

Mr. W.H. Power's report to the Local Government Board on diphtheria in Pirbright, and on the influence of the school there in the behaviour of the disease / [W.H. Power].

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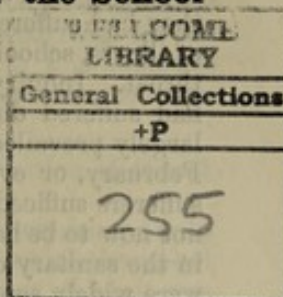
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**Mr. W. H. Power's Report to the Local Government Board on
Diphtheria in Pirbright, and on the influence of the School
there in the behaviour of the Disease.**

GEORGE BUCHANAN,

Medical Department,

April 28, 1883.



This inquiry was instituted under circumstances as follows:—

On the 27th November last the Guildford Rural Sanitary Authority applied to the Board through its Health Officer, Mr. Joseph Smith, for advice respecting diphtheria prevalence in Pirbright that was regarded as having had relation with the operations of the National School there. Mr. Smith stated that since May last this school had on several separate occasions been closed, and each time for several weeks, on account of diphtheria among the scholars; and that diphtheria in the parish having undergone diminution or cessation during each interval of school closure, reappeared, and mainly among school children, each time that the school recommenced operations. Upon this evidence the Board directed the present investigation into the conditions of diphtheria prevalence in Pirbright.

The parish of Pirbright is situated 4-6 miles from Guildford town, at the extreme north-west of the rural district. Except to the eastward it is coterminous with parishes in the Chertsey and Farnham districts. Geologically, it is wholly on the sands and loam of the Upper and Middle Bagshot beds, the land being poor and little cultivated, consisting largely of heath and common. Notwithstanding its sandy nature, the soil cannot be regarded as dry, water being commonly held up near the surface by an impervious stratum: the water is mostly impregnated with iron. The population of the parish is almost wholly of the labouring class, and it is essentially a scattered population. Near to the church on the east of the parish there is some considerable aggregation of dwellings constituting the "village." Here 30-40 houses are spread for several hundred yards along two converging highways, on one side only of each highway. Again, at Dawney's Hill, north of the village, and about $\frac{1}{4}$ mile distant, is another and smaller group of cottages near the national school. But generally the houses of Pirbright, occurring singly or in very small groups, are dispersed over several miles of country. The sanitary circumstances of the parish may be deemed above the average. Few dwellings are overcrowded, and almost without exception they have garden ground or other ample space about them. This, while sufficing for utilization (in each instance on the premises) of slop drainage and privy contents, has generally admitted of the tolerably safe disposition of the pit privy in reference to the dwelling and to the surface well which exists in most gardens. Recently the sanitary authority by adoption of watertight tanks for the collection and storage (in each instance away from the house) of slop refuse, has still further diminished risk to surface wells—such as had before arisen by careless people casting foul slops on the ground near to wells. These matters have a bearing on the subject of inquiry as tending to show that there is not in the physical and sanitary circumstances of Pirbright any ready explanation of the diphtheria: that, for instance, from the wide dispersion of dwellings, households have had, for the most part, but little intercommunication, while as regards other sanitary circumstances they are commonly exceptionally distinct and separate one from another.

Upon becoming associated with Mr. Smith, I quickly learned that, in addition to definite diphtheria, there had been in the parish a large prevalence of sore throat, much of which had not come under medical observation, and that commonly persons who had had what they or their parents regarded as trivial sore throat, suffered later on from paralyzes of the sort that are apt to follow diphtheria. This had been specially noticeable in regard of school children, and Mr. Hill, the schoolmaster, was able to cite many children (some not known to have been ill at all) who, on their reappearance at school after one or another of the intervals of school closure, could hardly see large print, or had difficulty in articulating intelligibly. It became obvious, therefore, that inquiry would be incomplete that did not, beside diphtheria, take account of minor sore throat, and that a house to house inquiry was requisite for ascertaining more precisely what had been occurring in the parish. This was accordingly undertaken, and has included almost all the houses in the place, and, in addition, some half dozen houses

