrhœa." The Local Board, however, declined to pass any general resolution on the subject, but decided that each case should be reported and dealt with separately. As a matter of fact, I found that notices were only served upon owners in respect of privies or ashpits that were in a state of dilapidation. In some of these cases the owners had done nothing more than repair the broken walls; in others, the ashpit had been covered in; but in hardly any had it been reconstructed, reduced in size, filled up, or lined with cement. I was informed that most of the house property was in the hands of a number of small owners, and that in the present depressed state of trade in the district there was great disinclination to lay out money on property except for such repairs as were absolutely necessary.

The Surveyor to the Local Board gave me a lithographed plan of an improved midden closet which he had devised. In this the ashpit was reduced in size —4 ft. 6 in. × 3 ft. for two privies,—roofed in and ventilated, the brickwork being laid in cement; it was furnished with a grid for sifting the cinders, beneath which was a kind of saddle for directing the fine ashes to either side of the ashpit so as to fall on the excreta. The ashpit had the fault of being sunk 2 feet below the surface of the ground. The grid and saddle were moveable for convenience of cleansing. The Surveyor, however, had been unable to get this plan generally adopted, only a a single ashpit having been erected on his pattern.

The removal of night-soil is let to a contractor for 42*l.* 5*s.* per month, 507*l.* per annum; the contractor takes the manure, and the Sanitary Authority supply him with disinfectants. Where, as is frequently the case in the older part of Ince, the passage to the back yard is too narrow to allow a cart to be taken up it, the scavenging is performed in the following laborious and dirty manner: The ashes and night-soil are thrown out from the pit upon the unpaved surface of the yard; thence they are shovelled up into a wheelbarrow, wheeled through the narrow passage, and deposited in a heap upon the street, whence they are again thrown up into the cart. The scattered remnants of the refuse are swept up, and disinfectants sprinkled about; but from the nature of the surface of the unpaved streets and courtyards, some of the foul matter must necessarily soak or be trodden in. The removal of night-soil is effected in the daytime. The privies in Ince are so placed that access can be had to them otherwise than through a house. The scavenging was not performed as efficiently as might be desired. I saw a good many ashpits over-full, the refuse being scattered over the yard around the ashpit door. There are two depôts for the manure, one on the canal bank whence it can be sent away by barge. A circumstance which adds considerably to the difficulty of keeping the ashpits properly scavenged, so long as the present system is continued, is that many of the poorer inhabitants of Ince use as fuel a kind of coarse refuse coal or "bass" which they pick up on the pit banks. This, in burning, leaves a large quantity of shaly ash, which speedily fills up the ashpits, not only necessitating a more frequent emptying, but rendering the contents of so little manurial value that farmers refuse to take them.

For this and other reasons I am inclined to think that the system of scavenging best adapted for Ince would be one in which the ashes and dry refuse are collected separately from the excrement. On suggesting to the officers of the Sanitary Authority who accompanied me on my inspection whether some form of the pail system might not be adopted with advantage, I was assured that no such system would work in Ince, as owing to the rough habits of the mining population, the pails and other breakable parts would be knocked to pieces or used as firewood in a few weeks.

These fears are, I cannot but think, groundless or exaggerated. Learning that the pail system was in use in the adjacent borough of Wigan, I called upon the Medical Officer of Health of that borough, Mr. Barnish, who with the Inspector of Nuisances courteously escorted me to some of the worst parts of the town, and gave me an opportunity of seeing the system in operation among a population as least as rough as that of Ince. The pail closets were greatly superior in cleanliness and comfort to the old midden privies, and I saw no marks of rough usage, and was assured that no difficulty had been met with on this score. That the system proves satisfactory seems to be shown by the fact that although it has only been introduced two years, 1,100 closets have been converted, and only 800 remain on the old system. The cost of conversion, as I am informed, averages about 1*l.* 10*s.* per closet. The cost of removal is about the same as under the old system. I am informed by Mr. Holt, Borough Treasurer, that the annual net cost is about 3,000*l.*, the town council employing their own staff and selling the manure, while two years ago, when the scavenging was let by contract, the lowest tender was 220*l.* per month, and the cost was increasing year by year.

Sanitary Administration.—The Local Government Acts were adopted in Ince at a meeting of the ratepayers on September 6th, 1866, and the adoption sanctioned by the Home Office on October 20th. The Local Board held its first meeting on December 19th, 1866. It consists of 15 members, and meets once a month. Since its formation it has expended on public sewers 3,513*l.* 14*s.* 3*d.*, on private drainage 2,087*l.* 5*s.* 5*d.*, on new paving, &c. 7,465*l.* 17*s.* 9½*d.*, and on a public water supply 32,000*l.* The last-mentioned expenditure was defrayed by means of a loan; the others have been paid for out of current rates. Nearly the whole of the above expenses have been incurred since 1870.

The Local Board have appointed Mr. R. S. Hall as Medical Officer of Health at an annual salary of 20*l.*, half of which is repaid by the Local Government Board. Mr. Hall makes systematic inspections of his district, and visits houses where outbreaks of infectious disease have occurred. He submits to the Urban Sanitary Authority monthly, on a printed form, reports on the sickness and mortality of his district, and on any conditions which he may have observed which are likely to affect injuriously the health of the district. These reports appear to be taken into consideration by the Sanitary Authority. The Medical Officer of Health receives from the Registrar monthly lists of the deaths which have occurred in his district, and also immediate notice of deaths from infectious diseases, unless the deceased have been his own patients. There is an Inspector of Nuisances, Mr. Benjamin Howgate, who is also collector, and receives 80*l.* a year salary, of which no part is repaid by the Local Government Board. He gives me the following statement of proceedings taken by him for the abatement of nuisances since his appointment in May 1877.

Nuisances reported			892
Notices served	Verbal 495		
	Written 336		861
	Printed 30		
Nuisances abated			820
Nuisances not abated			47
Works in progress			25
Legal proceedings taken			3

There is a code of byelaws, which was sanctioned by the Home Secretary on May 11th, 1867, containing provisions for the regulation of new streets and buildings, of slaughter-houses, and of common lodging-houses, also for the prevention of nuisances, and for the cleansing of footways and removal of refuse. The byelaws with reference to the construction of new buildings appear to be strictly enforced. I saw a row of houses standing empty and partly unfinished, which the Surveyor to the Local Board told me he had refused to pass, as not being in conformity with the byelaws, nor provided with sufficient privy accommodation.

At the time, however, when the byelaws were adopted the Local Authority were empowered by law to make byelaws with respect to the structure of walls of new buildings, only for securing stability and the prevention of fires, and not for purposes of health.

There are no common lodging-houses in the district, and only two slaughter-houses which are said to be but little used.

Population.—The following figures given me by the clerk to the Urban Sanitary Authority show the rapidity with which the town of Ince has sprung up, owing to the development of the coal trade and other industries :—

Year.	Houses.	Population.	Increase.		Average Inmates per house.
			Houses.	Population.	
1851 - - -	766 (estd.)	3,670	—	—	4·8
1861 - - -	1,561	8,266	795	4,596	5·3
1866 (Board formed) -	1,892	9,460 (estd.)	331 } 708	1,194 } 3,722	5·
1871 - - -	2,269	11,988	377 }	2,528 }	5·28
1879 - - -	3,134	14,500 (estd.)	865	2,512	4·6

Thus the population more than doubled between 1851 and 1861, and between 1861 and 1871 increased 45 per cent., or 3·8 per cent. annually. If this rate of increase were maintained, the population at the present time would be 16,140, but it is probable that the rate of increase has of late years been less. Reckoning five inmates to each house, and allowing for those now empty, the present population will be 15,000. The Medical Officer of Health, in his reports, estimates the present population at 14,000, and the clerk at 14,500. The highness of the birth and death rates, even as calculated upon a population of 15,000, renders it probable that these estimates are under, rather than over, the mark.

Mortality and Sickness.—The vital statistics of Ince-in-Makerfield for the 4¾ years ending September 1879 are given in the following tables, the population being taken as 14,000.

TABLE 1.

Year.	Births.			Deaths from all Causes.					Deaths from principal Zymotic Diseases.			Deaths under 1 year.		
	Total.	Rate per 1,000.		Number of Deaths.		Rate per 1,000.			Total.	Per 1,000.		Total.	Per 100 births.	
		Ince.	England and Wales.	In Ince.		In Ince.		England and Wales.		Ince.	England and Wales.		Ince.	England and Wales.
				Registered in Township.	With Workhouse Deaths added.	Registered in Township.	With Workhouse Deaths added.							
1875 -	755	53·9	34·0	373	383	26·6	27·3	22·2	53	3·8	3·3	138	18·4	15·8
1876 -	773	55·2	36·5	368	371	26·3	26·5	21·0	73	5·2	3·0	133	17·2	14·6
1877 -	778	55·6	36·1	393	396	28·1	28·3	20·4	97	6·9	2·6	139	17·9	13·6
1878 -	749	53·5	35·9	384	396	27·4	28·3	21·7	78	5·6	3·3	153	20·4	15·3
1879 - (9 months —Jan.–Sept.)	578	55·0	36·7	246	253	23·4	24·1	21·5	33	3·1	2·3	75	12·9	13·2

TABLE 2.

Deaths from	1875.	1876.	1877.	1878.	1879, 9 months.
Small pox - - - -	—	—	—	—	—
Measles - - - -	—	21	11	10	1
Scarlet fever - - -	14	16	40	14	8
Diphtheria - - - -	—	—	1	1	—
Croup - - - -	—	—	3	10	9
Whooping cough - - -	16	4	10	4	7
Enteric fever - - -	8	10	8	11	5
Diarrhœa - - - -	15	22	27	38	10
Cholera - - - -	—	—	—	—	1
Phthisis - - - -	10	12	18	17	20
Bronchitis, pneumonia, and pleurisy	120	97	108	98	49
Heart disease - - -	10	14	8	5	8
Injuries - - - -	34	17	13	20	15
Other causes - - -	146	155	146	156	113
Total - - - -	373	368	393	384	246

TABLE 3.

Deaths at undermentioned ages.	1875.	1876.	1877.	1878.	1879. 9 months.	Total.
Under 1 year	138	133	139	153	76	1,080
1–5	82	89	114	104	52	
5–15	21	20	24	26	17	684
15–25	19	11	17	14	10	
25–60	70	76	65	51	66	
60 and over	43	39	34	36	25	
All Ages	373	368	393	384	246	1,764

It will be seen from the preceding tables that both birth and death rates in Ince are high; the former excessively so. The births during the past $4\frac{3}{4}$ years are equal to an annual rate of 54·6 upon a population of 14,000, or 50·9 upon one of 15,000. It is evident, therefore, that the population must be on the average a young one, consisting mainly of children and of young adults, and those in the prime of life, *i.e.* at the child producing ages.

The average death-rate for Ince during the past $4\frac{3}{4}$ years has been 26·5, if we take the population as 14,000, or 24·7 if as 15,000. Adding, however, the deaths of persons belonging to the township who have died in the workhouse, which is situated outside the district in the borough of Wigan, these rates will be increased to 27·0, or 25·2 respectively, the average death-rate for England and Wales during the same period having been 21·3. One circumstance, which increases to some extent the mortality in Ince, is the large number of deaths which occur from injuries of various kinds. Ninety-five deaths from injuries occurred during the $4\frac{3}{4}$ years, the most frequent causes being drowning in the canal, falls of the roof in coal mines, and being run over by railway trains. The death-rate in Ince from the seven principal zymotic diseases of the Registrar General, viz., smallpox, measles, scarlet fever, diphtheria, whooping cough, fever, and diarrhœa, has been on an average during the past $4\frac{3}{4}$ years 5·0 per 1,000 per annum on a population of 14,000, the average rate for England and Wales having been 2·9. During that period scarlet fever and enteric fever have apparently never been absent from the district for long together, deaths occurring every year.

The mortality among infants and children is also an unfavourable feature in the vital statistics of Ince. Out of every 100 children born, 18·1 die before attaining the age of twelve months, the average throughout England and Wales being 14·5. Again, of the deaths during the period of $4\frac{3}{4}$ years, more than 60 per cent. have been those of persons under five years of age.

On looking through the returns of deaths to ascertain the causes of this high mortality among children, I find that of 1,080 deaths of children under five years old, which took place since January 1875, 283, or 26·2 per cent., were from bronchitis and other inflammatory diseases of the chest; 264, or 24·4 per cent., from the principal zymotic diseases, viz., scarlet fever, measles, whooping cough, diphtheria, fever, and diarrhœa; 156, or 14·4 per cent., from the wasting disorders of childhood, called on certificates "marasmus," "tabes mesenterica," &c., but which in many instances might most correctly be designated "improper feeding"; and 145, or 13·4 per cent., from "convulsions," the latter a symptom rather than a disease, being produced by a variety of causes, and a common mode of termination to many fatal diseases of childhood.

