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West Riding of Yorkshire County Council.

SECOND
ANNUAL REPORT
ON
The Work of the Bacteriological Laboratory.

January 1st to December 31st, 1902.



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BY

P. J. CAMMIDGE, M.B. (Lond.), D.P.H. (Camb.), etc.

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ON

THE WORK OF THE BACTERIOLOGICAL LABORATORY.

January 1st to December 31st, 1902.

During 1902 the work of this department has been carried on continuously and has shewn a steady increase, more particularly in the later months of the year. Although, as will be shown later on in the report, the increase has not been confined to any one section, it is in connection with examinations for diphtheria that the most striking developments have taken place. Last year 195 medical men practising in the West Riding forwarded specimens to the laboratory for examination, while this year 251 (of whom 71 were Medical Officers of Health) took advantage of the facilities afforded, an increase of 56.

The arrangements made early last year for the supply of "outfits," and the collection of material for examination, have been found to work satisfactorily, although in certain districts the original stock of "outfits," has had to be supplemented by further supplies, either on account of the presence of an epidemic in the neighbourhood or in consequence of the extra activity of the practitioners in that locality. Records of all "outfits" received or supplied have been carefully kept, and in the appendix will be found a list of the sanitary districts of the Administrative County with the number of specimens received from each during the year, compiled from these records. (Appendix III). A return of the stock which the laboratory books showed to be in the hands of the local authorities, and a summary of the examinations made for the district during the preceding year, was sent to the Medical Officer of Health for each sanitary area early in January, 1903 (Appendix II.), in order that their stocks might be kept correct and leakage prevented.

All specimens have been examined as soon as possible after their arrival in the laboratory and a report on each despatched to the medical man in charge of the case, and the Medical Officer of Health for the district in which the patient resided, as soon as the examination was completed. In dealing with diphtheria particular care has been taken to avoid all delay, as confirmation of the diagnosis in this disease at the earliest possible moment after it has been suspected, is of the utmost importance not only to the patient

but also to the public health. As was mentioned in last year's report, a diagnosis can be made in a considerable number of cases within a few minutes of receiving the specimen by making a cover-glass preparation direct from the swab and staining it by Neisser's method. During the past year this procedure has been adopted with all primary examinations for diagnostic purposes and has resulted in a very satisfactory saving of valuable time. A detailed account of the results obtained will be found under the heading of Diphtheria. Realizing that the delay caused by the transmission of reports through the post might be of serious importance in many cases, arrangements were made early in the year to telegraph the result of the examination of any specimen which was accompanied by sixpence or a stamped telegraph form. A leaflet to that effect was prepared and circulated (Appendix I.) During the year 295 telegrams relating to examinations made in the laboratory have been despatched in consequence. Of these 273 were in connection with cases of diphtheria, and 22 cases of suspected enteric fever.

It has been found possible to obtain a clinical history of the majority of the cases investigated in the laboratory up to the time of the examination, and in most instances this has been supplemented by an account of the subsequent course and termination of the case. A useful check has thus been kept on the laboratory results, and a measure of the reliance that can be placed on the methods of examinations employed has been obtained. It is unfortunate that the scientific investigations required for a bacteriological diagnosis must, from the nature of things, be divorced to a certain extent from the clinical examination of the case, for the worker in the laboratory is apt in consequence of his detachment to have his views narrowed, while on the other hand the clinician is in some instances tempted to conceal information which might materially modify the bacteriologist's view of the case. The system, however, which has been adopted in this laboratory from the first, of requiring a clinical history of the case with the specimen, has been an undoubted service in maintaining an intimate relation between the department and the clinical side of that branch of medicine with which it has to deal. The tables and figures in the succeeding pages of the report have been compiled from the laboratory records, and in the tables the clinical history and final diagnosis of the practitioner in charge of the case have been embodied.

The total number of examinations made in 1902 has been 2236, as compared with 863 in the period covered by the last annual report. As the laboratory was only open for nine months in 1901 a certain proportion of the very marked increase must be discounted. But even then the work of the department has nearly doubled in the course of the year, for in the last nine months of 1902 over 1700 specimens were examined in the laboratory as compared with 863 in the corresponding period of 1901. If the rate for the nine months of 1901 be taken as the rate for a year, 1150 specimens would have been examined which gives an increase for 1902 of over 1000 specimens.

In the following table a general summary of the examinations made during the year is given, and for the sake of comparison, the figures from the corresponding table in last year's report are also introduced.

GENERAL SUMMARY OF THE SPECIMENS EXAMINED IN THE LABORATORY

	Total.		Serum Reaction for Enteric Fever.		Sputum for Tubercle Bacilli.		Suspected Diphtheria.		Miscellaneous	
	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902
January...	—	226	—	22	—	32	—	162	—	10
February	—	161	—	12	—	39	—	101	—	9
March ...	—	145	—	11	—	31	—	91	—	13
April ...	17	137	2	14	7	42	7	74	1	7
May ...	48	158	4	23	18	43	23	85	3	7
June ...	81	139	10	12	38	33	29	89	4	6
July ...	79	149	11	11	28	31	30	101	10	6
August ...	79	135	19	11	19	34	31	83	10	7
September	114	159	42	18	33	34	26	100	13	7
October ...	141	279	38	34	35	44	55	191	13	10
November	139	298	31	30	26	41	72	221	10	6
December	165	250	20	21	24	33	101	188	11	8
Total ...	863	2236	117	219	228	437	383	1486	75	94

The highest monthly total for the year occurred in November, when 298 specimens were reported on. Of these 221 were samples from cases of suspected diphtheria, a marked contrast to the 72 examined in the corresponding month of 1901. The examinations made for the diagnosis of enteric fever reached their maximum in September last year, but this year, owing probably to the cold and wet season, the maximum was not reached until October, and even then fewer specimens were received than might have been expected in an average year. It will further be noticed that from July onward fewer specimens were received from enteric fever cases. Unlike diphtheria and enteric fever, the examination of sputum for tubercle bacilli has not been appreciably influenced by the seasons, and from 30 to 40 a month was the average number received throughout the year.

On July 11th, 1902, I gave a lecture on "The Serum Reaction and the Excretions in Enteric Fever," followed by a practical demonstration in the laboratory, to a well-attended gathering of Medical Officers of Health. The lecture has since been published in "Public Health," and reprints of it circulated among those likely to be interested.