that, although in other parishes, belonged geographically to Pirbright. This census sought information as to circumstances of escape as well as those of attack, and it therefore took account of the inmates of each house, their several ages, whether or not they had suffered illness, and got together full particulars of the date of attack, gravity of illness, school attendance and the like, of individuals suffering from diphtheria or sore throat. Inquiry of this sort had not proceeded far before it became evident that children had suffered disproportionately to other persons, and that the diphtheria which had largely prevailed in the parish in May and April had had its beginning there in March, February, or even January. Special investigation of the circumstances of the earliest sufferers sufficed to show that useful information respecting the origin of the disease was not now to be had. The first cases could not be satisfactorily accounted for. Nothing in the sanitary circumstances of their houses served to explain them; moreover, they were widely separated, and their families, seemingly, were not acquainted with each other. This much may, however, be said—the residences of some of the earliest cases were in the northern part of the district which adjoins Chertsey Union, where, and notably at Bisley, a very short distance from Pirbright, diphtheria had prevailed at the end of 1881 and at the beginning of 1882. Upon the whole it was likely that the Pirbright outbreak had been related in a fashion that had become obscured to the Bisley diphtheria; but, however this may have been, all that now seemed feasible was examination of the conditions of extension of the disease in Pirbright. This, in view of the special incidence on children, has been mainly inquiry as to the part played by the school in the spread of diphtheria.

The broad results so far of my inquiry are summarised in Table I. It gives for each of nine periods the circumstances of Pirbright school (whether open or closed), and the incidence of diphtheria and sore throat on houses and on persons at different ages in the parish.

TABLE I.

Period.*	Pirbright School open or closed.	Houses newly invaded.	Persons attacked.				Total Cases.	Cases afterwards fatal.
			Children under 15 years.		Other Persons.			
			Diphtheria.	Sore Throat.	Diphtheria.	Sore Throat.		
1 January to 1 April - (13 weeks.)	Open - -	4	6	2	—	—	8	—
1 April to 20 May - (7 weeks.)	Open - - (Closed 16 May.)	14	23	6	3	3	35	3
20 May to 1 July - (6 weeks.)	Closed - - (Reopened 27 June.)	9	11	3	4	3	21	1
1 July to 22 July - (3 weeks.)	Open - - (Closed 13 July.)	7	9	2	1	—	12	3
22 July to 2 September (6 weeks.)	Closed - - (Reopened 28 August.)	3	1	1	3	3	8	—
2 September to 30 September. (4 weeks.)	Open - - (Closed 26 September.)	6	4	1	2	—	7	1
30 September to 11 November. (6 weeks.)	Closed - - (Reopened 6 November.)	4	1	1	2	—	4	—
11 November to 25 November. (2 weeks.)	Open - - (Closed 21 November.)	3	3	1	—	—	4	—
25 November to end of December. (5 weeks.)	Closed - -	2	—	2	2	3	7	—
52 weeks.	—	52	58	19	17	12	106	9

* Calendar weeks are here taken in each instance to the end of the week in which the change noted in Column 2 was made.



The term diphtheria here includes all cases so designated by the medical man in attendance, and as well cases of sore throat which inquiry showed had been followed by sequelæ, such as are commonly associated with diphtheria. Sore throat, on the other hand, is used to denote sore throat not followed by paralysis, but occurring for the most part in families invaded by definite diphtheria. Henceforward in this report it will be convenient to include both diphtheria and sore throat under the one term "throat illness."

Two points of interest are developed by this Table I., viz., the distribution of throat illness in time and its incidence on children.