If we look for the probable causes of this high mortality we find that they may be grouped under two headings: 1st, local unsanitary conditions which the Sanitary Authority in their public capacity can remedy, and 2nd, social and domestic conditions and habits unfavourable to health, which for the most part lie beyond the cognizance of public authorities, and for the remedying of which we must look to education and the gradual adoption of a higher standard of life.

Among the former class I would especially note the unsatisfactory method of excrement disposal mentioned in an earlier part of this report; large wet open middens used in common by several houses, giving off their effluvia—it may be, specifically infected—within five to seven yards of the back doors of the houses; unpaved back yards fouled by excreta and refuse, which can never be properly cleansed, and dirty unmade streets with pools of stagnant water, wetting the feet of those who pass through them, and fouled with refuse and filth of all kinds.

Among the latter, so far as I can learn from the medical men and others with whom I have conversed, the principal is the prevalent neglect and mismanagement of children. Early marriages are frequent, and those who become mothers, having been brought up as factory workers, have but little knowledge or experience of the management of a home. Many of the women go out to work, some in masculine attire on the pit-banks, others in the factories, leaving their infants to be taken care of at home by old women or by elder children. I was informed by Mr. White, Certifying Surgeon, that more women were going out to work now than in previous years, partly owing to the depression in the coal trade, the wife having to go out to work to supplement the diminished earnings of her husband, partly to the minimum age for "full-timers" having been raised by the Factory Act, 1877, from 13 to 14, in consequence of which mill-owners have taken on a larger number of old hands, preferring them to "half-timers."

As suggestive instances of the perils to which childhood is exposed in the district, I may mention that in the period of $4\frac{3}{4}$ years for which I have examined the death returns for Ince, I find that 13 children were found dead in bed with their parents, probably overlaid, and eight were burnt or scalded to death while left in charge of other children. I did not hear of any instances of baby farming, such as would come within the scope of the Infant Life Protection Act. I could not learn that drugging was particularly prevalent. It was stated to have diminished since restrictions were placed on the sale of opiates by the passing of the Pharmacy Act; the principal form in which it exists being the use of various patented "soothing syrups," "teething powders," and "infants' preservatives." I was informed that until lately there was a great dearth of milk in Ince, and that the usual food for children was bread sopped in water. Recently, however, there has been an improvement in this respect, several dealers supplying milk regularly.

Great carelessness appears to prevail among the population at large with reference to the spread of infectious diseases. If a family happen to be attacked with scarlet fever the neighbours all come to see the sick person, and often bring their children. Indeed I was told that it would be considered an unneighbourly act not to do so.

There is constant communication between Ince and Wigan, and the diseases that may prevail in one town are frequently introduced into the other. Children employed as half-timers in factories in Wigan usually attend the schools there. There are several National Schools in Ince. The Inspector of Nuisances, who is also School Attendance Officer, tells me that the managers require a medical certificate of safety before admitting any children from houses in which infectious diseases have existed.

Disinfection and Isolation of the sick.—Disinfectants are furnished by the Sanitary Authority to persons whose households are attacked with infectious disease, and the houses are disinfected at its termination, but scarcely in my opinion effectually. The usual method is to pour an ounce or two of hydrochloric acid upon a teaspoonful or two of chlorate of potash, thus evolving chlorine gas. As the amount evolved is not sufficient to prevent the room being occupied at the time that the so-called disinfection is going on, it can hardly be supposed likely to be effectual in destroying any morbid poison that may be present. It is not the custom to remove the wall paper.

The Urban Sanitary Authority has no disinfecting apparatus, the reason assigned being that it is considered that the carrying of infected clothing through the streets would be a greater source of danger to the public health than the disinfection would be of security.

There is in the district no provision for the isolation of persons suffering from infectious diseases. The Wigan Town Council have a small hospital for infectious cases near the border of the Ince district, and the Ince Local Board have on more than one occasion endeavoured to enter into an arrangement for the use of it, but the Town Council have refused, on the ground that the accommodation is not more than they require for their own use. The Ince Local Board have also made overtures to that of Hindley to combine with them for the purpose of providing a hospital, but the Hindley Local Board have declined. I was told, however, that even if a hospital for infectious diseases were provided, it would probably be but little used, as there was a strong prejudice among the people in the district against hospitals of all kinds, so that no one would enter it unless compelled by a magistrate's order, which can only be granted in a small proportion of cases. This prejudice, which is common among ignorant persons elsewhere, may be expected to disappear when people find that their neighbours who have been in the hospital have not been maltreated and "experimented on," but, on the contrary, have been kindly taken care of. No proceedings have been taken under section 126 of the Public Health Act, 1875.

In conclusion, I have to thank the Ince Local Board and their Officers, and the other gentlemen who have supplied me with information for this report, for their courteous assistance.

H. FRANKLIN PARSONS, M.D.

RECOMMENDATIONS.

1. Continuous attention should be given by the Urban Sanitary Authority and their Surveyor to the state of the sewers, in order to insure that they shall be maintained in repair and properly cleansed and emptied.

The charcoal trays and lids to the ventilating shafts should be removed, as they seriously impede the proper ventilation of the sewer without any compensating advantage.

2. The present offensive arrangements for the storage and removal of excrement should without delay be abolished, and some better system substituted. If the Urban Sanitary Authority consider that the water-closet system is not applicable to the circumstances of the district, some one of the "dry" systems should be adopted. If middens or fixed receptacles for night-soil be retained, they should be constructed in accordance with the following principles:

(*a.*) The receptacle should be so constructed as to allow of the frequent application and thorough mixture with the excreta of dry ashes or of earth.

(*b.*) The receptacle should be roofed or covered in so as to keep out the rain, and should be provided with doors and sufficient means of ventilation by shaft or otherwise.

(*c.*) The receptacle should be constructed of non-absorbent impervious materials so as to be water-tight.

(*d.*) The bottom of the privy should be at least three inches above the level of the ground.

(*e.*) The dimensions of the receptacle should be as small as practicable.

(*f.*) The privy should be removed from the house to a sufficient distance to obviate nuisance, and it should be provided with sufficient means of access for emptying otherwise than through the house.

Some method in which the excreta are received into moveable receptacles and kept apart from the bulk of the dry refuse will probably be found best adapted to the requirements of the district. On this point the attention of the Urban Sanitary Authority may advantageously be given to the official report to the Local Government Board, "On certain means of preventing excrement nuisances in towns and villages."

The Urban Sanitary Authority might also with advantage inspect the working of the pail system in the adjacent borough of Wigan, and other towns.

For the effectual working of any system, it will probably be found necessary that the Urban Sanitary Authority should take the removal of excrement and refuse into their own hands.

3. The provisions of section 150 of the Public Health Act, 1875, should be put in force with respect to the levelling, metalling, channelling, and making good of those private streets which are in a condition to require it.

The common courtyards should be properly levelled so as to slope to the grids in order that surface water may run off, and they should be either paved or asphalted so as to be capable of proper cleansing.

4. Frequent and systematic inspections of the district should be made by the Inspector of Nuisances, with a view to ascertain what nuisances exist in it requiring removal. These inspections should extend to the interiors of the dwelling-houses as well as to their surroundings.

The Urban Sanitary Authority should use such powers as they possess under the Public Health Act, 1875, including byelaws under section 44, for the prevention of nuisances arising from the throwing of refuse and offensive matters upon streets, courts, and waste ground.

The Urban Sanitary Authority should enforce the cleansing and purifying of all houses which may be found in such a condition as to be a nuisance or injurious to health.

5. All houses in which infectious disease has existed should be effectually disinfected by fumigation with sulphur, and by removal of wall paper and limewashing.

Efficient means should be provided by the Sanitary Authority for the disinfection of clothing and bedding that have been exposed to infection. This object will probably

be best secured by the provision of a disinfecting oven, in which an equable temperature of 220°–240° Fahrenheit can be maintained for some hours. Provision should be made for the conveyance to the disinfecting apparatus of articles needing disinfection with such provisions that no risk to the public need be apprehended.

6. Some provision should be made for the isolation of cases of infectious disease. This should not be delayed until another epidemic has actually broken out, as the chief use of such accommodation is to isolate the first cases of disease, and thus prevent it from gaining a footing in the district. As a commencement under the present circumstances of the district, a detached cottage standing in its own ground in which a man and wife without family might reside to take care of the house when empty, and to nurse any patients that might be admitted, would probably be the most readily available and cheapest arrangement.

The byelaws in force in the district should be revised, and, where necessary, brought into accordance with the present state of the law.

Provisions should be made with respect to new buildings for purposes of health. This the Urban Sanitary Authority have power to do under section 157 of the Public Health Act, 1875. For instance, it would be well to adopt a requirement that whenever houses are built upon made ground, the site of the house shall be covered with a layer of concrete or other impervious material in order to prevent noxious emanations from the soil being sucked up into the house.

The Urban Sanitary Authority should consult the series of Model Byelaws lately issued by the Local Government Board.

APPENDIX.

ROYAL INSTITUTION LABORATORY, LIVERPOOL.

ANALYSIS of Ince Water obtained from Wells sunk in the Red Sandstone Rock at Golborne.

Organic and other volatile matters, per gallon	1·75
Mineral matters	30·62
Total residue on evaporation	32·37

The mineral matter consists of—

Chloride of magnesium	Small quantity.
„ of sodium	Do.
„ of potassium	Very small quantity.
Sulphate of lime	Do.
„ of magnesia	Abundant.
Carbonate of lime	Do.
„ of magnesia	Do.
Oxide of iron	Small quantity.
Nitrates	Trace.

Hardness before boiling	14
„ after boiling	7·5
	6·5

This water is of good quality, being free from organic matter of animal origin. The hardness is the only objectionable feature, and this is not at all excessive.

(Signed) EDWARD DAVIES, F.C.S., &c.

Dr. Ballard's Report to the Local Government Board on an Outbreak of Enteric Fever at Tolcarne Head, Newquay, Cornwall, and generally on the Sanitary Condition of the Urban Sanitary District of Newquay.

George Buchanan,
Medical Department,
February 24, 1880.

Locality, population, &c.

The Urban Sanitary District of Newquay, part of the parish of St. Columb Major, is situated on the north coast of Cornwall, at the southern end of Watergate Bay. It embraces an area of about 216 acres, skirting that part of the bay (known here as Newquay Bay), from a little to the east of Tolcarne Point to Fistral Bay on the west, and it includes a bold headland or narrow-necked promontory stretching out into the sea between the two bays, and merely used as a look-out and recreation ground. The population in 1871 was 1,121, and there were 252 inhabited houses. Since that year the number of houses and the population have increased. The number of inhabited houses now on the rate book is 334; so that, assuming the number of occupants in each house to be similar to that found at the last census, the stationary population of the district may now be taken to be about 1,486. But perhaps this estimate may be a little too high, since Newquay is a place much resorted to, of late years, by visitors during the holiday season, and many of the newer houses let in lodgings during the summer months may, on this account, be occupied, at other times, by smaller families than they are capable of accommodating. During the visitors' season of 1879, lodgings were let at 44 houses (at least), and in the height of the season (in August) the population of the district would probably be raised by about 400 persons.

Geology.

The geological formation on which Newquay stands is an argillaceous laminated rock known as "Killas," which to a depth of from about 10 to 20 feet is loose and slabby, but below this depth becomes firm and hard, but is still laminated. The dip of the stratification is southerly. Nearly vertical veins of quartz intersect the rock, and the edges of these are visible in many places on the surface of the ground. The rock is not remarkable for fissures.

Arrangement of streets and houses.

The village, or, as it may now almost be termed, the town of Newquay, is formed by one long main street, skirting the bay and roughly following its outline; in order to follow its outline it makes a bend of nearly a right angle at "Commercial Square," opposite the deepest recess of Newquay Bay. There are in the older parts several narrow streets and courts issuing from it in each direction, *i.e.*, towards the beach and towards the country, and in the newer parts especially, a few roads of good width passing off in the latter direction. The coast here is formed by high vertical cliffs, at the foot of which there is, at low water, an extensive range of pretty dry sands. The coast is indented by jutting portions of the cliff, the most important of which is Tolcarne Head at the east, to be presently specially referred to. Under the cliffs towards the western end is a small harbour used for the pilchard fishery and the exportation of minerals. Above the harbour the houses of the main street stand only a few feet from the edge of the cliff, but more to the eastward, the street gradually recedes from the cliff to a distance from it of about 200 yards. In the main street there is a tolerable continuity of dwelling-houses for about 550 yards, both to the east and to the west of "Commercial Square" before mentioned. So that the whole length of the village may be roughly taken at about 1,100 yards, or about two-thirds of a mile. To the south of Newquay the land rises rather steeply.

