**Mr. W. H. Power's report to the local government board on diphtheria at Hern Hill, in the Faversham rural sanitary district ; on the sanitary state of that district ; and on administration by the rural sanitary district.**

# Mr. W. H. Power's Report to the Local Government Board on Diphtheria at Hern Hill, in the Faversham Rural Sanitary District; on the Sanitary State of that District; and on administration by the Rural Sanitary Authority.

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The diphtheria which was the occasion of this inquiry occurred during the autumn and winter 1878–79 in the parish of Hern Hill, where it especially affected Staple Street. In this hamlet which comprises some 30 dwellings, there occurred in the space of a few weeks about 15 cases of diphtheria with 3 deaths. Investigation of this Staple Street diphtheria by the Medical Officer of Health for that portion of the Faversham Rural Sanitary District, suggested that the use of water from certain wells in the place had brought about the disease. Accordingly analysis was made by order of the Sanitary Authority of a series of samples of the well waters with the result of showing that chemically speaking, all wells but one in Staple Street yielded water that was unsafe, or but doubtfully safe, for drinking purposes. Hereupon action, which mainly consisted in cleansing, repair, or deepening of the wells themselves, was taken for improvement of the water supply of the place, and further analysis of the waters was then ordered. This, when it had been made, showed but little improvement in the quality of the water, and opinion gained ground that a source of well pollution existed in a deep stratum whence the water of these wells was believed to be derived. At this stage of affairs the Sanitary Authority, which since an early period of the injury had apparently dispensed with medical advice on the subject, decided to defer further action, and for the time being to resign an expressed intention of compelling closure of certain of these Staple Street wells. The difficulty that had arisen having been represented to this Board, I was instructed in November 1879 to investigate the circumstances under which the diphtheria had occurred, and to include in my inquiry observation on the sanitary state and on the administration of the Rural District.

### *Diphtheria and Throat Illness.*

Upon arriving in the district I found that before the invasion of Staple Street by diphtheria, throat illness had been generally prevalent among children in Hern Hill and neighbouring parishes; and that fatal cases variously registered as "acute laryngitis," "diphtheria and croup," "inflammation of the lungs" (uncertified), and "diphtheria" (also uncertified), had occurred respectively in Waterham, Sheldwich, Forstall, and South Street. Altogether the total outbreak of throat illness had extended over a considerable extent of country, and had persisted, with varying severity, during many months. In the parish of Hern Hill alone there occurred in the 12 months ending July 1879 above 70 cases of throat illness of greater or less severity, with 8 deaths. The above statements are based on information got together from various sources during a visit which I made to the place for the purpose of ascertaining the cause or causes of the outbreak. In my visit I encountered difficulties of the sort which usually beset investigations respecting diphtheria, and in the end I was forced to abandon the inquiry. For this result the lapse of time (nearly two years) since the occurrences in question is mainly responsible; people's memories having in the interval become hazy respecting matters whereon exact information was necessary for due consideration of the subject. Except in regard of fatal cases, the dates of attack could rarely be fixed with any degree of accuracy, and thus no hope could be entertained of obtaining

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trustworthy information as to the conditions of life of patients at the period of their seizure. Moreover, in not a few instances families had since their attack by diphtheria changed their residence, or even removed from the district. Nevertheless, I inquired in some detail respecting the Staple Street cases, and, though without result so far as trustworthy indication of the cause of the disease is concerned, I found reason for doubting the relation which had here been suspected to exist between the diphtheria and the use of water from certain wells. These, "Miles'" well and "the Horse-shoes'" well, were, it would seem, resorted to by several families that escaped illness, while more than one family in Staple Street that suffered from diphtheria obtained water (I was assured) from other sources. Another circumstance, too, suggested doubt as to this outbreak being attributable to water. Anterior to and coincident with diphtheria prevalence in Staple Street, many families widely distributed through Hern Hill parish had suffered from diphtheria or throat illness, notwithstanding that their water supplies were different not only from those in question but also from one another. Hence, if water was the agent of infection as regards the total outbreak in the parish, many wells differently situated and widely separated must at nearly the same time have yielded water capable of conveying the disease. This seems very unlikely. Indeed, upon grounds similar to those whereon, as regards Staple Street, a water theory was based—*i.e.*, community of circumstance at the time of the outbreak among persons attacked—another possible cause of the diphtheria is suggested; one moreover which (if it could be relied on) would explain, not the invasion alone of six out of the seven families attached in Staple Street, but the invasion also of numerous other families scattered through the parish. This other cause is school attendance. Hern Hill School, which is situated in a small hamlet of that name, has an average attendance of some 100 children of both sexes, most of whom reside in the parish. Of this number nearly one-half (including some from outside the parish) were, during the winter 1878–79, absent at one or another period owing to sickness, most of which is believed to have been throat illness, and no less than six of them died. No doubt, therefore, children from various parts of the parish living under home conditions of great diversity, must have had again and again during school hours relation with other children sickening with or recovering from throat illness. But evidence of this sort is not conclusive as against school attendance. In other enquiries of the present nature, where school attendance has not come in question, or where it could be excluded as a cause of the prevailing disease, it has been found that epidemic diphtheria is specially prone to attack children, notably children at ages that attend school. In just the same way, ague, or any other complaint, if it were a disease habitually confined to children at ages 3 to 12 years, would be found, in a district in which it was prevalent, to have attacked mainly the school children of the place. The above observations are not intended to negative such presumption as arises from other considerations, that the school at Hern Hill may have had some concern in the propagation of diphtheria in the parish. No doubt here, as is believed to have happened elsewhere, school attendance may have assisted in the spread of throat illness; but I was unable to satisfy myself that it had played more than a subordinate part in the production of the outbreak.

*Faversham Rural Sanitary District and its Sanitary circumstances.*

In a former report, dated August 1875, made after inspection of the Faversham Registration District, I have dealt mainly with the town of Faversham, which, though administered for the most part by Improvement Commissioners as Urban Sanitary Authority, is in its circumferential parts under the jurisdiction of the Guardians as Rural Sanitary Authority. In dealing once more with the Rural Sanitary District it will be convenient now and again to contrast past with present experiences. For the purpose of this report I propose using the term "town" to signify those circumferential parts of Faversham town which are in the Rural Sanitary District. The town proper within the area of the Improvement Commissioners will, when referred to, be spoken of as Urban Faversham.

As I have observed in my former report, the Faversham Rural Sanitary District consists topographically of undulating country, with a general dip

from south to north. Its higher parts on the south are mainly of Chalk, lower portions toward the Thames estuary are on Thanet beds, while in the neighbourhood of the Swale creeks the soil consists of brickearth, gravel, and alluvial clay. Eastward, about one-fifth of the district is high-wooded hills, on gravel covered London clay. The district comprises 21 rural parishes, and in addition portions of four others: Faversham, Ospringe, Preston, and Davington, which include among them those circumferential parts of Urban Faversham which are under the jurisdiction of the Guardians as Rural Sanitary Authority. The population of the rural district, estimated last year at some 19,000, is mainly agricultural; but in the neighbourhood of Urban Faversham, where chiefly increase of inhabitants since last census has occurred, large numbers of persons are employed in the industries of the place:—powder mills, breweries, cement works, and notably brickyards.

*Dwellings.*—House property *in the town portion* of the district is mainly for accommodation of the artizan class. Much of it is of comparatively recent erection, and generally houses are fairly well built and ventilated; usually they have gardens. Upon the whole the house property contrasts favourably with much of that in the older parts (about the quays) of Urban Faversham, where timber-built dwellings, often huddled together on insufficient area, are, as a rule, small, unventilated, dilapidated, or ruinous. But in the Brents there are not a few houses belonging to this class; though as regards ventilation and repair many are considerably improved since I reported on them in 1875. Some in the Lower Brents, however, remain in much the same condition as when I last saw them. These besides being often dilapidated and ill-ventilated, are much beset by outbuildings which prevent free circulation of air about them. *In rural parts of the district*, too, there is a good deal of cottage property of a sort erected some generations back when the requirements of health and decency were less considered than at present. Many of these old cottages are falling into decay, and at probably no very distant time will become unfit for habitation. Dilapidation, however, is not altogether confined to old dwellings, for even comparatively recent erections have here and there, either from original defects of construction or from misuse by their tenants, so far fallen into disrepair as to call for the notice of the Sanitary Authority. A good deal of the specially dilapidated house property in town and country is in the hands of a few owners, who can with difficulty be brought to expend money on repairs. No doubt tenants of such dwellings are mostly thriftless or poor persons, caring little as to the quality of their accommodation; notwithstanding, many pay as high rent as tenants of much better dwellings; some of them a rent that must be regarded as higher, when the amount of the accommodation is taken into account. *As regards new buildings*, there is throughout the district abundant evidence of appreciation of a higher standard than heretofore in providing dwellings for the labouring classes, and in particular instances the result is highly satisfactory. There has been, however, as was inevitable, lack of uniform regard for the sanitary requirements of dwellings, such as might have been had under byelaws of the sort which have recently been adopted, and which are now being enforced in certain parishes of the Rural Sanitary District.

*Overcrowding.*—Some instances came under my notice where the inmates of particular dwellings tended to be more numerous than could wholesomely be accommodated. But house-to-house inquiry by the Inspector of Nuisances seems to show that ordinarily overcrowding is not common; mainly it occurs at busy seasons among the brickmaking class.

*Water Supply.—In the town portion* of the district the water supply is derived from the mains of the Faversham Water Company and from wells; *in the country* mainly from wells or rain-tanks, occasionally only from streams or ponds. *As regards the town portion*, the mains of the Water Company have since 1875 been extended to Ospringe Street, where most of the dwellings on both sides of the road are now, through the action of the Rural Sanitary Authority, supplied with the Company's water. In Preston parish north and south of the railway station, houses have been connected with the Company's mains, though many here still depend on wells, few of which are bored wells, for their water supply. To the south-westward of Urban Faversham too, there are still many dwellings in Faversham parish dependent upon wells for their water; while in the populous neighbourhood of the Brents, to which the

mains of the Water Company have not yet been extended, people still resort as in 1875 to a few bored wells in preference to their surface wells, with the result that many go a considerable distance for water. On this side of Urban Faversham one group only of dwellings, Priory Row, has water from the mains of the Water Company. As regards quality of water yielded by wells of the town, I doubt, for reasons stated in my former report, whether any wells, except bored wells, can be trusted to afford a uniformly safe supply. No doubt analysis of wells has failed to find ground for their closure, but it should be remembered that analysis ordinarily testifies only as to certain chemical qualities of a particular sample at a particular time, and is able to say nothing respecting uniform safety of the well from which that sample was obtained. As an instance in point, a well at the back of Edward Packer's Cottages in Ospringe Street at the corner of Waller's Road, has been three times subjected to analysis with the result on each occasion that its water could not be pronounced unfit for drinking purposes. This well on the occasion of my visit furnished water which was conspicuously fouled by waste laundry water from a drain near at hand that was believed to discharge into a cesspool at no great distance from the well itself. *In rural parts of the district*, the quality of the water supply and the facilities for obtaining water vary very greatly. On high ground to the south of the district, where it is wholly chalk, wells are necessarily deep, some of them being sunk over 200 feet. From most of these wells good water is doubtless obtained, especially from those which are steyned in mortar or cement for prevention of soakage into them through the superficial soil above the chalk. Such wells are not, however, very numerous on these high lands, and thus many persons cannot readily obtain well water; moreover the labour of raising water by bucket and windlass some 200 feet is no small matter. Hence not a few people use rain water which is carefully caught and stored in these high districts, or they resort, as about Perry Wood, where there are scarcely any wells, to superficial springs or ponds. Following the dip of the land from south to north towards the lower levels of the district, wells sunk into the chalk become shallower and more numerous, and in the area of the Lower London Tertiaries (mostly Thanet beds) and Alluvium wells become mere surface wells with abundant supply of water. Probably most of the shallower chalk wells, when properly steyned, and when their surroundings admit of it, afford fairly good water. But much of the water derived from wells in the Lower London Tertiaries and Alluvium is of very doubtful quality. Such wells are in effect surface wells, though many of them are sunk to a depth of 40–50 feet. Almost invariably they are dry steyned, apparently with the intention of allowing percolation into them from all levels of the soil; consequently they are liable to befoulment by any noxious matters impregnating the soil in their neighbourhood. A convenient illustration is afforded in regard of Staple Street, where, it will be remembered, the water of particular wells has again and again been analysed and on each occasion pronounced unfit for drinking purposes. The hamlet consists of some 30 dwellings rather closely aggregated on an eminence formed of Thanet beds which here consist of light porous loamy sand. Into this soil the numerous wells of the place were sunk to depths varying from 40–50 feet. None of the wells reach the chalk, and few if any of them are more than dry steyned; hence the water they yield must be largely supplemented by, if indeed it be not mainly derived from, that soaking through the superficial soil hereabouts; which soil is of so porous a nature that, as described by a resident, "it soaks up rain like a sponge." Besides rain it no doubt soaks up other fluid matters either fouling its surface or leaking into it from non-water-tight underground receptacles. To this latter class belong all the privy "vaults" and many of the cesspools, as well as not a few slop drains, some of which it is obvious lose themselves in the ground. Sources of soil pollution of the above sort are not unusually numerous, nor are they in closer relation with the wells, at Staple Street than in other places. But it so happens that here, the nature of the soil affording unusual facilities for percolation through it of fluid foulness, the wells (which are in effect porous shafts sunk to a level approaching though falling short of that of streams on all sides) cannot fail to drain the soil in their neighbourhood. Under these conditions, the wells receive much dangerous matter, and in the course of time an amount of foulness that is recognised by the unassisted senses; and it is then,

and not before, that the use of these wells for drinking purposes is abandoned. Probably at the present time one well alone in Staple Street, one of those on the Mount Farm premises, yields water natural to the soil of the place. And this well, though comparatively a new one, cannot be trusted to do so for long, as it is situated beneath a cattle shed the floor of which is in no way protected against the soakage of foul matters into the soil. As I have said, Staple Street is but an instance of physical conditions in the district favouring befoulment of well water. In other places similarly circumstanced as regards soil and wells, a like process of earth and water fouling is in progress, as at Graveney and at Teynham. At Conyers Quay the water of the surface wells has long been condemned by the inhabitants, and recently the Rural Sanitary Authority has incurred an expense of 400*l.*–500*l.* in boring a well here and in supplying water from it to a public pump. As regards the whole district it should be borne in mind that for securing wells against foul soakage no process can be relied on that does not, beside preventing fouling of the ground surface, abolish all privies, cesspools, and drains that permit soakage of their contents into the soil about wells.

