

THE WORK OF A COUNTY BACTERIOLOGICAL LABORATORY.*

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THE total number of specimens dealt with during 1907, was 5,896, which exceeds the 1906 total by 1,254, and the average of the preceding three years by 2,603, the increase mainly occurring in the Diphtheria and Miscellaneous sections.

DIPHTHERIA EXAMINATIONS.

There was an increase of 681 in the number of swabs examined for the diphtheria bacillus, 3,940 being dealt with as compared with 3,259 during 1906. School investigations conducted from this department account for 530, the corresponding figures for the preceding year being 325.

An explanation is usually given of the grouping of diphtheria specimens into two classes:—(1) primary, comprising all swabs received for the first time for purposes of diagnosis, and (2) secondary or convalescent swabs, sent at later dates from the same cases, usually with the object of ascertaining whether the patient is yet free from infection. The great bulk of the secondary swabs is furnished by certain of the isolation hospitals, the patient being detained in isolation as long as the infective organism is reported as still being present.

In addition to cases suspected of actually suffering from diphtheria, swabs are also sent from diphtheria "contacts," and from cases of scarlet fever. There is an increasing tendency on the part of medical men to make use of the laboratory for the examination of contact, and a more general adoption of this practice would be welcomed. As regards scarlet fever, a fair number of swabs is received from cases newly admitted to some of the isolation hospitals. These are sent as a routine precautionary proceeding against the introduction of diphtheria into the hospital by cases of mixed infection, or by cases of diphtheria which may simulate scarlet fever. Similar investigations would gladly be undertaken for other isolation hospitals within the Riding.

RESULT OF BACTERIOLOGICAL EXAMINATION OF 3,940 SPECIMENS FOR THE DIPHTHERIA BACILLUS.

Final Diagnosis ascertained after the lapse of three months.	Diphtheria Bacillus.	
	Found.	Not found.
Diphtheria 600	508	92
Not Diphtheria 650	27	623
No Return 1186	276	910
Convalescent Cases 1504	621	883
Total 3940	1432	2508

* Annual Report, 1907.

It should be explained that in this table "Final Diagnosis" represents the ultimate opinion of the medical attendant as to the nature of his case. This information is supplied in response to periodic requests from the laboratory in connection with primary swabs only.

The table presents some features which call for comment and which may be most conveniently considered in the order of grouping therein adopted.

Final Diagnosis Diphtheria.—Positive results are seen to have been obtained bacteriologically from 508, or 84.6 per cent. of the 600 swabs from cases eventually diagnosed as diphtheria. More than 15 per cent. of the 508 cases were reported as having characteristic complications, and forty-one proved fatal, a case mortality of 7.9 per cent.

Negative results were obtained from the remaining ninety-two swabs of this class, equivalent to 15.4 per cent. Of these, eighteen proved positive on repetition, while a further negative result was obtained from twenty-one other repeated swabs, although sequelæ, characteristic of diphtheria, were observed in three of the cases from which the latter specimens were derived.

Swabs were reported as sterile in five instances, no bacterial growth of any kind being obtained on cultivation, and requests for repetition were not complied with. A sterile result usually points to a faulty method of collection of the specimen and should not be accepted as final and indicative of safety.

The diagnosis of diphtheria was confirmed by sequelæ in seven of the remaining forty-eight negative swabs.

Final Diagnosis not Diphtheria.—Of the twenty-seven swabs which gave positive results in this group thirteen were from "contacts," not actual sufferers, who would therefore not be classed as clinical cases of diphtheria. In the absence of similar information with regard to the remaining fourteen, the presence of the diphtheria bacillus appears not to have carried weight as a determining factor in diagnosis.

No Return.—After deducting from this group 530 school swabs there remain 656 primary swabs with regard to which no information was supplied in answer to the request for a statement of the final diagnosis. This is unfortunate, as the value of the deductions to be drawn is considerably lessened by the reduction of the number of specimens available for statistical examination.

Convalescent Cases.—In addition to repeated swabs, as before explained, this group includes a number sent for the first time, not for diagnostic purposes, but at a later stage only for an opinion as to freedom from infection.

There were forty-four primary and forty-three secondary swabs reported as sterile, a total of eighty-seven. It should be emphasised that a sterile result ought not to be accepted as indicating the absence of the diphtheria organism from a throat. Sterility is usually due to the action of antiseptics applied as a local remedy, but may result from failure to bring the swab into proper contact with the affected portion of the fauces. In all cases a further specimen should be sent.