Tolcarne Head.

At Tolcarne Head, and about 300 yards beyond the last row of houses to the eastward, there have, within the last two or three years, been erected near the edge of the cliff a good hotel, and a few private houses, adapted for a

good class of residents. One of these houses, Seaward Villa, now occupied by Mr. M. and his family, stands by itself to the westward of the hotel, a narrow roadway to the cliff intervening. The remaining houses stand in a row to the eastward of the hotel; three of these are occupied, one by Mr. B. and his family, the next house to it by the Rev. Mr. E. and his family, the third by Mr. L. (the builder) and his family, and beyond this there are two more houses in course of construction by Mr. L. One side of this row of houses faces the sea. At Tolcarne Head the cliff is perpendicular, and about 90 feet high; but away from the sea, the land slopes to Tolcarne Valley, the natural drainage of which is into a shallow tidal river, "the Gannel."

The immediate occasion of my inquiry was an outbreak of enteric fever in these new houses at Tolcarne Head. It had in due course been reported to the Local Government Board by Mr. Boyle, the Medical Officer of Health, and being at the time at Newquay for my holiday, I was instructed to investigate it. I very quickly became aware of the fact that, although the chief incidence of the fever had been of late upon the occupants of the houses at Tolcarne, other cases of fever had occurred about the beginning of the year, and that one was even still existent in the village proper. Mr. Boyle, in his report, attributed the fever at Tolcarne to sewage pollution of the well which supplied the houses there with drinking water, but his opinion was not unchallenged.

Sewering and drainage.

Prior to 1876 there was no proper system of sewers: the only public drains were 12 inches square roadside superficial drains originally provided for the purpose of road drainage. They were roughly constructed with slabs of "killas" at the sides and top, the bottom of them being the natural loose "killas" rock. Where there were waterclosets they were allowed to discharge themselves into these drains. In other cases the privies in the place were provided with ordinary cesspits dug in the loose "killas" rock. But in 1878 a system of pipe sewering was introduced, a loan having been contracted for the purpose, at a total cost of 3,136*l*. The work was commenced about June 1st, 1875, and completed about April 18th, 1876.

As the work of sewering proceeded the old privy cesspools were with certain exceptions abolished,* and the drains of private premises were diverted from the old roadside drains and connected with the new system. The street drainage was also carried by trapped gullies into the new system. But although the use of the old square drains was thus abandoned altogether, these drains were not broken up. They were left to become inevitably highways for the rats, which always abound at a port, and which naturally would burrow from them in all directions beneath the village.

The main sewers are made of 12-in. socketed pipes mostly; those only towards the outskirts of the system, and such as enter directly the tunnel (to be mentioned immediately) in its course to the outfall being 9-in. pipes. From about the middle of the village (Commercial Square) a tunnel has been constructed in the rock along the course of the western half of the main street towards the outfall, situated about 200 yards to the west of the harbour. It is a large tunnel, high enough for a man to walk through (about 5 feet), and in constructing it the rock had in places to be blasted. The total length is about 968 yards, and it terminates in a 15-inch stoneware pipe, carried for about 286 yards along a private roadway beneath the cliff, which pipe discharges into another short tunnel or shoot about 14 feet long, inclined downwards at an angle of about 45°, and terminating in a 9-in iron pipe which is carried into the sea and discharges itself below low-water mark.

Some water issuing from the rock in the neighbourhood is conducted into the 12-in. main sewer at Commercial Square by 6-in. pipes, and water is said always to be running through it. The entrance to the tunnel is by a door at its commencement, and there are four manholes into it from the public street. There is a storm outlet by a 15-in. pipe into the harbour. The sewers are ventilated by means of 4-in. iron pipes carried up from them to above the eaves of houses. These ventilating pipes are situated at the end of each main branch, and at appropriate intervals where there is a long course of

* The clerk informs me that at the end of 1874 and in the early part of 1875 about 100 privies were converted into "earth closets." Later on, some of these were converted into "waterclosets."

sewer. Altogether there are said to be 37 such ventilators provided. No public provision is made for flushing the sewers; but in dry weather a man is said to be sent round to fill the traps of the street gullies with water; but at times very offensive smells have proceeded from the gullies in consequence of neglect of this practice.

Defects soon discovered.

Perhaps the arrangement of tunnels and outfall pipes was the best arrangement which the circumstances of the place admitted of. About this I can hazard no opinion—but assuredly a good deal of the drainage work was done in a slovenly and imperfect manner. In two instances the pipes were so badly laid, and at levels so incorrect, that the Local Board, the Surveyor tells me, soon after the work had been completed, had, in consequence of chokings and inefficiency of action, to spend about 100*l.* in rectifying the errors committed. Furthermore in the course of my inquiry I heard of several instances in which the drains from private premises had been so imperfectly laid that nuisances shortly arose on account of their inefficiency, and in which the drains had to be taken up and relaid. Such facts as these cannot fail to leave on the mind an uncomfortable feeling of uncertainty as to the way in which the rest of the work has been done, and a fear lest some day evil may arise from some as yet undiscovered faults in the original work. There are still some houses towards the boundary of the district to which the system of sewers has not been extended. Such is the case with the houses at Tolcarne Head, and also with two houses at Mount Wise, the nearest of which is only 150 yards from the end of the Mount Wise sewer: to this house I shall have occasion to revert. There are also some houses newly erected within the village itself to which the convenience of a sewer has not been afforded.

Privy accommodation.

When the new sewers were put in, the privies, cesspit privies, and such earth or ash closets as existed, were for the most part converted into water-closets; that is to say, the old form of privy was abandoned, and a pipe was brought from the sewer and a pan and trap were provided.

Some of the best houses have water cisterns for the water supply of the closets, but in by far the larger proportion the closets have no supply of water. In these instances it is expected that the slops of the house will be thrown down the closet, and, should this be insufficient to carry away the excrement from the pan, that water will be brought for the purpose in some vessel and thrown down. In seasons when there is little or no rain this is the only flushing that the sewers receive, and its insufficiency must be obvious. At such times dangerous accumulations must take place in the sewers, and these accumulations can only be washed away when an abundance of rain again falls. The fact that foul smells arise from street gullies in dry weather when a supply of water to the traps is neglected, shows that sewage matters which ought to issue from them in a fresh and inoffensive condition, do really accumulate and undergo decomposition within them. In some instances during my inspection I found the traps of the closets filled with excrement, and in many more the pans themselves were filthy from excrement adhering to them—a natural result of the non-supply of water. I saw nowhere any proper ventilation provided for the soil pipes—in some few instances there was a futile pretence at ventilation by means of a very long half-inch leaden pipe reaching to the roof of the house. This matter is one which is evidently not understood at Newquay. Some small houses have no privy accommodation at all; and in these instances the excrement is thrown out of the chamber-pot usually on to some heap of ashes or refuse in the garden of the house, if it have one, or, if it have not one, in some neighbour's garden. One woman of whom I inquired what she did with excrement replied, that she supposed she did "as the cats do." Some houses have tubs beneath the privy seat; and in these cases, inasmuch as the Local Board does not afford facilities for cleansing them, their contents are usually disposed of either by casting into a shallow hole in the earth or upon some heap of ashes, or sometimes by burying. I was told that there were several houses which were provided with earth closets, but most of the so-called earth closets shown me by the Inspector of Nuisances were tubs or pails containing no earth at all, and not used as earth closets. In some instances again the privy was of the nature of a shallow cesspit privy, that is to say, the excrement fell either into a shallow excavation, or upon the bare earth beneath the seat.

Ashes and refuse matter.

Ashes and refuse matters are in some few of the best houses collected in covered ash-bins, but the rule throughout Newquay is for the ashes with vegetable and animal refuse of all kinds to be deposited in the gardens attached to the houses, either in a shallow hole dug in the earth or upon the surface of the ground. In any case, there are nearly everywhere large accumulation of such matters in the rear of the houses, especially of the smaller houses. The excuse which the Inspector of Nuisances made to me for not dealing with these things was, that people wanted the stuff to dig into their gardens, and that they must needs keep it for this purpose.

Water supply.

The water supply is universally by wells sunk deep in the "killas" rock. None of them were steyned even in the upper part. There are two public wells, one in the roadway of "Commercial Square," and another about half-way between that place and Tolcarne. The first-mentioned well is very old, having been in existence much longer than the memory of any of the inhabitants goes back. Both the public wells are covered and provided with pumps. For the most part the private wells are open draw-wells, but few of them are covered and provided with pumps. Dr. Dupré has made an analysis (App. No. 2) of a sample of water I took from the old town well, and (App. No. 1) of water which I drew from one of the most frequented of the private wells, which is situated in a court to the westward of it. The entire depth of the latter well is 48 feet, and when it was measured on September 22, 1879, it had seven feet of water in it. There is always, it is said, an abundance of water in the old town well, which is largely used by the inhabitants of the houses about it. Dr. Dupré's results of analysis of these two waters are favourable as respects the samples taken on September 12, but show that the waters have come into them from a soil strongly impregnated with sewage matters; and, although these matters had been well oxidised in the samples taken on that day, there is no security against their being more dangerously polluted at some other time when sewage matters may chance to be washed into them in a less thoroughly oxidised condition. Probably they were much worse before the village was sewered, and should there be any amount of leakage from ill-constructed or defective sewers or drains, the waters, not only of these, but of other wells may become actually dangerous to drink. Before quitting Newquay I learned that there is a prospect of a supply of water being shortly obtained by a Water Company, and brought into Newquay, from a wholesome source a few miles to the eastward of the district.

Dwellings of the labouring classes.

The dwellings occupied by the labouring classes are clean and tidy, and contrast most favourably in these respects with houses of a similar class which I have been accustomed to see in various parts of the Midland Counties. There does not appear to be any remarkable overcrowding in them.

Keeping of animals, slaughtering, &c.

Pigs are unwholesomely kept in the midst of filth in undrained pigsties in many places, and the cowsheds are, with a single exception, close, ill-constructed, dirty, and undrained. The two slaughter-houses also are undrained, ill-paved, and unclean. In respect of the keeping of pigs, cows, and in respect of slaughter-houses, the byelaws of the Board are systematically disregarded, both by the persons who keep them and by the Inspector of Nuisances, whose duty it is to report breaches of the byelaws to the Local Board.

Adulteration of milk.

The adulteration of milk sold in the town is flagrantly obvious. I myself was supplied with poor milk, which on one occasion contained a number of small worms such as are apt to be found in dirty rain-water cisterns. I heard a complaint of a similar occurrence which was made to me by a resident during the course of the inquiry. The Local Board have taken no steps to correct this evil.

Mortality.

Until a Medical Officer of Health was appointed after the establishment of the Local Board District, the deaths occurring in Newquay were not distinguished from those occurring in the rest of the Registration Sub-district of which it forms part. The Annual Reports of the Medical Officer of Health, however, furnish me with the materials for the following Table, in respect of the mortality during the last $5\frac{3}{4}$ years.

	Total Deaths from all causes.	Deaths from certain specified Diseases.						
		Small-pox.	Measles.	Scarlatina.	Diphtheria.	Whooping Cough.	Fever.	Diarrhœal Diseases.
1874 - -	16	—	—	—	—	—	4	1
1875 - -	23	—	—	—	—	—	2	1
1876 - -	27	—	—	—	2*	—	1	2
1877 - -	16	—	—	—	—	1	—	1
1878 - -	25	—	—	—	3	—	—	—
1879 (Jan. 1 to Sep. 30)	18	—	—	—	—	—	2	—

* Two other deaths were registered as from "Croup."

As I cannot feel safe in forming any estimate of the actual population year by year, I give merely the crude numbers. But making a fair allowance for increase of population since 1871, the deaths in 1875, 1876, and 1878 were obviously more numerous than they might have been expected to be in a place so healthily situated as Newquay.

Fever in Newquay.