*Sewerage and Drainage.*—In regard of *the town portion* of the district, no sewerage works have, since my report in 1875, been undertaken by the Rural Sanitary Authority, nor has any arrangement been come to with the Urban Authority, whereby circumferential parts of the town may be drained into the urban sewers. As in 1875, the Brents neighbourhood, which constitutes the North Preston Drainage District, is the only part of the town in the Rural Sanitary District that is systematically sewered. Other parts here and there are drained by private enterprise; as for instance, Priory Row, where the closets and sinks of some 50 dwellings discharge by a common drain into the Davington ponds. About the railway station, too, owners of several blocks of property have caused connexion of their houses with the urban sewers. But in this neighbourhood many houses, some of them fitted with waterclosets, still drain to cesspools, as does more house property in Ospringe Street and Waller's Road. *In rural parts of the district* sewerage of a certain sort exists at Oare and at Boughton. The Oare sewerage, which about a year ago, was carried out at the instance of, though not under supervision by, the Rural Sanitary Authority, provides for the drainage to the creek of a portion only of the village. Neither the sewer here nor the house drains are ventilated, and as a consequence foul smells from sinks and waterclosets are frequently complained of. In some of the houses fever has lately occurred. The Boughton sewer is an old barrel drain in the high road, receiving for the most part slop drainage only from the north side of the street, and discharging into a watercourse at the bottom of Boughton Hill. Recently the Sanitary Authority has repaired this sewer, providing at the same time ventilation at its upper end; and further improvement of it is contemplated. With the exceptions I have noted, and a further one at the workhouse where considerable sewerage and sewage disposal works have been carried out, drainage generally in the rural district is on the slop-cesspool system. This system, which is not new to the district, has, in course of time, been considerably extended, recently with increasing modification and improvement. Cesspools of the older kind which receive storm water as well as slops, are evidently not water-tight; they rarely require emptying, so rarely that the position of many has become mere matter of tradition: these cesspools are very numerous, and no doubt are frequently responsible for the fouling of well-water. Of late years this sort of cesspool, which was evidently intended to get rid of liquid refuse underground, has begun to be replaced by more or less water-tight receptacles for storage of slop water only. Under the Sanitary Authority's new byelaws, cesspools are constructed on the principles embodied in the Board's model; a method of cesspool construction that might well be adopted throughout the whole rural district. Formerly sink connexions (where indoor sinks existed) with cesspool drains was almost invariably direct; now, through action of the inspector of nuisances, it is rare to find a sink that does not discharge in the open air over, or near to a trapped drain inlet.

*Excrement disposal.*—*In the town portion* of the district privies have been generally, though by no means completely, abolished. Usually they have been replaced by pan waterclosets, which discharge sometimes to sewers, more

commonly to cesspools. Almost invariably these closets, like those in Urban Faversham, are destitute of water supply, and depend for their flushing upon an occasional pail of water cast into the pan. As a result, careless tenants permit their waterclosets to become well nigh as foul and offensive as ordinary privies. It is much to be regretted that conversion into waterclosets of privies in connexion with buildings has not included a full supply of water for flushing purposes laid on to each closet. Under existing regulations of the Faversham Water Company there would appear no excuse for allowing waterclosets to remain without a proper supply of water, since water supplied to closets is no longer regarded as an *extra* in the case of "private houses where the usual number of inmates does not exceed eight persons." In the Upper Brents, privies have been replaced since 1875 by a pail-system, which is now, after careful attention by the Sanitary Authority (personally, and by its officers), very completely administered. Here privies have been converted into closets, each fitted with a pail and supplied with dry earth. A contractor is under agreement with the owner of the property to furnish this dry earth, to apply some of it daily to the contents of each pail, and to empty each pail three times weekly. In addition he is responsible for the scavenging and removal of ashes and refuse, and the flushing weekly of the drains. Perhaps the earth does not get applied so regularly and efficiently as it might be applied to the contents of the pails; but the total result of this administration is highly satisfactory. The Upper Brents, which in 1875 abounded in nuisances, are now in a sanitary state that will compare favourably with that of any property of a similar class in the district. The pail contents, ashes, and other refuse, are carried away by the contractor to a depôt in the marshes, and the resulting manure is from time to time sold to farmers. As yet the sale of the manure has not covered quite one third of the cost of the contract, though it is thought that in the end better prices may be obtained. *In rural parts of the district*, the "vault" privy is the common method of excrement disposal. Privy vaults are, as their name implies, sunk into the earth, and few, except recent erections, are in any degree water-tight. Consequently they foul the soil about them, and are therefore a constant source of danger to wells in their neighbourhood. This danger has been to a certain extent recognized, and privies have been removed from proximity to wells. But it has to be borne in mind that mere proximity of these privies to wells is not the sole measure of their dangerous quality; in soil like that at Staple Street for instance, an interval of many yards between the privy vault and the well gives no security against soakage from the one to the other. Here and there in the district, through the wisdom of particular owners, or by influence of the Inspector of Nuisances, earth or pail closets have been adopted on a small scale, with the result that none who visit them can doubt, apart from all questions of soil fouling, their superiority to the ordinary privy.

*Ash and refuse disposal.*—Except that mentioned in reference to the Upper Brents, there is not in any part of the district systematic removal of ash or other refuse. In *the town portion* such matters are disposed of by tenants in their gardens, or are removed by private arrangement with the urban scavenger, or with farmers. Under these circumstances removal of refuse from the neighbourhod of dwellings is too often delayed until intervention of the Inspector of Nuisances becomes necessary. Similarly *in the country parts* people seem to prefer to store their refuse in vicinity to their dwellings, instead of collecting, as they might do, each day's accumulation in a movable receptacle, and carrying it to a remote part of their gardens. Especially is the inconvenience of this habit conspicuous in large villages such as Greenstreet, Boughton, and the like, where a systematic method for dealing safely with refuse matters is much wanted. General provision, both in town and country, of proper ashpits in safe situations, such as is aimed at by the Inspector of Nuisances, will probably do a good deal towards mitigating the evil I have noted.

*Keeping of animals.*—In *the town portion* of the district pig keeping has, owing to intervention of the Inspector of Nuisances, become less common than in 1875. No pigs are now allowed to be kept within 30 feet of an inhabited dwelling, and this limit has caused the abatement of not a few pig nuisances. Fowls and rabbits, however, are kept in abundance, often in inconvenient proximity to dwellings. *In rural parts of the district* pigs have generally been removed to the ends of gardens, and are not often a source of nuisance.

*Administration by the Rural Sanitary Authority.*

In compliance with the Public Health Act, 1872, the Authority appointed medical officers of health and an Inspector of Nuisances. The health officers were the four district medical officers, each of whom acted for his own medical district. This apportionment of the rural district among four health officers continued, with several personal changes, until March of the present year, when, at the instance of the Board, the Sanitary Authority decided to appoint one Medical Officer of Health to act for the whole district. Dr. F. A. Gange, who was elected to the post, has a yearly salary of 150*l*. Throughout the whole period under consideration the office of Inspector of Nuisances has been held by one person, Mr. Adkins, whose present salary is 135*l*. per annum. Both of these officers are under the Board's Order. The Sanitary Authority has met monthly to transact business and to receive reports from the Inspector of Nuisances of his work. These monthly meetings of the sanitary authority have not been attended by the four health officers, but these gentlemen have reported, in writing, quarterly as well as annually to the Sanitary Authority. Mainly their quarterly reports have been concerned with the diseases prevalent in their several districts, while the monthly reports of the Inspector of Nuisances have dealt with the sanitary state of various parishes of the whole district. Dr. Gange, since his appointment for the whole district, has attended the monthly meetings of the sanitary authority, at each of which he has presented a written report respecting portions of his district that have engaged his attention since the last meeting. Heretofore (until Dr. Gange's appointment) most of the work of the Inspector of Nuisances has been carried out without reference to the several health officers, who, on the other hand, rarely conferred together respecting medical advice to be given to the Sanitary Authority. To this lack of competent medical advice respecting the district as a whole may partly be attributed failure in certain directions of the Sanitary Authority in dealing with matters that seem to have called for comprehensive and well-considered action. As was inevitable under this former method of administration the Sanitary Authority had come to rely almost wholly on its Inspector of Nuisances for information respecting the circumstances of its district, and on this officer and on its clerk for advice as to the best means of dealing with matters brought under its notice. As an instance of desire of the authority for bringing about sanitary improvement of the district (a disposition that does not admit of doubt, and of which I had abundant evidence during my inquiry) it is only necessary to refer to the action taken in regard of the Staple Street wells. In this case, it is true, the outcome of the action taken was hardly satisfactory, though not by default of the Authority.

In exercising its functions the Sanitary Authority has had the advantage of the services of a very able Inspector of Nuisances, of whose method of routine work some notice would appear instructive. Upon his appointment this officer set to work to make a house-to-house survey of the 25 parishes of his district, and this survey was completed within a twelvemonth of its commencement. In it was recorded, for the information of the Sanitary Authority, particulars as regards each house as follows:—description of the dwelling, names of owner and of occupier, number of rooms (sleeping and other), number of inmates (adults and children), water supply, privy or closet accommodation, and drainage; as well as other details respecting the sanitary condition of the place. Upon the basis of this survey action in the sense I reported in 1875 was commenced, and is still being followed. Since the completion of his preliminary survey, year by year the inspector of nuisances has re-surveyed his district, parish by parish, recording particulars respecting the sanitary state of each house and premises in books kept for the purpose. These survey books are, as soon as a parish is completed, presented by the Inspector of Nuisances at the monthly meetings of the Sanitary Authority, together with particulars in his journal respecting dilapidations, nuisances, sanitary wants, &c., in regard of which he has issued notices.* At the next subsequent meeting of the Sanitary Authority the Inspector of Nuisances, after further examination of the premises

* Copies are kept of all notices issued. The notices themselves are sent through the post in registered letters.

under notice, reports the result of his intervention, and gets instructions from the Sanitary Authority in regard of persons who have disregarded his notices. Formerly the ultimate result of these parish inspections was prosecution of a considerable number of offenders, but now that the inspector's method of work is fully understood in the district such result rarely happens. In two years there have not been any legal proceedings thus arising. Besides work of the above sort the inspector of nuisances reports specially on the sanitary circumstances associated with particular outbreaks of infectious disease, and on other matters of a more general kind to which his attention may have become directed. Under the Public Health (Water) Act, 1878, and under the new byelaws recently obtained, this officer is also in a limited sense, surveyor to the Sanitary Authority.

As will be inferred from the details I have given of the routine works of the Inspector of Nuisances, no small portion of the Sanitary Authority's action has been repression of nuisances, and the bringing about of such sanitary works as owners of property can be got to carry out. The improvements noted in regard of the Upper Brents and the Oare drainage are instances of the latter sort of action. But other and wider considerations have engaged the attention of the Sanitary Authority. With reference to general improvement of the water supply in the district, the Sanitary Authority has caused in five years 122 analyses to be made of samples of water from various sources, with the result of closing many wells. By such means, as also by advice and persuasion, considerable extension of the service of the Faversham Water Company has been brought about in the town portion of the district. In the country, at Conyer's Quay, the Sanitary Authority has, as already mentioned, expended 400–500*l.* in boring a well, and in supplying the water thus obtained to a public pump for use of the inhabitants. In regard of the Public Health (Water) Act, 1878, the Sanitary Authority issued a circular letter calling attention to the provisions of the Act as regards new buildings, and offering suggestions as to methods of meeting its requirements; and further, obtained from the Inspector of Nuisances an additional survey of the district, made specially with reference to the circumstances of water supply to each house. Questions hence arising respecting deficient or unsafe water supply at Teynham hamlet and in the Perry Wood district are occupying the Authority. In regard of all new buildings throughout the district, the Sanitary Authority now requires inspection and certificate by its own officer respecting the circumstances of water supply before permitting a house to be tenanted. In 1876 the Sanitary Authority applied to the Local Government Board for certain urban powers in parishes of the town portion of the district, as well as in certain other parishes containing considerable aggregations of population; and in 1879, byelaws made under the provisions of sections 42, 44, 157, 158, 169 (second and third paragraphs), and 170, received the Board's sanction. These byelaws are now commencing to be enforced in the district. Especially as regards new buildings, drainage of such buildings, and construction of privies, ashpits, and cesspools, the sanitary authority has lost no time in exercising its new powers, and with the result that already there may be seen in the one town of Faversham absolutely new dwellings of essentially different sorts. The one sort, erected under the byelaws of the Rural Sanitary Authority, fulfil, as regards ventilation of drains, and position, construction, lighting, and ventilation of closets, those requirements which modern enlightenment have demanded; the other sort, now in course of erection under Urban management, and without byelaws, fall very far short of a proper standard in most, and sometimes in all, of these particulars. In the country parts of the district general improvement in house construction is not thus visible, but for these parts the Rural Sanitary Authority has not the same power to make byelaws. Byelaws in the subject matter of section 157, sub-section 4, of the Public Health Act, would appear proper for the whole of the Rural Sanitary District.

It will have become evident in the course of this report that since my inspection of the district in 1875, the Faversham Rural Sanitary Authority has continued to be alive to its responsibilities, and that in sanitary improvement of the district considerable advance has been made: an advance due alike to the direct action of the sanitary authority itself, and to its further action through property owners and other persons. But in certain not un-

important directions wherein the Sanitary Authority might have induced property owners to secure safer conditions to their tenants, or might, by executing in the first instance necessary structural works, have paved the way for further improvement of the sanitary circumstances and health of the district, the Authority has not yet exercised all its powers. Thus, in the matter of impure water supplies in rural places, where there were difficulties in ordering the immediate closure of wells, the existing sources of supply might have been protected to an important degree if, while above ground nuisances were being repressed, more stringent action had been taken for preventing privy pits, cesspools, and drains from leaking into the soil in the neighbourhood of wells. As regards structural works, the necessity for sewerage in circumferential parts of the town, to which attention was drawn in 1875, has been disregarded. No difficulty of an engineering sort prevents provision for drainage of those portions of the town above and below the railway station, which drainage might be effected by properly constructed sewers, laid in connexion with those of the urban system. Sewerage of the Ospringe Street and Wallers Road neighbourhood may be less easy of accomplishment, but upon this point the advice of a competent engineer might at least have been taken by the Rural Sanitary Authority, either acting alone, or considering, in conjunction with the Urban Sanitary Authority, the question of provision of an intercepting sewer for this neighbourhood along with that portion of the urban district which comes in question. Again, in the matter of provision for isolation of infectious disease occurring in the district, nothing has been done. In 1875, when this question was brought forward, the Rural Sanitary Authority, after some consideration, deferred their action, and the question does not appear to have been further entertained. In this connexion I may usefully mention the fact that recently the Guardians of the Poor have acquired two cottages on ground adjoining the workhouse premises, which cottages it is proposed to utilize, after they have been reconstructed, for the isolation of infectious sickness occurring among paupers. It may be that the Rural Sanitary Authority will be disposed to regard the provision thus made by the Guardians as satisfying in some sense the wants of the Rural District. But it must be borne in mind that no hospital building on workhouse premises and under workhouse administration can (be it ever so efficient) properly be used for reception of persons of non-pauper class. No doubt the Rural Sanitary Authority, if it possessed a proper hospital duly administered, might arrange with the Guardians for treatment in such hospital of infectious cases occurring among the pauper class, though the Rural Sanitary Authority is not at liberty to send into a workhouse hospital, infectious cases occurring among persons who are not paupers. Probably the question of hospital provision would be best dealt with by combination between the Rural Sanitary Authority and the Faversham Urban and Port Sanitary Authorities for erection of a hospital building, duly provided with mortuary, ambulance, and disinfecting chamber, &c., on a scale to meet the requirements, pauper and non-pauper, of all three sanitary districts. At the present time the Guardians alone, of all authorities in the district, possess a disinfecting apparatus. This, which is a "Nelson stove," erected since 1875, has been so far used solely for workhouse purposes.

In bringing this report to a conclusion I would note that the Faversham Rural Sanitary Authority having appointed a Medical Officer of Health for the whole district, is now entering on a new phase of administration, which gives promise of consistent, comprehensive, and sustained action in the future. It is in regard of sewerage, of water supply to dwellings and to closets, and of ash and refuse disposal, that the attention of the Sanitary Authority should be more immediately and particularly given within the town portion of its district: while in the more rural parts, the subject that most presses for its consideration is the protection of watercourses from risk of injury by excrement, slops, and refuse.

