Mr. W.H. Power's report to the Local Government Board on an outbreak of diphtheria in the Hendon ward of the Hendon urban sanitary district / [W.H. Power].

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Mr. W. H. Power's Report to the Local Government Board on an Outbreak of Diphtheria in the Hendon Ward of the Hendon Urban Sanitary District.

R. THORNE THORNE,
For the Medical Officer,
April 5, 1883.

The outbreak in question occurred in January of this year. On the 5th of the month 14 cases of diphtheria came simultaneously under the notice of Dr. Cameron, the Medical Officer of Health; most of them occurring in his private practice. The 14 patients were in six houses (one of them being Dr. Cameron's own residence), dispersed over Hendon village. Up to the 5th of January no case of diphtheria, with the single exception of a nurse in Dr. Cameron's family attacked a day or two earlier, had been heard of in the place for several weeks. Upon this evidence Dr. Cameron, as Health Officer, at once set to work to discover a common cause of the diphtheria. First, he gave attention to the sanitary circumstances of the houses invaded, and, in view of the known defects of the public sewerage of Hendon, he inquired especially as to their drainage circumstances, but without finding in this direction any satisfactory explanation of their attack. These houses, which were without exception better class houses, many of them standing in their own grounds, did not for the most part drain to the public sewers. Generally they were in their sanitary circumstances well appointed and well cared for, and in regard of several very special pains had been taken, and at considerable cost, to render them, as the term is, sanitarily perfect. In a word, the chief of them were houses that might be regarded as protected, either naturally or specially, against public sewer or private drain influence. Very soon, however, in the course of his inquiry, Dr. Cameron got a suspicion that infection of diphtheria might have been conveyed to the invaded houses in milk, and in the end he learned that every one of the families then known to him as recently attacked had obtained their milk supply from a particular source. Further, he ascertained that certain other houses escaping diphtheria, and not easily to be differentiated as regards physical and sanitary circumstances from houses that were invaded, did differ from these houses in the single circumstance of milk service. Hereupon Dr. Cameron examined a sample of milk from the particular dairy that came in question, and a sample also of the pond water there used for farm and dairy purposes. The former he could find no fault with analytically, but the latter he discovered to be fouled to a large extent by sewage matter, and to contain in abundance animalculæ that were visible to the naked eye. Notice was forthwith given (6th January) to the dairy farmer of the result of this water analysis, and he was cautioned against further distribution of this milk until his cows, after examination by a competent authority, had been certified to be in good health, and until he had procured for his cows and for dairy purposes a proper supply of water.

Upon commencing, 24th January, my inquiry at Hendon I learned that there had been diphtheria and other throat illness of less definite sort in the village anterior to, coincident with, and subsequent to the remarkable outbreak above referred to; and in addition it appeared that at the end of December there had occurred in the Mill Hill Ward of this Urban Sanitary District, three to four miles distant from Hendon village, nearly a dozen cases of very decided diphtheria. As to the total amount of diphtheria and throat illness in the Hendon Ward, and the precise localities that had been affected by it, Dr. Cameron was not yet completely informed; for though some private medical practitioners in the district habitually give him notice of the occurrence of infectious sickness in his district, others withhold information of this sort. Hence it became important to get knowledge of all diphtheria attacks, and of cases of throat illness that might have been diphtheritic in their nature, that had occurred in the parish during

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December and January; and to this end I sought information of each of the several medical practitioners in the place. All of them were so good as to help me, and in the course of a few days supplied me with lists of diphtheria and sore throat cases coming under their notice in the period referred to. Meanwhile I made investigation of the Mill Hill diphtheria for the purpose of learning what relation (if any) the disease there had had with that in Hendon village. So far as I could learn by detailed inquiry of the patients, there had been no sort of connexion between the two series of cases, and having satisfied myself of this, I thenceforward concerned myself with the circumstances of diphtheria and sore throat prevalence in Hendon Ward alone. The chief facts of this prevalence as learned of the medical practitioners assisting me and supplemented by personal inquiry, with the facts also as to milk service of the several houses invaded, are given in the following table:—

TABLE showing for the Hendon Ward of the Hendon Urban Sanitary District the date of invasion of Houses affected by Diphtheria and Throat Illness in the two months ending January 1883; the localities of those Houses; the Cases occurring in them, with Date of Attack, Age of Sufferer, and Nature of Illness in each instance; and the Milk Service of the several houses. As regards each household invaded, attacks occurring in addition to the first case are printed in *italics*.