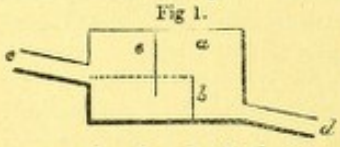
It is within the recollection of the older residents that about 20 years ago Newquay was visited by a very severe and fatal epidemic of enteric fever. It was about this time that Mr. Boyle first began to practise there, and he tells me, as the result of his experience, that since that time cases of enteric fever, more or less numerous, have occurred nearly every year. In September 1874, in consequence of a communication made by Sir James Paget, Dr. Blaxall was instructed to inquire into an epidemic of enteric fever which was then prevalent, and which is indicated in the table of mortality, above given, by the record of four deaths from "fever." The epidemic broke out in Newquay towards the end of June, and attacked both residents and visitors in the various lodging-houses. Dr. Blaxall himself saw 30 or 40 cases of various degrees of severity; and he observed "that the distribution of the "fever coincided in a remarkable manner with the ramifications of a sewer," one of the old square sewers or drains (mentioned before in this report), the outlet of which was situated on the beach in the immediate vicinity of the cliff on which Eothen House stands. Out of 13 gentlemen forming an university "reading party" and lodging at this house, five were attacked with the fever "soon after leaving." I have not been able to ascertain the total number of observed cases that occurred during this epidemic, but the epidemic was unquestionably a severe one. Mr. Boyle has given me a list of 72 cases, and there were in addition many cases in his club practice which are not included in the list. Summing up, Dr. Blaxall writes:—"Taking into consideration all "the circumstances, I am of opinion that the main cause of the outbreak of "fever was a polluted atmosphere, occasioned by the escape of sewer air in "the immediate vicinity of the dwellings and in some instances into the "dwellings themselves." He further makes mention of "accumulations of refuse" and "a general prevalence of those insanitary conditions which favour the generation and spread of enteric fever." After the receipt of Dr. Blaxall's statement, the Board entered into a correspondence with the Local Board of Newquay, urging the necessity of improving the sewering arrangements of the place and of taking measures to secure the proper ventilation and flushing of the sewers, and also urging that the regular removal of refuse and excrement should be undertaken by the Local Board itself as the only way in which such removal was likely to be carried out efficiently. It was consequent upon this correspondence that the conversion of some of the cesspit privies into so-called "earth-closets" was effected; but the Local Board neither undertook to supply earth nor to remove the excrement from the closets.

The history of the outbreak of fever which has taken place in 1879 is, so far as I have been able to ascertain the facts, as follows:—On January 11, Mrs. D. came as a visitor to reside at the house of Mrs. H., who occupied one of a pair of houses forming almost the last of a row of houses going out of Newquay towards Tolcarne, and situated upon the new system of sewers with which these houses were connected. She must at the time of her arrival have

at least been in the incubation stage of enteric fever, for she sent for Mr. Boyle to see her on January 13th, when he found her suffering from the fever. She had a very severe attack of a thoroughly typical character, with diarrhœa, tympanites and rose spots, and the illness was complicated with pneumonia. The medical attendance lasted until April 4, and she ultimately recovered. A family of seven persons went to lodge at this house on April 21 or 22, and remained until May 12, when they returned home to Plymouth. On May 20 one of the children of the family was found to be suffering from enteric fever, and another of the children suffered from the same disease at a later period.

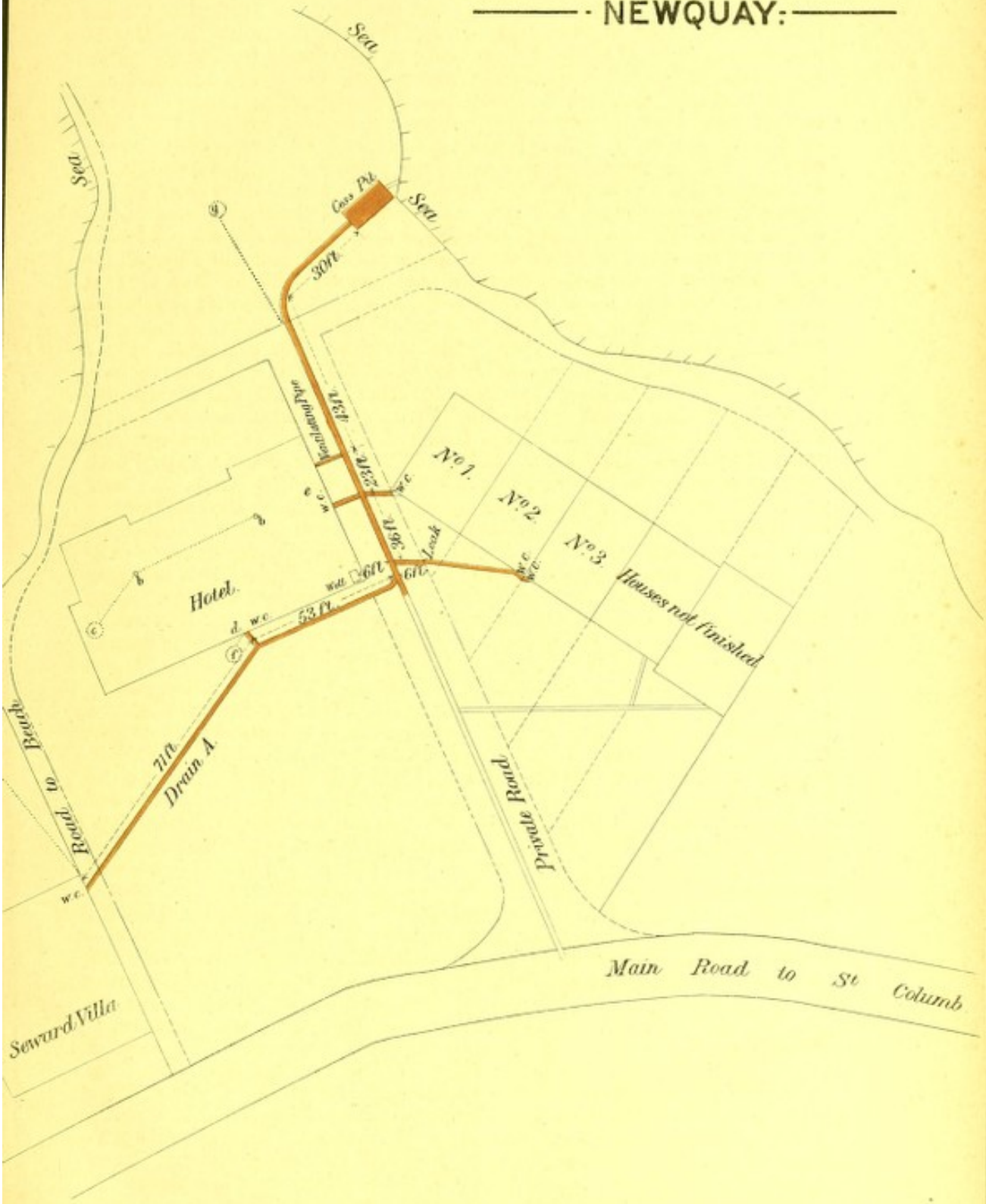
The next cases that happened were those at Tolcarne Head, and in order to explain them it is necessary to give a somewhat detailed account of the *locus in quo*, the system of drainage adopted there, and the nature of the water-supply. The accompanying plan shows the position of the hotel and houses at Tolcarne Head, as respects each other, the cliff, which is there about 90 feet high, and the main road; and also the position of the waterclosets of the several houses, the line of the pipe drains as now existent, and the position of a cesspool into which the main drain discharges itself near the edge of the cliff. The first of the houses occupied was Seaward Villa in May 1874, at which time the watercloset was drained into a cesspit, indicated at *a*, which was not provided with any means of overflow nor with any ventilation. It was abolished in April of 1879, when the closet was connected by the pipe drain A with the system of drainage of the hotel and other houses. Since May 1877 this house has been occupied by Mr. M. and his family; previously to that it was occupied by Mr. L. (the builder) and his family. The hotel was originally two houses facing the sea, one of which was first occupied by Mr. L., the builder, in May 1877, the other one not having been occupied at that time; subsequently, additions having been made, they were united to form the hotel, which was first occupied as such by the hotel-keeper, Mr. R., and his family in December last year. The original two houses had each a watercloset indicated by *b b*, which discharged themselves into a cesspit (similar to that at Seaward Villa) situated at *c*. When the houses were converted into an hotel these waterclosets and the cesspool were done away with, and waterclosets for the hotel were provided at *d* and *e*. The watercloset at *d* discharged itself into a cesspool at *f*. No. 3 in the row of houses was first occupied by the builder in March 1878. The house No. 1 was occupied first by Mr. B. in March 1878. The house No. 2 was first occupied by a tenant in July, August, and part of September 1878, by a family which was throughout that period free from illness, after which it was empty until May 1879. Rev. Mr. E. and his family entered into occupation of No. 2 on May 10th, 1879, while No. 3 has, since March 1878, been occupied by Mr. L., the builder, who occupies it now. The closets and sinks of these three houses and the hotel watercloset *e* were originally drained into a cesspool indicated at *g*, similar to the other three cesspools mentioned, that is so say, so arranged that liquid matters should soak away into the loose killas in which they were sunk and not require an overflow pipe to carry them off. All were alike unventilated. Where the soil pipes of the several waterclosets entered the drains, what the builder calls a "mason's trap" was introduced. Fig. 1 indicates its construction. It consists of a cavity *a* about 2 feet long and 1½ feet wide, and about a foot deep, enclosed by masonry, and having a thin partition *b* rising about half way up from the bottom. *c* is the entrance pipe and *d* the exit pipe. Between *b* and the entrance pipe there is a little receiver thus formed, into which a dip stone *e* from the cover dips down about 3 inches. The dotted line shows the level of the contents of the trap. The soil pipes of No. 2 and 3 both entered the same trap. The closets of Seaward Villa, and of Nos. 1, 2, and 3, were supplied with water by means of rain-water cisterns. In no instance did the overflow pipes of the rain-water cisterns enter the drains.

Fig 1.



In April 1878 the Local Board addressed a letter to the Board to the effect, that 1°, the drainage of these new houses must be provided for; 2°, that they were unable, on account of the levels, to connect their drains with their new general system of sewers; and 3°, asking the consent of the Board to their making a large water-tight cesspit near the edge of the cliff, from which the liquids should be let off at suitable times when the tide was in. The answer

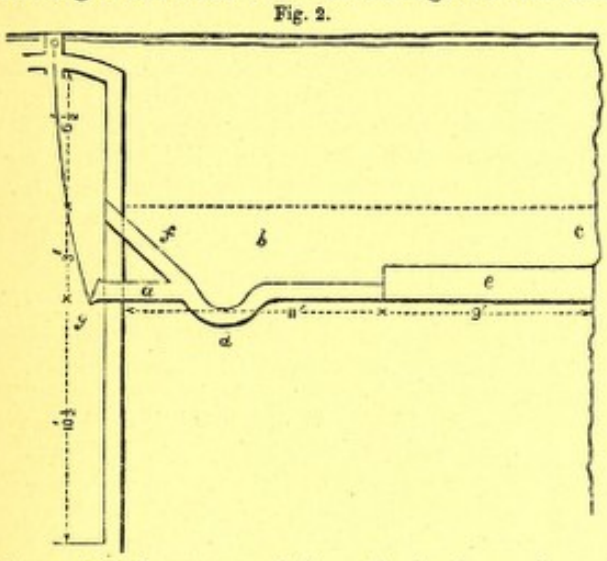
NEWQUAY:



PLAN OF THE HOUSES AND DRAINAGE AT TOLCARNE HEAD.

given by the Board on May 17th, was 1°, that "the Board's sanction to the proposed works was not needed"; 2°, "That the cesspit should be so con- "structed and managed as to prevent any nuisance being caused by it, and "that, therefore, it must be made watertight and be properly covered and "ventilated, and arrangements must be made for its being regularly emptied "at proper times;" 3°, The Board added the advice "that excrement should not "be discharged into the drain communicating with the cesspool, but that "arrangements should be made by pail or earth closets for its being other- "wise disposed of and frequently removed." The Local Board, during the autumn, proceeded to carry out their proposed scheme, and to make the large cesspit marked upon the plan, and to carry the drains from the hotel and other houses into it. In the month of October the work was finished, and the pipe drainage into the cesspit was established, as shown upon the plan, with the exception of the drain A leading from the watercloset at Seaward Villa. The 71 feet of pipes from this to the junction of the nearest hotel water-closet *d*, and the 53 feet from the junction to the main drain were not laid in until the end of April 1879. The cesspit *g*, was abolished about the month of November. The cesspits *f* and *a* were, however, not abolished until the 124 feet of pipe above-mentioned were laid in April 1879. The Local Board's cesspit excavated in the rock, in the situation indicated in the plan, is 18 feet long × 4 feet wide and 20 feet deep, and is arched over with masonry. In sinking it the rock was loose enough for the excavation to be made without having recourse to blasting, until within about 3 feet of the bottom. The sides were lined with rough masonry consisting of various sized and variously-shaped slabs of killas laid in mortar, and the interior and bottom were then covered with one coat of cement, about ½ inch thick, just to make the surface even. The annexed woodcut, Fig. 2, represents a section of the end of the cesspit towards the cliff and the pipes proceeding from it. On the side next the cliff a 6-inch overflow pipe *a* was put in and carried through a short tunnel *b* made in the rock to the face of the cliff *c*. A few feet from the cesspit a siphon trap *d* was introduced. After a course of about 11 feet this pipe was introduced into the mouth of a 12-inch iron pipe *e*, 9 feet long, which opened at the other end upon the face of the cliff. About 3 feet above the overflow pipe another 6-inch pipe *f* was introduced and brought down to join the overflow pipe on the cesspit side of the siphon trap. This was put in to serve, it is said, as a storm overflow. A flap cover or valve *g* was provided at the mouth of the lower ordinary overflow pipe, and the means of raising it in order to discharge the contents of the cesspit was provided in the shape of a rod which passed up through the roof of the cesspit to a handle which was, together with the roof of the cesspit itself, covered with sods. The only way in which the cesspit could be ventilated, then, was through the storm overflow pipe, trap, &c. to the face of the cliff. The drains of the hotel and Nos. 1, 2, and 3 (9 and 6-inch pipes) were then connected with a 12-inch main pipe, which discharged into the cesspit not merely slop waters from these houses, but also excremental matters from the several waterclosets. Here, then, were three errors committed by the Local Board *in direct contravention of the Board's advice*, viz., the reception of excrement into the cesspit, the introduction of the discharge pipe at such a level as rendered it impossible that the cesspit could ever be properly emptied through it on the raising of the valve, and the neglect to provide a proper means of ventilation for the cesspit. Foul gases generated within the cesspit could only find exit by forcing their way either through the trap in the discharge pipe or

Fig. 2.



through the traps of the drains leading from the several houses. The danger to the inhabitants in the latter event was enhanced by the fact that no arrangements for ventilating the drains or soil pipes of the houses had been provided. Hence, in the event of the house traps having been forced, the cesspit air must have entered the houses.