31st July 1880. W. H. POWER.

# Dr. Airy's Report to the Local Government Board, on several Outbreaks of Diphtheria in the Fourth Quarter of 1879.

GEORGE BUCHANAN,
Medical Department,
11th December, 1880.

In pursuance of the instructions given me (February 3rd, 1880), "to visit some of the "sub-districts, in which it appeared by the Registrar-General's Returns for the fourth "quarter of 1879, that there had been strongly localised outbreaks of diphtheria, in "order to inquire as to the behaviour of this disease among small communities," I now submit the following report of my inquiries in eleven sub-districts, in which the mortality from diphtheria during the quarter in question had been, in proportion to the population, excessive. They were visited in the following order:—

| | District. | Sub-district. | Parish. |
|---|---|---|---|
| 1. | Midhurst | Fernhurst | Lurgashall. |
| 2. | Dunmow | Stebbing | Felstead |
| 3. | Bosmere | Coddenham | Henley and Barham. |
| 4. | Thrapstone | Raunds | Raunds. |
| 5. | Clitheroe | Chipping | Chipping. |
| 6. | Carnarvon | Llandwrog | Llanllyfni and Llanwnda. |
| 7. | Festiniog | Beddgelert | Beddgelert. |
| 8. | Builth | Builth | Llandewyrewm. |
| 9. | Pembroke | Tenby | Manorbier. |
| 10. | Haverfordwest | St. David's | Mathry. |
| 11. | Bideford | Hartland | Woolfardisworthy. |

In attempting a survey of the results of the inquiries concerning diphtheria, which are here reported on, reference will constantly be made to the "Heads for local "inquiry in districts where diphtheria has been epidemic,"* which were drawn up in 1859 by the Medical Officer of the Privy Council for the use of the inspectors of the Medical Department and of other local inquirers, in view of the then recent and alarming prevalence of that disease.

The main heads indicated in the Minute referred to were the following:—

1. As regards the general features of the district.
2. As regards the duration, extent, and novelty of the epidemic in the district.
3. As regards contemporaneous or recent diseases in the district.
4. As regards local and personal conditions pre-disposing to diphtheria.
5. As regards the communicability of diphtheria.
6. As regards the symptoms of diphtheria.
7. As regards the treatment of diphtheria.

Under each heading were arranged certain definite points for particular inquiry.

Proceeding on these lines, a large amount of detailed information was gathered at that time, in 1859, which, though regarded by the Department as inconclusive,† was especially valuable as relating to the earliest period of the modern diphtheria-invasion, when in most of the districts visited there was no history of previous epidemics of the same disease.

Since that Minute was issued, the field of inquiry with regard to the spread of infectious disease has been enlarged by the discovery and establishment of the fact that, in the case of certain diseases, infection is spread by milk. This, therefore, becomes a point to be kept in view in future inquiries. It suggests the addition to the above-mentioned scheme, of a separate heading, "Indirect modes of spread of diphtheria."

Again, the progress of microscopic research has led to the identification of certain minute fungoid organisms (microzymes, micrococci, bacteria)‡ as constantly present in, and apparently causative of, certain infectious diseases. This discovery opens a new line of inquiry, and suggests new points on which information should be gathered, such as (besides the most minute attention to the drinking water) microscopic examination of matters carried in the air, and relation of infection-spread (otherwise unaccountable) to direction of prevailing wind.

Referring to the "Heads for Local Inquiry" above mentioned, the following is a résumé of the evidence which I collected.

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* Second Report of the Medical Officer of the Privy Council, 1859, p. 161, *et seq.*

† Third Report of the Medical Officer of the Privy Council, 1860, p. 13.

‡ In respect of diphtheria, see Oertel in Ziemssen's Cyclopædia of Medicine (English Translation), vol. i., p. 587, *et seq.*, and Hueter and Tommasi, Centralblatt, 1868, No. 34.

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1. *As regards the General Features of the District.*—(*a.*) In the majority of cases the regions affected, and especially the points at which the disease first broke out, were high and exposed to the wind. In almost every case the soil was more or less clayey and wet. In some instances the surrounding land was well cultivated and drained; in others it was enclosed pasture, and in others open waste common. At Lurgashall, in Sussex, and at Glanaber (Beddgelert) there was much wood and copse, but the other places attacked were mostly bare and open, on bleak ridges, shelterless wastes, and exposed mountain sides.

The selection by sporadic diphtheria of high exposed sites has been observed by Mr. A. Wynter Blyth, late Medical Officer of Health for a combined Devonshire sanitary district. (Sanitary Record for May 15, 1880, p. 409. "Of the epidemics or partial "outbreaks in my district, for every one so-called sporadic case which has occurred in "valleys, five have broken out on, comparatively speaking, lofty breezy situations.")

The greater prevalence of diphtheria in clayey (as contrasted with sandy) regions has been noticed by several observers, recently by Dr. Kelly, Medical Officer of Health for the combined sanitary district of West Sussex: (Sixth Annual Report, p. 59, "Diphtheria "is of frequent occurrence, and more especially is this the case in those villages which, "like Fernhurst and Lurgashall, are on the Weald Clay.")—and by Dr. Ashby, Medical Officer of Health for Grantham and neighbouring districts, who finds the disease chiefly prevalent on the Lias Clay; instances of its occurrence on sandy soil being traceable to personal intercourse with previously infected places. Oertel, however, (in "Ziemssen's "Cyclopædia of Medicine," vol. i., p. 583) says, "In Holstein the disease has been "observed with almost the same frequency in the swamp districts and on the dry "highlands, on moist clay and the driest sand." It would be important to ascertain by more extensive inquiry whether diphtheria in sandy localities can be generally traced to personal intercourse with previously infected places (as found by Dr. Ashby), or whether in those localities it exhibits the same appearance of *de novo* origin, which it so often presents in its more favourite haunts on clayey soil. If the former be the case, the phenomenon might be explained in one of three ways: either the disease is capable of spontaneous origin in dwellers on the clay, but not in dwellers on the sand; or, is produced by a contagium, which can be indefinitely preserved in a clayey region, but not in dry sandy places; or is produced by an organism which has a habitat (external to the human body) in wet clayey regions, but does not thrive in sandy tracts.

It has long been observed that thinly populated regions suffer from diphtheria more severely than crowded towns, or, at least, that the latter do not suffer in anything like the proportion of their density of population as compared with rural parts. The observation holds good for longish periods of time, so that the fact is not to be explained by major prevalence following longer absence. The fact is consistent with the theory which would ascribe diphtheria to the agency of a local miasm; while it certainly militates against the theory that the spread of the disease is simply a matter of personal communication (for the chances of personal communication are much greater in a town than in the country), unless the difference of conditions of town life and country life can induce in the bodily systems exposed thereto a difference of susceptibility of the diphtheritic infection.

Inasmuch as all my inquiries related to rural districts, the question of the relation of diphtheria prevalence to density of urban dwellings receives but little illustration in this report. I may, however, in this connexion, remark upon the singular fact observed in the outbreak at Llandewyrcwm, near Builth, in Brecknockshire, that, among a number of children attending the same village school, diphtheria only attacked children who came from rural parts of the parish, from isolated cottages in the valley, or from little farmsteads on the hillsides, but not a case,—not even of slight sore throat,—was known to occur among scholars (almost one-half of the entire number) who came from a suburb of the town of Builth, though all were alike exposed to the same conditions of personal communication in the school, and to any insanitary influences connected with it. The numbers involved were almost too great to admit of the inequality being explained as the result of accident.

(1) *b.* In the districts which I visited, though the disease was found in relation to general wetness, yet it did not appear to have any concern with the nature of the supply of drinking water, being found equally in regions supplied by wells, by running streams and by stagnant ditches and pools. In some of the most severe cases the water on analysis was found to be unusually pure: in others it was certainly polluted.

(1) *c.* No evidence was met with that ague, autumn fever or diarrhœa, or bronchocele, or any other endemic disease characterised especially the districts where diphtheria appeared.

2. *As regards the Duration, Extent, and Novelty of the Epidemic.*—(*a.*) Of the eleven outbreaks here recorded, one commenced in August, two in September, four in October, and four in November. In point of duration, they varied greatly, from one to six months. In several of the districts thus infected the disease has reappeared after some months had passed without any sign of its presence, hinting that the diphtheria poison may have still survived.

The influence of season upon diphtheria prevalence deserves attention. The Registrar General's quarterly returns show that for the whole of England and Wales diphtheria in its fatal results has a marked, and on the whole very uniform, variation of intensity within each year.

TABLE I.—DIPHTHERIA MORTALITY IN ENGLAND AND WALES.

| Year. | First Quarter. (*a.*) | Difference, *a* and *b*. | Second Quarter. (*b.*) | Difference, *b* and *c*. | Third Quarter. (*c.*) | Difference, *c* and *d*. | Fourth Quarter. (*d.*) | Difference, *d* and $a^1$. | First Quarter next Year. ($a^1$.) |
|---|---|---|---|---|---|---|---|---|---|
| 1870 - - | 710 | −186 | 524 | +57 | 581 | +302 | 883 | −172 | 711 (1871). |
| 1871 - - | 711 | −128 | 583 | −109 | 474 | +161 | 635 | −49 | 586 (1872). |
| 1872 - - | 586 | −111 | 475 | −69 | 406 | +119 | 525 | +54 | 579 (1873). |
| 1873 - - | 579 | −119 | 460 | +42 | 502 | +217 | 719 | +64 | 783 (1874). |
| 1874 - - | 783 | −115 | 668 | +51 | 719 | +231 | 950 | −54 | 896 (1875). |
| 1875 - - | 896 | −151 | 745 | −125 | 620 | +197 | 817 | +44 | 861 (1876). |
| 1876 - - | 861 | −234 | 627 | −26 | 601 | +132 | 733 | +26 | 759 (1877). |
| 1877 - - | 759 | −212 | 547 | −74 | 473 | +270 | 743 | +70 | 813 (1878). |
| 1878 - - | 813 | −108 | 705 | −11 | 694 | +333 | 1,027 | −224 | 803 (1879). |
| 1879 - - | 803 | − 90 | 713 | −170 | 543 | +254 | 797 | −80 | 717 (1880). |
| Total - | 7,501 | — | 6,047 | — | 5,613 | — | 7,829 | — | 7,508 |
| Average - | 750 | −145 | 605 | −44 | 561 | +222 | 783 | −32 | 751 |

Table I. shows that in the last 10 years 1870–9 the mortality from diphtheria in the first quarter, sometimes greater, sometimes less than that in the quarter preceding, has always exceeded the mortality in the second quarter, and this again in most years (seven out of ten) has exceeded that in the third. The most striking feature in the Table is the great excess which the fourth quarter constantly shows over the third.* From this fact alone, it might be inferred with some probability that epidemic diphtheria would be found to originate most frequently in the early part of the fourth quarter. The point is worth investigating, for, if established, it would lend support to the theory that the morbific agent is an organism with seasonal development, attaining its chief reproductive power in the autumn, the very season when the air is known to be especially charged with fungoid germs.

Accordingly, I have collected from the 2nd and later Reports of the Medical Officer of the Privy Council, from Reports by the Board's Medical Inspectors, and from other sources all the records I could find, in a brief search, of dates of origin of diphtheria epidemics and have arranged them month by month in the following Table :—

TABLE II.—MONTHLY DISTRIBUTION OF DIPHTHERIA OUTBREAKS.

| —— | Reports of Medical Officer of Privy Council. | Inspectors' Reports. | Other Sources. | All Sources. |
|---|---|---|---|---|
| January - - - | 2 | 2 | 0 | 4 |
| February - - | 3 | 1 | 2 | 6 |
| March - - - | 4 | 0 | 2 | 6 |
| April - - - | 3 | 2 | 1 | 6 |
| May - - - | 3 | 3 | 0 | 6 |
| June - - - | 8 | 2 | 0 | 10 |
| July - - - | 11 | 4 | 1 | 16 |
| August - - - | 4 | 5 | 1 | 10 |
| September - - | 6 | 3 | 2 | 11 |
| October - - - | 16 | 14 | 7 | 37 |
| November - - | 4 | 10 | 2 | 16 |
| December - - | 7 | 3 | 2 | 12 |
| Total - - - | 71 | 49 | 20 | 140 |

* *See* also Oertel in Ziemssen's Cyclopædia of Medicine, English Trans., vol. 1, p. 583, where reference is made to Wibmer's statistics as showing especial prevalence of this disease from September to December.

These figures, indicate a very strongly marked preference for October as the time of year when epidemic diphtheria breaks out,—a preference which cannot but have an important bearing on the etiology of the disease.

(2) *b*. The fatality of the disease, or the proportion of deaths to attacks, varied in different instances from about 10 to 50 per cent. This difference is to be accounted for partly by a difference of type of the disease, and partly, in limited outbreaks, by its exceptional intensity in some particular family or families invaded by it. Some uncertainty must always attach to this estimate of proportional fatality, on account of the doubt respecting the milder cases of sore throat, which usually accompany an epidemic of diphtheria.

(2) *c*. As regards the novelty of the disease in the districts visited, I should observe that some of these districts were especially selected for inquiry, for the express reason that there had been no previous record against them of diphtheria mortality for several years past. This was the case, for example, at Felstead, at Henley, at Chipping, at Llandewyrewm, at Manorbier, and at Woolfardisworthy, where it was hoped that, in the absence of a compromising history, the mode of introduction of the disease might have been more easily and with less ambiguity detected. That the result did not at all correspond to this expectation is in itself a fact of no little importance, which will have to be considered below, as bearing upon the question of the nature and origin of the disease.

3. *As regards Contemporaneous or Recent Disease in the District.*—(*a*.) These epidemics of diphtheria were marked by very various degrees of severity in individual cases. Even in the same family one child would die, while another would have only a "bad cold." But I did not find that the severe disease was, as a rule, led up to by a series of milder cases. At Lurgashall, it is true, in a district where diphtheria is endemic, sore throats had prevailed before diphtheria broke out. At Mathry, in the St. David's district, diphtheria had prevailed for several years, and the particular outburst which formed the subject of my inquiry was confused in its origin with the remains of others that had preceded it. At Chipping there was much uncertainty as to the precise commencement of the epidemic. In all the other (eight) cases there was no doubt that the earliest observed attacks were of a specific nature. A typical instance of this was seen at Woolfardisworthy, where diphtheria broke out in a family of children at a lonely farmhouse, with no history of previous sore throats at the village school or any other place which the children had visited.

In this respect my inquiries furnish little, if any, illustration of the view regarding "progressive development of infectiveness," suggested by Dr. Thorne Thorne.

(3) *b*, *c*, *d*. In the Chipping district the epidemic of diphtheria was preceded by scarlatina; but there was nothing to show that a previous attack of scarlatina was protective against diphtheria. In some places there had been a good deal of whooping cough, but in no case did there appear reason to regard the successive epidemics as intimately related. There was no history of erysipelas or puerperal fever, or continued fever prevailing in any close relation to diphtheria.

(3) *e*. In each district endeavour was made to ascertain if there had been any noticeable disease among cattle, horses, sheep, pigs, dogs, cats, poultry, or domestic vermin. Taken as a whole, the result of these inquiries, as far as any relation to diphtheria was concerned, was next to nil. Liver fluke had prevailed, and was still prevalent among sheep in very many parts of the country, being attributed to the wetness and coldness of the previous summer. At Aberedw, near Builth, some horses suffered from "strangles" (which I understood to be a contagious throat inflammation of no great severity), at a farm where diphtheria had broken out previously.

