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**Mr. W. H. Power's Report to the Local Government Board  
on an outbreak of Diphtheria at the Village of  
Bleadon, in the Axbridge Rural Sanitary District.**

GEORGE BUCHANAN,  
Assistant Medical Officer,  
May 5, 1879.

IN the Return of the Registrar General for the fourth quarter of 1878, fifteen deaths from diphtheria are reported as having occurred in the Burnham sub-district of the Axbridge Union. All these deaths, it is stated in a foot note, occurred in the parish of Bleadon; and all, except one, were registered as malignant sore throat. The data thus furnished gave occasion for the present inquiry.

On my arrival in the district it soon became evident that the disease in question had been genuine diphtheria. Not only was the clinical history of fatal cases precisely that of diphtheria, but many persons at the time of my visit convalescent from throat illness exhibited various neuroses characteristic of the specific disease. As is not uncommon with epidemic diphtheria the present outbreak comprised cases of all degrees of severity, varying from what under other circumstances might have been regarded as trivial sore throat to diphtheria in its worst and most rapidly-fatal form. Altogether inquiry at Bleadon has extended to 24 invaded households, including 68 cases. All of these cases (except two in a family at the hamlet of Shiplate) occurred between early October 1878 and mid-March of the present year in one village, Bleadon, which has (as ascertained by inquiry) in 102 houses a population of 411 persons. Thus, in this village, one in five of the households, and one in six of the population, have in less than six months been invaded by diphtheria. The deaths from the disease, 17 in number, have in the same period amounted to one in every six of the households, and one in every 23 of the population.

*The village of Bleadon* is situated at the base, and on the southern slopes, of a limestone range (Bleadon hills), which on the northern bank of the river Axe, near to its estuary, rises abruptly from an alluvial plain (Burnham Level). The village, somewhat scattered along two roads, crossing one another at right angles about its centre, extends from east to west upwards of a mile, and from north to south about half that distance.

*The Dwellings*, though perhaps one half of them are little if at all above the level of the alluvial plain, are for the most part situate on the rock. Except a few farmhouses, the rectory, inn, &c., dwellings are of the cottage class. They are built of stone, with thatched or tiled roofs. Many are old, small, and dilapidated. Frequently old dwellings do not possess back windows, or such windows as they have are not made to open. Several of these old and tumbledown cottages have been closed. Most cottages have gardens, often of considerable size.

*Water Supply.*—This is almost wholly from wells, which probably all get their supply from the same water stratum, the depth of the well varying with its elevation above marsh level. In the centre of the village, and on the roads leading north and east of it, wells are deep and scarce, and most persons resort (many of them very long distances) to the parish well,—a draw well some fifteen feet deep situated within some 30 yards of the churchyard, below it and directly in its line of natural drainage to the marsh. South and west of the village on low land bordering on the marsh wells are numerous, and most dwellings have their own. Commonly, these wells are dip or draw wells, a few only being fitted with pumps. Of the 102 households in the village between 30 and 40 resort for water to the parish well, while the remainder are supplied from their own or from neighbours' wells. A few only admit obtaining water from the marsh dykes.



*Drainage.*—Except road drains, constructed of rubble, but here and there supplemented by earthenware pipes, there is no drainage. The road drains, besides carrying off to the marsh dykes storm water receive (when accessible for the purpose) slop and other liquid refuse. Mainly, however, slop as well as solid refuse is got rid of in the gardens.

*Excrement removal* is almost wholly by pit privies. These are situated in the gardens, and though as a rule at a distance from the dwelling are many of them placed at a level above it. Commonly, they are very rude, often they are tumbledown structures; their pits, which are usually mere excavations beneath or in the rear of the privy, can scarcely be in any sense water-tight. Upon the lower ground of the village bordering the marsh where privies and surface wells often exist near together in gardens, privy-pits of the above sort must be regarded as seriously dangerous to well water. Nominally, privies are emptied as required by the occupiers, and their contents applied to gardens. Many that I saw, however, were overfull or otherwise in a foul state.

*Animals.*—Pig-keeping is common among the cottagers, and the sties are erected in the gardens. Most sties at the time of my visit were untenanted, and I did not observe any special nuisance arising from pig-keeping.