According to the County Medical Officer's summary of Infectious Diseases, there were 1,014 notified cases of enteric fever in the administrative county in 1902. During the year 219 samples of blood were examined by the Serum (Widal) reaction for the diagnosis of the disease, and in the previous nine months, when 1,612 cases were notified, 117 examinations were made, thus giving a ratio of laboratory examinations to notified cases of 1 in 4.6 for 1902, and 1 in 9.1 for 1901. From these figures it would appear that medical men in the Riding have employed the reaction as an aid to diagnosis in a greater proportion of cases in 1902 than in 1901, and much more extensively than a mere statement of the actual increase in the laboratory figures would suggest. It is to be hoped, however, that in the future even wider use will be made of the laboratory for this purpose as, allowing for the 94 cases which gave a negative result, and were not enteric fever, only slightly over 11 per cent. of the notified cases were examined.

It is true that in many of these the investigation was made because the clinical signs and symptoms which usually characterise the disease were absent or ill defined, and as it is just these mild and anomalous cases that are liable to spread the infection, the laboratory fulfilled its function as a public health institution by assisting in their recognition.

Enteric fever is notoriously a disease concerning which mistakes in diagnosis are liable to occur and it is unfortunate that greater advantage is not taken in many districts of the assistance which the serum reaction affords. In his annual report for 1902 on Mexborough, Dr. Huey draws attention to this fact and says, "Five specimens of blood from suspected typhoid cases were sent up to the Bacteriological Department of the County Council, and I think the great value of such a department ought to be more widely recognized by the Medical men in each district as cases of mistaken diagnosis are by no means uncommon, and great suffering and expense is avoided by this most valuable department of the public service."

An analysis of the results obtained with the 219 specimens examined by the serum reaction together with the clinical history of the cases as recorded at the time of the examination, and the final diagnosis after the lapse of three months, are shown in the following table:—

EXAMINATION OF 219 SPECIMENS BY THE SERUM REACTION FOR ENTERIC FEVER.

*RESULTS of Serum Reaction.	FINAL DIAGNOSES, ascertained after the lapse of three months.	CLINICAL CHARACTERS, as recorded by Medical Attendant.			
		ROSE SPOTS PRESENT		ROSE SPOTS ABSENT	
		Diarrhoea	No diarr.	Diarrhoea	No diarr.
MARKED 95	Affirmative ... 86	30	30	9	17
	Negative ... 0	0	0	0	0
	No Return ... 9	3	1	3	2
	Total 95	33	31	12	19
DOUBTFUL 30	Enteric Fever. 28	6	8	9	5
	Not Ent. Fev. 1	0	0	0	1
	No Return ... 1	0	1	0	0
	Total 30	6	9	9	6
NEGATIVE 94	Enteric Fever. 5	2	1	0	2
	Not Ent. Fev. 64	4	34	1	25
	No Return ... 25	1	6	3	15
	Total 94	7	41	4	42

* The Microscopical method has been employed throughout, and two dilutions, 1 in 20 and 1 in 40, with a time limit of one hour, used for each case. The reactions obtained have been interpreted as follows:—Where both dilutions showed clumping and loss of motility at the end of the hour a diagnosis of "enteric fever" was made, but if the reaction was present only in the 1 in 20 dilution a guarded opinion was given and the case stated to be "probably enteric fever," if both preparations were unchanged the case was reported as "probably not enteric fever."

It will be seen that 95 specimens gave a "marked reaction," and were reported as "enteric fever." Information concerning 86 of these was subsequently obtained, and bore out the laboratory diagnosis. Of the 30 "doubtful" cases, reported as "probably enteric fever," 28 were finally diagnosed as enteric fever, but one was stated to be a case of general tuberculosis. The average day of the disease on which a positive reaction was obtained was, as was the case last year, the 11th, but one case gave a characteristic result on what was reported to be the 3rd day after the appearance of the first symptoms. In four cases a positive reaction was obtained on the 5th day of the disease, in 3 on the 6th day, in 13 on the 7th, in 8 on the 8th, in 9 on the 9th, and in 18 on the 10th day of the illness. One case gave a well marked reaction 111 days after the appearance of the first symptoms.

The subsequent history of the 114 cases that gave a positive reaction, and concerning which information was obtained, showed that 14 died (2 from hæmorrhage, 7 from heart failure and exhaustion, 1 from perforation of the intestine, and in 4 the cause of death was not stated). In 7 cases a relapse occurred, and in one instance it proved fatal from hæmorrhage from the bowel. One of the cases in which death was due to heart failure had a very tuberculous family history and at first the disease from which the patient suffered was thought to be general tuberculosis, but a well marked serum reaction on the 10th day of the illness confirmed the suspicion that it might be enteric fever, and the subsequent course of the disease agreed with this diagnosis.

Of the 94 cases in which no serum reaction was obtained, 64 turned out not to be enteric fever. The information supplied concerning these shows that pneumonia, influenza, simple gastro-enteritis, appendicitis, tuberculosis, and peritonitis were the diseases most commonly mistaken in their early stages for enteric fever. The negative result of the serum reaction was no doubt of service in many instances in suggesting a revision of the diagnosis. In five cases, which gave no reaction, a final diagnosis of enteric fever was made, but in one of these a positive result was obtained four days later, the first examination having been made on the seventh day of the illness, and so does not strictly speaking come in this class. No reply was received to the circular letter of inquiry concerning 35 cases (10 giving a positive and 25 a negative reaction), which leaves 184 in which it is possible to check the laboratory results by the subsequent history of the cases. An analysis of these shows that in slightly over 4 per cent. the serum reaction was at fault, a better result than last year, when 5.4 of the cases finally diagnosed as enteric fever failed to show the reaction. Even this would be improved if those sending specimens to the laboratory would remember that a single negative result, especially in the early stages of the disease, does not exclude enteric fever, and that it is advisable to control it by one or more subsequent examinations. The case already mentioned, which showed no reaction on the seventh day, but on the eleventh gave rise to typical clumping and loss of motility in a typhoid emulsion, is a noteworthy example of this. One of the cases which turned out to be enteric fever, but gave a negative reaction, was examined on what was reported to be the third day of the disease, and three others on the eighth day, so that it is probable that a second examination later might have given a different result.