The only instance in which the circumstances were such as to raise suspicion of diphtheria being caught from lower animals was at Felstead, in Essex, where, just about the time when diphtheria broke out in the village, some sheep suffering from throat disease of an unusual and fatal character, were herded close to the little school which was the scene of the outbreak. The almost simultaneous seizure of the two children first attacked appeared to point to one common source of infection, and there was no history of previous diphtheria with which both children could have come in contact. The evidence was not conclusive. In view, however, of recorded instances* of the communication of diphtheria from man to lower animals, such facts as this at Felstead deserve to be noticed, as suggestive of the possibility of the reverse process of infection.

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* *See* Dr. Sanderson, in 2nd Report of Medical Officer of the Privy Council, p. 246. Dr. Ashby refers to Robertson of Kelso, in the Veterinary Journal, 1875, and to Sir John Rose Cormack, in the Lancet, vol. i., 1875, p. 592. See also the Sanitary Record, July 1879, p, 16, and October 1879, p. 157.

4. *As regards Local and Personal Conditions predisposing to Diphtheria.*—(*a*, *b*.) The disease in its epidemic extension was not found to show any constant preference for spots characterised by any particular features of elevation, airiness, dampness, or otherwise; nor for foul overcrowded unventilated hovels as compared with more wholesome dwellings. There were two striking instances (at Raunds and Chipping) of diphtheria apparently taking rise in houses where the atmosphere was tainted with fæcal emanations, but more often there was nothing offensive to be found in the houses first invaded.

(4) *c*. It was not noticed that the houses visited by diphtheria were those which had previously suffered from other disease.

(4) *d*. There was no conspicuous or disproportionate exemption of families in comfortable circumstances as compared with those in a lower condition of life.

(4) *e*. Though I cannot furnish any precise analysis of the ages of those attacked, it was observed generally in these epidemics (as has often been observed before) that infants and adults, as a rule, escaped, or were only very slightly affected, while children from 2 to 12 years were especially liable to this disease.

To the above-mentioned general rule of exemption of infants and adults there were several exceptions. (*See* Bosmere, § 7; Clitheroe, § 6; Beddgelert, § 3; Haverfordwest, § 2.)

In some of the districts visited, I could not help noticing that the families affected were mostly fair-haired; but as I cannot state the relative proportion of dark and fair complexions existing in the population of the district, the observation is of no value.

In many of the families attacked there was something of a phlegmatic habit, or a history of phthisis, or of proneness to throat affections; but examples to the opposite effect were about equally numerous, where it was noted that the family history was good and the children robust.

5. *As regards the Communicability of Diphtheria.*—(*a*.) It rarely happened that in a family of several children, all equally exposed to the risk of infection, only one was affected. (*See* Carnarvon, sec. 2.) (*b*.) The usual experience was that, where diphtheria was once introduced into a family, all or most of the children were attacked, some, perhaps, simultaneously, or at intervals of one or two days or a week, the parents at the same time often suffering from more or less severe sore throat.

(5) *d*. The variety of circumstances under which diphtheria appears to spread by means of personal communication, was illustrated in several of these outbreaks. First and most frequently operative was the circumstance of dwelling together under the same roof, and next, sitting together in the same school. Probably the disease is often disseminated in a similar way at church and chapel (as observed by Dr. W. Ogle at Llanddausaint in Anglesea), but of this I have no certain instance to record.

Diphtheria may be caught in occasional visits to the bedroom or dwelling of a diphtheria patient (Festiniog, § 3); or, perhaps, in making purchases at a shop where the shopwoman is ill with diphtheritic sore throat. (Festiniog, § 3. Clitheroe, § 7).

Diphtheria may be conveyed from one locality to another by a person who has contracted diphtheritic sore throat at the one place afterwards visiting a susceptible family at the other. (Builth, § 7. Pembroke, § 7).

Diphtheria may be conveyed to a new locality by a person who has been in contact with a diphtheria patient, but has not himself contracted the disease. A striking instance of this occurred in the Beddgelert outbreak, (Festiniog, § § 4, 7),where a girl, who was in service at a house infected with diphtheria, though not suffering herself, appears to have conveyed the infection to her mother's house, 6 miles distant. This fact gives proof of a most perilous facility, under some conditions, of transport and dissemination of the diphtheria poison. Not only does the poison adhere to the person or clothes of the patient himself, but it can attach itself also to the person or clothes of an occasional attendant in such force as to survive the dissipating and diluting and destroying action of the air during a journey of several miles, and display its infectious property in the community to which it is thus newly introduced.

Seeing how greatly the chances of spread, and the difficulties of tracing it, are increased by this power of mediate communication, it may be asked whether this is not sufficient to explain the untraceable and apparently unaccountable origin of many outbreaks which at first seem to admit of no explanation but that of *de novo* or spontaneous origination. To what extent this is true cannot at present be affirmed.

As regards indirect modes of conveyance of the infection, bearing in mind Mr. Power's investigation of an epidemic of diphtheria, in North London, in which there seemed reason to regard the spread of the disease as connected with a certain milk supply, I made enquiry on this point in each district that I visited, but in every case the facts were negative of the theory that milk was the vehicle of infection.

I failed to find any instance of diphtheria being spread by parcels of clothes or bedding or other infected articles.

As to relation of diphtheria spread to the direction of the prevailing wind, I have no evidence to produce.

6. *As regards the Symptoms of Diphtheria.*—All the usual symptoms were fully exemplified in these outbreaks.

At Henley a fatal case occurred, which, if really due, as I believe, to the poison of diphtheria, must be called a case of laryngeal diphtheria, being (it was stated) unattended with formation of membrane on the tonsils or pharynx, but marked by swelling of the throat and discoloration after death. In the same epidemic a new born infant appears to have had the healing of the umbilical sore retarded by diphtheritic exudation.

7. *In respect to Treatment of Diphtheria.*—I learnt from Mr. Mackenzie, of Raunds, in Northamptonshire, that the inhalation of vapour of iodine with steam had proved very beneficial in promoting the separation and expulsion of the false membrane.

### *Inferences from the Foregoing Observations.*

In the course of my inquiries, and in reading the accounts given by other observers, nothing has struck me so much as the failure in the great majority of cases to trace the cause to which the origin of an outbreak of diphtheria can with any probability be ascribed. Sometimes, there is a suspicion of previous intercourse with an already infected district; sometimes attention is directed to foul water or foul air, sometimes to inclemency of weather, sometimes to a coincident malady in some lower animals; but in the majority of the cases, the history of the origin of the disease is an utter blank.

This, we may feel sure, would not be the case if personal communication with previous diphtheria were a necessary or habitual condition of a new outbreak of the disease. Compare, in this respect, the behaviour of small-pox; scarcely a case of small-pox occurs in the country that cannot be traced to personal intercourse, direct or indirect, with some earlier case of the disease. The usual history is that a servant girl has been sent home, sickening, from London; or that a villager has been to London to visit a relative ill with small-pox; or that a tramp from a town were small-pox is known to be prevalent has slept in the village; or that the clothes of some one who has died of small-pox have been brought home without being disinfected. Diphtheria, on the other hand, will break out at a lonely farm house in a bleak waste, where intercourse is rare at all times, and, as regards infection, utterly untraceable.

In the subsequent extension of diphtheria, the agency of personal intercourse can generally be traced. This brings out more strongly the independent character of the *commencement* of the outbreak. Just as, in the later course of the epidemic, we find that a considerable proportion of the cases bear evidence of being due to personal intercourse; so among a number of epidemics we might fairly expect to find a considerable proportion, which in their commencement (if really due to personal communication) should bear similar evidence of that parentage. The origin of many outbreaks might still remain untraceable, but such would, at least, not be the almost invariable rule.

This objection still holds, if it be urged that the personal communication may be untraceable, because some of the intervening cases have been so slight as to be unrecogniseable. We may be sure that for every epidemic that would require this theory to explain it, there would be two or three that could be referred to unmistakeable sources.

On this point I would refer to the inferences at which Dr. Sanderson arrived at the close of his extensive enquiries in 1859–60. (2nd Report of the Medical Officer of the Privy Council, p. 261.) He points out "that the transference of the disease from one "place to another was in some instances determined by local proximity, but that in "those cases in which it was not so, that is, in cases in which the disease appeared for "the first time in a locality distant from any in which it had previously existed, "*the circumstances were frequently such as to shut out even the possibility of personal com-*"*munication.*" "Hence," he says, "the conclusion is unavoidable, that unless it be "supposed that the material cause of diphtheria is from time to time generated *de novo*, "it is *capable of existing and moving from place to place independently of its subjects.*" (See also Mr. A. Wynter Blyth's paper on "Prevention and Propagation of Diphtheria" already referred to). From this conclusion I think there is no escape.

Other objections may be urged against the theory of surreptitious personal communication. Why should it operate more frequently in sparsely populated country districts than in densely inhabited towns, in which latter the facilities of intercourse are

far greater than in the former?—or on clayey soil more frequently than on sandy soil? —or in October more than nine times as often as in January?

In spite of all that can be urged as to the facility of indirect or mediate conveyance of the contagium of diphtheria from person to person, the great weight of evidence and probability is against the theory of personal communication, direct or indirect, as the cause of these autumnal outbreaks of the disease.

We are left to the alternative stated by Dr. Sanderson. Either the materiai cause of diphtheria is from time to time generated *de novo*, in the sense of arising apart from a previous case of the disease, or it is something which, originating only in the human body, is yet capable of existing and moving from place to place independently of its subjects.

I cannot but think that the evidence which has accumulated in these and other reports forbids the presumption that the material of diphtheria is a something peculiar to the diseased human body, and incapable of producing its effects except by transmission in some way from a diseased to a healthy human body. It would appear, on the other hand, that it must have, in the above sense, some origin *de novo*, while afterwards possessing the faculty of communicating disease from man to man. Proceeding to consider it on this assumption, the possibility of its origin *de novo* being within the human body has first to be thought of. I need hardly stop to ask if it is possible that the human system should possess the habit of annually developing diphtheria in autumn by some spontaneous depravation of a natural secretion, or otherwise, independently of external influences. It is evident that there is some external agent at work, especially in clayey wastes, in autumn, that is capable of inducing diphtheria in susceptible persons. This agent cannot be a combination of merely physical influences, such as cold, and wet, and fog, and wind, and want of sunshine, for diphtheria outbreaks exhibit no constant relation to the presence of such influences; and those influences have no such climax of intensity in October as is required to account for the excessive frequency of diphtheria outbreaks at that season.

It may be suggested that some non-specific product of vegetable or animal decay, most abundant in autumn and in wet localities, may by some poisonous action induce in susceptible persons a depravation of mucous secretion, which then, somehow, acquires the specific property of infectiousness. It may be answered that the habitual site of commencement of a diphtheria outbreak is not a dell in a wet wood, where the products of decay would be most likely to hang and accumulate,* but more often a bleak barren ridge where the surface air is most rapidly changed and most copiously diluted. And independently of this objection, there is a great difficulty in understanding how a morbid process, supposed to be set up by an external non-specific agent, could afterwards be communicated with perfect similarity by means of a specific agent of a different kind.

If like effects betoken like causes, it must be granted that the matter which causes diphtheria in the later extension of an epidemic is of the same kind as that which causes it in the first case. But in the later cases the morbific matter is something that has multiplied greatly in its progress through a series of human bodies. Therefore, the original morbific matter should be something of a specific nature that is capable of multiplication in the human body.

Nothing will satisfy this condition, except a specific living organism. At this point our inquiry comes into relation with the discoveries of Oertel and Hüter (referred to in the footnote on page 1).

Setting aside the question whether this specific organism is or is not capable of spontaneous generation, it concerns us to ask whether it is capable of multiplication outside as well as inside the human body,—"now fructifying in soil or water of "appropriate quality, and now the self-multiplying contagium of a bodily disease."†

If this morbific organism were incapable of thriving outside the human body, the untraceable October outbreaks of the disease could only be ascribed to the revivification under autumnal influences, of organic diphtheria germs liberated from the body of some former diphtheria patient, and surviving undestroyed. But why, if their natural haunt and habitat be the human body, should the month of October have such a special revivifying influence upon them? Their revivification could only be attributed to moisture and other physical conditions, which do not so conspicuously distinguish one month from another.

It is, moreover, difficult to understand how, on this supposition of inert wind-borne

* Dr. Woodforde, however, has found diphtheria apparently favoured by thick growth of trees about a village, and disappearing when the trees were thinned. (See Sanitary Record, February 1880).

† Simon, "Essay on Contagion," Brit. Med. Journ., December 13 and 20, 1879, p. 974.

disease germs, the populations of towns and sandy tracts should enjoy so much immunity as they do.

On the other hand, suppose the infective organism is capable of thriving outside the human body, its external habit might be parasitic in some lower animal, or vegetable, alive or dead, or on the earth, or in water, or in air.

As to the first, it has not been noticed, as far as I am aware, that diphtheria usually occurs in relation to the presence of any particular animal, still less to any particular disease of any particular animal. If such relation does hold, the animal must be very minute, for inquiry concerning the larger animals acquits them of any habitual share in the process of infection.

The supposition that diphtheria, in the origin of an outbreak, is caused by an organism that haunts air, or water, appears to me to conform most closely to the requirements of observed fact.

It is quite reasonable to suppose that such an organism, having a subsistence dependent upon seasonal conditions, should have its own special season of maximum growth and reproductive power; that it should be capable of infecting water or milk; and that it should affect preferentially a particular character of soil, such as clay, and avoid the smoky purlieus of a town.

The preference of diphtheria for dwellings in exposed and elevated situations is difficult to explain on any theory, except that of exposure to the wind and to whatever the wind may carry. (For valuable arguments and suggestions in support of this theory I would refer to Mr. A. Wynter Blyth's paper cited above.)

Such facts as that of the immunity of town children attending a country school, could be understood, if we suppose that the country children, taking another direction, breathed air containing an organism which the town children escaped.

Possibly, the "progressive development of infectiveness" observed by Dr. Thorne at Llanrhaiadr, might correspond (as Dr. Thorne has himself suggested *), to progressive development of the organism towards the attainment of full reproductive power.

Such an organism might be expected finally to yield itself to microscopic identification in its (supposed) native haunts.

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## MIDHURST.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Midhurst; Sub-district, Fernhurst. Four deaths from diphtheria. (Registrar's note, "The "four deaths from diphtheria occurred in the parish of Lurgashall.")]

1. The district of Midhurst in the West of Sussex and especially this sub-district of Fernhurst, which lies on the Wealden Clay, is one which is habitually visited by diphtheria. Year after year, in one village or another, along a certain tract of clayey, wooded, wet country, the Medical Officer of Health has had his attention called to isolated outbreaks of diphtheria.

2. The neighbouring villages of Lurgashall and North Chapel have been among those most frequently visited by this disease. There was an outbreak of diphtheria at North Chapel, two miles from Lurgashall, in 1878. Possibly from the survival of the contagium derived from North Chapel (for there is communication between the two villages), or possibly from the revival of dormant contagium derived from former attacks of diphtheria in Lurgashall itself; diphtheria (or at least severe sore throat of a contagious nature) appeared anew near the latter village in June 1879, in the family of a copse cutter, named Kingshott. The children first attacked were a brother and sister, aged 10 and 13, who were attending Lurgashall school. Subsequently two older brothers and also the father and mother were attacked. All recovered. This family lived in a lonely cottage, a mile distant from the village. There was no suspicion of recent diphtheria at the school which the children attended; nor was there anything in the surroundings of the house of a specially unwholesome character,—nothing beyond the general wetness of this part of the country.