Now this was the state of affairs at the beginning of 1879. In the early part of this year offensive odours began to be noticed when the wind blew from the direction of the sea, and these offensive smells were still being complained of, especially in the evenings, when my inquiry commenced. They evidently came from the cliff, and were attributed to foul gases discharged from the overflow pipe. It would appear, then, that the trap in this pipe was inefficient, either because it contained no water or because the pressure within the cesspit had been effective in driving the pent-up gases through it. In order to remedy this nuisance a 4-inch downcast pipe was, at the beginning of June, carried from the opening of the 12-inch iron pipe part of the way down the face of the cliff, and it was lengthened in September.

When Seaward Villa and the two houses subsequently incorporated into the hotel were built, a well was sunk in the situation marked on the plan. It was first sunk 72 feet into the "killas" rock (*i.e.* about 18 feet short of the level of the bottom of the cliff) and, no water having been arrived at, a tunnel was driven westward for about 42 feet. The water came in, I am informed, at a spot about 12 feet from the bottom of the shaft, the remaining length of the tunnel furnishing no water. Water has at no time been very abundant. In times of rain there has been sufficient for use, but after a week of dry weather during the period of my inquiry no water was obtainable from the pump, and again when I visited Newquay on October 10, the well was dry. At first water was drawn by means of a bucket and windlass, but in January of this year a force pump was introduced, but was not much used before February 17. This pump broke down from some defect in construction after it had been in use about two months, and the well water was consequently not used by anybody during about one fortnight while repairs were being executed. Since then (*i.e.* since the end of April) it has been in use for the supply of the houses. The well-water has not been used, however, to supply drinking water to all the houses at all times. The facts are these:—At Seaward Villa up to the restoration of the pump last April little or no well-water was drunk, rain-water being used for drinking purposes, but after its restoration, it was used "partially," *i.e.* recourse was had to it when the rain-water ran short, and on some other special occasions. At the hotel the well-water was not used prior to February last, since there was plenty of rain water and it was troublesome to raise water from the well by means of the bucket and windlass. Since February and up to the middle of July (except when the pump had broken down) the well water was used to supply drinking water to the hotel. Since the middle of July water has been brought from the nearest town pump. At No. 1 in the row of houses nothing but rain water filtered through a carbon filter has been used for drinking at any time. Nos. 2 and 3 have habitually used the hotel well-water up to the middle of July. Since then water has been obtained from the above-mentioned town pump or from a neighbouring farm.

Unusual facilities for obtaining a history of the illnesses that have occurred at Tolcarne are afforded by the fact that Mr. Boyle, the Medical Officer of Health, is the only medical practitioner at Newquay or for many miles round, and has attended professionally all the sick persons requiring medical attendance in the place. He tells me that on February 22 last he was called to see Mrs. R., the wife of the hotel keeper, and he continued his attendance until March 16. At first he thought that her illness was due to debility, the result of prolonged lactation, but he subsequently felt convinced that this was not the case, but that, although she did not suffer from either diarrhœa or vomiting, her illness was due to an attack of what he regarded and termed "simple fever." She did not keep her bed.

There appears, however, to be some obscurity about this illness and its cause. It is certain that one day (the exact day being not determinable) Mrs. R., the wife of the hotel keeper, paid a visit to Mrs. H., at the house mentioned above, where Mrs. D. was ill with enteric fever, and sat for a considerable time, waiting to see Mrs. H. in Mrs. H.'s own sitting room, which

communicates by a door with a passage in which the watercloset is situated. I am informed that Mrs. R. was not well when she paid this visit, but whether she was at that time ill with "fever," or was simply ill as the result of prolonged lactation, prior to her attack of fever, is not clear. The fact of her not having been compelled to keep her bed is no proof that her illness was not "enteric fever," since sometimes an attack of this disease is so mild in its character as to be doubtfully distinguishable from other diseases, until further events occur to throw fresh light upon the nature of the illness.

But nothing more did occur, so far as inquiry has enabled me to discover, until the month of May. The hotel was opened for visitors on April 7, 1879. On May 10 the Reverend Mr. E. and his wife and family, consisting of their three little girls aged 13, 11, and 7 years, another little girl aged six years, and three women servants, came to reside at No. 2; a governess aged 40 came on the 12th, and another woman servant on the 16th. They came from the vicarage in a Staffordshire village where fever was not existent. Mr. E. had he told me been induced to purchase the house partly on an assurance, given on the authority of the Chairman and Clerk of the Board, that the drainage arrangements had been approved of by the central authority in London.* On May 26th or 27th, *i.e.*, 16 or 17 days after coming to the house, Mrs. E. was taken seriously ill, and she was ill for three weeks. Her illness commenced with rigors, but she had no diarrhœa. She kept up, however, although quite unfit to be up, in order, she says, to look after her child, who also was soon after attacked. Mr. Boyle says the illness was unquestionably enteric fever. On June 3 Janet E., aged 11 years, was found by Mr. Boyle to be suffering also from enteric fever; she had been ailing for some days previously. She had diarrhœa but no rose spots. On the same day Margaret N., the little visitor, was also taken ill and had an attack characterised both by diarrhœa and rose spots. On June 25 Mabel E. was attacked, but her illness was mild, and she had no diarrhœa. On July 6, one of the servants, E. P., aged 32, who had nursed the sick children, was taken ill and was still in bed during the time of my inquiry. She had a very severe illness, characterised by diarrhœa, rose spots, and delirium. On June 10, Mrs. N., aged about 33 years, from Lynn near Lichfield, the mother of Margaret N., came on a visit and left on the 20th. Returning, she spent one night at an hotel in Bristol, and then went to her mother's house (where there had been no illness) at Walsall, where she stayed about 11 days, and then feeling very unwell went home to Lynn. Her illness commenced with rigors, nausea, and headache on July 2, and she was first seen by Dr. Morgan of Lichfield on July 6. Dr. Morgan tells me she had a very severe attack of enteric fever, with delirium and great prostration, and during the fourth or fifth week she had free hæmorrhage from the bowels. Last of all, Lilian E., the youngest daughter, was attacked. She was first seen by Mr. Boyle on August 13, but had been ailing for a fortnight previously. She had a severe attack, with rose spots, diarrhœa, tympanites, and delirium, and she was ill with the fever when I saw her in the first week of September. Ultimately all those attacked recovered. Out of 12 persons who resided, or had visited at the house between May 10 and August 11, seven suffered from attacks of fever; of the remaining six persons two are believed to have had fever previously, and were so far protected from a second attack.

Two days before E. P., the servant at No. 2, was taken ill, namely, on July 4, two lads, aged respectively 19 and 16 years, apprentices to Mr. L. the builder, and who were occupied sometimes in a workshop about 50 yards from the row of houses, and sometimes in the houses Nos. 4 and 5, which were in course of erection, were both seized with illness in the same way, and were attended by Mr. Boyle. The lads resided each at his home, these homes being isolated farmhouses, and a mile or two apart. They always slept at home, but took their meals with them to their work, and either ate them in the workshop or sitting near the edge of the cliff, where they had often been seen looking out upon the sea during their meal times. They drank the water

* Mr. Boyle informed me that he had been told this distinctly by the chairman and the clerk, and had therefore not hesitated to repeat it. On my mentioning this fact to the chairman he did not deny it, but replied that he regarded the letter of the Board of May 17th, 1878, as equivalent to a "tacit sanction" to the arrangements.

from the hotel pump. They were great friends, and were nearly always together. Both began to be ill on July 4 with rigors, and their illnesses were characterised by rose spots, and delirium, but neither of them had diarrhœa. Of these lads G. P., aged 19, died; the other lad, T. R., aged 16 years, recovered after a severe illness. No other cases occurred at the home of either of the lads.

About the same time also, namely on July 7, the house No. 3, occupied by the builder Mr. L., was invaded by the fever. His family consisted, in addition to himself and his wife, of four children, aged 13, 11, 3, and 1 year, and a female servant, aged 18. One of the children, G. L., aged 13, was attacked about July 7, and another, A. L., aged 11, about August 4. Both illnesses were mild in character. The servant appears also to have been ill on July 11, and had to go home with a mild attack of fever.

All the above illnesses, it is to be observed, occurred in persons residing or working at the houses on the eastern side of the hotel, and up to the early part of July, Seaward Villa, on the western side, had escaped attack. But on July 11 Mr. Boyle was called to see Mrs. M., the wife of the occupant of this house, aged 49. She had not been away from home for a good many weeks. She was in Liverpool with Bessie M. in May, and both returned home on or about May 16. She was well enough to entertain some friends on July 9, but after her friends were gone she complained of headache. Her illness was characterised by diarrhœa, rose spots, tympanites, delirium, and bowel hæmorrhage, and she died on August 2. Mr. M.'s family consisted, beside his wife and himself, of six children, aged respectively 14, 13, 12, 10, 7, and 6 years, a governess, Miss V., aged 19 years, and two woman servants, aged respectively 24 and 21 years. In addition, three visitors came to the house on June 30 and left on July 5, being Mr. and Mrs. V., aged about 50 years, and Miss H., a cousin of Miss V., the governess. Of these residents and visitors four were attacked with fever, making five persons altogether out of 14 persons who had slept in the house between the end of June and the beginning of August.

Bessie M., aged 13, was first attended by Mr. Boyle on July 14, having felt ill some days previously: she had a mild attack without rose spots or diarrhœa. Miss V. was first seen by Mr. Boyle on July 19, and also had a mild attack without rose spots or diarrhœa: she had manifestly been ill some days before the 19th. Miss H. (the visitor) having left on July 5, went home to Esher, in Surrey; on her way home she visited a friend in King's Square, Bristol (in which house and immediate neighbourhood there had been no fever), where she remained until July 16. On July 20, Mr. Izod, a medical practitioner at Esher, was called to see her, and found that she had been unwell for several days. She had an unquestionable attack of enteric fever with a little delirium, and an exceedingly full eruption of rose spots. On August 1, Ethel M., aged 14, was first seen by Mr. Boyle; she had been feeling ill some days previously: she had a sharp and long illness with diarrhœa, spots, and delirium, and was not thoroughly out of the doctor's hands when I visited the house on September 3. About the same time Henry M., aged 12, was sick, pallid, and ailing, but was not ill enough to keep his bed. It appears probable that most of the persons who had fever in this house received the infection about the same time or within a few days of one another. Whatever the medium might have been through which they received it, it was operative between June 30 and July 5, when Miss H. was at the house. Ethel M. probably received the infection at a later period, and perhaps through a different medium to the other four. She slept with Bessie during part of her illness, and later on in the same room but in a different bed, and attended to her at night.

No. 1 in the row of houses and the hotel (with the exception of Mrs. R.) appear to have escaped invasion by the fever, and these exceptions (so far as they are real and not apparent exceptions) must be taken into account when we come to consider the causes of the several attacks of fever.

No. 1 is occupied by Mr. B., his wife, and two young women servants. It is a superior lodging-house, and during July and up to the time of my inquiry had been successively occupied by visitors, none of whom, so far as I could learn from Mr. B., had subsequently suffered from illness. He says he believes he should have heard of any illness had it occurred.