For the detection of the diphtheria bacillus, the cultural method is chiefly relied upon. This has the drawback of requiring a period of at least twelve hours for incubation, thus necessitating a delay of about a day in the furnishing of reports. This is a matter of some importance in the early stages of diphtheria, from the standpoint of both isolation and treatment, and in order to minimise the disadvantage as far as possible an "immediate" examination of each primary swab is made early on the day of its arrival at the laboratory. After the inoculation of media for cultural examination, smear preparations from the swab are made and examined microscopically, a special stain being employed (Gordon Pugh's formula). If organisms stained in the manner characteristic of diphtheria are observed, a preliminary report is furnished that the diphtheria bacillus is probably present, this being subject to confirmation on the following day by examination of the culture. "Preliminary" reports are stated in terms of probability only, because it is possible for other organisms to simulate the bacillus of diphtheria. Although the margin of error from this cause is small, only six out of 300 reports being erroneous during 1907 (see table below), it is considered undesirable to vouch for absolute identity on preliminary examination.

PRELIMINARY EXAMINATION OF 1,754 SWABS.

Culture gave :—	Immediate Examination gave :—	
	Positive Results.	Negative Results.
Positive Results 689	294	395
Negative Results 1065	6	1059
Total 1754	300	1454

For various reasons, one being that only a small number of diphtheria organisms may actually be present on the swab, the diphtheria bacillus is only detected on preliminary examination in a certain proportion of the specimens from which positive results are subsequently obtained by cultural methods. The table shows that it was possible to furnish a positive immediate report upon 42 per cent. (294 out of 689) of the specimens from which the diphtheria bacillus was finally isolated by cultural methods.

In the last Annual Report an analysis was made of the results furnished by swabs received from 185 cases of diphtheria, the object being to ascertain the average persistence of the diphtheria organism in the throat during an attack of the disease. Only such cases were included as fulfilled the necessary conditions, viz.: A definite statement was made as to the date of onset of the illness, the diagnosis was confirmed bacteriologically, and successive swabs were furnished until negative results were obtained. A similar inquiry into 216 cases from which swabs were received during 1907 shows that the diphtheria bacillus was, on the average, last found to be present on the twenty-eighth day from the commencement of the attack. Taking the average persistence in days

of the specific organism in the throat as being the mean between the last positive and the first negative results (at which date the bacillus may be presumed to disappear), the duration of infection in these cases was 33·4 days, or practically five weeks.

PERSISTENCE OF DIPHTHERIA BACILLUS IN 216 CASES

(based on the last possible results.)

Under 1 week	...	12	per cent.
1 week and under 2	...	9·7	"
2 weeks	" 3	17·2	"
3 "	" 4	20·8	"
4 "	" 5	17·6	"
5 "	" 6	7·8	"
6 "	" 7	4·6	"
7 " and upwards	...	10·3	"

This table shows that the average period of possible spread of infection from the throat in these cases varied from less than one week to seven weeks and upwards, and demonstrates the danger attendant upon adopting an arbitrary period of, say three or four weeks, for the isolation of diphtheria cases.

The services of the department were called for in three localities in connection with outbreaks of diphtheria having special incidence on children attending certain schools. These schools were visited with the local medical officer of health, and swabs were taken either from all the children present or from those whose throats presented abnormal appearances, according to local circumstances. Altogether 530 swabs were taken during twelve inspections of nine school departments. As is usual during an outbreak of diphtheria among school children, the diphtheria bacillus was found in throats which presented no clinical evidence of disease, and the "carrier" was thus repeatedly demonstrated. Examples may be quoted of two schools of 105 and 93 children respectively, all of whom were swabbed. Positive results were obtained from eight throats in both instances, though none of these showed any evidence of disease beyond a little congestion of the fauces in a few instances. In dealing with diphtheria, which differs markedly from such infectious diseases as measles and whooping cough in that any danger signal is frequently absent, the importance of bacteriological methods of investigation is thus amply demonstrated.

Serum Diagnosis of Enteric Fever.—During the year, 300 blood specimens were received in connection with cases of suspected enteric fever. This is the smallest number examined in any year since 1904, the decrease being accounted for by the diminished incidence of the disease in the administrative county, the number of cases notified during 1907, viz., 597, amounting to little more than one-half of the average for the preceding three years. The ratio of specimens submitted for diagnosis to cases of enteric notified is, however, higher than in any previous year since the establishment of the laboratory.