3. No other cases were recognised or remembered until October, when the disease broke out afresh among children attending Lurgashall school. This recrudescence of the infection first showed itself in a family of six children; of whom three, who attended the school, were first attacked, and then two younger ones, while the parents and eldest son (17) escaped. All recovered. They lived at the edge of a clayey waste, called Windfold Wood Common. Two other families in the same locality were soon

* "Remarks on the origin of Infection," The Practitioner, vol. xx., No. vii., June 1878, p. 480.

afterwards infected, and in the course of November and December the epidemic extended to six other families in different parts of the parish. In addition to these, there were five families, in each of which there occurred more than one case of sore throat of a suspicious character, but not definitely diphtheritic, though apparently in connexion with the prevailing epidemic of genuine diphtheria.

4. Including all, 15 families were invaded. These comprised 93 members, of whom 53 were attacked with throat affection more or less severe. Five cases ended fatally. In 12 out of the 15 families that suffered, the persons first affected were children attending Lurgashall school. Of the remaining three, two had children at school, but in one case the mother, and in another a child, not attending school, was the first to take the disease. Lastly, only one family, that had no children at school, was attacked, and this was next door to a house in which four children were ill.

5. The school, which had been open all through October and November, was closed on December 2nd; and after that date only one fresh family was attacked, though new cases continued to appear in some of the families that had been previously infected.

6. Radiating from the school the disease extended to widely separate parts of the parish of Lurgashall, among which there was no community of domestic conditions, such as milk, water, &c., which could be suspected of being concerned in the spread of the infection. There was no knowledge of any disease prevalent among cattle, sheep, geese, poultry, or other animals. Personal communication alone appears to have been the agency by which the infection was transmitted from person to person; and the assemblage of children at the village school afforded a ready means of its transmission from family to family.

7. This outbreak had, before my visit, been carefully inquired into by Dr. Charles Kelly, Medical Officer of Health for the West Sussex combined district. Dr. Kelly's frequent experience of diphtheria, and especially of its remarkably unequal incidence upon different parts of his extensive district, gives particular value to his observations. The predilection that diphtheria shows for wet clayey tracts as contrasted with sandy tracts; the habitual re-appearance of the disease in the autumn, its apparent preferential incidence on families that have shown a liability to throat affections; and especially on children who have long distances to walk to and from school; these are points illustrated or suggested by Dr. Kelly's experience and deserving of systematic study.

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## DUNMOW.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Dunmow; Sub-district, Stebbing. Four deaths from diphtheria. (Registrar's note, "The "four deaths from diphtheria occurred in one family.")]

1. This proved to be a very limited outbreak of diphtheria, commencing early in September 1872, at a small private school in the village of Felstead, three miles east of Great Dunmow, and extending in one family to other members who did not attend the school.

The situation of the village is high and bleak. The soil is clay, irregularly covered with gravel.

There had been no diphtheria in the neighbourhood for more than a year. The last preceding cases occurred in the spring of 1878 at Lit. Bardfield, about six miles to the north.

The weather was fine before and at the commencement of the epidemic. There was nothing to suggest any climatic influence as the cause.

2. The little school above mentioned had only nine scholars, belonging to eight families in the village. School re-opened after the harvest holidays on September 8th. On that day all the children were present, except one, Jane Snell, who was staying with friends at Forest Gate, near London. She returned next day, September 9th. On September 12th she complained of feeling ill, and stayed away from school. On the 15th she was seen by a medical man, and was found to have diphtheria. On the same day the same medical man saw another of the school children, named Maud Weaver, and found that she was suffering with the same disease. She had been ill two days.

3. On the 18th a third case occurred in another girl attending the school, named Helen Taylor, one of a family of six children, living at a farm house in the village. The school was closed next day. Helen Taylor recovered, but four of her brothers and sisters were successively attacked at intervals of a few days, and died, all four, within three weeks. A cousin staying in the same house was also attacked, but recovered.

An infant escaped altogether. There were objectionable features in the privy arrangements at the Taylor's house; the privy was placed in a re-entering angle of the house-wall, and had a door into the house as well as a door into the garden. The pit was drained by a pipe-drain of about 6 inches diameter into a stagnant moat about 60 feet distant from the house. The outlet of the drain was open, and when the wind lay in that direction, a privy smell was perceived in the house. The pit had also a side opening, external to the privy, for convenience of flushing. This opening was immediately beneath one of the kitchen windows. Possibly these admissions of foul air may, by lowering the health of the children, or in some other way, have conduced to the fatal results of the attacks of diphtheria; but, I think, it is more probable that these results were mainly due to some constitutional predisposition to diphtheria in this family, such as has frequently been observed in regard of this and other infections.

4. Returning to the earlier cases, of Snell and Weaver, it appears that Maud Weaver had during the holidays been staying at Great Bardfield, more than a mile from Little Bardfield, where diphtheria had been present in the previous year; there was, however, no evidence that she had been in contact with any person or thing that could be suspected of harbouring the infection of diphtheria. It could, therefore, only be supposed either (1) that Maud Weaver had contracted the disease from her school fellow, Jane Snell, or (2) that both these children had been infected from one common source. (The possibility that they might have been almost simultaneously yet independently infected is too remote to be taken into account.)

5. Against the former hypothesis must be set the shortness of the interval between the two attacks. Jane Snell's illness dates from 12th September, Maud Weaver's from 13th September. The period usually assigned to the incubation of diphtheria is from two to five days. But it may be suggested that Maud Weaver caught the disease from Jane Snell, while the latter was still incubating with it. This might have taken place, at the earliest, on 9th September; which would give four days, perhaps five, as the incubation period in Maud Weaver. Indeed on any hypothesis connecting these two cases (Snell and Weaver) the incubation period in the latter cannot have been greater than five days.

6. Jane Snell herself may possibly have contracted the disease before returning from Forest Gate, or in the railway train on the journey home. Dr. Armistead, Medical Officer of Health for the combined district, which includes the Dunmow Union, to whom I am much indebted for valuable assistance, made careful inquiries at Forest Gate, but did not hear of any diphtheria in the neighbourhood where Jane Snell had been staying. The girl herself had no recollection of having come in contact with any person who appeared to be suffering from throat disease. The supposition that she in some way brought the infection with her, and speedily transmitted it to her schoolfellow, either sharing with her the original contagium, or else reproducing it at an early stage of incubation, furnishes, perhaps, the most probable explanation of the origin of the outbreak.

7. There was, however, a curious circumstance in connexion with the school already mentioned, which at least deserves to be recorded. Shortly before, and for some time during, the prevalence of diphtheria among the school-children, a flock of diseased sheep brought from London, were kept in a field which was entered by a gate just under the back window of the school room. Morning and evening the flock passed through this gate, into and out of the field. Occasionally the back window of the school room was open. It was suggested that the children might have been infected by the breath of these sheep mingling with the air of the schoolroom. The school mistress, however, never perceived any offensive smell in the room, nor was her attention drawn to the sheep in any way. The animals do not appear to have been seen by a skilled veterinary surgeon; and there is great doubt as to the nature of their disease; but the grazier to whom they belonged expressed himself confident that they were not suffering from anything infectious, for some healthy sheep were kept with them for a fortnight without catching the complaint. But sick and healthy were all slaughtered, in evident desire to get rid of the whole lot. In a report to the Dunmow Rural Sanitary Authority on this outbreak, the Inspector of Nuisances states with regard to the sheep, "several of them "died soon after arrival, others were stuck being very ill, and I am informed that their "throats were ulcerated, full of loathsome matter, and their plucks also." The butcher in whose shambles the sheep were slaughtered considered that the throat ulceration was nothing more than what he was familiar with in old worn-out ewes; but his assistant who was more immediately concerned in the slaughtering described the appearance and stench as something very unusual.

It might have been expected, if these diseased sheep caused diphtheria, that other persons besides the school children should have been affected, for, not to mention the

men and boys employed at the grazing farm, it was remembered that a number of boys from Felstead Grammar School had stood in the road watching these sheep as they were driven to or from the field one day. But no case of sore throat occurred among them.

Without knowing more about this disease of the sheep, and without gathering confirmatory evidence in other instances, it would be hazardous to suppose that there was any relation but that of accidental coincidence between the presence of these diseased sheep and the appearance of diphtheria in the school.

8. There was no knowledge of any other disease prevailing among farm stock or domestic animals at the time.

9. The schoolroom was a first-floor room, well lighted and ventilated, and amply large enough for the reception of nine scholars. At the foot of the stair which led to it, and under one corner of the schoolroom was a water-closet, ventilated by two windows in its two external walls. There was no smell from this closet. Nothing in connexion with the school appeared open to objection.

10. It was noticed that the children who were attacked were all dwelling in the village, and that three or four, who came from an adjacent hamlet called North end, escaped with nothing more than a slight temporary malaise. The numbers in question are too small to make the fact significant, and its significance, if any, would probably be found dependent on something else than distance of dwelling. On enquiry I learnt that the three children first attacked, Snell, Weaver, and Taylor, sat together at one side of a table in the middle of the schoolroom; opposite to them sat three other children, of whom two escaped, the third being another of the Taylors who subsequently caught the disease, in all probability at his own home. At a separate desk, against the wall behind the first three children, sat three others, who also escaped.

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## BOSMERE.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Bosmere; Sub-district, Coddenham. Four deaths registered from diphtheria. (Registrar's note, "Of the four deaths from diphtheria, two occurred in the parish of Barham, and two in Henley.)]

1. Barham and Henley are adjoining parishes in the Bosmere Union. On their confines, but chiefly in the latter parish, at the little village of Henley, five miles north of Ipswich, the outbreak occurred which was marked by the four deaths above noted. The position of the village is bleak and exposed, on an elevated plateau of cultivated clay land.

2. As far as could be learnt, diphtheria first appeared in the family of a hay dealer, named Steward, at a small farm-house in Barham parish, about half a mile from Henley. The family consisted of the father and mother, five children (ages two, four, five, seven, eight), and a servant girl. The four elder children were attending the Henley school, about a mile distant. The one first attacked was a little girl of five years. She was taken ill on the 21st of November on returning from school in the evening, and she died on the 27th. On the same day the mother was confined with a sixth child. From the mother's description it would seem that when the infant was three or four days old, the umbilical sore put on an unwholesome appearance and became affected with something resembling diphtheritic exudation though it did not become distinctly membranous. Beyond this, the infant did not suffer. All the other members of the household were attacked, one after another, with diphtheria, and one of them, a girl of eight years, died on the 25th of December.

Suspicion attached to the drinking water which was used by the Stewards. It was obtained from a well in close proximity to a foul privy at the back of the house. For washing purposes, and also occasionally for drinking, they drew water from a weedy pond in the garden.

3. No disease among farm stock, cattle, or sheep had attracted attention. There had been some mortality among fowls in the summer from a malady which affected their feet in the first instance, attributed to the wetness and coldness of the season.

4. There had been no known communication with any other infected place. It is, however, quite possible that the father, in the course of his business, may have come in contact with some infected person and may have brought the infection home. In the neighbouring Hartismere Union there were three deaths from diphtheria in the same quarter, and one in the Stowmarket district, and one at Ipswich, showing that there were several possible sources of infection around.

5. The school to which the Steward children went stands in an exposed situation, and appears to have been insufficiently warmed, for at several cottages I was told that the children had often come home complaining that they were "perished with cold." The summer had been wet and sunless, and the winter began early with unusual severity. The children who suffered most severely from diphtheria were among those who had appeared to feel the cold most. Owing to the distance of their homes from the school, many of the children had to bring their dinners with them, with a bottle of milk or cold tea to drink. They often drank also from a ditch pond of surface water at the nearest cottage, such as in elevated clayey districts usually serves for all purposes of water supply. The dwellers at this particular cottage, however, were not attacked with diphtheria.

6. After the first appearance of the disease in the Stewards' family about November 21st, those who remained well continued to attend school. Early in December others of the school-children were attacked. One named Worledge, residing in the village, half a mile from the Stewards, was taken ill on December 8th, and died on the 10th. Another of the same family was ill about the same time, but recovered. There were also two or three doubtful cases here. These children were of rather delicate appearance and were said to be subject to colds. There was a history of phthisis on the father's side. The local conditions were not such as to attract attention.

7. Three other families were visited by diphtheria in December. In each family the child first attacked was one who was attending the village school. In one there were three cases which ended favourably; (a fourth child, an infant of seven months, died on December 18th, of "atrophy.") In another, three children and their mother were attacked; one of the children, aged nine, died on December 21st after two days' illness. The mother, when I saw her, was in a state of great weakness, scarcely able to stand, her breathing was short and her voice half a whisper. She had been ill 11 weeks. The family seemed sunk in poverty.

8. A boy of nine who resided in quite another direction from any above mentioned, but who attended the same school, died on December 16th, after being ill for a week or more (there was no certain recollection of the length of his illness) with symptoms which were not those of normal diphtheria, but there was some swelling of the throat, and after death the throat was observed to be discoloured. The death was certified from "erysipelas." Two other children in the house, who did not go to school, were unaffected except with colds. It is difficult to disconnect this fatal case from the prevailing epidemic of diphtheria, a disease which admits of considerable variation in degree of intensity, and to some extent in nature of symptoms.

9. Altogether in this outbreak (including three slight cases, and the abnormal case last-mentioned) there were 21 persons attacked, of whom five died.

The origin of the epidemic remains undiscovered. The spread of it was due, I think there can be no doubt, to the personal intercourse of the children at school, the healthy ones intermingling with schoolfellows who came from infected houses or who suffered from mild attacks of the disease.

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## THRAPSTONE.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Thrapstone; Sub-district, Raunds. Two deaths registered from diphtheria.]

1. In addition to the record of two deaths from diphtheria in the Raunds sub-district in the last quarter of 1879, information reached the Board that a serious outbreak of the disease had occurred in the village of Raunds, near Thrapstone, in the further course of the winter.

The village occupies the slopes of a little valley, an eastern offshoot of the valley of the Nene, which in this part of its course has a general direction from south to north. The higher plateau of arable land consists of Oxford clay: a bed of limestone, and another of ironstone crop out in the slope of the valley side. The lowest part of the village is on the Lias clay.

2. It appears that about the middle of November a child, named Elsie Smith, between three and four years of age, residing in a clean well-built house near the southern end of the village, and attending a little dame-school near at hand, was attacked with diphtheria and died on November 20th. About the same time a little boy, named Stubbs, $2\frac{1}{2}$ years old, living not far from Smith and attending the same school, was taken ill in the same way and died on November 24th. Other cases speedily appeared among children

who came together at the school, and among other members of the same family. Subsequently the disease spread widely in the village and the increasing number of foci of infection increased at once the facility of its spread and the difficulty of accurately tracing it.

3. My inquiry was limited to the earliest cases in November. There was nothing at the homes of the children Smith and Stubbs that could be accused of giving rise to the disease. Their dwellings lay on opposite sides of a branch road that leads up from the lowest part of the village to the higher level of the arable land.

There seemed good reason to think that the children had contracted the disease at the school, for attendance at school was, as far as was known, the only condition common to the first five or six cases. In this direction inquiry was somewhat at fault, for the old lady who kept the school had since died, and information regarding it could only be obtained from the neighbours. The house stands near the bottom of a steep row of half-a-dozen cottages rising from the road. The privies and ashpit belonging to the row are placed at the top, and the ground is so steep that there appears to be some risk of soakage from them into the soil under the cottages. Up to the time of the outbreak there had been, it was stated, a nuisance immediately in front of the door of the school, arising from a choked drain, and accumulation of slops on the surface. The old lady who kept the school had become so infirm that she could not walk so far as the closet at the top of the row. The result was a retention of stools in a chamber vessel, which was kept in the room where the little children, eight or ten in number, were gathered for schooling. A neighbour described the smell in the school-room as so bad that she could not stay in it. The house was unoccupied and locked up when I visited the place, but looking in at the window I could see that the school-room was very small, only about 8 feet square.