Although it has been impossible to discover the source of the infection in all the cases examined, an attempt has been made to indicate the probable origin in many. Direct infection from another patient appears to be answerable for a fair proportion, and suggests the need for more efficient nursing, especially among the poorer classes. In one instance a woman and her two daughters were all apparently infected while nursing the father of the family; for the time of onset of the disease corresponded with the incubation period to which such a method of origin would give rise, and a younger daughter and two sons who took no part in the nursing were not affected. In another instance the only person attacked in a household of seven, beside the original case, was the patient's mother, who sickened six weeks after the commencement of her son's illness. In this case the urine was very probably the medium of infection, and it is only one of several in which investigation showed that ignorance and carelessness in the disposal of this excretion was the means of transmitting the disease to others. It cannot be too strongly insisted on that the urine of enteric fever patients is frequently highly infectious, and that it may remain so for a very long period after the general health has been re-established. A striking example of the need for great care during convalescence is the case of a woman who took her daughter for a holiday in order that the latter might recoup after an indefinite complaint, which, although not sufficiently severe to lay her up, had necessitated her relinquishing her employment and going home. A fortnight after the commencement of the holiday the mother was taken ill, and ten days later a sample of her blood examined in the laboratory gave a well marked serum reaction for enteric fever. On examining the daughter's blood a similar reaction was obtained, and her urine was found to be crowded with typhoid bacilli. In the case of the wife of a trooper, recently returned from South Africa, the only probable source of the disease seemed to be her husband, who had suffered from enteric fever on the way home, and whose urine was found to contain typhoid bacilli. The danger of drinking water from wayside brooks and other water supplies of unknown origin is illustrated by two persons who developed symptoms of enteric fever about a fortnight after a picnic at which they drank the unboiled water taken for tea from a small brook. The rest of the party, who only drank the water after it had been boiled, escaped. The disease in a miner was attributed to his having drunk the water in a coal pit which had flowed from the surface down the side of the shaft. An outbreak involving four cases, with one death, was apparently initiated by a visitor to a farm, who suffered from diarrhoea during the first week of his stay. It is unfortunate that it was found impossible to follow him up and obtain a sample of his blood to verify the suspicion as to the true nature of the diarrhoea from which he suffered. The serum reaction may, however, frequently be of use in clearing up the diagnosis in such cases and helping to throw light on otherwise inexplicable outbreaks of the disease. In one instance a family of five were all ill with an anomalous febrile disorder, which in two of them gave rise to serious anxiety. A positive serum reaction with the blood of one of the more serious cases gave a clue to the nature of the others, and a diagnosis of enteric fever was made and confirmed.

Examination
of Sputum
for Tubercle
Bacilli.

The death-rate for phthisis in the West Riding has shown a steady decrease for the last nine years, from 1·33 per 1,000 in 1898 to 0·99 per 1,000 in 1902. This improvement must, in part at least, be attributed to a more universal recognition of the infectious nature of the disease and to greater precautions being taken in dealing with the infected discharges of sufferers from tuberculosis. The only certain means, however, of demonstrating that the discharges of a particular patient are infected is by careful bacteriological examination, and consequently such examinations are not only of importance to the individual in deciding the diagnosis in many early and ill-defined cases, but they are also of service to the public health in-as-much as they bring home to the sufferer, as nothing else can, the fact that he himself is harbouring the germs of the disease, and is liable, unless he takes proper precautions, to transmit them to those around him. As a concrete example of the moral effect of a positive examination, a case under the care of Dr. Bond, of Brighouse, may be mentioned. Dr. Bond writes:—"I should like "to tender my sincere thanks for the help you have given me in this case, "because that help is largely responsible for the prospect of a good result, as "since the receipt of your positive diagnosis I have been able to get treatment "more systematically and persistently carried out than before, as well as more "care being observed to prevent the infection of others in the house." The good effect in certain cases of repeated failure to find tubercle bacilli in a patient's sputum must also not be lost sight of, and a case of Dr. Christy Wilson's, of Doncaster, illustrates this. The patient, a joiner, had suffered for some time from a troublesome cough and had lost weight, when, as he did not improve, it was thought advisable to have his sputum examined for tubercle bacilli. This was done on two occasions, and each time no bacilli were found. Four months later Dr. Wilson wrote that the case was one of bronchitis, and he further said "The man is an intelligent fellow, and had read "a good deal about tubercle. As soon as he knew that no bacilli could be "found he was immensely relieved, and began at once to improve. He "quickly gained flesh, and returned to work and is now quite well."

The number of examinations of sputum made each month during the year has remained fairly constant, although a slight rise occurred in the spring and early autumn. Altogether 437 specimens were examined, as against 228 in the previous nine months. In the majority of cases the physical signs of the disease were indefinite, or not detected, and the suspicion of tuberculosis rested on the presence of cough, emaciation, sweating, or evening rise of temperature, with or without a family predisposition to the disease. In the following table the cases are classified and arranged in accordance with the result of the bacteriological examination, the physical signs of disease, the presence or absence of family history, and (in those cases where the laboratory examination was negative) the final diagnosis after the lapse of four months from the time of the examination:—

RESULTS OF THE EXAMINATION OF 437 SPECIMENS OF SPUTUM
FOR TUBERCLE BACILLI.

Tubercle Bacilli found in 131.			No Tubercle Bacilli found in 306.		
Physical Signs of Disease.	Family History of Tuberculosis.	No Family History of Tuberculosis.	Final Diagnosis ascertained after lapse of four months.	Family History of Tuberculosis.	No Family History of Tuberculosis.
Present 32	8	24	Not Tuberculosis 239	45	194
Doubtful 82	21	61	Tuberculosis 16	7	9
Absent 11	3	8	Doubtful 20	8	12
Not Recorded 6	—	—	No Return 31	—	—
Total ...	32	93	Total ...	60	215

Of the 437 specimens examined 131 (*i.e.*, 30%) showed tubercle bacilli, and in 306 (*i.e.*, 70%) they were not detected. In 11 of those in which a positive result was obtained the medical attendant was unable to detect any physical signs of disease, and in 82 they were of a doubtful character. Consequently in over 90 cases the bacteriological examination was of great diagnostic value. It will be noticed that only 16 of the cases in which no tubercle bacilli could be found were finally diagnosed as pulmonary tuberculosis, so that the specific bacillus was detected in over 89 per cent. of the cases of undoubted tuberculosis submitted for examination, a most satisfactory reflection to those responsible for the investigations. A family predisposition to the disease was recorded in 25 per cent. of the cases in which tubercle bacilli were found, while in those in which the examination was negative and were finally diagnosed as "not tuberculosis," it was noted in 23 per cent. of the cases.