As to time. Passing over the first period, during which diphtheria was acquiring a hold on the parish, we come to compare the seven weeks ending May 20, during which the school was open, with the following period of six weeks (ending July 1) during which it was closed. The weekly number of attacks declined between the two periods; and declined only among children under 15 years old. The school was now re-opened for three weeks, and in that period the weekly attacks became again more numerous, becoming so solely among children under 15. The school being again closed for six weeks, the weekly attacks among children fell almost to the point of disappearance of the disease among them, but new cases occurred among older persons. During the last four months of the year, the school has been twice again opened and twice again closed, with some corresponding fluctuations (smaller in actual amounts) in the appearance of the disease, suggesting a relation between the work of the school and the occurrence of the throat illness, and between the suspension of the school work and the disappearance of the throat illness. Upon the whole, the facts thus far by no means exclude influence of the school on the later behaviour of throat illness in the parish, though they admit of a suspicion that school influence may have been subordinate to some other and more general influence operating through the parish, alike in kind though different in degree, upon children and on other persons.

The incidence of the throat illness on children under 15 years seen in the table is striking, and for the reason that "children under 15" includes all children habitually attending school, may seem hardly to require us to hesitate about connecting the disease with the school. Indeed upon very similar evidence schools have, ere now, been believed to have been the sole propagators of diphtheria. But diphtheria, as is now well known, is notably prone to attack children, and especially children at ages 3-15, which are beyond all others the school-going ages. Such children are, in point of fact, far more susceptible of the disease than babies and older persons. Hence evidence of the above sort is not by itself of much value as proving school influence in dissemination of the disease.

Accordingly, in the present instance, the incidence of the throat illness upon children has been studied in considerable detail in the houses of the parish, with the result of finding as usual large immunity from the disease of babies under three years; and much time has been spent in attempting to differentiate between mere age influence at ages 3-15 years, and any influence that may have been special to the school. Especially has information been sought as to whether among certain divisions of the parish (made for the purpose of this inquiry, all of which sent many children to school) there had been any notable differences in the local incidence of the disease on children at 3-15 such as might serve as a starting point for further inquiry. But no such differences have been found.* Throat illness, so far as such children have been concerned, seems to have affected all divisions of the parish pretty uniformly, and at much the same time, nor are there any notable differences in the duration of the prevalence of the disease in the several sub-divisions. These facts are shown in Table II., where the incidence of throat illness per cent. of each class referred to is printed in italics.

* Amongst the several groups thus formed of children 3-15 years old, there were, as regards children at the more advanced age of 12-15 years, certain obvious differences of incidence of throat illness (See Table II.); but the numbers dealt with, in each instance were so few as to be altogether untrustworthy.

TABLE II.

Locality.	Bearing with reference to Village.	Distance from Village.	Houses.		Persons, all ages.		Persons at ages:—									
			Total.	Invaded and dates.	Total.	Attacked.	0-3		3-12		12-15		15-20		20+	
							Total.	Attacked.	Total.	Attacked.	Total.	Attacked.	Total.	Attacked.	Total.	Attacked.
Village	—	—	36	March 2 May 1 July 2 Aug. 1 Sept. 3 Oct. 1	160	22	14	1	28	13	7	2	24	3	87	3
					10	13		7		45		28		12		8
Dawney's or Boro' Hill.	N.	½ mile	17	Feb. 1 April 1 June 2 Sept. 2 Nov. 3	74	19	5	1	25	10	5	3	2	1	37	4
					9	27		20		50		60		20		10
West Heath	N.W.	1-½ mile	18	May 3 June 1 July 1 Aug. 1 Sept. 1 Oct. 1	87	16	12	1	20	9	3	1	8	2	44	3
					8	18		8		45		33		23		6
Cowshot and Primley.	N.W.	1-2½ miles	18	Jan. 1 April 1 May 2 July 1	92	15	6	—	22	10	8	2	8	1	48	2
					5	16		0		45		23		12		4
Duchies	S.W.	1-3 miles	28	April 2 May 3 June 2 Nov. 1 Dec. 1	121	16	11	—	25	9	10	3	9	—	66	4
					9	13		0		26		30		0		6
Collins Green and Hogley.	S. and S.E.	1-2 miles	20	April 1 May 1 June 3 July 3 Aug. 1 Nov. 1 Dec. 1	156	18	4	—	28	10	13	2	27	3	84	3
					11	11		0		23		15		11		3
Whole Parish	—	—	144	Jan. 1 Feb. 1 March 2 April 5 May 10 June 8 July 7 Aug. 3 Sept. 6 Oct. 2 Nov. 5 Dec. 2	690	106	52	3	148	61	46	13	78	10	306	19
					52	16		6		41		26		12		5