#### I.—MAIN FACTS OF THE DIPHTHERIA OUTBREAK.

I do not propose to discuss in detail all the evidence which somewhat exact inquiry in various directions has accumulated. It will be enough that I should state the main facts of the outbreak, and afterwards refer briefly to some possible causes of it which seem to deserve notice.

1. *As to Incidence of the Diphtheria as regards Time.*—This is shown in the following Table, which between October 5th 1878 and March 22nd 1879, deals with a period of 24 weeks. Up to October 10th, the date of attack of the first sufferer by the outbreak, diphtheria had not, it would seem, occurred for many years in Bleadon:—

TABLE I.

Week ending.	Households Newly Invaded.	Fresh Cases.	Deaths.	Week ending.	Households Newly Invaded.	Fresh Cases.	Deaths.
October 12th -	3	3	-	January 4th -	-	-	-
" 19th -	-	1	1	" 11th -	1	4	-
" 26th -	*5	9	3	" 18th -	-	-	-
November 2nd -	5	11	3	" 25th -	-	1	-
" 9th -	3	10	1	February 1st -	-	-	-
" 16th -	2	11	3	" 8th -	-	1	-
" 23rd -	-	3	1	" 15th -	-	-	-
" 30th -	1	3	1	" 22nd -	1	2	-
December 7th -	1	2	2	March 1st -	-	-	-
" 14th -	-	3	-	" 8th -	-	-	-
" 21st -	-	-	-	" 15th -	2	3	-
" 28th -	-	1	-	" 22nd -	-	-	2
Total 12 weeks -	20	57	15	Total 12 weeks -	4	11	2

\* This number includes the household invaded at Shipplate.

2. *As to Incidence of the Diphtheria as regards Place.*—A brief statement of the position of households invaded early in the outbreak will suffice to show that the disease was not confined to any particular part of the village. In the week ending October 12th, the three households invaded were all situated in the main village, within a radius of 100 yards. In the week ending October 26th, the five households invaded were situated one near the centre of the village; two, some 200-300 yards to the south of it on the Lympsham Road; one a quarter of a mile westward on the Weston Road; and one at Shipplate, nearly a mile distant on the east. In the week ending November 2nd, the five households invaded were situated, three not far from the centre of the village; one a quarter of a mile south of it on the Lympsham Road, and one half a mile westward at Purn. In the week ending November 9th, the three households invaded were situated, one a quarter of a mile south of the centre



of the village on the Lympham Road, and two in an isolated dwelling on the top of a hill above a quarry.

3. *As to Incidence of the Diphtheria as regards Age.*—Of the 68 persons attacked in the parish none were under 3 years of age; 43 (63 per cent.) were between 3 and 15 years; and 25 (36 per cent.) were over 15 years. Of persons living in the village, 26 were under 3 years of age and were not attacked; 140 were between 3 years and 15 years, and 30 per cent. were attacked; while 245 were over 15 years, and 9 per cent. were attacked. The deaths were, at ages 3-15 years, fourteen, or 10·0 per cent. of persons living at that age; at ages above 15 years the deaths were three, or 1·2 per cent. of the population at such ages.

## II.—AS TO CERTAIN POSSIBLE CAUSES OF THE OUTBREAK.

1. *As to personal Infection from antecedent Diphtheria or Throat Illness.*—In this connexion the first sufferers of each of the 24 households invaded are mainly important. Of these 24 persons, six were over, and 18 were under 15 years of age. In four out of the six adults communication with previously infected households or persons is known to have occurred; in two no opportunity of human infection could be ascertained. As regards the 18 children, four were ascertained to have entered infected dwellings or to have played with other children who had recently suffered from throat illness; while, in regard of the remaining 14 no opportunity of infection from any antecedent case could be learned.

2. *As to Influence of School Attendance.*—Two schools exist in the village, the National day school with its attached Sunday-school, and the Chapel Sunday-school. At the date of the outbreak the National School had a daily attendance of nearly 100 children, and the Sunday-schools together weekly about an equal number. Thus, so long as the schools remained open, most of the village children at school-going ages had such opportunity as may have existed at school of becoming infected there. The schools, however, were on the outbreak of the disease very promptly closed; the Church schools on October 21st, and the Chapel Sunday-school on October 27th. All remained closed till near the end of December. Assigning, as has heretofore been done, one week as the probable limit of the incubation period of diphtheria contracted at school, the following Tables (II. and III.) afford a measure in some sort of the influence of schools in inducing attack by diphtheria of children under 15 years, and in bringing about the invasion of separate households.