The family at the hotel was small until the time it was opened for visitors in April, and consisted of Mr. and Mrs. B. who kept the hotel, a child aged three years, and a baby aged fourteen months, with a small staff of three servants; but since the opening there have been living in the house seven servants, two of whom came when the hotel was opened, and the rest have been changed at different times. Of those who were there at the time of my inquiry, one came in May, two in July, and one in the beginning of August. None of them have been ill, nor have a charwoman nor a washerwoman who came and had meals in the house occasionally. Mr. B. frankly read over to me from his books the names of the visitors and families who had been staying at the hotel, many of whom he said he had since heard from, and some of whom had come to the house a second time; and none of them, so far as he had heard, had been ill after they left. Of course there were casual visitors besides, who either slept a night or two, or took casual meals in the hotel; of them, as might be supposed, he could say nothing. The servants used habitually the lower of two waterclosets at *e* on the plan. Visitors used either of the waterclosets *d* or *e*.

These are the main facts of the local outbreak at Tolcarne, so far as I have been able to gather them. What were the medium or media through which the contagium was received by the persons who suffered? We look naturally first of all for the influence of foul air and foul water, the more ordinary media of its conveyance—for faults of drainage and faults of water supply. Inquiries I made put any suspicion of conveyance through milk supply out of the question.

Now it happens that, in this case, there were opportunities of conveyance of contagium, both through foul air and polluted water.

1. *As to foul air.*—I mentioned the fact that complaints had arisen of foul smells proceeding from the part of the cliff at which the exit pipe from the cesspit debouched. These foul smells prevaded at times the whole neighbourhood, and the residents of all the houses and persons working at the unfinished houses, as well as the hotel visitors, were exposed to them. They were very bad at times, when heavy rains had washed out part of the contents of the cesspit, and once when the well at the hotel was pumped dry, the water having then run off into the cesspit and through the storm overflow down the cliff. But the smell was not confined to these occasions, but was noticed (though in a minor degree) in dry weather also, especially when the wind blew from a northerly direction. When the bad smells were observed in dry weather, the foul air pent up in the cesspit must have found exit through the trap in the discharge pipe, either by forcing its way through the water in it, or because there was no water in it at all. That it occasionally forced the trap is probable, because this water-trap was the nearest and most ready way in which the gases could escape, since on opening and examining one of the "mason's traps" (that into which the waterclosets of No. 2 and 3 discharged), through which traps the gases after traversing a long length of pipe could otherwise only have escaped, I found the trap on the house side of partition *b* of the trap densely choked with excrement, through which the gases could only have passed to the house side of the dip stone under very great pressure. But there are grounds for believing also, that, however the case may have been for a time after a flow through the storm overflow, there were other times when the trap of the discharge pipe was dry. The grounds for this belief are fully entered in my note book. Leakage from the cesspit such as would bring the level of its contents below the level of the discharge pipe *a* would have the effect of causing the trap to be dry. That the cesspit was leaky and did leak some time in the early part of the year is unquestionable, although the date when it commenced to leak is not determinable. It was found to have leaked when the examination of it was made in July and repairs of the discharge pipe were made.

I myself made two examinations. The first was on September 3, when, the tunnel through the rock having been opened, I descended into it and saw a leak in the masonry of the cesspit through which two fingers could pass a little below the situation of the discharge pipe. Liquid matters were flowing out of this leak into the tunnel and into the rock. The second examination I made was on October 10, when, on again visiting Newquay, I found the cesspit open and cleaned out. On that occasion I descended into it and

noticed that at the sides towards the bottom very large patches of the cement with which the pit had been lined had fallen off, leaving the rough masonry exposed, and that in various places there were in the mortar between the slabs holes into which I could introduce my fingers, and through which sewage must have been able to pass with readiness. I quite believe that, for a long time prior to these examinations, the principal discharge of the contents of the cesspit had been through the various leaks and not through the discharge pipe and trap; and that probably the only occasions on which any liquids entered the siphon at all were when the hotel well was pumped out, or when sufficient rain fell to fill the cesspit to the level of the storm overflow.

I have already mentioned three points in which the Local Board had contravened the advice given them by the Board on May 17th, 1878. Here is a fourth point: they had not made the cesspit watertight. The work had been, as builders say, shamefully "scamped." I cannot here avoid calling to mind similar scamping of work done in respect of the drain connexions in the town which ought to have been supervised by the Surveyor of the Local Board so as to ensure their having been made properly.

But foul air also entered the houses. Probably in some instances and occasionally, as for example when strong winds from the north blew in at the mouth of the open pipe on the face of the cliff, sufficient pressure might have been exercised on the house traps (mason's traps) to have forced them. Mr. B. at No. 1 told me that on some occasions he had noticed the level of the water in his watercloset a good deal disturbed. But the main source of foul air entering the houses was from the "mason's traps." When I had the trap at Nos. 2 and 3 opened, and at the same time water run down from the closets, I found that it did not run easily through the trap, but accumulated on the house side of the dip-stone, and only ran away very slowly by percolation through the load of excrement collected within the trap. When the cover was *in situ*, therefore, foul air on the house side of the dip stone must have been displaced whenever water was run down the closets, and could only have escaped into the closets and through them into the houses within which the closets were situated. This must have been the case more or less in every watercloset of the houses at Tolcarne; there was but one doubtful exception in the waterclosets situated at *d*, at the hotel where, when the connexion of them with the drain outside was made, a 2-inch pipe was carried up to the eaves of the house from the house side of the dip stone of the "mason's trap." The significance of this source of foul air will appear presently.

2. *As to polluted water.*—Suspecting from a complaint he had heard that the water from the hotel well had, prior to the illness of the builder's apprentices, had a disagreeable odour and flavour, and suspecting further from other circumstances that the cases of fever that had then occurred might have been due to some pollution of this water, Mr. Boyle induced the Local Board to order an examination to be made of the drains in the vicinity of the well. This was done on July 15th, and the result in the words of the Medical Officer of Health's report was as follows:—"On uncovering the main drain, which is "8 feet from the surface and 6 feet from the well, the soil was found to "smell strongly of sewage matter; and on searching further, it was found "that the junction (joint?) of two private drain pipes leading from "houses Nos. 2 and 3, as marked on the plan, was defective, owing "either to a displacement of cement or an insufficient quantity having been "used. The soil around was saturated with sewage matter, and on a rush of "water having been sent through the pipe from the closet of either house, it "was distinctly seen to issue from the defective joint. From these facts," he adds, "I am of opinion that the well has been contaminated with sewage through percolation, &c." On July 25th he reported further that the well having been pumped out (this was done on the 18th) a large deposit of mud was found at its bottom, and also in the level leading to it. Up to August 9th, when Mr. Boyle again reported and advised that the well should be closed, it had not been cleansed, but it was cleansed subsequently. Writing to the Local Government Board on August 20th, Mr. Boyle said that the water had not been used subsequently for drinking or culinary purposes. The inhabitants of the houses who (with the exception of Mr. B.'s family at No. 1), had been

in the habit of drinking the well water, and the hotel, now obtained and used drinking water from the nearest town pump or from the wells at some neighbouring farms. There were two probable sources of this filthy pollution of the well. One has just been alluded to, namely, percolation from the soil sodden with sewage extravasated into it from a defective drain only about 10 feet off, that soil being a loose and flaky killas. The other source of pollution was, without doubt, the percolation through the killas of sewage which for a long time had been leaking out of the ill-constructed and leaky cesspool which the Local Board had made on the cliff at a distance of about 45 yards from the well. The sewage which leaked out certainly ran away into the killas and disappeared; and the dip of the stratification is southerly in the precise direction of the well and the level at the bottom of it.

Looking at the thing from a merely practical or administrative point of view, there was quite enough here in the foul air which the people at Tolcarne had to breathe, and the foul water which was supplied to them to drink, to account for the spread of enteric fever when once the infective principle or contagium of that disease had gained admission into the drains or into the well.

A consideration of the facts relating to each case and household invasion, which facts are fully detailed in my note book, has satisfied me that both the above-mentioned conditions were actually concerned in the spread of the fever. The conclusions to which these facts have led me are the following:— 1°. That the well-water at the hotel having become polluted by infiltration of sewage from the cesspit constructed by the Local Board, the first three cases that occurred at No. 2 arose from the drinking of that polluted water some time between May 10th and 20th. 2°. That subsequently the disease spread to other persons in this house and in No. 3 through the medium of foul and infected gaseous emanations rising from the "mason's trap" with which the watercloset soil pipes of these two houses were connected. 3°. That the two apprentice lads who worked at the unfinished houses obtained the infection they received, either by exposure to the foul air issuing out of the discharge pipe of the cesspit on the face of the cliff or from drinking the polluted well-water, probably from the former source. 4°. That the family at Seaward Villa, who as well as their visitors were water drinkers (total abstainers), received the infection from the use of the polluted well-water, which had in the meantime been additionally polluted from the leaky drain pipes discharging infected sewage into the neighbouring earth and rock from No. 2; but that one of the family (Ethel M.) might have got it from the foul and infected air rising through the closet from the "mason's trap," or more directly from exposure to the infection while attending on her sister Bessie. It is worthy of remark that the family occupying No. 1 and their lodgers, who did not use the hotel water for drinking purposes, appear altogether to have escaped invasion by the fever. On the other hand, it is remarkable that none of the family resident at the hotel were attacked with fever after the illness of Mrs. R., the hotel-keeper's wife, notwithstanding that the only water used for all purposes was the water from the hotel well. Nor, so far as I have been able to learn, had any of the visitors at the hotel been attacked, although of course it has been impracticable to ascertain this fact except in a small proportion of instances. As full an inquiry as I could make, however, satisfied me, first, that neither the family nor the servants at the hotel drank cold water unless quite exceptionally; and secondly, that cold water was habitually drunk by hotel visitors at their meal times in only a small proportion of the total number of them.

But with the knowledge of the etiology of enteric fever which we at present possess, something more than pollution of air and water with ordinary sewage filth is necessary to render the fouled air or fouled water effective in producing that disease. We look therefore for the source of specific infection of the contents of the cesspit from which infected foul air is believed to have issued, and from which infective matter is believed to have percolated into the hotel well. Assuming that Mr. Boyle has been correct in his diagnosis of Mrs. R.'s illness at the hotel in February and March, the infection of the cesspit is accounted for, and the ancestry of the contagium may perhaps be traced back to the case of enteric fever that occurred in January at the house of Mrs. H. It is no valid objection to this explanation that Mrs. R. did not have any diarrhœa. The excreta, even although not loose, would have been equally

capable of conveying infecting matter. But if he was not correct, we still have before us the possibility of the infection of the cesspit by the excreta of some casual visitor at the hotel who had used one of the hotel closets in April. Such a casual visitor would have most likely used the closet *d* in the hotel lavatory. This closet also has a "mason's trap," but from the first construction of this closet the trap has been ventilated by a 2-inch pipe issuing from the house side of the dip stone and terminating at the eaves of the hotel roof, and has at no time been offensive when used. Neither would it be a valid objection to say, in this case, that it is unlikely that a person suffering from enteric fever would visit an hotel casually, since it is well known that persons in the early stage of the disease, and sometimes in a stage which is not early, and even in a diarrhœal stage, may be quite capable of travelling. Subsequently when the leakage from the drains of Nos. 2 and 3 occurred, the matters that escaped from the drain which it is believed found their way from the saturated earth into the well unquestionably carried with them the specific contagium of enteric fever.

Other Cases of Fever in Newquay.

Two other cases of enteric fever have occurred in the village in 1879. They had, however, no traceable connexion with the Tolcarne cases. One was the case of a girl, Bessie H., aged 13, residing with her father, mother, two brothers, and a younger sister, (all but the last of whom had had fever on former occasions,) at Deer Park, on the western side of Commercial Square, and using drinking water from "Wetton's well," of which an analysis is given in the Appendix to this report (No. 1). She was first seen by Mr. Boyle on June 5th, had a sharp typical attack, and ultimately recovered. The other case was that of Jane B., aged 10 years. She was taken ill with vomiting on August 10th, and was first seen by Mr. Boyle on August 20th. She resided at 3, Beacon Terrace, the last row of houses at the western end of the village, with her father, mother, an elder sister, and an infant, two of whom, namely, the father and elder sister, had had fever on former occasions. She had a sharp typical illness, and ultimately died. Both these children went to school at the Board School, which was not closed for the summer holidays until August 22nd. Bessie H. had been regular in her attendance up to May 30th, but Jane B. had not been at school since July 16th, having been kept at home by the negligence of her parents, not because she felt ill. Bessie H. might have obtained her infection at school, inasmuch as all the drains of the girls' school-house, put in at the time of the sewering of the village, were found on subsequent examination to have been untrapped, and inasmuch as most offensive effluvia had for a long time been complained of as issuing from them. On the occurrence of any disease of a specific nature in the town, the specificity must have extended to the school drains. There was, indeed, a pretence at trapping made in respect of the girls' lavatory, but the trap, when Dr. Boyle examined it, was broken and ineffective, and must have been in this condition when it was first put in. No other girls attending the school, however, suffered from fever except Jane B., and she had not been at school between July 16th and August 10th, when she is said to have exhibited the first symptoms of the illness from which she died. The period elapsing between July 16th and August 10th was three and a half weeks, a period of incubation unusually protracted. If she did not get her fever at school, there were other opportunities for her getting it casually in such a place as Newquay, where no confidence can be placed in the perfection of the sewering or drainage arrangements.