The following Table gives the final opinion of the medical attendant compared with the bacteriological result :—

Final Diagnosis ascertained after the lapse of three months.			Results of Serum Reaction.		
			Positive.	Negative.	Doubtful.
Enteric	92	...	73	15	4
Not Enteric	109	...	2	105	2
No Return	99	...	31	67	1
Totals	300	...	106	187	7

Excluding those cases concerning which no final opinion was obtained, Widal's test gave a decided positive reaction in seventy-five instances, in seventy-three of which the bacteriological diagnosis was confirmed by the subsequent progress of the cases—the exceptions being regarded as influenza and ulcerative colitis respectively. Of 120 cases in which no reaction could be obtained, in 105 the result was confirmed by the final diagnosis of the medical attendants, while the remaining fifteen were considered to be enteric. The specimens classed as doubtful are those which gave too feeble a reaction for a definite opinion to be expressed.

From the above Table and those of preceding years, it will be seen that the bacteriological and ultimate clinical diagnoses by no means invariably coincide, and it may be of interest, as giving some indication of the value of Widal's test, to note the proportion of cases in which they are found to disagree. For this purpose the number of specimens dealt with in a single year is too small to afford a reliable guide, and an analysis has therefore been made of the total number (1,224)—concerning which the necessary information was available—dealt with in the laboratory since its establishment in 1901. This shows that 1·2 per cent. of the positive results and 17·9 per cent. of the negative results were at variance with the final opinion of the medical attendant. The former figure may be regarded as a fair representation of the liability to error in positive examples, a considerable proportion of which error is doubtless due to cases where the reaction is merely a relic of a previous unrecognised attack of enteric; but a great reduction would be effected in the proportion of discrepant negative results if more care were exercised in the collection of specimens. Evidence of overheating of the blood during sealing of the collection pipettes with consequent destruction of agglutinative properties upon which Widal's reaction depends, has been frequently met with; and in other instances the blood has been submitted for examination within the first few days of illness, at which period agglutinins have not developed in a considerable proportion of cases. Request for repetition has not always been complied with.

Even when errors in collection are eliminated, it has been estimated that in from 5 to 10 per cent. of cases of *clinical enteric fever* the blood does not

give Widal's reaction when tested with the *B. typhosus* at any stage of illness.

It is probable that a considerable proportion of these are cases not of true enteric, but of paratyphoid infection, a disease clinically identical with enteric, but produced by bacilli distinct from, though closely allied to *B. Typhosus*. In this disease the diluted blood serum gives no re-action when tested with the latter organism, but re-acts readily with the particular variety of *B. Paratyphosus* responsible for the illness, and by this means identification of the disease may be established.

It has not been found practicable in this laboratory to test specimens with *B. Paratyphosus* as a routine procedure, the employment of several varieties of the organism, involving considerable expenditure of time, being necessary, but the test has been applied in a few special cases, and it is hoped that in future its more extensive use will be possible.

From consideration of the foregoing figures it is evident that while great reliance may be placed upon positive reactions, negative results are somewhat less trustworthy, and the recognition of this fact is essential for the correct interpretation of laboratory reports.

An outbreak of enteric occurring in the West Riding in 1907, and investigated by this Department, well exemplifies the difficulty in diagnosing, and the danger of overlooking an atypical case of this disease. The majority of cases constituting the epidemic were traceable to direct or indirect infection by a person who had suffered from a febrile illness which, beyond the temperature, presented none of the usual symptoms of enteric, and was not recognised as such by the medical attendants. A specimen of this patient's blood, procured during late convalescence, gave so marked a reaction in high dilution as to place the nature of the illness beyond doubt, and it is reasonable to assume that the earlier application of Widal's test, by leading to the adoption of precautions against conveyance of infection, would have prevented the occurrence of secondary cases.

The laboratory records contain numerous additional examples of the value of this test in throwing light on obscure illnesses.

It may be of interest to note the relative frequency of occurrence of the characteristic symptoms, apart from fever, upon which the differential diagnosis of enteric is usually based, and a consideration of the sixty-nine cases occurring during 1907, in which a positive Widal reaction was confirmed by the final diagnosis, and full clinical details were supplied shows that :—

In thirty-two cases "rose spots" were absent, and no enlargement of the spleen could be made out; in seventeen of these, more or less diarrhoea occurred.

In eleven no spots were seen, but the spleen was enlarged, and in seven cases diarrhoea was present.

In twenty-one a typical rash occurred, but the spleen was not enlarged; diarrhoea was present in fourteen.

In five both spots and enlarged spleen were found, and in four of these diarrhoea also occurred.

