

AN OUTBREAK OF DIPHTHERIA CHECKED BY PROPHYLACTIC USE OF ANTITOXIN, AND THE ISOLATION OF INFECTED PERSONS.

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TOWARDS the end of October 1900 the Sanitary Authorities of Cambridge and Chesterton found themselves face to face with a serious outbreak of diphtheria; the first official notification had been on October 14th, and by October 23rd eleven cases had been notified, of which four terminated fatally, on October 15th, 21st, 22nd and 26th respectively. These four were all children attending the Infants' Department of a certain Higher Grade School, and the other seven cases were either children of this school or persons closely associated with them.

This limitation at the outset was very favourable to the taking of energetic measures, while the severe character of the outbreak made such measures imperative. The Medical Officer of Health, the Public Health Committee of the Borough Council and at their request the Pathological Department of the University, all combined to arrest the epidemic, and thanks to the hearty co-operation of the medical men of the town, their efforts were rewarded with a great measure of success.

On October 23rd preparations were made at the Pathological Laboratory for the bacteriological examination of suspected individuals and of those who had come in contact with them. A small body of students were got together to visit the school-children in their homes, to take swabs from their throats and from those of others living with them, and to recommend and administer a prophylactic injection of antitoxin whenever it seemed desirable. To R. H. Mayo, M.B., E. Ward, and P. R. Roy the thanks of all concerned are due for carrying out this part of the work.

On October 24th the children (about 60 in number) of the Infants' Department of the above-mentioned school, which had been closed two days previously, were visited in their homes, swabs were taken from their throats and from those of their brothers and sisters, and in many cases a prophylactic injection of antitoxin was given; several more of these children were injected on the following day, the result of the bacteriological examination of the swabs taken from them having been the detection of diphtheria bacilli, though there were as yet very trifling, if any, clinical symptoms of the disease.

A circular was then sent out to all the practising members of the Medical Profession in the town, informing them that the Public Health Committee had arranged for a free supply of antitoxin for both actual cases and "contacts," and that swabs might be obtained from the Pathological Laboratory, and when used sent there for bacteriological examination. Further they were requested to obtain three consecutive negative examinations from their convalescent patients before pronouncing them free from infection.

A few cases having occurred in two other schools, as many as possible of the children attending these schools were also visited in their homes and examined for diphtheria bacilli; and when later the epidemic was well in hand, in order to obtain a "control," swabs were obtained of 43 children attending a fourth school in which no case of diphtheria had occurred. The results of these examinations are reported in the next paper.

In all, over 950 bacteriological examinations were made of 650 persons; and 102 pure cultures were isolated, and tested for power of forming acid out of glucose and for virulence.

These measures were attended by a considerable amount of success; for though a large number of notifications continued to be made, many of them were founded on doubtful clinical signs together with the discovery of suspicious micro-organisms which ultimately proved to be pseudo-diphtheria bacilli. Only one death occurred among the cases notified after October 23rd.

The progress of the outbreak is shown in the following table of weekly notifications and deaths in Cambridge and Chesterton<sup>1</sup>:

<sup>1</sup> The number of notifications of diphtheria in previous years may be of interest for comparison. From 1890 to 1899 inclusive they were as follows: 23, 20, 8, 15, 7, 24, 10, 16, 34, 27. In 1900 previous to the outbreak there had been 15 cases notified in the early part of the year, none in June, July or August, and one in September, which could not be connected in any way with the outbreak which followed. These figures are not *strictly*

TABLE I.

Week ending	Oct. 20	Cases notified	
		3	2 fatal
"	"	27	2 "
"	"	Nov. 3	1 "
"	"	10	0 "
"	"	17	0 "
"	"	24	0 "
"	"	Dec. 1	0 "
"	"	8	0 "
"	"	15	0 "
"	"	22	0 "
"	"	29	0 "
"	"	Jan. 5	0 "
Total		67	5

Mortality 7.5 per cent.

As soon as the disease had spread beyond the school in which the first cases occurred, the Public Health Committee arranged for the opening of an Isolation Home for the reception of children who were found to be harbouring the diphtheria bacillus without being themselves ill.