Date of Invasion of Household.	Locality of Household.	Cases, Date of Attack, and Nature of Illness.	Milk Supply of households:—particular Dairy, or other source.
1882.			
27th November	John Street - -	Aged 1. 27th November. Fatal diphtheria	Other source.
27th „	Tenterden Park -	Aged 4. 27th „ Diphtheria -	Particular dairy.
29th „	Church Lane - -	Aged 6. 29th „ „ -	„
11th December	Brent Street - -	Adult. 11th December. Sore throat -	„
		„ 18th „ „	
		„ 24th „ Quinsy.	
		„ 24th „ Sore throat.	
19th „	Sunny Gardens -	Aged 14. 19th December. Inflamed throat	„
1883.			
2nd January -	Church Lane - -	Nurse. 2nd January. Diphtheria -	„
		Aged 8. 5th January. „	
		„ 3½. 5th „ „	
		„ 1½. 5th „ „	
5th „ -	Sunny Gardens -	Cook. 5th January. „ -	„
5th „ -	Tenterden Park -	Servant. 5th „ Slight diphtheria -	„
		Aged 13. 5th January. Diphtheria.	
		„ 10. 6th „ „ -	
		„ 11. 6th „ Slight diphtheria.	
		Adult. 13th „ Sore throat.	
5th „ -	Tenterden Park -	Aged 9. 5th January. Diphtheritic sore throat.	„
		Aged 13. 5th January. Diphtheritic sore throat.	
5th „ -	Holder's Hill - -	Three children. 5th and 6th January. Sore throats.	„
5th „ -	Tenterden Park -	Aged 6. 5th January. Fatal diphtheria -	„
		„ 3. 6th „ Slight „	
5th „ -	Holder's Hill - -	Four adults. 5th and 6th January. Sore throats.	„
5th „ -	Tenterden Park -	Aged 8. 5th January. Diphtheritic sore throat.	„
		Aged 6. 5th January, Diphtheritic sore throat.	
		Aged 4. 5th January. Diphtheritic sore throat	
		Aged 3. 8th „ Fatal diphtheria.	
		Cook. 18th „ Severe „	
		Adult. 20th „ Slight „	
5th „ -	Tenterden Park -	Two children. 5th and 6th January. Diphtheritic sore throats.	„
6th „ -	Church Lane - -	Several cases. 6th to 9th January. Sore throats.	„
Early „ -	Holder's Hill - -	Adult. 6th (?) January. Diphtheritic sore throat.	„
		Aged 4. 23rd January. Fatal diphtheria.	
		Adult. 29th „ Slight „	
		Adult. 1st February. Fatal „	
Early „ -	Brent Street - -	Several cases. Sore throat. - -	„
Early „ -	Foster Street - -	Aged 14. 4th (?) January. Slight diphtheria	Other source.
		Aged 11. 6th „ Enteric fever.	
7th „ -	Harding Street -	Adult. 7th „ Sore throat -	„
		Aged 16. 13th „ „	
		Aged 6. 17th „ „	
		Aged 14. 23rd „ „	

Date of Invasion of Household.	Locality of Household.	Cases, Date of Attack, and Nature of Illness.	Milk Supply of households:—particular Dairy, or other source.
1883.			
10th January -	Bell Lane - -	Adult. 10th January. Acute tonsilitis -	Particular dairy.
Mid „ -	Finchley Lane - -	Two children. Slight diphtheria - -	„
Mid „ -	Brent Street - -	Aged 5. 14th January. Slight diphtheria	„
		Adult. 23rd „ Enteric fever.	
Mid „ -	New Brent Street -	Child. Diphtheria - - -	Other source.
Mid „ -	Victoria Road - -	Aged 4. Mid January. Sore throat -	Particular dairy.
		Aged 6. „ „	
16th „ -	Tenterden Park -	Adult. Sore throat - - -	„
17th „ -	Church Lane - -	Adult. 17th January. Slight diphtheria -	Other source.
		„ *20th* „ *Sore throat.*	
22nd „ -	Prince of Wales Road -	Aged 2½. 22nd January. Fatal tonsilitis and bronchitis.	„
25th „ -	Harding Street -	Aged 14. 25th Janusry. Sore throat -	„