In 125 of the positive cases the sex of the patient was stated, and of these 73 were males and 49 females. Seventeen males and four females are stated to have improved under treatment, 6 males and 9 females were worse, while 18 males and 16 females had died, giving a death-rate, within four months of the positive examination, of 24 per cent. for males and 33 per cent. for females. Although these figures are interesting too much stress must not be laid on them, as the number of cases dealt with is, at present, too small to allow any reliable conclusions being drawn from them. In a few years time however the collected statistics of the past prepared in this way will no doubt be of value.

The average age of incidence in the cases examined this year appears to have been 33, being somewhat lower for females than males, namely 24 years for the former and 36 for the latter. Two patients in whose sputum tubercle bacilli were found were over 60 years of age and two were only 13.

The influence of occupation on the liability to pulmonary tuberculosis is well known, and the laboratory statistics again emphasise the extra risk which certain employments involve. During the past year tubercle bacilli have been found in the sputum of 18 mill-hands, 5 clerks, 5 school teachers, 5 stone masons, 6 ganister miners, and 6 miners (? coal). A similar incidence was noted last year, when out of 79 positive cases 14 were mill-hands, 8 stone masons or quarrymen, and three teachers. Excluding mill-hands the trades most frequently met with were those involving the working of stone.

The high mortality from tuberculous disease of the lungs among stone workers is emphasised by the interesting information given in connection with one of the cases examined this year, that out of 13 men who worked with the patient 40 years ago 10 had died of phthisis, besides many others who have worked with him since. The age of these patients is usually above the average age of males examined, 40 or over, and in most of them there is a prolonged history of lung trouble during which no tubercle bacilli can be found. The changes brought about in the lungs by the irritating particles of stone evidently render them more susceptible to infection by the tubercle bacillus, and if the initial changes are impossible of prevention some effort might be made to protect them from the final infection and its disastrous results. In two of the school teachers large numbers of bacilli were found, and as they were still engaged in teaching, they constituted a serious source of danger. The institution of a system of periodical medical inspection of those engaged in school work, with a more detailed physical and bacteriological examination of all who show even a suspicion of disease, is much to be desired, not only as a means of controlling tuberculosis, but also as a preventive against the spread of other infectious diseases. In two cases in which tubercle bacilli had been found previously, and where the patient had apparently recovered under the open air treatment, bacilli were still detected in the sputum. It is consequently desirable that such patients should not be allowed to regard themselves as free from infection until repeated bacteriological examinations have shown that their sputum is no longer a source of danger to others.

Direct infection from a previous case is again noted as the probable source of the disease in a considerable number of cases. A woman of 50 was believed to have contracted the disease while nursing her two daughters, one of whom had been ill with consumption for a year and the other for eighteen months. In another family two brothers who occupied the same bed were attacked within six months of each other. A boy, whose sputum showed crowds of tubercle bacilli, had lost his mother and two sisters, all living in the same house with him, within eighteen months from phthisis.

An interesting example of the utility of a bacteriological examination in arriving at a diagnosis in a doubtful case of incipient phthisis, is that of a patient whose sputum was sent to the laboratory for examination in May, 1901.

Although there were no physical signs of disease detected in either lung he was sent abroad in consequence of the report from the laboratory being unfavourable. On his return to England all the symptoms had subsided and he was apparently cured, although since a bacteriological examination was not again made it is not certain that his sputum was free from tubercle bacilli. In January, 1903, he had influenza and a second specimen of his sputum showed numerous tubercle bacilli. He was now seen by a well known consulting physician who could not find any evidence of disease in either lung, and declared that he was perfectly sound and that the bacteriological examination was a mistake. A further specimen was then submitted for examination by his family medical attendant and large numbers of virulent tubercle bacilli found. The question now was, were any steps to be taken in face of the physician's opinion and on the strength of the bacteriological report alone. It was decided to take further advice and another specialist was shortly consulted. He detected signs of early disease at the apex of one lung and ordered the patient to at once commence the open air treatment. Before this was done, however, the disease rapidly developed and unmistakable clinical evidence of tuberculosis was found.

There were 19 deaths among the 239 patients who were suspected to be suffering from consumption, but in whose sputum no tubercle bacilli could be found and which were finally diagnosed as "not tuberculosis." The causes of death given were bronchitis, heart disease, spinal caries, diabetes, meningitis, and cancer of the lung. In one of the cases of cancer a correct diagnosis was made in the laboratory from the examination of a specimen of fluid drawn from the chest some time before death.

In 1901 the total number of specimens examined for diphtheria bacilli was 383. This year over four times as many have been reported on, the number received and examined up to December 1902, being 1486. Of these 752 were primary examinations made for diagnostic purposes, and 734 were specimens from convalescent cases to determine their freedom from infection. In 1901 there were 267 examinations made for the former purpose and only 116 for the latter,—a most satisfactory increase this year in the number of examinations from convalescent cases. Each month of 1902 has shown a higher total of diphtheria examinations than the corresponding month of the previous year; in fact every month of 1902 brought more work of this description than had to be dealt with at any time in 1901 (save in December when the figures were somewhat higher than those for the summer months of 1902). The highest total for diphtheria since the opening of the laboratory was reached in November, 1902, when 221 were reported on. Taking October and November, 1902, together, more specimens were received in two months than in the whole of 1901, which in itself is good evidence of the rapid growth of the work in this department. That the larger number of examinations made this year is not due to an increased prevalence of the disease is shown by the fact that in 1901 there were 1535 cases of diphtheria notified in the administrative county, while in 1902 there were but 1429. An analysis of the results obtained, classified in accordance with the final diagnoses of the medical men in charge of the cases is given in the following table :—

Diphtheria
Examin-
ations.

RESULT OF BACTERIOLOGICAL EXAMINATION OF 1486 SPECIMENS
FOR DIPHTHERIA BACILLI.