4. On further inquiry I learned that there had been cases of throat disease, occurring in adults, in two other houses in this same row, a month or two before any of the school-children were attacked. It is not certain that the throat disease was diphtheria though the relation in respect of locality, between those earlier cases of throat disease, and the later cases of pronounced diphtheria was exceedingly suspicious. Nothing was known of any importation of the infection. The origin of the disease must, I fear, remain doubtful; but it is difficult to escape the impression that its fatal incidence upon little children attending the dame-school was in some way dependent upon, or determined by, the foulness of the atmosphere in which the children were assembled.

5. Up to the 16th of February there had been 54 cases of diphtheria, of which five had ended fatally.

6. The arrangement above described of privies placed close at the top of the row of dwellings to which they belong, appears to be usual in Raunds. There is evident danger of the house foundations and basements becoming soaked with fluid from the privies and polluting the air in the dwellings.

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## CLITHEROE.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Clitheroe; Sub-district, Chipping. Population, 3,301. Eleven deaths registered from diphtheria. (Registrar's note, "Diphtheria prevalent in the townships of Chipping and Thornley.")]

1. The locality affected by this outbreak of diphtheria was the village of Chipping, at the foot of the Bleasdale Moor, and the neighbouring hamlets of Hesketh Lane and Thornley, in the wide valley that lies between Bleasdale Moor and Longridge Hill, in Lancashire. Longridge Hill is composed of millstone grit; Bleasdale Moor of mountain limestone; and the intervening valley slopes are formed of the debris of the hills around. The soil is less clayey than that of most localities in which diphtheria is found to prevail; but some of the houses in which the disease had occurred were in notably exposed situations.

2. The Medical Officer of Health, Mr. W. P. Counsellor, of Whalley, near Clitheroe, placed at my disposal all the information he had obtained relating to the outbreak. The first intimation that he received of the occurence of any case of diphtheria was towards the middle of December, when he heard from the Registrar of two deaths from that disease in the neighbourhood of Chipping, on the 25th and 30th of November. His first visit to the infected district was on December 14; and on his recommendation the schools at Chipping and Hesketh Lane were closed from that day

to the 16th of February 1880. The mischief, however, had already been done. A third death had occurred in a fresh quarter on December 4; fresh foci of infection appeared on all sides; and the epidemic rapidly reached the proportions indicated by the number of deaths (11) registered before the end of December. The epidemic still increased, with further fatal results in January 1880.

3. I did not attempt to collect particulars of the outbreak in its later extension, but confined my inquiry to the earlier cases, endeavouring, if possible, to ascertain the mode of origin of the infection.

The death which occurred on December 4th was the first of four deaths in the same family (Sefton), residing at a comfortable farm house at the foot of Longridge Hill. The children, ten in all, were healthy—had never had a doctor before. They had attended the Chipping School, and had there been in company with children (Nuttalls) who came from a house already infected with diphtheria. Besides the four who certainly died of diphtheria, there was a fifth child, aged $2\frac{3}{4}$, who died about the same time, the death being registered from "otitis." The Medical Officer of Health had no doubt that this also was a case of diphtheria, though somewhat abnormal in its symptoms. A girl of $16\frac{1}{2}$ years recovered from a severe attack of diphtheria, but she suffers from paralysis. The Seftons had milk from their own cows, which were quite healthy. There was no disease, that was known of, among animals. Water was had from a copious spring close to the house. Above the spring was a soaking manure heap, which would probably have seriously affected the purity of the water, if the source of the latter had been a well instead of a strong spring.

The Nuttalls, above mentioned, from whom the Seftons probably caught the disease, lived in one of a row of cottages on the bank of a stream in a narrow ravine at the foot of a hill near Chipping. The place was known as the "Bottoms." The father is a workman in a smith's shop near by. The eldest boy (William, 12) took a day at school and a day at the shop, alternately. One day after the end of October, he felt ill after working in the shop, with all the symptoms of a violent cold. His mother took care of him, and he got well, but he has since had difficulty of deglutition, his speech and eyesight have been affected, and he has felt very weak. There were four other children in the family; they have all suffered in different degrees; a girl of 10 felt ill one evening, but was well the next morning; a little one of two years was next attacked, but recovered; on November 21 Alice Nuttall (6) came home from school at dinner time, feeling ill. She died on November 30. Her sister Annie (8) fell ill on November 24, but recovered.

This family had previously been very healthy, and the children not subject to any throat affection. The house was clean, and there was nothing in its surroundings to find fault with. Water was drawn from a well at the lower side of the road, believed to be supplied by a natural spring in the bank. Milk was seldom obtained. No disease was known of among animals.

5. About the same time that William Nuttall was ill, a boy named Kay, 10 years old, also suffered from a bad cold and sore throat, for which poultices were applied; he had difficulty of swallowing, and his voice was affected; his tonsils show distinct excavation. He was one of a family of four children, the ages of the other three being 15 years, 7 years, and 10 months. They lived at a cottage called Abbots Barn, in a very exposed elevated situation a mile from the village of Chipping. The three elder children were attending a school in Hesketh Lane, not the same school that was attended by the Seftons and Nuttalls. On November 15th, the eldest and the third (aged 15 and 7) were taken ill—they were going to school at the time—and the younger (aged 7) died on November 25th. The eldest recovered. The baby was not attacked. The family were healthy, and "never had so much to pay a doctor before." There was no reason to suspect the milk or water supply, or any domestic conditions. No previous cases of sore throat had been noticed at the Hesketh school; and it appears probable that the two later attacks in this family were dependent upon the earlier illness of the boy aged 10. In what way he contracted the infection is not known. A boy of 14, named Chester, at a neighbouring farm in a more sheltered situation, had previously suffered with a sore throat, but he was a boy who was unusually subject to sore throat, and his recent attack did not appear to have been in any way different from the earlier ones. It is true, there was the appearance of recent loss of tissue from the upper part of the tonsils; and it was stated that caustic had been applied. The dwelling is a comfortable farm house. No suspicion attached to the local conditions.

6. Questioning the Nuttalls as to any previous case of sore throat, I was told of a woman who kept a little toffy-shop in Chipping, much resorted to by the children, and by William Nuttall among others. I found this woman (Mrs. Mair), and from her description have little doubt that in the early part of October she was suffering

from diphtheria. She "had something wrong with her throat," experienced difficulty in swallowing, treated herself with poultices and applications of lard, and has kept her face carefully tied up with a handkerchief ever since. For a long time she was very weak and noticed that her voice was altered. She was seen by a local practitioner, and was told by him that her disease was diphtheria. She had no idea how she could have caught it; but acknowledged that hawkers and such people frequently called at her shop. (I have since heard from Mr. Counsellor of a recent extension of the outbreak in the neighbourhood of Stonyhurst College, "the infection having been brought over the hill "by the fathers of the respective children *who are hawkers.*" I suspect that persons of this class are often instrumental in disseminating infectious disease.)

Mrs. Mair's cottage was close and dirty. Her husband had lost the use of his lower extremities, and could not keep himself clean. Mrs. Mair described the atmosphere of the bedroom as being very offensive at night. She obtained water from a roadside streamlet, apparently nothing but surface water from the side of a field.

7. It might be suggested that Mrs. Mair, having in some way contracted diphtheria, may have communicated it to children making purchases at her shop, either by the medium of the air they inhaled or, possibly, in adhesion to the sweetmeats they put in their mouths.

The further extension of the disease appears to have been mainly due to assemblage of the children at the schools.

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## CARNARVON.

[Registrar General's Quarterly Return, 1879, Fourth quarter.—District, Carnarvon; Sub-district, Llandwrog. Population, 10,995. Five deaths registered from Diphtheria. (Three at Llanllyfni, two at Llanwnda.)]

1. This outbreak of diphtheria occurred among a population partly agricultural and partly engaged in slate-quarries, on the western slopes of the mountains that intervene between Snowdon and Carnarvon Bay. The soil is a detritus of slate-rock. The rock itself appears in many places. The families affected resided for the most part in separate cottages on the hill side.

2. The first case occurred in a strong healthy child of five years, named Owen Jones, the son of a quarryman, living at an out-of-the-way cottage on the bare hill side, in the parish of Llanllyfni. On September 26th he came home from school feeling ill, and complaining that his school fellows made his head ache. He died after nine days' illness. Except attendance at school and occasionally at chapel, this boy had been nowhere but at home, and there is no evidence whatever to suggest in what way he can have taken the disease. No person with sore throat was known to have visited the house. There had been no recognised case of diphtheria recently in the neighbourhood, though during the past 12 months there had been several cases in the southern headland of Carnarvonshire. The cows are kept in an outhouse adjoining the dwelling. There was no known disease among them, nor among other animals. The vicinity of the cottage was defiled by a soaking manure-heap, as is the case with the majority of cottages of the same class. There was nothing in the nature of the water supply to cause suspicion. The weather had been moist and muggy.

There was no doubt as to the nature of the disease; yet no other members of the family were infected, though a sister, aged 19, and a brother, aged $8\frac{3}{4}$, slept with the sick child till the day of his death; a younger child, between three and four years, also escaped.

3. It does not appear certain that any other children attending the same school were infected from Owen Jones. Two children, indeed, had sore throats, but none till the latter part of November, nearly two months after Owen Jones's last attendance. Meanwhile, however, in the adjoining parish of Llanwnda, in a hamlet at a considerable height on the hillside, two or three miles from Llanllyfni, a child of five years died of diphtheria on October 28th; a younger child in the same family escaped. Another death from diphtheria took place in another family in the same neighbourhood on December 23rd. No connexion was positively traced between them, but there had probably been personal communication between the two houses.

4. Again, on December 11th, a girl, named Elizabeth Roberts, came home ill with sore throat from the village of Penygroes (close to Llanllyfni), and died on December 20th. It was not known how she caught the disease. She is said to have been exceedingly susceptible to sore throat, and her mother and sister likewise, to such a

degree that "if they only wetted their feet they would have to lie in bed for a week or more." A girl of 13, named Williams, who was visiting at the Robertses', and who slept with Elizabeth Roberts, was taken ill after returning to her own home on December 15th, and her sister (16) began to sicken on the 20th. Both of these recovered. About the same time that Elizabeth Roberts was taken ill in Penygroes, a child of four years, named Evans, in the same village, was attacked with diphtheria, and died on December 16th. Here again nothing could be learnt as to the probable mode of infection.

5. This cluster of diphtheria cases was exceptional in being mainly, if not entirely, independent of school concourse. Careful enquiry into the attendant circumstances had been made, soon after the actual occurrence, by the Medical Officer of Health, Dr. Hugh Rees, of Carnarvon. The mode of origin, and, to a great extent, the mode of spread are alike untraceable.

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## FESTINIOG.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Festiniog; Sub-district, Tremadoc. Five deaths registered from diphtheria. (Four in Beddgelert parish, population 1,423.)]

In this outbreak of diphtheria, though most of the cases occurred in the parish of Beddgelert, yet the village of that name was untouched. The locality in which the first case, and most of the subsequent cases appeared, was the roadside hamlet of Glanaber, at the lower end of Llyn Gwynant, in the deep valley of Nant Gwynant, facing the eastern slopes of Snowdon, about four miles above Beddgelert. The hamlet lies at the foot of a thickly-wooded slope which keeps it damp, and, in winter, sunless through the greater part of the day. The soil is partly clayey, composed of debris of the slate rock of the surrounding hills.

2. On October 31st, 1879, a boy named Thomas Humphreys (healthy, not liable to sore throat), was taken ill with diphtheria, which ended fatally on November 7th. On the day of the attack, after leaving school, he had been over-heated in pursuit of a ram (stated to be healthy), and then got a chill at chapel. In the preceding weeks he had not been away from Glanaber, nor had any person come to Glanaber from any locality known to be infected. A month before there had been at least one case at Llanllyfni (*see* report "*Carnarvon*," above), on the other side of the Snowdon mountains, 15 miles distant, but no communication between the two villages was known to have taken place. The Humphreys' house is rather damp. The family got milk from two or three different places. No disease among cattle or sheep was known to exist at the time. Water was obtained from a spout on the hillside above the hamlet (perhaps remotely liable to a chance of contamination from the evacuations left by children who were sent to fetch water), or from the river which flows out of Llyn Gwynant.

3. In the week succeeding Thomas Humphreys' death, diphtheria appeared in six other families in Glanaber. In five out of the six, the first persons attacked were children who had been at school with the boy Humphreys. In the sixth (the family of William Jones), there was no child of school age, but the first person attacked was Mrs. Jones, who had been several times in Humphreys' bedroom while he lay ill. Jones and Humphreys were next-door neighbours. Mrs. Jones kept a shop. Only two or three of these families had milk from the same dairy. They had water from the same source, the spout above mentioned, which I cannot suspect of having had any share in causing the disease. I think there can be little doubt that the infection spread to these six families simply by personal communication with Thomas Humphreys. More than a month later, a girl of 13, residing at an isolated farmhouse, about a mile from Glanaber, was taken ill with diphtheria, and died on January 2nd, 1880. She used frequently to come into Glanaber, to chapel, or to the shop kept by Mrs. Jones, and it is probable that she caught the disease by personal contagion.

4. A girl of 13, named Williams, who was in service at Mrs. Jones's, at the shop, went home on Tuesday, November 11th, to spend the hiring day holiday (November 13th), at her mother's, at a cottage, one of a pair, six miles from Glanaber, in a most sequestered spot, known as Gardd-llygaid-y-dydd, among the upland pastures on the slopes of Cynicht, at the head of the Traeth Mawr. She stayed there till Saturday, November 15th. She herself had no sore throat, at least she was not ill; but shortly after her return to service two of her sisters at Gardd-llygaid-y-dydd were taken ill with sore throat. They recovered. Then the family in the adjoining cottage (Evans) caught the infection early in December. Mary Evans, aged three, died on December 14th, after about nine days' illness. Mr. and Mrs. Evans were also ill, but recovered.

5. A little later, a family of six children, named Parry, living in a cottage on a wooded bank, within a mile of the last-named cases and attending the same school (at Pontaberglaslyn) with the Williamses, were attacked with diphtheria. They all recovered, but the eldest has since suffered from paralysis. An infant escaped altogether, as also did the adults. The school was promptly closed, and no other cases occurred among the school-children.

6. A death from diphtheria occurred on December 12th at a roadside cottage near Tremadoc. This case appeared to be entirely unconnected with any of those above-mentioned. None of the family had been near to any place that was known to be infected, nor had any person been to their house who was likely to bring infection. No clothes or bedding, or any such articles had recently been brought to the house. The only thing suspicious about the house itself is that it stands by the side of the high road from Glanaber and Beddgelert to Tremadoc. Tremadoc is the principal market town and railway station in this part of the country.

7. With the exception of this case near Tremadoc, the whole of the outbreak in the Tremadoc sub-district, as above described, appears to hang together in a not improbable chain of personal communication.

Especial interest, I think, attaches to the infection-colony that settled at Garddllygaid-y-dydd, if, as the evidence appears to indicate, the infection was conveyed thither from Glanaber by the eldest girl Williams, who was not herself attacked. It may be supposed that the infection was carried in her clothing.