It was gratifying to find that the above-mentioned precautionary measures could be carried out without much difficulty. The parents with scarcely an exception allowed bacteriological examinations of their children to be made, and the great majority accepted injections of antitoxin when recommended, and after its nature had been explained to them. Over 100 injections were made by the laboratory staff alone, and no complaints of rashes or other unpleasant consequences reached the Sanitary Authority. Moreover, it was found possible in most cases to persuade parents to allow of the removal of their children to the Isolation Home.

The three consecutive negative examinations were not always obtained in the case of patients treated in their homes. Examples mentioned in the second paper show how necessary it is not to rely

comparable with those of the outbreak itself, because during the period of the latter bacteriological examination was for the first time extensively used, with the result that some mild cases, which would probably have otherwise escaped detection, were notified, while two notifications were withdrawn on the result of a negative bacteriological examination. The figures for the outbreak include all notifications, except those withdrawn, whether confirmed bacteriologically or not. For their analysis see the next paper. For the early part of this year since Jan. 5th the weekly notifications have been: 1, 1, 0, 2, 0, 1, 4, 1, 3.

upon a single negative examination, more particularly at a time when antiseptics are being applied to the pharynx. The great majority of patients were found to rapidly become free from the diphtheria bacillus during convalescence; but in two instances the bacilli have persisted for more than two months. It is exceedingly difficult to persuade such persons or their parents and guardians of the continued risk of infection. And the absence of symptoms or of any pharyngeal lesion is urged against it both by them and by some medical practitioners. It is nevertheless most important that such persons should continue to be isolated, more particularly when the bacilli which they harbour have been shown to be fully virulent. Many different kinds of antiseptics have been tried, but as yet no effective means of getting rid of the bacilli has been found.

*The Origin of the Outbreak.*

The distribution of infection in the first-mentioned school was traced to a case of chronic membranous rhinitis (G. N.). The origin of this case however could not be determined. About the time it commenced another of the school children (G. D.) fell ill with scarlet fever, and two months later while still in the Hospital for Infectious Diseases, where there were no known cases of diphtheria, the diphtheria bacillus was found in his throat. This then may have been a case of scarlet fever associated with diphtheria from its commencement, and if so, either boy may have been infected from the other, or both may have become infected from a common source.

While the actual origin of the outbreak has not been cleared up, there is no doubt about the way in which the infection became distributed: On October 23rd G. N. a member of the 3rd class of the Infant Department of the school already mentioned, was visited among other infants attending this school. He was found to be having tea with his brothers and sisters, and was in very good spirits, though he looked rather pale, and appeared to be suffering from nasal catarrh. His mother said he had had a "stuffy cold in the head" for about three weeks. During this time he had been regularly attending the school. Bacteriological examination revealed virulent diphtheria bacilli in great numbers in the nasal discharge, and after his removal to hospital, membrane was seen in the nose. His father, mother, sister, and brother, all the members of this family were found to have diphtheria bacilli in their throats. From three

of them (including G. N.) cultures were isolated and proved to be virulent. No less than seven of the nine male members of his school class (including himself and G. D.) suffered from diphtheria before October 23rd. The remaining two boys having been injected with antitoxin may have been saved by this means; though it is only fair to say that the pseudo-diphtheria bacillus was the only suspicious-looking micro-organism found in their throats.

It was notable that while seven of the nine boys of this class suffered from diphtheria, only one of the seven girls in it was affected, and one other was discovered to be harbouring a virulent diphtheria bacillus. For almost all their lessons, the boys and girls of the class were mixed indiscriminately, and according to their schoolmistress they played together out of school hours. The only explanation of the unequal incidence of the disease upon boys and girls was that twice a week the girls were separated from the boys to do needlework while the latter had a drawing lesson. It can scarcely be doubted that it was during this drawing lesson, when slates were in use, that the infection was distributed.

The following table shows the distribution of infected persons among the three classes of the "infants" attending this school:

TABLE II.

	Class I.		Class II.		Class III.	
	Boys	Girls	Boys	Girls	Boys	Girls
Cases	2	2	1	1	7	1
Deaths	1	0	1	0	2	0
Healthy children with diphtheria bacilli	1	1	3	0	0	1
Healthy children without diphtheria bacilli	15	13	7	4	2	5
Total No. of children in class	18	16	11	5	9	7

The conclusions arrived at are incorporated with those at the end of the following paper.