Final diagnosis ascertained after the lapse of three months.	Diphtheria bacilli found in 736.	No diphtheria bacilli found in 750.
Diphtheria 374	358	16
Not Diphtheria 290	3	287
No Return 88	38	50
Convalescent Cases 734	337	397

The result of the laboratory examination was confirmed by the final diagnosis in all but 19 cases; 16 of the latter were stated to be diphtheria, although no diphtheria bacilli could be found in the specimen sent to the laboratory. In some cases this apparent failure to diagnose the disease bacteriologically was due to the specimen being taken too soon after an anti-septic had been applied to the throat, and in others the swab had probably not been applied to the affected part. For in ten the cultures prepared from the swab gave no growth at all, and the other six showed only cocci and yeasts. The three cases diagnosed as diphtheria, but said not to have suffered from that disease, were bacteriologically undoubted diphtheria and are probably examples of the difficulties attending the diagnosis of mild and complicated cases, when the clinical appearances only are relied on. In his annual report for 1901 on the Thurlstone district, Dr. A. C. J. Wilson emphasises this point and says "On one occasion, I had two cases of sore throat under my care, in persons living next door to each other. One was severe and appeared to be diphtheria, the other looked like a mild case of sore throat. On sending the two specimens to the County laboratory, however, the mild case was stated to be diphtheria and the severe case simple tonsillitis, and this was confirmed by subsequent events."

The age and sex of 393 of the cases in which diphtheria bacilli were present was ascertained, and it was found that there were 162 males and 231 females. The average age of the males was 9.7 years, and of the females 11.1 years. Classified according to age periods they were found to be arranged as follows:—

	Under 5 years	From 5 to 15 years.	From 15 to 25 years.	From 25 to 35 years.	Over 35 years
Males ...	60 (37 %)	80 (49 %)	17 (10 %)	5 (3 %)	1 (0.6 %)
Females ...	57 (25 %)	129 (57 %)	25 (11 %)	14 (6 %)	7 (3.0 %)

The chief interest of this table lies in the apparent liability of females to be attacked by diphtheria later in life than males. For at all age periods above five years the percentage of cases is higher for the former than the latter. This is probably accounted for, in part, by the greater risk of infection which females run through the nursing of the sick members of a household generally falling on them, and it is noteworthy that in nine cases, this is given in the laboratory returns as the source of the infection. But the habit of promiscuous kissing, which is a peculiarly feminine attribute, is probably responsible for a certain amount of their increased liability.

Although diphtheria owes its name to the false membrane seen in the throats of typical cases, it is now almost universally recognised that in many cases of undoubted diphtheria no membrane is formed. During the year 112 cases of this kind have been met with, and typical diphtheria bacilli isolated from each. The occurrence of a nasal form of diphtheria has too, in recent years been recognised, and as such cases are not easily recognisable without a bacteriological examination, they are very liable to remain undiagnosed and be left free to spread the infection; 15 specimens have been received from patients whose only sign of the disease was a more or less profuse discharge from the nose, and as many of these were children attending school the value of the positive bacteriological examination in their cases is very obvious. In 38 cases of "contacts," virulent diphtheria bacilli were isolated from the throat and suitable precautions taken to prevent their spreading the disease.

In some cases of scarlet fever with marked throat symptoms, a secondary infection by the diphtheria bacillus appears to be present, and during the past year seven cases of scarlet fever complicated by diphtheria have been examined. In seventeen others however no diphtheria bacilli could be found. One case of small-pox was also investigated but with a negative result.

The final diagnosis returns show that 25 of the cases in which diphtheria bacilli were found died of the disease, a death rate of 7 per cent. Paralysis supervened in 39 cases, or 11 per cent., and two of these died. No false membrane was seen in seven of the cases with paralysis, including one of those that died.

The source of infection in the majority of cases, where it has been possible to trace it, has been found to be contact with a previous case, although in many instances it was only the occurrence of the typical case that drew attention to the milder original one. One medical man declares his belief that his patient caught the disease from sickly fowls kept by the patient's father, and in support of this view he remarks that "*the increase of diphtheria in his neighbourhood has kept pace in a remarkable manner with the increase of fowl-keeping by the villagers.*" As has already been mentioned the nursing of diphtheria patients is responsible for a certain number of cases in women, and one case has been met where the driver of an ambulance contracted the disease. In many instances adults who have been in contact with diphtheria seem to harbour the bacillus, without themselves being suffering from any symptoms of the disease, or at most only a slight sore throat. A striking example of this occurred in the West Riding in the spring of 1902. A child of four was suddenly attacked with severe dyspnoea. An examination of the throat showed a typical diphtheritic membrane which, on bacteriological

examination, was found to be crowded with diphtheria bacilli. As this was the first case in the town for some time, a careful search for a possible source of infection was made. Enquiry showed that an elder sister with whom the patient slept had had a slight sore throat on returning from a holiday in the country the previous week. The holiday had been spent with a brother who was working in a town which was free from epidemic diphtheria, but it was found that he had complained of a sore throat when he first joined his sister. In both their throats virulent diphtheria bacilli were found. It was then ascertained that his fellow lodger had been employed for several days in the week preceding the holidays in a district where diphtheria was very prevalent, and that as a matter of fact he had stayed in a house where cases of diphtheria had occurred. In this instance it would appear that there were at least three intermediate hosts between the two typical cases, and that in one there had been no symptom at all, while in the other two they were so slight that no attention was paid to them. A recent case of diphtheria, occurring in one of the boarders in a large girls' school, also bears on the same subject, and shows how bacteriology may be of service in detecting the source of the infection and preventing its spread. On this occasion, as soon as the case had been proved to be diphtheria, cultivations from the throats from all the inmates of the house were made, and they showed that the cook was probably the source of the mischief, for, although she presented no signs of disease beyond slight reddening of the fauces, her throat was found to be swarming with typical diphtheria bacilli. On being questioned, she confessed that a few days previously she had been to see her brother who was laid up with "a very bad sore throat." Prompt measures to isolate the sufferers and to disinfect the throats of the other girls were successful in limiting the outbreak to those originally affected; but had it not been for the assistance rendered by the bacteriology in detecting the source of the infection a widespread and serious epidemic might have resulted.