Accepting then as a fact that a special incidence of throat illness on children at the more susceptible ages in Pirbright has uniformly obtained throughout the parish, the question arises, how far has this been due to mere age as conducing to attack, and how far to difference of exposure, whether at school or elsewhere, of such children to a cause of diphtheria? For answer to this question a standard of comparison is wanted, and that afforded by the behaviour of throat illness toward *persons of various ages in the families that had become invaded* may perhaps suffice. In 50 such families in Pirbright, there were, exclusive of the first sufferers, 251 persons living in the presence of diphtheria subsequent to its introduction into the house; so far as the disease may have had its origin on the premises, exposed to such influences as may have caused the disease in the original sufferer; so far as the disease is infectious, living in the same room, sleeping in the same or in the next room; parents nursing children, children tending one another, all presumably under circumstances of free and sustained exposure to the infection of the disease. Among these 251 persons there were—

Living at ages 0-3	22, of whom	2 were attacked, or	9.0 per cent.
„ „ „ 3-12	59, „	23 „	38.0 „
„ „ „ 12-15	22, „	7 „	31.8 „
„ „ „ over 15	148, „	20 „	13.5 „

So that under the circumstances of these families actually invaded, children at ages 3-15 suffered three or four times more than babies and older persons, and children 3-12 to a somewhat greater extent than other children.

These several percentages 9, 38, 32, and 13½, may be taken as expressing the relative proclivities to throat illness of one and another age-period, under *equal* circumstances of exposure; and we are now in a position to consider the relative incidences actually observed in persons of one and another age under circumstances of life in non-infected houses in Pirbright; and to examine the indications that may appear whether children at ages 3-15 have or have not been exceptionally exposed to the operation of the causes of throat illness. Obviously in proceeding to this examination we have to take account solely of *first attacks* in families and of no subsequent attacks. Now in Pirbright there were persons living—

At ages	0-3	52, of whom	1	was a first sufferer.
"	"	3-12	148,	" 37 were " "
"	"	12-15	46,	" 5 " " "
"	"	over 15	444,	" 9 " " "

And the several percentages on these ages were 1·8, 25, 10·8 and 2. Thus, while throat illness was but seldom introduced into the family by the baby or by the grown-up members of the family, it was brought by the child of 3-12 not very much less often than it would have been brought if the child had been living in an atmosphere of persons infected by throat illness. And this difference between the child of 3-12 and other persons is found, after all due allowance has been made for the differing susceptibility of various ages to contract the illness. The child of 3-12 years, therefore, has for some reason or other apart from its age been the child to get the disease and to take it home to the family that has hitherto been free from it. The next question to be decided is, what has been the influence specially affecting children of this age.

This special influence can hardly have been other than some condition or conditions involved in the process of school going. For, as has already been shown, all parts of the parish have alike been affected by throat illness, and this mainly in the persons of their children, and the several parts have had few conditions in common except it has been school attendance; moreover, in each division of the parish the speciality of the incidence of throat illness has been on children 3-12, which are the chief school-going ages; infants under 3 years not having attended school at all, while children above 12 and under 15 years have attended in small numbers and less uniformly. No doubt enough has been made out to show in a general sort of way school influence; nevertheless, it has been thought desirable to examine the question further, and in some detail, with a view of learning more precisely what has been the value of school influence in determining the results observed. To this end, by help of the schoolmaster, Mr. Hill, note has been made in regard of each period of school operations of the school attendance of each child in the parish; and the incidence of throat illness on children 3-12 at school and not at school, and on other persons, has been studied in each period of the school operations. Similarly, the facts of incidence of throat illness have been studied for each period of school closure. For it was seen that the total influences causative of throat illness, though they might be a diminishing, were probably a varying quantity; and that in successive periods, the total children, and as well other persons, not yet attacked, was a gradually diminishing number. So also it was seen that not only did the number of children at school and not at school vary in different periods of school operations, but that it varied also, according as school was open or closed, within totally different limits; for instance, children (speaking only of children not yet having undergone attack) at school might in separate periods be nil or they might number 100, while children not at school were rarely below 40, but could in periods of school closure be above 100. In making investigation on the above lines, regard was had to the necessity for distinguishing between first sufferers and after sufferers of their families, when estimating school or other influences; and in order that the school should not be unduly credited with cases that might possibly have got their infection just before school reopened, some slight rearrangements of the groups of weeks constituting the several periods was adopted. The result is embodied in table III. where rates are, as before, printed in italics.