Deductions drawn from so small a number of cases do not of course possess any statistical value, but the particulars given above serve to illustrate the clinical variability of the disease.

EXAMINATION OF SPUTUM FOR TUBERCLE BACILLUS.

There is practically no increase in the number of sputa examined for the tubercle bacillus, the total being 583 as compared with 575 during 1906.

In the following Table the bacteriological results and the final medical opinion are combined :—

Final Diagnosis ascertained after the lapse of three months.		Tubercle bacillus found.	Tubercle bacillus not found.
Tuberculosis	195 ...	154	41
Not Tuberculosis	177 ...	—	177
No Return	211 ...	52	159
Total	583 ...	206	377

The tubercle bacillus was found in 154, or 79 per cent., of 195 sputa from cases finally regarded as tubercular in their nature. Physical signs were stated to be either absent or indefinite in thirty-two cases which gave positive bacteriological results, showing the importance of this method of diagnosis at an early period where any suspicion of tubercular infection arises.

The forty-one cases finally regarded clinically as phthisis, although the tubercle bacillus was not detected in the sputum, demonstrate the importance of repeating specimens upon which negative reports have been furnished, though the possibility of error in clinical diagnosis in some of these cases should be borne in mind.

Information was given concerning the family history in 150 of the cases found bacteriologically to be tubercular, and is classified below :—

FAMILY HISTORY OF TUBERCULOSIS.

	Male	Female	Total
Stated to be known ...	32	21	53
Stated not to be known ...	61	36	97
Totals ...	93	57	150

In one-third only of the total cases, therefore, was there known to be a family history of tuberculosis, and in half of these again (twenty-six of fifty-three) the relationship of the patient to other affected members of the family was such as to suggest direct infection rather than inheritance of a constitutional tendency to the disease. The fact that environment is of greater importance than heredity as a predisposing factor appears to be demonstrated by these figures.

MISCELLANEOUS EXAMINATIONS.

In addition to the specimens which have already been considered, 1,073 examinations were made which are classified as "miscellaneous," and are roughly grouped as follows :—

Ringworm	...	972
Anthrax	...	24
Cerebro-Spinal Meningitis	...	9
Urine for Typhoid Bacillus	...	10
Urine for Tubercle Bacillus	...	15
Other specimens for Tubercle Bacillus	...	19
General Bacteriological	...	12
General Pathological	...	12

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Ringworm.—The microscopic diagnosis of ringworm was commenced in this laboratory during 1906 in connection with specimens collected by members of the staff during school inspections. During 1907, in a circular dealing with the scope of the work undertaken in the County Laboratory, the attention of the local medical officers was drawn to this branch of investigation, and through them the private practitioners in the Riding were invited to send specimens for examination, the object in view being the diminished prevalence of ringworm among school children. Printed instructions for the collection of specimens of hair suspected of being infected with the parasite and envelopes for their transmission are now supplied on application. So far the request for such examinations has been limited, for out of a total of 972 specimens, 860 of which gave positive and 112 negative results, 950 were collected by members of the staff, the remaining twenty-two being furnished by private practitioners. Practically all the specimens were from school children, but the 950 must not be taken as indicating individual cases existing in the schools, for specimens were frequently taken from the same children on re-inspection to judge as to their fitness for re-admission to school.

Anthrax.—Of the twenty-four anthrax investigations, the material was in twelve instances from man and in six from animals. Six specimens of cotton cake were also examined, upon which cattle reported as having died of anthrax had been fed, but the anthrax bacillus was not found in any of the specimens from man, all but one were from suspected malignant pustules. Excluding this specimen, a sputum from a textile operative, which gave a negative result, there were eleven specimens from ten suspected cases, the anthrax bacillus being found in material from two out of five textile operatives, in two further cases after contact with anthrax carcasses, and in one other case where the occupation was not stated; a total of six positive specimens from five cases.

Cerebro-Spinal Meningitis.—In consequence of the prevalence of cerebro-spinal meningitis in Glasgow and Belfast, and reports of sporadic cases throughout the country, the fact that bacteriological examinations would be undertaken in connection with this disease was notified to the local medical officers of health in the circular before referred to. Material from nine cases was received, including two swabs from the naso-

pharynx, and five specimens of cerebro-spinal fluid, one of the latter being collected by a member of the staff in consultation. A brain was also sent, in which a large hemorrhage was found, and also the brain, spinal cord, and cerebro-spinal fluid from a child by order of the coroner. In no specimen was the organism of cerebro-spinal fever found, and there seems little doubt that in the great majority of isolated cases reported from various parts of the country the meningitis was not of the infective type. This is not to be wondered at, as the medical practitioner in this country has, fortunately, practically no opportunity of observing this disease, apart from rare outbreaks in large centres of population.