The liability of adults to suffer from atypical forms of diphtheria is especially important in those engaged in teaching children, for such cases, if not quickly recognised and isolated, may easily start an epidemic. In two cases this year the origin of the disease was traced to a music teacher who continued her occupation while suffering from a sore throat. In another case a teacher in an elementary school sought advice for a throat affection which on bacteriological examination was found to be diphtheria. As she was seen during the week-end holiday it was possible to isolate her before any harm was done, but had she continued to attend school it is probable that she would have been the means of conveying the disease to a number of the susceptible children. In a district where diphtheria had been epidemic for some time the throats of several children attending school, and apparently in normal health, were found, on bacteriological examination, to be harbouring virulent diphtheria bacilli. Such cases are not uncommon and in dealing with epidemics of diphtheria it would be an advantage to those responsible for their control, if more extensive use were made of the laboratory for the purpose of detecting these "carrier cases" and examining "contacts." Once diphtheria has obtained a hold on a community it is exceedingly difficult to stamp out, but a little timely care in dealing with the first cases, and those in contact with them, may save the expense and anxiety involved in a large outbreak.

The employment of Neisser's stain in the rapid diagnosis of diphtheria has been continued this year with most satisfactory results, for by its use it has been possible to correctly diagnose the disease in nearly 50 per cent. of the positive cases within a short time of the arrival of the specimen at the laboratory, and to thereby save 24 hours in making the report. In no case has the result obtained by this method proved to be fallacious, although in two instances the cultures made from the swab did not grow, and at first it was thought that a mistake had been made. Subsequent investigation showed, however, that this was not so, for they were typical diphtheria clinically and it was found that the failure of the culture was due to the specimen having been taken a very short time after the throat had been treated with an antiseptic, so that a probable mistake was avoided by the employment of this method. In the following table the results of the examinations made with Neisser's stain are compared with results of the examinations of cultures from the same specimens and the final diagnoses of the cases:—

RAPID DIAGNOSIS OF DIPHTHERIA WITH NEISSER'S STAIN.

Cover-glass preparation from the "swab," stained by Neisser's method.	Culture.	Final Diagnosis ascertained after lapse of three months.	
Positive 167	Positive 356	Diphtheria 374	Total 752
Negative 189	Negative 18		
Positive 2	Positive 3	Not Diphtheria 290	
Negative 16	Negative 287		
Positive 0			
Negative 3			
Positive 0			
Negative 287			
Positive 18	Positive 38	No Return 88	
Negative 20	Negative 50		
Positive 0			
Negative 50			

The proportion of secondary examinations made this year to determine the freedom of convalescent patients from infection, is higher than in 1901, but it is not even yet as high as it should be. Many cases in which bacilli were found at the first, or subsequent examinations, have not been submitted for further investigation, and although they were probably kept in isolation for some time longer it would have been better if they had been declared free bacteriologically before they were discharged. No observer, however experienced, can say from the clinical appearance of a case alone that it is free from infection and ready for discharge. The adoption of a fixed time of isolation for all diphtheria cases is likewise fallacious, for, although many cases may be clear in a month or five weeks, a considerable proportion remain infected for a much longer period, in spite of every care being taken, and only repeated bacteriological examinations can determine when the patient is no longer liable to infect others. This year one case was examined seven times, at intervals of a fortnight, before the bacilli disappeared. Three other cases were examined on six occasions and seven patients showed diphtheria bacilli at

Diphtheria,
Convalescent
Cases.

four examinations but were free on the fifth. As is shown in the table on page 58, nearly half the specimens from convalescent cases, presumably sent because they were considered fit to be discharged, were found in the laboratory to contain diphtheria bacilli, and there is no doubt that these examinations have been of great service in preventing the spread of the disease by imperfectly recovered cases. Dr. Coleman in his report to the Hemsworth District Council remarks that—"During the epidemic of diphtheria it was a great boon to be thus able to obtain with promptness a definite pronouncement on suspicious cases; and it was equally valuable to ascertain at what stage patients in the hospital became free from infection and fit for discharge." Before discharging a diphtheria patient, particular attention should be paid to the nose and ears, for they may harbour bacilli for a long time after the throat is clear. As an illustration of this the case of a boy who was discharged from a fever hospital six weeks after his admission for diphtheria may be mentioned. He was apparently in perfect health when he returned home, save for a very slight watery discharge from one ear. Within ten days of his arrival a brother and two sisters were taken ill with diphtheria, and an examination of the discharge from his ear in the laboratory showed that it contained typical diphtheria bacilli, and was probably the source from which the other children had derived the infection.

Miscellaneous
Examinations.

A number of examinations that do not come under any of the previous headings have been made, and although numerically they have constituted only a small proportion of the work of the department for the year, many investigations required were of an intricate character and necessitated a considerable expenditure of time and labour. The following is a tabular statement of the nature of the materials investigated and the number of samples of each examined:—

Urine	... 36	Meat	... 7	Diseased Animals	1
Blood	... 1	Milk	... 4	Malignant Pustule	7
Pus	... 3	Soil	... 1	Wool	... 2
Pleural Effusion	1	Water	... 31		
				Total	... 94

Urine.

The presence of disease-producing bacteria in the urine is not uncommon in certain disorders, and since their presence can as a rule only be detected by bacteriological methods such investigations are of great importance in preventive medicine. One of the diseases in which the urine is of especial importance as a vehicle for the spread of infection, particularly in the later stages of the disease, is enteric fever, and it is regrettable that the medical men in the Riding have not taken greater advantage of the facilities afforded by the laboratory for determining whether the urine of their patients was infected or not. During the past year 29 samples of urine from enteric fever cases have been examined, and in 13 of these typhoid bacilli were found, a higher proportion than in 1901 when 9 out of the 23 samples gave a positive result. One specimen examined this year was of great scientific interest, for there was isolated from it an organism which, while closely resembling the typhoid bacillus in many respects, differed from it in several particulars. A series of careful experiments showed that it must be classified as a para-colon bacillus, —an organism which has in recent years been described as the cause of a disease closely resembling enteric fever but not so fatal in its results.

Seven specimens of urine were examined for tubercle bacilli. In two the bacillus was detected, but in the other five it could not be found. Subsequent information concerning the latter showed that two of them were suffering from stone and that another had an abscess of the kidney.

Two samples of pus were examined for tubercle bacilli, and one for streptococci, all with a negative result. The sample of blood was taken from a case of puerperal fever to determine if possible the nature of the infection, with a view to treatment by a suitable serum. But on examination in the laboratory it was found to be sterile. The investigation of fluid drawn off from the chest may frequently yield information of value in making a prognosis and the specimen of pleural effusion was sent to be examined for tubercle bacilli. No bacilli could be found however in this case.