TABLE III.

Periods.	Pirbright School.	Children at ages 3-12.								Other Persons.				
		Children not recently attacked at beginning of period.	At School.				Not at School.				Total not recently attacked.	Newly attacked.	First Cases in their Families.	After Cases.
			Total not recently attacked.	Newly attacked.	First Cases in their Families.	Secondary Cases in their Families.	Total not recently attacked.	Newly attacked.	First Cases in their Families.	Secondary Cases in their Families.				
January to 27 May. (21 weeks.)	Open (closed 16 May.)	148	96	28	16 16.6	12	52	6	2 3.8	4	496	17	1 0.2	16
27 May to 8 July. (6 weeks.)	Closed - (reopened 27 June.)	114	—	—	—	—	114	12	9 7.8	3	479	7	2 0.4	5
8 July to 22 July. (2 weeks.)	Open - (closed 13 July.)	102	62 *[6]	5	3 4.8	2	34	—	— 0.0	—	472	1	1 0.2	—
22 July to 9 September. (7 weeks.)	Closed - (reopened 28 August.)	97	—	—	—	—	97	2	—	2	471	6	3 0.6	3
9 September to 7 October. (4 weeks.)	Open - (closed 26 September.)	95	56	4	4 7.1	—	39	1	1 2.5	—	465	2	1 0.2	1
7 October to 11 November. (5 weeks.)	Closed - (reopened 6 November.)	90	—	—	—	—	90	—	—	—	463	4	4 0.8	—
11 November to 2 December. (3 weeks.)	Open - (closed 21 November.)	90	48	3	2 4.1	1	42	—	— 0.0	—	459	4	2 0.4	2
2 December to end of December. (4 weeks.)	Closed -	90	—	—	—	—	90	—	—	—	455	4	1 0.2	3

The facts of this table, in their general bearing, accord with those of Table I. so far as they admit a probability that school influence has not been the only influence causative of throat illness in Pirbright. But seemingly it has had a larger share in the throat illness, at any rate in the attack of children at later periods of the epidemic, than from Table I. appeared likely. For Table III. shows that attacks of throat illness at ages 3-12, occurring among such children first of their respective families, were in two ways related to school. In uninfected families, children of this age who at a given period were attending school, became affected by throat illness five or six times as numerously as children of the same age who at the same period were not attending school. And this was observed on every occasion when the school was open and the opportunity for comparing the two existed. While the school remained open in the early months of the year, the rate of attack in children 3-12, presumably susceptible of diphtheria but not having the disease at home, was 16.6 per cent. of those who were at school, 3.8 per cent. of those who were not. The next time the school was open, the respective rates were 4.8 and 0.0; the third time, 7.1 and 2.5; and, on the November occasion, 4.1 and 0.0. The numbers upon which these percentages are based are indeed small, but on the other hand the indication which they furnish is too uniform to be mistaken.

Going into the facts of Table III., with the object of stating the incidence of throat illness in the given group of children at periods when the school was open in comparison with periods when it was closed, it is found that comparative statement is not to be made numerically:—

The periods in question were not of similar length; the children who stayed at home only because the school was closed, taken with the children who never went to school at all, made up a variable which did not lend itself to examination; while the watchfulness for cases of minor throat illness, exercised by teachers when the school was open and wanting at periods of school closure, introduced a further variable that interfered with comparison of total throat illness at one and the other time. Thus during my inspection it would happen that illnesses learnt through school records were not remembered by parents, until some school-recorded fact was brought to their recollection. Fortunately there was no example of this last kind to vitiate comparisons invited by the table which follows.