Urine for Typhoid Bacillus.—Ten specimens of urine were examined for the typhoid bacillus, with a negative result in every instance, although seven of the cases from which they were derived were considered to be cases of enteric fever. It may be repeated here that the typhoid organism is not found in the urine in more than 30 per cent. of enteric fever cases, and seldom during the first two weeks. On the other hand, the widal reaction is obtainable from the blood in about 95 per cent. of such cases—in the great majority within a week or ten days—so that the diagnostic value of urine examination will be seen to be slight compared with the blood reaction. The chief object, therefore, is to ascertain whether the typhoid bacillus is still being excreted in the urine, and the patient thus liable to be a source of infection. In enteric fever, as in diphtheria, the "carrier" case has come into prominence, and it has recently been stated that three or four per cent. of all cases of enteric fever continue to distribute infection after apparently complete recovery from attack. It seems reasonable to anticipate that bacteriological examination of the urine during convalescence from enteric fever will become a routine preventive procedure, and its desirability in the case of persons who are occupied in the production and distribution of milk and other food supplies hardly requires special emphasis.

Urine for Tubercle Bacillus.—Fifteen specimens of urine were examined for the tubercle bacillus, four of which gave a positive result. Two of the cases from which these were derived were finally diagnosed as tubercular, no opinion being obtained with regard to the other two. In a further case finally diagnosed as tubercular the bacillus was not found, while in six instances both clinical and bacteriological results were negative. It may be pointed out here that whereas a final report may be given on a sputum on the day of its receipt, so early a report in the case of urine is usually preliminary and provisional, the conclusive investigation occupying several weeks.

Other Tubercular Specimens.—Nineteen other specimens were examined for the tubercle bacillus, including nine of pleuritic fluid and pus from the pleural cavity, all of which gave negative results, as did also two of urethral secretion and one of pus from another source. The tubercle bacillus was found in the discharge from an elbow joint.

The remaining seven specimens were of food materials, and are detailed as follows:—

Milk.—Two specimens, one from a cow which supplied two tubercular children and one from a private can. In neither was the tubercle bacillus found.

Meat.—These were in each instance examined at the request of a local medical officer of health—

Case 1.—Mediastinal glands of slaughtered bullock. Bacillus found.

Case 2.—Liver and glands after purchase. Bacillus not found.

Case 3.—Glands, lung, and liver of pig. Bacillus found in all.

Case 4.—Caseous glands from pig. Bacillus found.

Case 5.—Lung of cow. Bacillus found.

General Bacteriological Examinations.—Of twelve examinations grouped under this heading, three were of urine specimens, four were to demonstrate the value of the aseptic precautions taken before operation in a general hospital, and one was to test the efficacy of an antiseptic preparation. Two milk specimens were also examined, one of which was regarded as a possible cause of diarrhoea, while the other was received from an isolation hospital on account of its alleged dirty condition. In neither case did the bacteriological results confirm the suspicion attached to the samples.

The remaining two specimens were water samples. One was from a shallow well, the water supply of five houses in which two cases of enteric had occurred—one of them fatal. Manurial contamination was regarded as possible, but bacteriological investigation afforded no evidence of this. The other sample was from a well situated in the fold yard of a farm where a recent case of enteric fever had occurred, and the bacteriological examination revealed undoubted evidence of the presence of excretal pollution of the water.

General Microscopical and Pathological Examinations.—The majority of these twelve specimens call for no special comment. Two were water samples for microscopical examination, and three were meat samples. In one of the latter, a cow's tongue, the ray fungus (actinomyces) was found.

NOTE.—The bacteriological work referred to in this article was conducted by Dr. F. Robinson, now County Medical Officer of Health, Cambridgeshire, and Dr. W. Sisam, now Medical Officer of Health, Handsworth.

PROCEEDINGS AGAINST A PARISH COUNCIL.—The Camblesforth Parish Council, near Selby, who own a cottage at that place, were summoned on December 28th before the Selby magistrates, for having a house unfit for human habitation. Dr. Stedman, Medical Officer of Health to the Selby Rural District Council, prosecuted, and Mr. George Winters, Clerk to the Parish Council, asked for an adjournment, in order that he might bring the matter before that body, with a view to the necessary repairs being carried out. The Bench agreed to a month's adjournment.