Blood,
Pus,
Pleural
Effusion.

All the seven specimens of meat were sent to the laboratory for the detection of tubercle bacilli, and in four they were readily discovered in large numbers. The four samples of milk also suspected to be infected with tubercle were uniformly negative. A quantity of soil taken from the neighbourhood of a dwelling, which it was sought to condemn as unfit for human habitation was received for bacteriological examination. Cultures prepared from it showed enormous numbers of micro-organisms, among which were found, in large proportion, various bacteria usually associated with sewage pollution. Nine samples of drinking water have been submitted to bacteriological analysis and four of them were found to be polluted with sewage material. The other five had the characters of an ordinary potable water. Microscopical examination of the sediments from 22 waters, sent for chemical examination, have also been made, and the results added to the chemist's report.

Meat,
Milk,
Soil
Water.

The diseases of animals in their relation to man offer a large field for investigation, particularly with respect to certain infectious diseases such as diphtheria, scarlet fever, etc. It is now well known that cats may suffer from diphtheria and transmit the disease to human beings. Horses and other domestic animals have also occasionally been shown to be infected. Hence the discovery of bacilli having the morphological characters of the diphtheria bacillus in the nose of a tame rabbit, sent to the laboratory early this year, is of interest. The animal belonged to a child who was suffering from diphtheria and whether it was infected by its master or the reverse was the case, it was a possible source of danger to those who came in contact with it. When first seen it was obviously ill and was suffering from paralysis of the hind legs, so that in the ordinary course of events it would probably have been taken into the house to be tended by other children and in turn infected them.

Diseases
Animals.

Cases of "wool-sorter's disease" occur more frequently in the West Riding than in almost any other part of the country, and consequently provision for its diagnosis bacteriologically is a matter of great importance. This is particularly so in connection with that form of anthrax which most commonly affects man, namely, malignant pustule. For in this variety the infection is at first purely local and, if diagnosed in time, is capable of being cured by surgical means. When treatment is delayed, however, in consequence of the nature of the affection being doubtful, the patient runs a serious risk of a general infection

Anthrax

setting in, with an inevitably fatal result. During 1902, nine specimens from cases of suspected malignant pustule were examined. Seven of these proved to be simple ulcers, not due to the anthrax bacillus, but in two instances this organism was isolated. Both cases were immediately operated on and both made a good recovery. One of the cases occurred in a worker in a blanket mill where much "foreign" wool was being employed. Samples of this were forwarded to the laboratory for examination, but the attempts made to isolate anthrax bacilli from it were not successful.

Conclusion.

In last year's report a hope was expressed that it would be possible to devote more attention in the year under review to the bacteriological examination of drinking water, milk, and other food materials,—a most important branch of public health bacteriology, but the stress of other work has been so great that there has been no time available to specially develop this particular department of the laboratory's activities. Attention was drawn in the same report to the opportunity which the laboratory afforded for the bacteriological examinations of "contacts" with diphtheria cases. Although, as has already been mentioned, some advance has been made this year in this direction, there is yet much more that could be done with great advantage, and it is to be hoped that medical men will come to look on the county laboratory not only as a place where assistance may be obtained in the diagnosis of difficult cases, but as an institution capable of helping them to PREVENT disease. The closer relation instituted between the County Council and the public elementary schools by recent legislation should tend to a more efficient control of those diseases to which children are particularly liable, and since the teachers are now in more direct touch with the County Council it should be possible to arrange for them to obtain medical advice immediately any suspicious case of even slight throat trouble is detected in the school, so that a swab may be taken from the child and his immediate companions, and at once despatched for bacteriological examination. By this means epidemics might in many instances be prevented, and the trouble and expense entailed thereby avoided.

During the year enquiries have been received concerning several outbreaks of so-called *ptomaine poisoning*, but in most instances it has been impossible to undertake any satisfactory investigation owing to the long interval that had elapsed before the information and samples were received. In future it would be well if Medical Officers of Health and others would transmit samples from all cases of suspected food poisoning in a fresh condition at once to the laboratory, and not wait to make exhaustive enquiries. Such specimens should be securely packed, and be accompanied by a brief indication as to the nature of the examination required. Full details can be sent by post later. It is advisable that a telegram should be sent to the laboratory immediately the specimens have been sent off in order that suitable preparations may be made to commence the investigation immediately on their arrival.

The conclusion of a full year's work has rendered it possible to estimate more precisely than was possible last year, on only nine months experience, the response which the medical men of the West Riding have made to the offer of the County Council to undertake free of charge such bacteriological investigations as would be of assistance in the diagnosis of certain infectious

diseases and of importance to the public health. Both as regards the number of specimens received and the wide area from which they have been drawn, there is every reason to be satisfied with the result. So great at times, indeed, was the press of work, especially during October, November and December, that the utmost difficulty was experienced in dealing with it satisfactorily, and should 1903 show a further addition, as appears likely, it will necessitate an increase in the staff of the laboratory if the reputation for efficiency which the department has earned in the past is not to be sacrificed. Although there are some practitioners who consider that they need no assistance in the diagnosis of diphtheria or enteric fever, the majority, especially of the younger men who have been trained to make use of the modern advancements in scientific medicine, readily acknowledge the advantages of such an institution in their midst as the County Bacteriological Laboratory. Several Medical Officers of Health in their Annual Reports acknowledge the assistance they have received in their work from this department and the following may be given as examples.

Dr. Lownds in his report on the Great Ouseburn district says "I should like to testify to the immense benefit we have received from the Bacteriological Laboratory at Wakefield;" and in his Annual Report to the Penistone District Council, Dr. Ross remarks, "The diagnosis of diphtheria in the early stage is often extremely difficult, or impossible, without a bacteriological examination, and I have to acknowledge, with thanks, the very valuable assistance rendered in making these examinations by the laboratory at the County Hall, Wakefield."

The thanks of the department are due to those practitioners who have so cordially co-operated to make the laboratory a success, by the information they have so readily given with regard to the clinical characters and termination of the cases under their care. It is only in consequence of this kindness on their part that it has been possible to present in the foregoing report on the years work something more than a mere array of figures and statistical returns. Any deductions which it may be possible to draw in future years from a comparison of the results of the past will owe their value very largely to the completeness of the clinical information which they have supplied in filling up the laboratory returns.