* The figure 6 in brackets are children regarded for present purposes as having got infected in the preceding period of school closure, though they were taken ill while attending school at the end of June or beginning of July. Hence 6 has been subtracted from 68, and the rate for this period of school operations has been taken on the remaining 62.

Such facts of Table III., however, as are concerned in the above comparison, admit of being stated in the form of a new table. Accordingly, I show in Table IV., what was the occurrence of throat illness among this particular class of the Pirbright community—children, aged 3–12, who had no infection at their own homes—during periods of school closure and school work respectively. In this table, by omission of the first period of regular school operations (for reasons that will be readily apparent), seven periods, each of a few weeks, come under review; and sufficiently valid comparison may be made between the four periods when the school was closed and the three periods when it was tentatively re-opened.

TABLE IV.—Showing in regard of periods of school closure and of school operations subsequent to culmination of the outbreak, the facts as to ascertained occurrence of first attacks of throat illness among children in Pirbright at ages 3–12 years.

Limits and Duration of Period.	Operations of School.	Children 3–12 (first sufferers of their families) attacked in the several periods.		
		Age and Date of Attack.	Nature of Illness and Result.	School Attendance.
May 17th to June 26th (41 days).	Closed -	5 years, May 26	Diph. slight, recovered	Never to Pirbright School.
		4 years, June 10	Diph. slight, do.	" "
		4 years, June 11	Diph. do.	Never to school.
		11 years, June 13	Diph. severe, do.	Not to school since 16 May.
		3 years, June 23	Scarlatinal diph. do.	Never to school.
June 27th to July 13th (17 days).	Open -	11 years, June 29	Diph., died - -	To school until 2 July.
		6 years, June end	Sore throat, recovered	To school until ill.
		10 years, July 4	" " " "	" "
		4 years, July 6 -	Diph., died - -	" "
		7 years, July 7 -	Diph., died - -	" "
		7 years, July 13	Diph., died - -	" "
		6 years, July 15	Diph. slight, recovered	" until 13 July.
		6 years, July 15	" "	" " "
July 14th to August 27th (45 days).	Closed.	—	—	—
August 28th to September 26th (30 days).	Open -	5 years, Sept. 18*	Diph. very slight, recovered.	Not to school since mid. July.
		7 years, Sept. 21	Diph., died - -	To school until ill.
		5 years, Sept. 23	Diph. slight, recovered	" "
		5 years, Sept. 24	Throat illness, "	" "
		9 years, Sept. 25	Diph. very slight, "	" "
September 27th to November 5th (40 days).	Closed.	—	—	—
November 6th to November 21st (16 days).	Open -	7 years, Nov. 12	Diph., recovered -	To school until ill.
		6 years, Nov. 14	Diph., " -	" "
November 22nd to December 31st (40 days).	Closed.	—	—	—

In view of the above facts, no doubt can be entertained that the conditions of school attendance have played an important part in the speciality of the incidence of grave illness

* This was an only child, aged 5 years, living in the village. She had not been at all to school since mid. July, and no cause could be assigned for her illness. Nor could any association of later cases with this child be established, such, for instance, as might help to explain their subsequent attack.

on children 3-12 in Pirbright. It is not of course intended to say that the school influence was the only factor of throat illness at that age; there may perfectly well have been some other factor operating for a while over the whole district, and upon persons of all ages.

There remains for special consideration the question,—in what has school influence consisted?

Two sets of school conditions may be thought of as competent for the results observed:—(1.) General conditions, physical or sanitary, of the school building or of its neighbourhood, and belonging therefore to the school or to the locality of the school; and (2.) Circumstances personal to children attending school, and contributed or conveyed therefore to the school by the children themselves. And in either case be it noted the speciality of operation on children might have been subordinate to some other and original factor of diphtheria.