TABLE II.

CHILDREN under 15 years ATTACKED week by week by DIPHTHERIA in BLEADON from early October to Mid-December.

Schools influence possibly operative.				Inter- mediate.	School influence not operative.					
Weeks ending.	Oct. 12th.	Oct. 19th.	Oct. 26th.	Nov. 2nd.	Nov. 9th.	Nov. 16th.	Nov. 23rd.	Nov. 30th.	Dec. 7th.	Dec. 14th.
Number attacked in week.	3	1	5	7	4	9	1	2	1	2
Of whom attended school during week antecedent to attack.	3	-	3	2	-	-	-	-	-	-
Of whom did not attend school within such period.	-	1	2	5	4	9	1	2	1	2



TABLE III.

FIRST ATTACK (invasion) of HOUSEHOLDS in BLEADON week by week from early October to Mid-December.

School influence possibly operative.				Inter- mediate.	School influence not operative.					
Weeks ending.	Oct. 12th.	Oct. 19th.	Oct. 26th.	Nov. 2nd.	Nov. 9th.	Nov. 16th.	Nov. 23rd.	Nov. 30th.	Dec. 7th.	Dec. 14th.
Total households invaded each week.	3	-	5	5	3	2	-	1	1	-
In which first sufferer attended school.	3	-	1	2	-	-	-	-	-	-
In which first sufferer did not attend school.	-	-	*4	3	3	2	-	1	1	-

\* Includes the first sufferer in the household invaded at Shiplate.

It will be observed from the above tables that up to November 2nd, a period during which alone school influence can have been operative in Bleadon, the incidence of diphtheria on children under 15 years *attending* school and *not attending* school is identical in amount; and further that as regards *first attacks* in households up to the same date, persons *not attending* school suffered even in excess of those *attending* school. Schools then cannot have had any appreciable influence in spreading the diphtheria. This conclusion derives support from the behaviour of the diphtheria after the reopening of schools. The National School was reopened to children who had escaped diphtheria on December 30th, and to children recovered from diphtheria on January 20th. No household however (except one where the attack was in the person of an adult) which had hitherto escaped, became invaded after the reopening until February 18th, and after that date none other until March 13th.

3. *As to Insanitary Circumstances.*—Locally an idea was entertained that a foul condition of the closets (two) at the National School had had to do with the diphtheria. The nuisances in question arose from faulty construction of the closets, or rather privies. These had many years ago been each furnished with a 3-inch overflow pipe connecting the space beneath the privy seat with a cesspool in a neighbouring garden; while for flushing purposes rain-spouts from the roof of the school and from that of the schoolmaster's house (against which the closets are built) had been made to discharge into the privies. As might have been anticipated, the 3-inch overflow pipes became frequently, especially in time of drought, choked, and the flushing when it subsequently occurred had the effect of churning up the privy contents, and of washing them through the interstices of the privy-pit into the ground about the privies as well as beneath the foundations of the schoolmaster's house, which with the privies is at a lower level than the school itself. So far as I can learn no sort of foul smell hence arising has been detected within the school, though one room at least in the master's house has from this cause been rendered from time to time untenable. Assuming potency for production of diphtheria from such nuisance, the data I have already given respecting school attendance and diphtheria seem to exclude its having in fact brought about the disease; unless indeed diphtheria thus arising (if it can so arise) has an incubation period greatly different from that with which we are acquainted. The school privies have since the outbreak been reconstructed, and are said now to fulfil their purpose without creating nuisance.

Another locally suggested cause of the outbreak is the parish well. This draw-well is, as has been said, unfortunately placed as regards the church yard. Further at the time of the outbreak a slop drain in relation with it was out of repair, and doubtless allowed of soakage back into the well of refuse water cast into it. Notwithstanding that analysis (by the county



analyst) dated November 9th, 1878, pronounced a single sample of this water free from contamination of sewage, it may be questioned whether this well can be trusted to afford a uniformly safe supply. However this may be, there is no evidence that this parish well has had to do with the production of diphtheria. Of households in the village resorting to it for water 9 or 24 per cent. were invaded; while of households obtaining water from other and very various sources, 14 or 23 per cent. were invaded.