8. Altogether there were 34 attacks, of which eight ended fatally.

Dr. Rees has since informed me of two more deaths at Glanaber in March 1880.

This outbreak, like that before described in the Carnarvon rural sanitary district, had been carefully investigated by Dr. Hugh Rees, Medical Officer of Health for the Carnarvonshire combined sanitary district, to whom my thanks are due for valuable assistance.

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## BUILTH.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Builth; Sub-district, Builth. Population, 3,336. Five deaths occurred from diphtheria. (Registrar's note, "The five deaths from diphtheria occurred in the parish of Llandewyrcwm.")]

1. The scene of this outbreak was the lower part of the valley of the Dihonw, a tributary of the Wye. The valley here forms an irregular basin, shut in by hills of considerable height to the S.E., S. and W., less confined towards the north, and opening to the N.E. into the larger valley. The hills are composed of shaly slate, and their flanks and bases are covered with a soil of shaly clay, derived apparently from the crumbling of the slaty rock. The valley is not thickly wooded. Tilled fields and pasture occupy the bottom and sides, and pasture extends to the hill tops.

The parish of Llandewyrcwm had, in 1871, 313 inhabitants. They are not gathered together in a village, but are scattered in small farms and separate cottages at all elevations on the hill sides.

2. Diphtheria first showed itself in an isolated cottage at the bottom of the valley, inhabited by a farm labourer named Jarman, his wife and five children, aged 14, 11, 9, 7, and 4. Those aged 11 and 9, both girls, were attending the parish school. Elizabeth (9) came home from school, ill, on October 23rd. In the school register she is marked as having attended school up to the 27th. She recovered. John (7) sickened on October 30th, and died November 1st. This death was so sudden that, no medical man having been in attendance, a coroner's inquest was held. The nature of the disease was made evident by the rapid sequence of fresh attacks in the same family. David (4) was taken ill on November 2nd, and died November 9th; and Ann (11) taken ill November 3rd, died November 16th. William (14) fell ill on November 8th, but subsequently recovered.

3. On November 10th the doctor was called to see a boy, George Whiting, ill with diphtheria, at a remote cottage, high up the hill. He had been attending the parish school up to October 29th, and was not known to have had any other opportunity of intercourse with the Jarmans. George Whiting (7) recovered, but two younger children (five and three), who were not attending school, subsequently sickened and died, one on November 25, the other on December 11th. The two deaths in this family, and the

three previously mentioned in the Jarmans' family, made the five deaths reported to Registrar-General. Eight other non-fatal cases occurred in four families that had children attending the Llandewyrewm school. Altogether, in connexion with this school, 15 children and one adult were attacked, in six families. Five of the 16 children died. In each of the six families the child first attacked was attending the school; except in one case where the infection, if derived from the school, was probably conveyed by an elder child who was attending the school, but was not taken ill. The school was not closed until the 8th of December.

4. The school building stands on the northern slope of the hill near its foot. It is rather damp and cold. The privies, with cesspit in common, are placed in rear, not far from the building. Above the school is a cow pasture, the surface drainage of which, in wet weather, runs in a little stream near the school. The water is certainly polluted by the droppings of cattle. The children often drink of it. The school mistress, however, believes the streamlet was not flowing at the time when diphtheria broke out.

In this, as in most country schools, it is usual for those children who reside at some distance to bring their dinners with them, in basket or bag, and stay at the school during the dinner hour. For drink, they bring a bottle of milk or tea. The bottles get broken, and then, for punishment, they are sent without any beverage. At these times, and indeed at all times, the children readily resort to the nearest runnel of water, with no thought of previous sewage contamination. A wholesome water supply at village schools is much to be desired.

5. Minute enquiry failed to discover any clue to the origin of this outbreak. No previous case of diphtheria had been known to have occurred in the Builth registration district since 1877, and then in a distant parish. There was no knowledge of any precedent or concurrent disease among animals, though more recently the sheep in Wales and the west of England have suffered extensively from liver-fluke. There was nothing exceptionally unwholesome in the site or surroundings of the Jarmans' cottage. None of the family had recently visited, nor had they received visitors from, any other district. No parcels of clothing, or bedding, or furniture had recently been brought to the house. No stranger was remembered to have called. Indeed the remoteness of the cottage from any public road makes it exceedingly improbable that any tramp or wayfarer would ever find his way thither.

The children went nowhere but to school. It is just possible that there may have been a previous unrecognised case of contagious sore throat at the school. The parents went to market at the town of Builth. The mother went there every day. There was a large fair at Builth on October 2nd. It is possible that the infection may have been brought into Builth by some stranger attending the fair from a distance, and may subsequently have been conveyed by the mother to her own home. But evidence of any such importation of the disease is wholly wanting.

6. There was one fact in this outbreak which appears at first sight highly significant. Nearly half of the children (about 20 out of 45) who attended the Llandewyrewm school, came from a corner of the parish, comprising southern outskirts of the town of Builth. Among these Builth children there was not a single case of sore throat, while among children who came from lonely cottages and farmhouses on the hill side, eight were attacked, or five if we reckon only the first attack in each family. Had the numbers been much smaller, we might have attributed this disparity to chance. On the other hand they require to be larger, to put chance wholly out of the question. In school, the children, whether from the town or the country, were all exposed to the same conditions. They were mixed together in one room. The different classes that were formed (according to the "standard" to which each child belonged), contained town children and country children alike. Many of both sections stayed at the school during the dinner-hour. On leaving school they would all pass the rivulet of surface-drainage at the foot of the pasture, and then emerging into a steep lane, the town children would turn down the lane, and the country children would turn up. This difference of direction on leaving school, and the difference in the situation of their homes, appear to be the sole conditions to which we can look for an explanation of the result. The first case having occurred in a child belonging to the country section, who, when out of school, was longer in company with other country children than with those from the town, there was slightly greater probability that subsequent attacks would occur among country children, but hardly in such disproportion as to account for the complete immunity of the town scholars. If diphtheria were caused by a malarious miasm, haunting certain cold clayey uplands, as ague haunts the banks of the Thames towards its mouth, we might suppose that the Builth children escaped,

because they took the opposite direction, and did not inhale the (supposed) malaria: but if it is only by personal communication, and especially by conc ourse of children at school, that this disease is spread, we are driven to suppose that by some means, in virtue of their suburban habitat, these Builth children were practically insusceptible of the diphtheritic infection, as compared with those who came from isolated hill-side homes.

7. A secondary outbreak of diphtheria occurred in January and February of the present year (1880) in the parish of Aberedw, on the opposite side of the valley of the Wye, apparently traceable to the previous outbreak in Llandewyrcwm. The father of one of the sufferers in that outbreak, who also himself had a bad sore throat, attended with difficulty of swallowing, and enlargement of glands, used to work at a farm called Tanycoed, on the southern slope of the hill above Aberedw village. He took his meals with the servants at the farm house. A servant girl there was taken ill with sore throat about Christmas Day. A daughter of the farmer was taken ill with diphtheria on January 7th, and died on the 15th. She had attended Aberedw school up to the time of her illness. Another daughter had a slight attack. The mother also had a sore throat. Thence the infection spread to a neighbouring farm (Trevaughan). The two farms are held by two brothers, and there was frequent intercourse between the two families. At Trevaughan six children were attacked, and three died. Shortly after the seizure of the child first attacked at Tanycoed (who had been attending Aberedw school) some children of another family attending the same school were taken ill with severe sore throats, and also the father and mother, but all recovered. The school master's infant also had a slight attack.

8. There was nothing in the local conditions to account for this outbreak, no community of poisoned milk, or water, or air, no prevalence of disease among animals (though since the children were ill at Trevaughan, some of the horses have had "strangles"). The outbreak appears to have been simply due to personal communication, and serves to illustrate the facile diffusibility of the diphtheritic infection by adults going to work, and children gathering together at school.

9. In this secondary outbreak there had been, at the time of my inquiry, 19 cases, four of them fatal. [Since then I have heard from Mr. J. F. Herring, Medical Officer of Health for the Builth rural sanitary district, that two more cases, both ending fatally, have occurred, one in the family at Trevaughan, and one at Tanycoed. Still more recently the disease has re-appeared fatally at the cottage in Aberedw, where previously the whole family had sore throats.]

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## PEMBROKE.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Pembroke; Sub-district, Tenby. Nine deaths registered from diphtheria. (Registrar's note. "The nine deaths from diphtheria occurred in the parish of Manorbier." Population, 694.)]

1. The occurrence, within a space of three months, of nine deaths from diphtheria in a parish having a population of only 694 persons, indicated a strongly localised outbreak which might be expected to repay study, especially as the district had been for some time past remarkably free from fatal diphtheria. Additional reason for inquiry was furnished by a letter from the Vicar of the parish complaining of its neglected sanitary condition. The Board therefore ordered an inquiry to be made as to the prevalence of diphtheria, and also as to the general sanitary condition of the parish of Manorbier.

I beg to report that I visited the district on March 9 to 13th. Comparatively little time was spent in examination of the local conditions, but various ramifications of the inquiry, having for their object the tracing the different threads of the diphtheria epidemic, occupied much time, though they produced but little satisfactory result.

2. Manorbier parish (area 3,493 acres, population 694, proportion of persons to acres 1 to 5), occupies a part of the south coast of Pembrokeshire, and extends inland to the Ridgeway, a conspicuous ridge of old red sandstone which runs across the peninsula east and west from Penally to Pembroke Dock. Between the Ridgeway on the north and the limestone sea cliffs on the south there is a middle range of high ground, of the Cambrian formation, which, at the surface, crumbles into a clayey soil. It was at Jameston, a high bleak village on this soil, that the first recognised cases of diphtheria occurred. Subsequently the disease spread to families residing on the limestone tracts.

The population is purely agricultural, and at the next census will probably be found to have diminished. The villages bear testimony in roofless walls and wall-less chimney stacks, to a long course of unrepaired decay. This decadence of prosperity is of course appealed to in excuse of nuisances unremoved, and sanitary works unattempted. Farming has been unremunerative, and the people are very poor.

The peasantry are poorly housed. Cottage rents at Jameston average 3*l.* a year. The average Pembrokeshire cottage consists of two rooms floored with rude concrete, walled with rough stone or clay, and open to the rafters, which carry a roof of slate or thatch. As a rule they have no upper storey. Exposed to strong winds from the Atlantic, the windows are small and are kept fast shut, and at night the family retires into a box-bed, enclosed above and on three sides and part of the fourth. Thus, though parts of the cottage are very draughty, there are domestic recesses which remain unventilated. It is rare to find any provision for carrying away the roof rain, and the walls often show signs of damp internally. The excessive rainfall in this part of the country adds to this disadvantage.

There is nothing in the shape of drainage. House slops are thrown into the privies, or poured out into convenient surface channels leading to ponds or ditches. The privies, when present, stand in the gardens or back yards, in some cases too near to the dwellings. The quantity of culm ashes from the kitchen fires serves in some measure to absorb the fluids of the cesspits, and mitigate their offensiveness. The cesspit matters are at distant intervals of time emptied out and buried in a corner of the garden.

Cows and pigs are commonly kept near human dwellings, with scarcely any attempt at cleanliness in their keeping. This form of filth may plead immemorial usage in an agricultural district, but it necessarily pollutes the air and often endangers the purity of the water, which is usually obtained from surface depressions near the villages.

The nature of the water supply differs, however, in different parts of the parish. There are several distinct villages or hamlets in the parish, each of which has its own peculiarities.

3. Jameston, on high clayey soil, has a "well," that is to say, a reservoir of surface water at which vessels can be dipped, in the outskirts of the village, about 15 feet below the general level of the village. In former years, presumably with a view to increase the yield, or at least the storage capacity, of the well, it has been dug to a depth of 8 feet. The sides are built with stone, and the cavity is roofed over with a slab of stone at the level of the path by which it is approached. Steps, partly submerged, lead from the path to the well. The water is liable to be polluted by the rinsings of the vessels that are dipped into it. A privy stands at a higher level about 50 feet distant, with garden ground and pasture between. A trench has recently been dug across the pasture, to divert any drainage from the privy. All about the village there are filthy pools and privies, pigstyes and dung heaps; and if, as it appears, the well is only a gathering of surface water, it cannot be pronounced safe from pollution by surface filth, though the water undergoes pretty good filtration before it reaches the well. Mr. D. P. Saer, Medical Officer of Health for the Pembroke urban and rural sanitary districts, has applied qualitative tests to the water of this well, and finds little, if any, sign of impurity in it. In very dry summers, such as that of 1877, the well has been nearly dried up, and the people of Jameston have had to fetch water from a spring in a cow-pasture, near Manorbier Newton, nearly a mile distant.

4. At Lydstep, a little hamlet on the high limestone near the coast, water is obtained from an open well in the side of a steep bank below the village. This appears to be a good spring, of a much more permanent character than the Jameston well, but even more inconvenient for the people, as the full cans have to be carried up the steep hill. A line of surface drainage from the village, which used to come rather near the spring, was being diverted when I visited the spot.

5. The village of Manorbier, on broken limestone ground at a lower elevation than Jameston or Lydstep, is supplied by a public tap with pure water brought in pipes from a neighbouring hill. This village is much resorted to in the summer by visitors from Tenby and Pembroke, who come to see the castle, and contains a few lodging houses and places of refreshment, and generally is in better condition than other parts of the parish.

6. Diphtheria, a disease previously unknown among these secluded hamlets, broke out at Jameston in November 1872, in the family of James Thomas, a carpenter and small farmer, living in a clean, dry, commodious house, one of the best in the village. The first to suffer was a girl of seven years, who was taken ill on November 17th. She, with three brothers and two sisters, attended the parish school, which stands in a central

position between Jameston, Manorbier, and Lydstep. She recovered; her brothers and sisters rapidly sickened. Three of them died on three successive days (Nov. 28th, 29th, 30th); another on December 2nd, and a fifth on December 10th. Thus, within a fortnight there were five deaths in one family alone. Meanwhile, the same disease appeared in two other families in Jameston, one family in Manorbier, and one family in Lydstep, all sending children to the same school. In each case the child first attacked was one who went to the school, and in two cases the children first attacked had been in close relation at school with one or another of the little Thomases. Three deaths occurred at Manorbier, all in one family (Allen), on December 3rd, 13th, and 31st. One death occurred at Lydstep, on December 8th (Nicholls). In this sudden outburst of the disease there were 16, perhaps 17, persons attacked, and nine of them died.

7. There does not appear to have been any extension of the disease from Manorbier or Lydstep, and this fact may with reason be attributed to the prompt measures of disinfection taken by the Medical Officer of Health and Inspector of Nuisances.

At Jameston, however, there was a servant girl in the Thomases' house, who came from the parish of Carew, in the northern part of the union. She had a sore throat on November 24th (a week after the first appearance of the disease in the Thomases' family) and returned next day to her home in Carew, a quarryman's cottage of the poorest class, with a filthy back yard sloping down to the back door. She stayed there a week, and then returned to Jameston on December 1st. Her brother at Carew, aged 10½, was taken ill on December 4th and died on December 11th, of "ulcerated sore throat." There was no other case of sore throat in Carew.