1. The physical and sanitary circumstances of the school and of the school locality seem to demand special notice inasmuch as they comprise a variety of conditions (all of which have before now been regarded as competent for diphtheria production) that might possibly be in some sort differentiated from like circumstances in other parts of the parish. And any differentiation of a decided sort between such circumstances in and about the school, and in other localities of the parish, might be of importance as tending to explain not only the circumstance of the outbreak having begun upon children, but the sustained incidence also of the throat illness on children attending at the school. But nothing definite in this sense has been made out. The school is a modern building in the erection of which unusual forethought seems to have been exercised. It stands alone on a sand eminence, and is distinct in its sanitary circumstances from the houses of the locality in which it is placed. The slop drainage of the master's house, and of the school lavatories is drained away to a cesspool in a garden many yards distant from the school, and no part of the interior of the building has connexion with this drain; all sink and lavatory pipes are conveyed outside and terminated over trapped drain inlets. Excrement disposal is by earth pails, which are well kept. Up to last May the children's closets were at the back of the lavatory outbuilding, adjoining the school; but on occurrence of diphtheria they were, for additional safety, removed to the further side of the playground. The well which is in the master's back yard seems exceptionally safely placed and cared for. Thus it appears that in all the matters referred to, school conditions have differed from other conditions of like sort in the parish only in being better ordered and administered. And therefore it is difficult to believe that anything in the sanitary circumstances of the school can have had any essential part in the production and maintenance of throat illness among the scholars. Nor did I get any suggestion of relation of food or dress or washing to the prevalent disease. So, too, with reference to the sanitary circumstances of the locality (Dawney's Hill, of Table II.) in which the school is situate, there is nothing at all suggestive of relation between matters of this sort and the diphtheria. They differ in no essential particular from those of other localities into which the parish has been divided; and, except in the matter of a common atmosphere, there can hardly have been community of condition for the school and for houses in its neighbourhood. Nevertheless, it has to be noted as at least singular that this Dawney's Hill locality has suffered from throat illness and diphtheria to a greater extent and for a longer time than other localities, and that five-ninths of its first sufferers had not at the date of their seizure recently attended the school.

II. Among conditions causative of throat illness that may have been contributed to the schools by the children themselves, personal infectiveness of children attending the schools is the only one which past experience would suggest for consideration. This, if it could be affirmed for each period of school operations, would, in view of the undoubted communicability of diphtheritic disease, go far to explain what has occurred among school children; and the question therefore arises how far can personal infectiveness have operated at the school.

In attempting an answer, we may first think of the school at a time of re-opening after having been closed on account of sickness. Generally, during such periods of school closure, much care was exercised toward effectually getting rid of infection. Not only was the school building and its contents thoroughly cleansed and fumigated, but disinfection of dwellings and clothing of persons that had been attacked was diligently practised in all instances. And on each occasion of re-assembly of the school (and re-assembly of school was not permitted until no diphtheria had for several weeks occurred in the parish), children that had suffered were excluded until they could be pronounced

completely recovered from their throat affection. Then, as regards times of active school work, so far as diphtheria and graver throat illness are concerned, it is not likely that convalescent children did in fact so return to school with their original infection about them as to give disease to fresh children; and more particular examination of the school records, with inquiry of the parents, suffices to prove that few, if any, persons suffering from diphtheria or notable throat illness did so attend within five or six weeks of their seizure. Unless, therefore, persons afflicted by diphtheritic neuroses are to be regarded as infective, it may be doubted whether diphtheria infection has again and again been introduced to the school by children convalescent from that disease. In the third place, the evidence as to possible introduction to the school of infection by children incubating or developing diphtheria is on the whole negative. Perhaps this may have occurred in the July period, when a girl, regarded as attacked 29 June, two days after re-assembly of school, continued to attend school until 2 July; it is, however, doubtful. This child, although indisposed as early as 29 June, did not have, it is confidently affirmed, any sore throat at all until 3 July, and there is ground for believing this to have been the true date of beginning of her fatal illness. If this may be believed, then, in this instance as on other occasions of re-assembly of school, the diphtheria seizures occurred so nearly together that the existence of a cause common to the several cases would account for the early July attacks even better than a hypothesis that one case had been derived from the other.