The above results of more extended inquiry tend to confirm the *primâ facie* conclusions of Dr. Cameron, and they justify the action taken by him thereon. For, bringing into account all throat illness that could be heard of as having occurred in the village during the first ten days of January, which was the period dealt with by Dr. Cameron, there were 15 households invaded, all but two of which had obtained milk from the particular dairy that has been called in question. And in the same period it will be noted that, with the single exception of slight diphtheria occurring in the same house with enteric fever, all the definite diphtheria attacks and all the fatal cases occurred among customers of this dairy. It is, be it observed, the sudden and considerable outburst of diphtheria in January that is held to have been referable to the particular milk service. Of certain cases of diphtheria or allied disease, both before and after the outburst, a like origin is not here affirmed. As will be noted from the facts of the table, some of this other diphtheria may have been, while some of it can hardly have been, related to the particular milk service; and in so far as the material cause of diphtheria can, and unquestionably often does, operate otherwise than through milk, it is likely enough that more than one agency productive of this disease has recently been operative in the Hendon Ward. At present, however, this other diphtheria remains unaccounted for; and though explanation of it, especially of that which occurred antecedent to the January outbreak, is wanted, absence of such explanation in no way invalidates the positive evidence adduced tending to connect multiple cases of diphtheria *occurring at a particular date in January* with the operations of the particular dairy. Nevertheless, in the detailed investigation that has been made as to the relation of this January outburst to the particular milk service, the fact of unexplained occurrences of diphtheria in Hendon anterior to that outburst has not been lost sight of, as will duly appear. Inquiry in the above sense has of necessity been concerned with matters already dealt with by Dr. Cameron, and these may be but briefly referred to. In other directions the results of inquiry, though they will be negative, may be regarded of sufficient interest to justify fuller mention. The chief points investigated are dealt with below under separate headings.

I.—Physical and Sanitary Circumstances of the Houses invaded.

Inquiry in this direction fully confirmed the conclusions of Dr. Cameron. Invaded houses were among the best houses of the place. As regards many of them it may be affirmed that nothing in their physical or sanitary circumstances served to explain the occurrence in them of diphtheria, and in so far as the disease may be regarded as liable to be conveyed by drain or sewer air, a considerable proportion of the invaded houses were among those of Hendon least exposed to such risk.

II.—Speciality of Incidence of the Diphtheria and Throat Illness on Customers of the particular Dairy.

Here, again, first inferences were fully borne out by later inquiry. The total houses of the Hendon Ward are 905, of which number 86, or one tenth of the whole, got their milk supply from the particular dairy. In the complete period (end of November to end of January) dealt with in the table, houses having this milk service, and becoming invaded, amounted to seven tenths of the total number invaded; while in the limited period, 1st to 10th January, regarded as that of chief operation of a milk cause of

diphtheria, such houses comprised nearly nine tenths of the houses invaded. It will hardly be contended, I think, that an incidence on customers of the particular dairy seven to nine times greater than what under equal conditions would be the expected incidence is likely to have been the result of mere accident.

III.—Speciality of Incidence of Diphtheria and Throat Illness on large Consumers of the particular Milk.

Reference to the table will show that in invaded houses children, who habitually drink more milk than their elders, suffered disproportionally to other persons. This fact is, however, by itself of little weight as indicating milk conveyance of infection, since in diphtheria outbreaks, from whatever cause, children are prone to suffer to a far greater extent than mere babies and other persons. Nevertheless, it deserves mention that, in the present outbreak, multiple cases of diphtheria, and especially severe and fatal diphtheria, tended to occur in families wherein the particular milk was habitually consumed by the children *unboiled* and in large quantities. And, as regards adults, too, it was noted in certain instances that those suffering from diphtheria were, beyond other persons in their families, large consumers of uncooked milk. Of children generally it may be said that those attacked by severe diphtheria were almost without exception consumers of uncooked milk, and on the other hand, it was observed of certain families that habitually cooked this milk before consuming it that their children wholly escaped illness.

IV.—Further Evidence associating the Diphtheria with the particular Milk.