*Note on Chronic Membranous Rhinitis.*

The name chronic membranous or fibrinous rhinitis has been applied to a certain class of cases of diphtheria in which the disease principally or solely affects the nasal mucous membrane, and is attended by little or no constitutional disturbance. Cases have been described on the Continent of Europe by Isambert, Concetti, Baginsky, and others, and in America by Park, Abbott, Ravenel, and Townsend.

References to the literature of the subject may be found in Ravenel's paper<sup>1</sup>. Ravenel collected about 77 cases, in 41 of which there was a clear record of bacteriological examination, and in 33 the Klebs-Löffler bacillus was found. In all the cases the disease ran a benign course, and in all but a few the membrane was limited to the nose, constitutional symptoms being either slight or entirely absent.

Virulent diphtheria has but seldom been observed to have been contracted from contact with a case of membranous rhinitis. Park<sup>2</sup> mentions an instance of a child with only a slight nasal discharge in which diphtheria bacilli were present, giving rise to diphtheria in four children, two of whom died. The child with nasal discharge was a member of a family in which there had been a case of diphtheria three weeks before. Ravenel also gives the history of an instance of this kind.

On the other hand a case of membranous rhinitis has not unfrequently been observed to give rise to another of the same kind. Concetti<sup>3</sup> obtained in two cases a history of direct infection from one to the other. Abbott<sup>4</sup> found two children affected in the same family. Ravenel did the same, and gives a further instance in which two children and their mother were all affected.

That membranous rhinitis not unfrequently gives rise to the same condition, and has not more often been observed to cause severe diphtheria, may be explained on the assumption of a high degree of individual resistance in the several members of one family; for it is obvious that when a case has occurred it is the members of the same family who are most likely to be exposed to infection. On the other hand it may be that the diphtheria bacillus concerned in these cases has a lower degree of virulence than usual. This indeed has been found to be the case on several occasions. Thus Park tested the virulence of five cultures which were described by Abbott as all of a low degree of virulence<sup>5</sup>. Virulent diphtheria bacilli were found in two of Abbott's three cases. From the second case a culture which was not only devoid of virulence but was also of low vitality was obtained thirty days later. And from his third case, at a time when membrane was still present in the nose, a diphtheria bacillus was obtained which did not cause death, but produced only a local swelling, and a temporary indisposition from which the animals recovered. Ravenel tested cultures isolated from eight of his cases. Five were of the usual degree of virulence, one caused a slough as large as half-a-dollar from which the animal recovered, one caused a slough and death in 17 days, and one caused death in 15 days, but the lesions were not characteristic. A loopful of a serum culture was the dose used, the guinea-pigs weighing 350 g. and sometimes more. From the last case but one a virulent diphtheria bacillus had previously been isolated by Dr Kneass. In all of Townsend's four cases of pure membranous

<sup>1</sup> Mazjick P. Ravenel, "A Contribution to the Study of Membranous Rhinitis." *The (Philadelphia) Medical News*, 25 May, 1895.

<sup>2</sup> Cited by W. H. Welch, "Bacteriological Investigations of Diphtheria in the United States." *Am. Journ. of Med. Sciences*, Oct. 1894.

<sup>3</sup> Cited by Abbott.

<sup>4</sup> A. C. Abbott, "The Etiology of Membranous Rhinitis." *The (Philadelphia) Medical News*, May 1893.

<sup>5</sup> One killed a guinea-pig in 4 days, two, each in 5 days, and two caused symptoms from which the animals recovered. Cited by Welch (*loc. cit.*), the dose not being stated.

rhinitis the diphtheria bacilli had the usual degree of virulence<sup>1</sup>. To these may be added some cases cited by Abbott. Concetti tested the virulence of cultures obtained from two cases, Stamm that of cultures from four cases, and Baginsky that of cultures from two cases. All these are described as virulent. From the case which occurred in Cambridge a highly virulent culture was obtained (see next paper, Table III. G. N. i.). Thus from 29 cases of membranous rhinitis mentioned here 21 have yielded virulent diphtheria bacilli, and 8 bacilli more or less attenuated. From two of the 21 cases moreover attenuated cultures were obtained at a later period.

	Virulent	Attenuated
Park	0	5
Abbott	2	1
Ravenel	6	2
Townsend	4	0
Concetti	2	0
Stamm	4	0
Baginsky	2	0
Cobbett	1	0

<sup>1</sup> Cited by Welch.