Diphtheria in Newquay.

Mr. Boyle informs me that the five fatal cases of diphtheria entered upon the Mortality Table (p. 5) were not the only cases that occurred in his practice in Newquay. Two of the five fatal cases, which occurred in 1876, are interesting on account of their having been associated with the introduction of drain or cesspool air into the bedrooms in which the children slept. The circumstances were these. The Rev. Mr. E., the curate of Newquay, began on August 18th, 1874, to occupy a detached and almost new house at Mount Wise, the watercloset of which was drained into a covered and unventilated

cesspool in the garden. This house had been previously occupied for a short time by a family who Mr. Boyle informs me had been quite free from illness of any kind while residing there. In one of the bedrooms there was situated an open rain-water cistern, having an overflow or waste pipe which discharged itself into one of the drains connected with the cesspool. The only trap it had was a bell trap on the top of the pipe, which, when examined after the illness about to be mentioned, was found to be dry. From this pipe offensive smells had been noticed as proceeding for some time, and from the room they more or less pervaded the house. In the room where the cistern was situated one child slept alone; another child slept with a nurse in a different room. On January 2 the child who slept in the room containing the cistern was attacked with diphtheria and died. No one else in the house suffered. Subsequently, believing the house to be unwholesome, Mr. E. quitted it and took up his residence in the town. On the sewer being brought to Mount Wise by the Local Board a request was made by the agent to have the pipe sewer brought up near enough to allow of the house being drained into it, so that the dangerous cesspool drainage might be abolished; but the Local Board did not accede to the request, and the house has since then properly remained unoccupied. The other fatal case referred to occurred in the village in a good house, which was occupied by a family of whom eight children with the mother slept in a large attic room, beneath the floor of which was a rain-water cistern. The waste pipe of this cistern was trapped with a bell trap, similar to that at Mr. E.'s house, and it terminated in the soil pipe of the watercloset, which discharged into a drain that entered the tunnel of the new system of sewers. All the children who slept in this room had attacks of diphtheria of varying degrees of severity, and one of them died. On subsequent examination of the bell trap it was found to be dilapidated, dry, and quite ineffective to prevent the rise of foul air from the waste pipe and through the floor into the attic.

Sanitary Administration.

There is scarcely even a pretence of ordinary sanitary administration made by the Local Board of Newquay, assuming ordinary sanitary administration to mean the speedy and regular removal from the district of things which the law regards as nuisances, the enforcement of the Board's own sanitary byelaws, and the adoption of those means which the Legislature has enabled sanitary authorities to adopt for the prevention and arrest of spreading diseases.

The Medical Officer of Health, Mr. Boyle, was only appointed to the office he holds on June 29th, 1879, so that it is too early as yet to criticise the mode in which his duties, as defined by the Board's order, have been performed. He is appointed under the Order of the Local Government Board of the 11th November, 1872, and is paid a salary of 10*l.* per annum. Being the only medical practitioner in the district or neighbourhood, and also the Poor Law Medical Officer, he is cognisant of every serious case of sickness in his district, and of every death that occurs, independently of which, however, he receives regular returns of deaths from the Registrar.

The Surveyor of the Local Board is the same person who fills the office of Clerk; he is also collector of the rates. Prior to his appointment, he had neither had technical education as a surveyor nor any previous experience in such matters as road making, levelling, drainage works, or building. Yet the "surveyor" has most important duties, requiring special technical knowledge for their performance, implicitly laid upon him by the byelaws of the Local Board. His salary as surveyor is 4*l.* per annum.

The Inspector of Nuisances is an elderly man, who by business is a stonemason, and who is paid a salary of 10*l.* per annum, not being, of course, required to devote more than a portion of his time to the duties of his office. He is appointed, like the Medical Officer of Health, under the Order of the Board. He keeps a report book, but not a continuous record book, and he enters in the former such things as it pleases him to regard as nuisances, omitting many things which he does not regard as nuisances, but which are declared to be nuisances by the Public Health Act, or which ought to be dealt with as nuisances under the byelaws of the Local Board. For example, he had not reported the numerous instances of filthy pig-keeping which I met with,

nor yet the very numerous breaches of the Local Board's byelaws forbidding the improper retention and accumulations of refuse matters, nor yet the neglect of the byelaws as to slaughter-houses, nor yet the neglect of the owners of houses to provide proper privy accommodation, nor yet the unwholesome condition of some of the privies that have been provided. When I asked him if he had ever had occasion to take out a summons for neglect of abatement of nuisance, he replied in the negative, for that the notices given were invariably complied with. Neither in the Board's minute book, nor in the inspector's report book, is there any indication of orders for sanitary work having been given by the Local Board upon reports by their Inspector. The following entry on the Local Board's minutes on 25th July last, shows that the Local Board has become aware of what it ought to have discovered long ago: "Serious complaints having been made of the in-" adequate inspection of the town by the Inspector of Nuisances, the clerk " was requested to direct the Inspector of Nuisances to regularly inspect " the town by districts, and to furnish him with a plan for carrying out such " inspections."

And now I have to describe the proceedings of the Local Board in respect to the advice I gave them on the occasion of an interview I had with them, on the completion of my inspection, on September 11th. After explaining to the Local Board so much as at that time was ascertained as to the cause of the fever, I left with them in writing the following memorandum of advice:—

" Immediate action necessary to be taken for checking the spread of enteric fever now existent in the Newquay Urban Sanitary District:

a. At Tolcarne:

1. The existing cesspool to be carefully and completely emptied by pumping out its contents into the sea on the occurrence of the next spring tides (*i.e.* on or about September 16th) and at the time of high water, proper disinfectants being freely used during the progress of the work under the direct personal supervision of the Medical Officer of Health. After the pumping out, the interior walls and floor of the cesspit to be thoroughly cleansed and disinfected, then carefully examined for leaks, and all leaks properly repaired under the personal superintendence of the Surveyor. After this the whole floor and inner walls to be well covered with coal tar.

2. After the above emptying and disinfection, no excrement to be permitted to be discharged into the cesspit.

3. The bottom of the cesspit to be raised to the level of the discharge pipe, and a sufficient water-tight valve to be provided to retain the contents of the cesspit at the intervals between the several periods of its discharge.

4. The contents of the cesspit to be daily discharged into the sea at high water by an officer or workman of the Board.

5. The hotel and houses now discharging into the cesspit to be provided with earth-closets or privy pails, or other appropriate and wholesome kind of privy accommodation in lieu of water-closets. The Local Board should exercise its powers to provide appropriate earth for any earth-closets provided, and should itself undertake the removal and disposal of the earth that has been used, or of the contents of privy pails, or of any other kind of privy receptacle provided.

6. The "mason's traps" in the course of the drains of all the houses at Tolcarne should be emptied, with the use of disinfectants, and abolished, and in lieu of them proper siphon traps should be introduced.

7. The cesspit should be freely ventilated by means of a 6-inch pipe proceeding directly up from the top of the cesspit.

8. Each house drain to be effectually ventilated by means of a 4-inch pipe, rising to above the roofs of the houses.

b. At Tolcarne and elsewhere in the district where cases of fever exist or have recently existed.

1. Waterclosets and other inlets to the drains to be daily dosed with carbolic acid [the disinfectant I found in use] by an officer of the Board for so long a period as shall be considered proper by the Medical Officer of Health.

2. Directions to be given that all articles of clothing, bedding, &c. used by the sick shall be disinfected with such disinfectant as may be prescribed by the Medical Officer of Health before they are washed or transmitted from the houses for washing or any other purpose."

In giving this advice as respects the drainage arrangements at Tolcarne, I simply fell back upon the original advice given by the Board on May 17, 1878, but I took pains to explain that my advice had reference only to the existing emergency, and that the arrangement was only to be regarded as a temporary one. I said that it would be necessary to make other and more fitting permanent arrangements for the drainage of the houses built and about to be built at Tolcarne Head.

When I again visited Newquay on October 10, I learned that the cesspit was not emptied until the night of Sunday, September 23 (a period of neap tides), and that it was not pumped out, but that the contents were baled out

by three men employed by the Local Board for the purpose, contrary to a second explicit warning given by the Medical Officer of Health. This work lasted all night and created a great nuisance to the neighbourhood. The sewage fell upon the sand at the foot of the cliff, and there soaked into it, and the stain was visible on October 10. Carbolic acid was, however, freely used during the process. Alterations and amendments of the cesspit were in progress, but the Board had preferred driving a new tunnel into the bottom of the cesspit to lessening its depth. The abolition of the "mason's" traps and the ventilation of the house drains had not yet been carried out. While the alterations and amendments of the cesspit were going on, the occupiers of the houses, not having had put before them sufficient reasons for disusing their waterclosets, refused to comply with some peremptory demands of the Local Board to substitute earthclosets. Since, therefore, the waterclosets discharging excrement through the drains into the Local Board's cesspit are still in use, it is clear that such imperfect action with regard to the disposal of the sewage as the Local Board is taking will leave the houses exposed at any time to the danger of a fresh outbreak of disease.

The Local Board has not made public provision of hospital accommodation for cases of infectious disease, nor yet public provision for the disinfection of infected articles; nor is there any public mortuary.

EDWARD BALLARD.

Recommendations.

1. The Local Board's minutes should in future be recorded in such a manner as to afford full particulars of its proceedings in respect of the various sanitary matters it may deal with, and in accordance with section 199 and Schedule I. of the Public Health Act, 1875.
2. The ordinary day-by-day sanitary administration of the district in all that concerns the ascertaining and removal of nuisances should be greatly improved. The Local Board should not only direct the Inspector of Nuisances to carry out all the duties, without exception, laid upon him by the Order of the Local Government Board (of which Order the inspector should be provided with a copy), but take care, by exercising due and constant supervision, that these duties are all strictly performed.
3. Especially the Local Board should see that, in accordance with sections 35 and 36 of the Public Health Act, every house in its district is provided with a sufficient watercloset, earthcloset, or privy and an ashpit, and in accordance with section 40, that such as are provided shall be kept so as not to be a nuisance or injurious to health.
4. It should see that its own byelaws relating to the deposit of refuse matters, the keeping of pigs and other animals, and as to slaughter houses are observed, so that the chance of any of these things becoming a nuisance may be avoided.
5. As respects dust, ashes, refuse matters, and other kinds of domestic rubbish, and as respects excrement collected in privies, it is desirable that the Local Board should itself undertake their removal by their own officers, or by a contractor, at regular and short intervals.
6. The sewering and drainage arrangements will require very careful watching and regular attention in order to discover as early as possible any defects in them, and to prevent their becoming a means of extending disease. Having provided sewers, and having permitted and encouraged the discharge of excrement into them, the Local Board is bound to provide further that this excrement shall not become a source of mischief, but shall swiftly be carried through the sewers and discharged out of them while in a fresh condition. Until the panned privies (so called "waterclosets") shall be all supplied with water, the Local Board itself should see that the drains connected with them are in some other way duly flushed, and, under the advice of a skilled engineer, should make provision for the systematic and periodical flush-

ing of the sewers of the town with water. The old square roadside drains, now thrown out of use, should be broken up and destroyed. The system of sewers should be extended to new buildings as they are erected in extension of the village, or as such sewers are required for the due prevention of disease in the district.