In the course of inquiry as to association of the diphtheria and the milk service, the circumstances of the dairy farm, the general management of the dairy, and the distribution of its milk service came necessarily under review: when this further and important fact appeared. The operations of the milk business, though confined, so far as Hendon was concerned, to Hendon village, had not been limited to the Hendon district, but had extended into the adjoining district of Finchley. The Finchley customers were, it is true, few as compared with Hendon customers, but they amounted to a score or so of houses; and, seeing that above 20 per cent. of Hendon customers' houses had been invaded, it was thought that this number of Finchley customers should have sufficed to afford at least some cases of diphtheria if the particular milk service had been really concerned in dissemination of the disease. Accordingly inquiry was made of Dr. Turle, Health Officer of Finchley, and of certain private medical men in the place, with the result of learning that the Finchley customers of the particular dairy had been by no means exempt from throat illness. Altogether nearly a dozen of these persons, in four families, had suffered from decided sore throat, and though only one of the cases was defined as diphtheria, several had been regarded as diphtheritic, and all had been of sufficient gravity to come under medical treatment. Nor was this all:—and what follows is interesting in regard of an admittedly undetected cause of the earlier diphtheria in Hendon. Further, it appeared that these Finchley cases were separated into two groups, one group occurring at the end of November or beginning of December, coincidently with the earliest attacks in Hendon that were associated with the particular milk; while the second group occurred in January, coincidently with the notable outbreak of diphtheria in Hendon, which has formed the subject of this inquiry. Thus not only was there in this Finchley experience corroboration of the already inferred relation between the particular milk service and diphtheria, but also there was strong suggestion that this milk had at two distinct periods, separated by an interval of several weeks, possessed the faculty alike in Hendon and Finchley of bringing about in persons consuming it throat illness of a diphtheritic sort.

This, then, is the evidence of the relation between the particular milk service and diphtheria. No doubt it falls short of absolute demonstration, though it goes far to convict the milk of having had a large share in the prevalence in Hendon of that disease. There remains to be considered:—how can this milk have acquired infective property? In this connexion two suggestions deserve notice.

In his preliminary inquiry Dr. Cameron, having received no information of the Finchley evidence that has proved suggestive of connexion between the November group of cases of diphtheria in Hendon and the particular milk service, was disposed to regard these earlier cases, or some of them, as due to undoubted defects of the

Hendon public sewerage, and to suspect the sewage matters of the place, further reinforced by infective material from these cases, as having been indirectly concerned in infection of the milk. And in the following fashion. The sewers from that portion of the village wherein are situated the residences of the November cases discharge into a ditch, which eventually passes within 22 paces of and at a higher level than a certain pond from which the particular dairy-farmer drew water for dairy purposes. Seemingly, in time of flood, water from this ditch is apt to overflow the land intervening between the ditch and the pond, and may even gain access to the pond itself. Dr. Cameron, therefore, thought that possibly sewage, bearing with it infection material from some antecedent case of diphtheria, had got access to the pond in time of flood, and, becoming transferred along with pond water to the dairy, had in the process of washing or rinsing milk utensils infected these vessels, or some of them, after a fashion that enabled it to increase and multiply subsequently in the milk that they in due course were made to contain. Upon the assumption that the milk had become infected after it was drawn from the cow, some such theory as this appeared almost absolutely requisite; for no diphtheria or throat illness could be heard of at the farm or among the persons employed there, and it did not appear from examination of the sanitary circumstances of the place, and the routine of the milk business, that the milk was at all likely to have been fouled in any other way; moreover, explanation of this sort accorded with a belief that has been commonly entertained as to what are the methods of milk infection. For myself I am disposed to think that if an infective property was added to the milk after it was drawn from the cow, the above explanation is as good as any other, and that as a provisional conclusion it is not materially invalidated by certain facts relied on by the implicated dairyman as confuting it altogether. He stated that for 16 years he had used the pond water in question for dairy purposes without any complaint against his milk, and that his milk utensils, after having been washed and rinsed with pond water that had been invariably first boiled, were wiped out with clean cloths kept specially for that purpose instead of being finally rinsed, as is customary in the trade, with cold water, pond or other.