4. *As to Diseases of Animals.*—Inquiry in the district as to diseases of animals, proved negative except in one instance. Lambs at a farm at Shiplate, in Bleadon parish, suffered toward the end of September, and subsequently, from a disease which up to that date does not appear to have been known in the neighbourhood, and to which the authorities of the Royal Veterinary College in London (who had both dead and living specimens furnished them) do not seem to have understood. The flock of lambs in question, some 60 or 70 in number, were well nigh all attacked, and upwards of 30 died. Most of the animals that died were buried; but a few were begged of the farmer by persons residing at Bleadon, ostensibly for the purpose of feeding their pigs. None were, it is said, sold. Proceeding to inquire as to any possible relation of such disease to diphtheria in the human subject, no evidence (after a lapse of five months) was forthcoming to associate this disease of lambs directly or indirectly with the human malady. I could not ascertain that any of the flesh of these lambs had been consumed in Bleadon; nor, was there any suggestion of a common cause operating alike on lambs at Shiplate and on persons at Bleadon, producing in the one "lamb disease," and in the other diphtheria. It may be noted, however, though not perhaps as having any special significance, that the lamb disease existed in its greatest intensity coincidently with the major outbreak of diphtheria; that the farmer's family suffered (the only one so suffering at Shiplate) early in the outbreak from throat illness of the nature of diphtheria; and that the first sufferer from diphtheria in Bleadon village was sister to a servant at this Shiplate farmhouse.

5. *As to Milk.*—Inquiry was made as to various articles of food as possible agents in propagation of the diphtheria. With the exception of milk none afforded any suggestion of such relation. With regard to milk it was found that though as an article of diet it is not universally in use at Bleadon, all of the households invaded took milk at least once weekly; most of them had it daily. The milk-supply of the place seems to have been both complex and variable. Some dozen persons keep their own cows, mainly perhaps for butter and cheese making, but also for the milk-supply of their own families, and as well for the habitual or occasional supply of a few neighbouring families. In addition there are in the village two milk retailers who supply more or less regularly some 50 of the households. Neither of these retailers (to whom I shall presently refer as No. 1 and No. 2) keep cows of their own, but instead they *rent* cows (few or many, according to season of the year and yield of milk) from one or more farmers in the parish. At the time of the outbreak the 24 households invaded seemed to have obtained milk as follows: 14 from retailer No. 1; 4 from retailer No. 2; and 6 from their own or from neighbours cows.

On the best inquiry that could be made five months after date it appeared that there was no relation worth a moment's consideration between milk and the incidence of the diphtheria epidemic, *regarded as a whole*. Thus, of the 60 households of the village comprising children among their inmates, presumably the households most susceptible of diphtheria—

36	were supplied by retailer No. 1, and 13 or 36 per cent. were invaded.
8	" " " " 2, " 3 " 37 "
13	" " their own or by neighbours' cows, 4 or 30 "
3	had no milk at all, and none "

On the other hand, when examination was made of the milk supply of those households which *suffered earliest* in the outbreak, it was noticed that of 16 households invaded up to November 9th, no less than 13 (81 per cent.)



obtained milk (some of them occasionally but most of them regularly) from retailer No. 1. This circumstance seemed at least suspicious and led me to attempt somewhat minute inquiry on the milk question. I found, however, in the lapse of time since the occurrence of the outbreak an insuperable obstacle to my obtaining such exact knowledge of a variety of circumstances as was necessary for the due consideration of the subject, and further inquiry in this direction had to be abandoned.

I have to confess, therefore, my inability to assign a cause for the extensive and intense prevalence of diphtheria in this village.

Having regard to the apparent absence in Bleadon of relation between insanitary circumstances and the diphtheria, I have not deemed it necessary to do more than refer briefly to the sanitary shortcomings of the place. But I think the attention of the sanitary authority should be directed to such parts of my report as deal with these matters. Especially should attention be given to the want of proper water supply in certain parts of the village; to the risk of dangerous pollution of the parish and other wells; and to the need that exists for a better and safer method of dealing with excrement.

W. H. POWER.

30th April 1879.

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