7. In particular, the sewering of the group of houses erected and in course of erection at Tolcarne Head should receive the earnest and best consideration of the Local Board, holding in view its very serious responsibilities under the circumstances detailed in this Report. The Local Board is bound to make provision to carry away the sewage, part of which is excremental matter, in such a way as to obviate the chance of its becoming again a source of disease among the population of the place, and to dispose of it in such a way as not to create a nuisance. It is therefore recommended that the cesspit in use, which, so long as it may be used as a receptacle for excrement from the houses draining into it, will continue to be a source of danger to the wholesomeness of the water in the hotel well, be speedily abolished, and that the sewage be carried by well-constructed drains and sewers from the several premises at Tolcarne Head, either into the system of sewers already provided for the sewering of Newquay, or to an outfall in the Tolcarne Valley, where the sewage shall be disposed of for irrigation purposes, or otherwise dealt with so as not to create nuisance; the arrangements being in any case made and carried out under the advice and superintendence of a skilled engineer.
8. The person who fills the office of surveyor should have knowledge and experience qualifying him to advise the Local Board upon matters relating to sewers, drains, and buildings, and as to other technical matters which under Statute or local byelaws form the subjects with which a local surveyor has to deal.
9. The Local Board should take the earliest opportunity to provide for their district a good supply of wholesome water from some source at a distance from the village, unless such a supply is provided by a company. In the meantime it should, with the assistance of the Medical Officer of Health, exercise a strict supervision over the wholesomeness of the existing well-water supplies, and in respect of them, as occasion may arise, exercise the power conferred by section 70 of the Public Health Act, 1875. In particular it should see that a sufficient and wholesome supply of water is at once provided for the group of houses at Tolcarne Head.
10. The Local Board should exercise its powers under the Sale of Food and Drugs Acts, especially as respects the adulteration of milk, and this particularly during the visitors' season, when the practice of adulteration is most flagrant.
11. The Local Board should exercise the powers conferred upon it by Section 131 of the Public Health Act, 1875, to provide due hospital accommodation for the isolation of persons sick with infectious diseases, and should cause to be removed thereto any such sick person as the Board is empowered to remove thereto by section 124 of that Act. The Local Board should also provide, under section 141 of the same Act, a mortuary, and also under section 122 public means of disinfecting infected articles. It should also generally exercise the powers conferred by section 120 and following sections for preventing the spread of infectious diseases.

APPENDIX A.

Report on Three Samples of Water received from Dr. Ballard, September 13th, 1879.

Samples contained in two Winchester quart bottles each: bottles stopped and stoppers tied over and secured by seal, seals unbroken. The bottles labelled—

No. I. "Wetton's Well, Newquay, September 12th, 1879."
No. II. "Town Pump, Newquay, September 12th, 1879."
No. III. "Hotel Pump, Tolcarne, September 12th, 1879."

No. I. is slightly turbid; Nos. II. and III. are clear. On standing, all three yield a trace of deposit, which is entirely mineral in the case of Nos. I. and II., but contains a number animalculæ and algæ in the case of No. III. All three are almost colourless, tasteless, and inodorous. They contain much chlorine, more particularly Nos. I. and III., probably due to infiltration of sea water. Nos. I. and II. contain much nitric acid, proving that the soil through which the waters pass must, at some time at least, have been strongly impregnated with sewage. Judging, however, from the minute amount of ammonia present, the very small proportion of albuminoid ammonia yielded, and the remarkably small amount of oxygen absorbed from permanganate, this contamination is not of recent origin, and at present the waters are perfectly wholesome. If however there are any sources of sewage contamination near, at the present time, the waters may not always be as good as they are now, since under less favourable conditions, unoxidized sewage matters might find their way into the wells. No. III. is not quite so satisfactory. The deposit it yields contains a variety of animal and vegetable forms, it absorbs more oxygen from permanganate, and contains more phosphoric acid than Nos. I. and II. The residue it leaves on evaporation is yellowish brown and blackens perceptibly on heating, whereas the residues from Nos. I. and II. are white and do not blacken. The sewage, or other contamination, though but slight, is thus somewhat more recent and therefore more injurious. Lastly, No. III. contains a small trace of lead, which in itself renders the water unfit for drinking. This last impurity could, however, no doubt be got rid of by preventing all contact of the water with lead.

The analytical details are given in the table annexed.

——	No. I.	No. II.	No. III.
Appearance	Very slightly turbid	Clear	Clear
Colour	Nearly colourless	Nearly colourless	Very pale yellowish
Taste	Tasteless	Tasteless	Tasteless
Smell	Inodorous	Inodorous	Inodorous
Deposit	Trace	Minute trace	Minute trace
Nitrous acid	None	None	None
Phosphoric acid	Slight trace	Minute trace	Trace
Metallic impurities	None	None	Slight trace of lead
Hardness before boiling	28·5 degrees	21·5 degrees	9·5 degrees
Hardness after boiling	15·0 „	6·0 „	8·5 „
Oxygen absorbed from permanganate	Grains per gallon 0·0070	Grains per gallon 0·0035	Grains per gallon 0·0105
Total dry residue	54·60	34·30	33·32
consisting of—			
Volatile matters	8·96	3·08	2·94
Fixed salts	45·64	31·22	30·38
Chlorine	10·93	5·22	11·18
Nitric acid	5·29	2·10	0·67
Ammonia	0·0000	0·0005	0·0005
Albuminoid ammonia	0·0031	0·0017	0·0028

A. Dupré.

Westminster Hospital, September 22, 1879.

APPENDIX B.

DIRECTION and FORCE of the WIND at NEWQUAY, CORNWALL, 1879, from REGISTER kept by Mr. W. E. MICHELL, F.R.A.S. (Chairman of the Local Board).

January	1	SE	5	February	1	SE	6	March	1	N	3	April	1	N	2
,,	2	SSE	4	,,	2	SW	3	,,	2	Var.	3	,,	2	NE	3
,,	3	W	4	,,	3	Var.	2	,,	3	,,	3	,,	3	N	3
,,	4	NNE	4	,,	4	,,	2	,,	4	W	5	,,	4	Var.	2
,,	5	SE	4	,,	5	SW	5	,,	5	SW	6	,,	5	Westerly	5
,,	6	S	5	,,	6	W	6	,,	6	NE	3	,,	6	W	5
,,	7	SE	7	,,	7	W	8	,,	7	Var	2	,,	7	NW	3
,,	8	ESE	8	,,	8	WSW	6	,,	8	SSE	5	,,	8	WNW	4
,,	9	Easterly	5	,,	9	S	4	,,	9	Var.	2	,,	9	N	2
,,	10	SE	7	,,	10	W	5	,,	10	,,	3	,,	10	NE	4
,,	11	E	4	,,	11	Southerly	4	,,	11	,,	3	,,	11	ENE	5
,,	12	S	3	,,	12	Var.	2	,,	12	Westerly	5	,,	12	Var	4
,,	13	Westerly	3	,,	13	SSW	5	,,	13	SSE	4	,,	13	NE	5
,,	14	SW	4	,,	14	Var.	2	,,	14	Var.	3	,,	14	ENE	7
,,	15	NW	3	,,	15	WSW	4	,,	15	W	5	,,	15	NE	5
,,	16	Easterly	6	,,	16	Westerly	4	,,	16	W	5	,,	16	N	5
,,	17	SSE	5	,,	17	NW	5	,,	17	WSW	5	,,	17	N	4
,,	18	NW	3	,,	18	NW	5	,,	18	SSW	3	,,	18	SE	4
,,	19	SSE	6	,,	19	SW	5	,,	19	Var.	1	,,	19	SE	8
,,	20	SSE	6	,,	20	NW	6	,,	20	NE	4	,,	20	NW	4
,,	21	ESE	5	,,	21	W	4	,,	21	NE	5	,,	21	NW	4
,,	22	E	4	,,	22	N	3	,,	22	NE	5	,,	22	SW	2
,,	23	E	4	,,	23	NNE	5	,,	23	ENE	5	,,	23	NW	5
,,	24	E	4	,,	24	Var.	1	,,	24	E	3	,,	24	NW	4
,,	25	ENE	4	,,	25	NE	5	,,	25	SE	4	,,	25	Westerly	5
,,	26	SE	2	,,	26	NE	4	,,	26	ESE	7	,,	26	WSW	5
,,	27	NE	3	,,	27	NW	2	,,	27	NE	5	,,	27	NE	5
,,	28	ENE	3	,,	28	NE	5	,,	28	Var.	6	,,	28	NE	5
,,	29	E	4					,,	29	WNW	5	,,	29	NE	2
,,	30	SE	4					,,	30	WSW	4	,,	30	NW	3
,,	31	SE	5					,,	31	W	4				

May	1	NE	5	June	1	W	3	July	1	Westerly	6	August	1	N	3
,,	2	NE	5	,,	2	S	3	,,	2	W	5	,,	2	E	5
,,	3	NE	3	,,	3	NW	4	,,	3	NW	5	,,	3	WSW	4
,,	4	N	3	,,	4	WNW	3	,,	4	NW	5	,,	4	W	4
,,	5	NE	3	,,	5	SE	5	,,	5	NW	4	,,	5	Var.	4
,,	6	N	6	,,	6	SSE	3	,,	6	W	5	,,	6	WNW	5
,,	7	NNE	7	,,	7	SSE	4	,,	7	W	5	,,	7	Westerly	4
,,	8	N	6	,,	8	SSW	3	,,	8	WSW	7	,,	8	NW	3
,,	9	N	6	,,	9	W	4	,,	9	WNW	6	,,	9	Var.	1
,,	10	NNE	5	,,	10	ESE	3	,,	10	NNW	4	,,	10	,,	2
,,	11	WNW	4	,,	11	SW	5	,,	11	Var.	4	,,	11	,,	4
,,	12	WSW	4	,,	12	W	4	,,	12	Southerly	4	,,	12	SSE	6
,,	13	WSW	3	,,	13	WNW	3	,,	13	NW	4	,,	13	WSW	3
,,	14	N	4	,,	14	W	3	,,	14	NNW	4	,,	14	N	3
,,	15	NW	5	,,	15	W	4	,,	15	NW	3	,,	15	Var.	4
,,	16	WNW	5	,,	16	NW	3	,,	16	SSE	5	,,	16	NW	6
,,	17	SSW	7	,,	17	NW	5	,,	17	Var.	2	,,	17	NW	5
,,	18	N	6	,,	18	Northerly	3	,,	18	NW	1	,,	18	Var.	2
,,	19	NNW	4	,,	19	SW	5	,,	19	SW	3	,,	19	,,	4
,,	20	W	4	,,	20	W	5	,,	20	WNW	7	,,	20	W	4
,,	21	WSW	3	,,	21	W	9	,,	21	NW	6	,,	21	SW	4
,,	22	SW	5	,,	22	W	4	,,	22	NW	5	,,	22	W	6
,,	23	NNW	6	,,	23	SW	5	,,	23	NW	3	,,	23	NE	4
,,	24	WNW	5	,,	24	W	4	,,	24	NW	4	,,	24	WNW	4
,,	25	N	5	,,	25	WNW	4	,,	25	WNW	3	,,	25	WSW	6
,,	26	W	4	,,	26	W	5	,,	26	SSW	4	,,	26	WSW	6
,,	27	NNE	5	,,	27	SW	7	,,	27	W	4	,,	27	W	8
,,	28	SE	7	,,	28	WSW	6	,,	28	Var.	3	,,	28	WSW	7
,,	29	SSE	4	,,	29	W	5	,,	29	,,	3	,,	29	W	5
,,	30	S	5	,,	30	SW	4	,,	30	NNW	3	,,	30	W	4
,,	31	NW	3					,,	31	SW	4	,,	31	NW	3

APPENDIX C.

RAINFALL at NEWQUAY during EIGHT MONTHS of 1879, from the REGISTER kept by MR. TREDIDGO.

—	January.	February.	March.	April.	May.	June.	July.	August.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1	·68	·45	—	—	—	·10	·08	·20
2	·58	—	—	—	—	·45	·15	·80
3	·40	·12	—	·06	—	·05	·04	—
4	—	—	·06	·05	—	·15	·04	—
5	—	·30	—	·15	—	—	—	·65
6	·40	·55	—	·20	—	·40	·30	·06
7	·45	·10	—	·15	—	·15	—	—
8	—	·40	—	—	·05	·12	·10	·04
9	—	·30	—	—	—	—	—	·03
10	—	·45	·20	—	—	·10	—	·25
11	—	·04	—	—	—	·20	·04	—
12	·05	·30	—	·10	·20	.06	·16	—
13	·30	·30	—	·25	—	·15	·10	—
14	·10	—	·18	·10	—	·30	·06	—
15	·50	·15	·06	—	—	1·10	·04	·20
16	—	·15	·08	—	·25	·40	·25	·70
17	·45	·04	—	—	·25	—	—	—
18	—	·10	—	—	—	—	—	—
19	—	·06	—	·48	·03	·10	60	·58
20	·06	·08	—	·08	·04	·08	—	·25
21	—	·20	—	·18	—	—	—	·30
22	—	—	—	·10	·06	—	—	·06
23	—	—	—	·05	·06	·10	·06	—
24	—	—	·10	·08	·10	—	—	·16
25	—	·03	·03	—	·06	—	—	·05
26	—	·10	—	—	—	·10	—	·25
27	—	—	—	—	·30	·05	—	·30
28	—	—	·02	—	—	·06	—	·02
29	—	—	·18	—	·08	·30	·06	—
30	—	—	·08	—	—	1·0	·20	—
31	·80	—	·05		·06		·20	—

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