P. J. CAMMIDGE, M.B. (Lond.), etc.

Public Health Laboratory,
County Hall, Wakefield.

Appendix No. I.

Telegraphic Reports.

Practitioners may obtain a preliminary telegraphic report on specimens concerning which a bacteriological diagnosis is urgently required, by enclosing sixpence, or a stamped telegraph form, in the outfit with the specimen. In such cases the result of the examination will be telegraphed as soon as possible.

Reports on sputum, Typhoid serum, or Diphtheria (if well marked) can usually be sent within about two hours after the specimen reaches the Laboratory. In slight or negative cases of suspected Diphtheria, it may not be possible to give an opinion for 10 or even 24 hours.

The Laboratory hours are 9 to 5 ; Saturdays 9 to 12, and as far as possible specimens should arrive during these hours.

P. J. C.

17-12-01

PUBLIC HEALTH LABORATORY,
COUNTY HALL, WAKEFIELD

Appendix No. II.

MEDICAL OFFICER'S DEPARTMENT,
COUNTY HALL, WAKEFIELD,
15th January, 1903.

MY DEAR SIR,

BACTERIOLOGICAL LABORATORY.

Annual Return for the Sanitary District of _____

In connection with your Annual Report it may interest you to know that the number of specimens received from the above district during the year ended 31st December, 1902, was as follows:—

Enteric Fever (Widal Reaction) _____
Sputum (for tubercle bacilli) _____
Diphtheria _____
Urine (for typhoid bacilli) _____
Miscellaneous _____

Please also note that, according to the books of this department, the above-named Sanitary District is debited with having the following 'outfits' for future use (at _____):—

Enteric Fever _____ Sputum _____
Diphtheria _____ Urine _____

Yours faithfully,

JAMES ROBT. KAYE,

County Medical Officer.

Appendix III.

TABLE SHOWING THE DISTRICTS FROM WHICH SPECIMENS HAVE BEEN RECEIVED DURING 1902.

<i>Urban Districts :—</i>			Hoylandswaine	..	—	Sowerby Bridge	..	5
Altofts	..	2	Hunsworth	..	—	Soyland	..	1
Ardsley	..	—	Ilkley	..	86	Springhead	..	—
Ardsley, East and West	12	—	Keighley B.	..	140	Stainland-with-Old Lindley	..	—
Baildon	..	—	Kirkburton	..	3	Stanley	..	14
Balby-with-Hexthorpe	..	—	Kirkheaton	..	—	Stocksbridge	..	8
Barkisland	..	—	Knaresborough	..	—	Swinton	..	18
Barnoldswick	..	2	Knottingley	..	2	Thornhill	..	3
Barnsley B.	..	12	Lepton	..	1	Thurlstone	..	17
Batley B.	..	40	Linthwaite	..	—	Thurstonland	..	—
Bingley	..	48	Liversedge	..	6	Tickhill	..	2
Birkenshaw	..	4	Luddendenfoot	..	4	Todmorden B.	..	10
Birstal	..	12	Marsden	..	2	Wakefield C.	..	79
Bolton-upon-Deerne	..	—	Meltham	..	2	Wath-upon-Deerne	..	3
Brighouse B.	..	100	Methley	..	—	Wheatley	..	—
Burley-in-Wharfedale	..	3	Mexborough	..	5	Whitley Upper	..	—
Calverley	..	2	Midgley	..	—	Whitwood	..	1
Castleford	..	13	Mirfield	..	9	Wombwell	..	5
Clayton	..	—	Monk Bretton	..	1	Worsbrough	..	—
Clayton West	..	5	Morley B.	..	44	Yeadon	..	5
Cleckheaton	..	10	Mytholmroyd	..	17	<i>Rural Districts :—</i>		
Cudworth	..	—	Netherthong	..	—	Barnsley	..	2
Darfield	..	—	New Mill	..	—	Bishopthorpe	..	1
Darton	..	3	Normanton	..	—	Bowland	..	1
Denby-and-Cumberworth	2	—	Oakworth	..	2	Doncaster	..	7
Denholme	..	—	Ossett B.	..	8	Goole	..	4
Dewsbury B.	..	4	Otley	..	25	Gt. Ouseburn	..	19
Dodworth	..	1	Oxenhope	..	1	Halifax	..	11
Doncaster B.	..	45	Penistone	..	15	Hemsworth	..	239
Drighlington	..	—	Pontefract B.	..	6	Hunslet	..	4
Elland	..	2	Pudsey B.	..	52	Keighley	..	—
Emley	..	2	Queensbury	..	2	Kiveton Park	..	—
Farnley Tyas	..	7	Ravensthorpe	..	—	Knaresborough	..	4
Farsley	..	—	Rawdon	..	5	Leeds (Roundhay and	..	—
Featherstone	..	—	Rawmarsh	..	5	Seacroft)	..	6
Flockton	..	—	Ripon C.	..	10	Pateley Bridge	..	—
Gildersome	..	—	Rishworth	..	6	Penistone	..	—
Golcar	..	2	Rothwell	..	3	Pontefract	..	—
Gomersal	..	—	Royston	..	5	Ripon	..	5
Goole	..	546	Saddleworth	..	3	Rotherham	..	—
Greasborough	..	—	Sandal Magna	..	9	Sedbergh	..	8
Greetland	..	—	Scammonden	..	—	Selby	..	—
Guiselley	..	—	Selby	..	1	Settle	..	27
Gunthwaite-&-Ingbirchw.	—	—	Shelf	..	—	Skipton	..	53
Handsworth	..	16	Shelley	..	—	Tadcaster	..	11
Harrogate B.	..	13	Shepley	..	—	Thorne	..	10
Haworth	..	8	Shipley	..	8	Todmorden	..	3
Hebden Bridge	..	10	Silsden	..	8	Wakefield	..	—
Heckmondwike	..	1	Skelmanthorpe	..	1	Wetherby	..	49
Hipperholme	..	1	Skipton	..	75	Wharfedale	..	8
Holme	..	—	Slaithwaite	..	—	Wortley	..	22
Holmfirth	..	5	Soothill Nether	..	—			
Honley	..	—	Soothill Upper	..	—			
Horbury	..	14	South Crosland	..	8			
Horsforth	..	41	Southowram	..	—			
Hoyland Nether	..	1	Sowerby	..	2			
						Total	..	2236