But even if we should assume that infection from case to case by diphtheria did really take place on each occasion of resumption of school operations, an important question remains wholly unanswered. On none of these occasions, be it observed, is diphtheria or grave throat illness recognised as having occurred among children in Pirbright for some weeks before the re-opening of the schools, and such illness, if it had occurred, could hardly have escaped notice. Yet, no sooner does school re-assemble than diphtheria, and commonly fatal diphtheria, re-appears among school children. Whence, then, came on each occasion of re-assembly of school, the assumed initiatory case of diphtheria? If arising by personal infection, from whom did this first case take the disease? And if not from an antecedent case of diphtheria, by what sort of case did this sufferer get infected?

Apparently, there is no sufficient answer to these questions in considerations arising from what has been noted elsewhere, viz., that trivial sore throat may, by what has been termed a process of "progressive infectiveness" operating through several individuals successively, give rise ultimately in other persons to attacks of true diphtheria. At Pirbright it is likely enough that trivial sore throats designable as "cold," though few can now be heard of, existed among children on each occasion of their re-assembly at school, but there is no evidence of progressively increasing gravity of the earlier cases, if indeed there was time for the process. On the contrary, with startling suddenness, multiple cases of diphtheria, and fatal diphtheria, promptly occurred on each occasion of re-opening the school; and cases intermediate in gravity between these diphtheria cases and the "colds" that on the above hypothesis gave rise to them, are not, except perhaps in the July period, to be found. No satisfactory explanation of this behaviour of the diphtheria is forthcoming.

This investigation has failed, therefore, in giving definite reply to the main question as to the nature of the school influence. Nor can any beyond speculative answers be made to other questions that may be thought of as arising from it. As for instance:—how far and in what direction would the later behaviour of diphtheria in Pirbright have been modified, had the school been closed in the first instance at an earlier date? and again, what would have happened if the school had not been closed at all?

In bringing this report to a conclusion, mention may be made of certain facts in the natural history of diphtheria that came under notice during this inquiry. These, though they may not be new, have interest in regard of the story that has been told. In our investigation of the incidence of throat illness upon families, Mr. Smith and I were struck, and independently of one another, by the apparently different ability of the disease in one and another instance to extend itself in families invaded. Not unfrequently, severe and fatal diphtheria appeared destitute or well nigh destitute of power to infect other children living along with it, while on the other hand cases of very trivial sore throat or "colds" that were not perhaps heard of (except by close questioning) often preceded, and were seemingly responsible for after-occurrences of true and fatal diphtheria in the family. Especially was this apparent capacity of mere sorethroat for breeding malignant diphtheria noticeable in regard of families comprising many young children. In such families severe or fatal cases of diphtheria tended to occupy a position midway in a series of attacks that began as sore throat and ended in similar fashion. And

further, we got a suspicion, though the instances were too few to justify any conclusion thereon, that, given the occurrence about the same time of two or more cases of trivial sore throat among children of a large family, such occurrence was likely to be quickly followed by severe diphtheria attack in one or more children of that family. This suspicion may like enough be hereafter proved invalid; it is only noteworthy as having arisen before the facts as to the behaviour of diphtheria in that larger family, Pirbright School, had been got together and formulated.

Finally, it is proper that this report should not close without acknowledgement of the valuable assistance afforded me in the inquiry. To Mr. Smith, who worked with me day by day in Pirbright; to Mr. Halsey, Chairman of the Guildford Rural Sanitary Authority; to Mr. Rees, Inspector of Nuisances; to Mr. Hill, the schoolmaster of Pirbright; and to Mr. Sells and Dr. Russell, medical practitioners in the district, not a little of that which tends to make the report exact, is due.

(Signed) W. H. POWER.

31 January 1883.

[While this report is passing through the press, information reaches the Board of recrudescence, several weeks subsequent to resumption (in January) of school operations, of diphtheria among Pirbright school children. Mr. Smith in reporting, on 29th March, this further outbreak, speaks of two houses invaded by the disease with three deaths.]

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