Another possible explanation of infectiveness of the milk, viz., by causes operating through the cow herself and enabling her to furnish milk capable of inducing diphtheria or throat illness in persons consuming it, seems to deserve notice, for a reason that will now appear. There is abundant evidence that shortly before the outbreak of diphtheria in Hendon, the milk distributed from this particular dairy was ropy or stringy. Especially was this the case on the 1st and 2nd of January, four to five days before the simultaneous occurrence of multiple cases of diphtheria among customers of the dairy. On these days several households either returned the milk to the dairy or made away with it on account of its ropiness, and some on account of its unpleasant taste or appearance. A similar condition of the milk, though much less noticeable, is believed by at least one family to have occurred toward the end of November. But at no time was this condition general, or at any rate it was not generally noted, for I made special inquiry on this head; seemingly, too, the ropy condition was most conspicuous in milk that had been kept over night. The fact of the ropiness of the milk was early brought to the notice of Dr. Cameron by persons referring illness to it, and no doubt this abnormal condition of the milk did much to call attention to association of the milk service with occurrence of diphtheria. It is indeed difficult to resist suspicion that ropiness of the milk and its ability to cause diphtheria may have been in some way related to each other, and the question arises, what caused this milk to become ropy? Unfortunately, though many surmises have been indulged in, no definite reply is forthcoming to the query. Dr. Cameron thought of the ropiness as perhaps produced in the milk by casual fouling of milk utensils with the pond water. But generally persons in the place having special knowledge of or employed about cows regarded the ropiness as due to some condition peculiar to the cow herself. This, too, was the particular dairy farmer's belief; he ascribed the ropy milk, which he spoke of as contributed at the particular time probably by all his cows, to use of undue proportion of dry clover-hay in the food of the cows, the result of carelessness by his cowman. No one, however, that I met with shared his belief in the ability of dry clover-hay to produce milk ropiness, though several considered that feeding of cows with too great abundance of certain green foods might produce it; and having regard to this man's statement that all the milk of his several cows was mixed before distribution, no one thought of more than one or two of his 18 cows as having been concerned in the abnormal condition of the milk distributed by him. Apparently the dairy farmer himself really held the opinion that ability to produce ropy milk had been limited among his cows, for he

informed me that so soon as the ropy milk was returned on his hands, he went round among his cows milking each separately into a glass vessel in order to discover *which cow it was* that was affording ropy milk. He failed, he said, to find any cow giving ropy milk, and this failure is important for he tested his cows in this fashion on the 3rd January, within some 24 hours of large distribution from this dairy of ropy milk. His statement is suggestive either that causes operating through the cow to produce ropy milk may tend to cease suddenly, or that milk inherently ropy does not necessarily develop its quality of ropiness until some time after withdrawal from the cow. No doubt ropiness of milk, as already noted in the account of this outbreak, may be enhanced by keeping the milk, and probably a small quantity of ropy milk added to and kept with a large amount of sound milk may in time render the whole ropy. Considerations of this sort led to the suggestion, not however made by the particular dairyman, that the extensive ropiness of the milk on the 1st and 2nd of January had been due to admixture at the dairy, at that particular time, of stale with fresh milk. All the above surmises are based, it will be observed, on the assumption that no actual disease of the cow, such as is admittedly capable of conferring ropiness on the milk, existed at the particular farm at the time in question. And probably the assumption is justified, in so far as any notable indisposition of the cows is concerned; on this point, indeed, the dairy farmer was very explicit, stating that none of the udder affections, which are included under the term garget, had occurred among his cows, all of which had, in his opinion, remained for many months in perfect health. His opinion, too, was fortified on the 7th January by a veterinary surgeon who pronounced all these cows free from disease. Upon this evidence about the cows I have no comment to offer, beyond remarking that these assurances might be entirely comforting, but for a growing misgiving to the effect that ailments of animals, so trivial as to be disregarded or even unnoticed by people about them, may have larger concern with occurrence of specific disease in the human subject than has heretofore been thought likely.

In bringing this report to a conclusion it is necessary to say a word about the Hendon sewerage. This is confessedly fragmentary, insufficient, and inefficient. In addition it is by many residents reputed to be dangerous to health, and much of the occasional diphtheria that has continued to arise in the district is locally freely ascribed to defects of the sewerage. Upon this point I need only say that given a sewer origin of diphtheria, the circumstances of sewerage in Hendon are likely to foster it, and that for this and for other reasons, one of which is the need for putting an end to sewage pollution of the River Brent and of other streams, no time should be lost by the Sanitary Authority in adopting and carrying out some such comprehensive scheme of sewerage and sewage disposal as that already prepared by the Authority's surveyor.

9th March 1883. W. H. POWER.