8. The course of the epidemic, then, after its first commencement in the Thomases' family, presents no difficulty of explanation. But how did it originate? There had been recently, as far as was known, no previous case of sore throat in the neighbourhood. There was no disease among animals. Mr. Thomas's house was remarkably free from vermin. One of the little Thomases had spent a fortnight at Pembroke Dock, some time in the summer or early autumn (the date was not remembered, but it was "when scarlet beans were in season,") but there had been no case of diphtheria or sore throat in the street, or in the town. Looking through the death-register, I found that there had been a death from "croup" in Pembroke Dock in May, but nothing else bearing the slightest semblance of diphtheria. Neither had there been any diphtheria in the town of Pembroke. Mr. Thomas's business as a carpenter takes him about the country a good deal, and it is not impossible that he may unwittingly have been in contact with a previous case of diphtheria, and may have brought home the infection, but he does not remember any occurrence that could be so construed.

9. I examined the death-register for the Tenby sub-district (which includes Manorbier parish), and found that there had been a death from diphtheria in Tenby on the 7th of April 1879. This case, as I learned by inquiry among the medical men in Tenby, occurred in a family which had previously lost a child from diphtheria in a distant part of Carmarthenshire, and had brought the other child (who had at first escaped the infection) to Tenby for safety. The greatest care was taken to disinfect the house in which this death occurred, by means of carbolic acid. None of the four medical men in Tenby whom I questioned had known of any subsequent case of diphtheria or sore throat in the town. The death-register contains record of a death from "laryngitis" on the 19th of April in Tenby, and another death from the same cause in July on Caldy island. I have no reason to suppose that either of these was really a death from diphtheria.

10. On September 18th, 1879, a child of seven years, the daughter of a labourer, named Harries, living at a poor cottage in a bleak situation on the very crest of the Ridgeway, was taken suddenly ill, and died next day, September 19th, before medical aid arrived. The death was registered from "croup." She had been "subject to croup" since she was a year old. Her neck (the mother stated) was not swollen, but was discoloured after death. Her brother, a year younger, was taken ill about the same time, and was apparently recovering, but had a relapse and died on October 12th. The medical attendant gave a certificate of death from "œdema of glottis," but on my making further inquiry regarding this case, he had no recollection of the circumstances, and could find no note relating to it. Two other children in the same family, aged five and three, were attacked a week after the elder ones, but recovered. There was swelling of the glands of the neck in these three later cases. An elder brother (eight) escaped altogether. This was certainly a contagious throat disease, and as there is no reason whatever to suppose that it was scarlet fever, we may think it was probably diphtheria. These children attended a school in the village of Saint Florence on the north side of the Ridgeway. On making inquiry of the schoolmaster and at several houses in St. Florence, I ascer-

tained that there had been several cases of sore throat among the school-children since the Harrieses were ill, but there was no clear recollection of the date. The schoolmaster himself, not at all subject to quinsy, had a sore throat with swelling on each side of the neck. But no fatal case occurred in the village. On inquiry at the village of Penally, at the eastern extremity of the district, I did not hear of any cases of sore throat among the school children there.

11. Returning to the family of Harries on the Ridgeway, I could learn nothing as to any conceivable way in which they could have contracted the infection, except that Mrs. Harries was in the habit of carrying butter once a week to Tenby to sell to a grocer. She had been in Tenby for this purpose on Saturday the 13th of September, five days before her daughter was taken ill. There were no children at the grocer's shop, and no person there was known to have had a sore throat. But the suspicion remains that the diphtheritic infection which had been brought into Tenby in April may have remained alive, perhaps renewed by a series of unnoticed sore throats among persons of a class who would not readily send for medical assistance, and that Mrs. Harries may have unwittingly come in contact with some infected person, and may have carried home the infection to her own children.

12. Possibly, by a similar occult transportation the disease may have been conveyed from the Harries's cottage on the Ridgeway, or from the (supposed) undercurrent of diphtheria in Tenby, to the Thomases' house in Jameston. This may be condemned as mere speculation, but the very fact that we are driven to such speculation has a positive value, for unless we may attribute to this infection a most transcendent subtlety, we must entertain some theory of origination of diphtheria *de novo*.

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## HAVERFORDWEST.

[Registrar-General's Quarterly Return, 1879, Fourth quarter. — District, Haverfordwest; Sub-district, St. David's. Twelve deaths registered from diphtheria. (Seven at Mathry, three at Llanrian.)]

1. In a report to the Board on the sanitary state of the Haverfordwest registration district by Dr. Horace Swete in June 1879, it is mentioned that diphtheria had been especially fatal in the St. David's and Fishguard sub-districts, that in those districts five deaths were registered in 1876, nine in 1877, ten in 1878, and three in the first five months of 1879. Dr. Swete describes an especially fatal outbreak of this disease in the family of a county magistrate in the parish of Mathry in 1878, in relation with certain structural defects of the dwelling house in which they resided. The last death in that family was on the 6th of February, 1879. There appears then to have been a lull in the epidemic. One death took place in the parish of Lanrian on the 3rd of June, and then no more till the disease broke out afresh in October.

It is too late to ask if the interval between these successive deaths was filled by a succession of non-fatal cases. Unfortunately the Medical Officer of Health for this district was unable to keep watch over the course of the epidemic, and no record of its successive phases has been preserved.

2. Among the various cases of diphtheria which occurred in this sub-district in the fourth quarter of 1879, very little connexion could be traced. This is hardly to be wondered at, if we bear in mind how prevalent the disease had been before, and in how many spots the poison had probably been lurking. It might well be supposed (to speak in the language of the germ theory of infection), that the seasonable influence of autumn caused a simultaneous revival of germs that had long lain torpid in many different parts of the district. Three deaths were registered in October, in three different parishes, St. Edrin's, Mathry, and Llandeloy. At St. Edrin's a young woman of 19, who was not known to have been in communication with any person suffering from sore throat, but who had been about in parts of the district formerly infested with diphtheria, was taken ill, and died on October 13th. Subsequently her two brothers, aged 15 and 8 were attacked, but recovered. At Llandeloy a young woman of 17 died of diphtheria on October 31st.

3. On October 28th a boy of six years, named Thomas Roberts, died of diphtheria at a lonely cottage (Castle Froga) in a barren expanse of high clayey land in the parish of Mathry, but far from the village of that name. The two youngest children in the same family, one of 19 months, the other an infant of three months, were afterwards attacked, and died on November 9th and 15th. Two other children aged nine and five, and the

mother, were also taken ill, but recovered. In this family the infection appeared traceable to a previous case at a neighbouring farm house, Priskilly Fawr, (nearly a mile distant) where was a young man who had been brought, ill, from a distant village, Welshook. While Thomas Roberts was ill, there was communication between the Robertses of Castle Froga, and a family named Williams living in a thatched cottage (Pen-y-bank) on a bleak eminence half a mile distant. Here three children were taken ill, and two died on November 7th and 11th. The father was afterwards attacked and recovered, but was long affected with dimness of eyesight, difficulty of swallowing and weakness of the limbs.

Fortunately none of the children at these two cottages were attending school. I enquired of the schoolmaster in the village of Mathry, but he did not know of any case of sore throat among his scholars.

4. In December a fresh crop of diphtheria sprang up in separate farm-houses in a bare, cold, clayey region to the west of Mathry. Among them there was evidence of spread of the disease by personal communication, though some links were wanting. A lad of 14, who afterwards died, (December 13th,) was visited during his illness by his cousin, a young woman of 26. She was afterwards taken ill, and, returning to her own home, appears to have given the infection to a younger sister, who died on December 26th. A little girl who visited this house also was attacked. Another death occurred in the neighbourhood on December 18th, of which I was not able to learn the relations.

5. In January of the present year (1880) a girl in service at Mathry was taken ill with diphtheria after a visit to a farm on the coast named Barry Island. There had previously been a case of diphtheria at this farm, and another case occurred there subsequently.

6. There had previously, in December 1879, commenced an outbreak in the neighbouring fishing village of Trevine, originating apparently in the arrival of a man from Barry Island suffering from diphtheria. The infection got among the schoolchildren and spread rapidly up and down the village. One child died on Christmas Day; another on February 23rd in the present year. There was still one case in progress at the same time of my visit.

7. Throughout this wide-spread prevalence of diphtheria in these remote parishes of the Haverfordwest Union, I heard of nothing in the shape of epizootic disease or any affection of the lower animals or anything noticeable in domestic vermin, in relation with the epidemic. The course of the infection bore no relation to milk supply; indeed in most cases, especially among isolated cottages, each family had its own separate supply of milk. It could not be said that the places which suffered most from diphtheria were distinguished by especial filthiness in themselves, or in their surroundings. All the positive evidence bearing on the spread of the disease resolves itself into personal communication among dwellers on a bare, cold, wet clayey soil.

8. I could not help noticing, though the fact may have been only accidental, that all the families attacked were fairhaired.

9. I have to regret that circumstances obliged me to curtail this enquiry unduly, allowing me to spend only one day on the scene. It is consequently far from complete in its details. In particular I am unable to state the total number of persons attacked. The want of guidance in the shape of previous reports of the Medical Officer of Health was felt as a serious hindrance to the enquiry. Much difficulty also attaches to an investigation depending upon question and answer, when the parties concerned do not speak the same language. In meeting this difficulty I have to acknowledge the assistance which I received from Mr. J. W. Francis, the sanitary inspector of the Haverfordwest rural sanitary district.

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## BIDEFORD.

[Registrar-General's Quarterly Return, 1879, Fourth quarter.—District, Bideford; Sub-district, Hartland. Five deaths registered from diphtheria. (All at Woolfardisworthy. Population, 749.)]

1. In this sub-district no previous death from diphtheria had been registered since 1873. So far, therefore, the ground might be supposed clear of the confusion attaching to a multiplicity of possible sources of infection due to previous outbreaks in the same locality (such as appeared to entangle the threads of inquiry in the Haverfordwest district which I had just left). On examining the death-register of the Hartland sub-

district, and conferring with the Registrar, Mr. R. Braund, I did not find any evidence of throat disease in the neighbourhood having recently preceded the first recognised cases of diphtheria.

2. Diphtheria broke out at the end of August 1879, in a family of the name of Prance, at an isolated farm house, called Hurley Mead, on high clayey ground, partly wooded, a mile and a half distant from the village of Woolfardisworthy. The family consisted of the mother (a widow), the grandfather, and seven children; Emma (14), Richard (12), Walter (11), John (9), Clara (7), James ($3\frac{1}{2}$), and Maud (2.) The last named was the only one of the family who escaped altogether. The two eldest and two youngest did not go to school. Of the others, Walter and John attended Woolfardisworthy school to August 29th (when the school broke up for the harvest holiday), and Clara had been to a little dame-school nearer home. The first attacked was Walter, who fell ill with sore throat on August 30th. The other children (except the youngest) caught the complaint in rapid succession. The last to take it was the eldest boy, Richard, who had not been attending school. He is described as having been a strong healthy boy, not subject to cold or sore throat. His symptoms were more severe than in the other children. His neck swelled, he had great difficulty in swallowing, and his eyesight was affected. He died on September 22nd. The death was certified from "ulcerated throat, seven days." On the same day the school was re-opened after the holidays. None of the Prances were allowed to attend.

3. On October 7th and 8th two children, cousins, Clara and Job Beer, aged 12 and $2\frac{1}{2}$ years, died of diphtheria, at two cottages within easy reach of one another, in the outskirts of Woolfardisworthy village. (The school was then re-closed on the 9th.) Of these two children, the one first attacked was the little boy Job Beer. He was taken ill about the 28th of September. At this time there had been no known spread of the infection in the village. (In one family, however, it was stated that one child had sore throat at the time of Richard Prances funeral. There was doubt as to the accuracy of the statement.) The only previous cases were the Prances at Hurley Mead. Had little Beer come in contact with any of the Prances? He was not old enough to go to school. Moreover, the Prances had not returned to school when it was re-opened. The little fellow did not stay much at home, but lived almost entirely at his grandparents, who keep the village inn. This certainly was the most likely place for falling in with people from the outlying parts of the parish. As a matter of fact, it was remembered by the child's grandmother that Walter Prance rode in from Hurley Mead one day, when his brother Richard was lying ill, to get some brandy. This was about September 17th, 11 days before little Beer was taken ill. Again, on the day of Richard Prance's funeral, September 24th, there was probably some opportunity of contact with some infected person or thing among the funeral party. In some such way as this, we may reasonably suppose, little Job Beer may have contracted the infection by personal communication with the Prances. While ill he was visited by his cousin Clara Beer. She was afterwards taken ill about the 3rd of October, and died, after a brief illness, on October 7th. She was the eldest of a family of four children, all of whom were attending school. A brother aged eight was attacked about a fortnight after Clara's death. He died, after five days' illness, on October 19th.

4. The school, which had been closed on October 9th, was re-opened on the 27th. Possibly some of the children returning to school brought back the infection with them, for in November diphtheria appeared in a family of children named Harding, at a remote farm-house. Three of them, aged 10, 8, and 6, who all attended the school, were attacked, and the two younger died, on November 28th and December 5th. Two elder children, aged 15 and 14, who did not attend school, were not attacked.

Another fatal case, registered as "croup," occurred on January 23rd, 1880, in a child of $5\frac{1}{2}$ years, named Edith Nicholls, residing within a mile of the village and attending the school. Including this case, there were seven deaths in this outbreak. The total number of persons attacked, including a shoemaker's apprentice from the village, who went home ill into a neighbouring parish, was 23.

5. No circumstance in common was found to mark the families that were invaded by diphtheria, except that the later attacks were more or less certainly connected with the earlier ones by the link of personal intercourse. There was no community of milk or water, no exceptional filthiness of dwellings, no known disease among animals, nothing noticeable among domestic vermin.

6. Here, as previously in the Haverfordwest Union, I observed that the affected families were mostly fair-haired. (In one or two cases no note as to this point was taken.)

7. We have now to ask with regard to the Prances, in what way they can first have contracted the disease. There was nothing in the local conditions to attract particular attention. The house is a good roomy farm-house, but in a decidedly exposed situation. Water is drawn from a well between the dwelling and the cattle-yard. From its situation it might be apprehended that the well would be liable to contamination by soakage from the muck in the yard. The water, however, was analysed by the late Medical Officer of Health, Mr. Wynter Blyth, and stated to be good. Milk for the household is furnished by their own cows, and is not supplied to other families in the village. Nothing was known to have been recently brought into the house to which any suspicion of infection could possibly attach. No person from the farm had visited any place or come in contact with any person that could be suspected of infection. No tramp, or stranger, or visitor from other parts was remembered to have come to the house.

8. There had been, it was rumoured, some cases of diphtheria at Fremington and Sutcombe. Fremington is beyond Bideford, some 20 miles distant, and I made no enquiries there. Sutcombe is a village in the Holsworthy Union, only six miles from Hurley Mead, and I heard that a girl Annie Sanders, in service at Sutcombe, had gone home ill with diphtheria, in the latter part of May, 1879, to her mother's in West Putford, only four miles from Hurley Mead. I could get no nearer than this, either in time or in distance. Mrs. Sanders told me that her daughter was ill for a long time, almost through the summer, with the after effects of the disease, but no other person at West Putford was known to have been attacked. She named three families in Sutcombe that had had attacks of diphtheria. I could get no evidence that either Sutcombe or Putford had had any communication with Hurley Mead; yet I cannot help suspecting that this outbreak at the latter place depended in some way, perhaps by an unnoticed chain of personal intercourse, or possibly not by personal intercourse at all, but, in the mode suggested by Mr. Wynter Blyth in his brief report to the Bideford Rural Sanitary Authority on the Woodfardisworthy epidemic, by wind transport of diphtheria germs, with the previous prevalence of the disease at Sutcombe or Putford.

I regret that my enquiry in this district took place after Mr. Wynter Blyth's resignation of the Health Officership, and that I could not have the advantage of his aid and experience.

HUBERT AIRY.