

RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF 1,000 CASES OF SUSPECTED DIPHTHERIA.

BY
R. T. HEWLETT, and HAROLD NOLAN.
M.D., M.R.C.P.

[From the British Institute of Preventive Medicine.]

THE following paper is an analysis of the records of the bacteriological examination of specimens from 1,000 consecutive cases of suspected diphtheria, forwarded by medical officers of health and practitioners from all parts of the kingdom to this Institute for diagnosis. We shall endeavour to give a summary of the results obtained and to draw attention to any points of special interest noted by us in the course of the work.

TRANSMISSION OF THE SPECIMENS.

The membrane or secretion has been forwarded in a variety of ways, some of which are highly creditable to the ingenuity of the sender. The method recommended by the Institute is to rub the diphtheritic patch or fauces with a sterile swab consisting of a little wool wrapped round the end of a piece of thick wire, this being contained in a stout glass test tube closed with a cork, in which it is sent out and returned after inoculation. In addition, another sterile stout glass test tube plugged with cotton wool is forwarded for the reception of a piece of membrane if there be any. The two tubes are enclosed in a tin case, which entirely does away with the risk of breakage in transit. In many instances, however, the practitioner adopts his own method, which may or may not be satisfactory; in the latter category may be mentioned swabs of antiseptic wool and membrane in alcohol, rum, and carbolic acid solution. In some instances the specimens sent have appeared to be quite hopeless, the preparation of a satisfactory culture being impossible; nevertheless we have been struck with the many positive results obtained with the most unpromising materials.

DIRECT EXAMINATION OF THE MEMBRANE.

When the specimen has arrived in a fresh and moist condition the diagnosis has been made in a comparatively small number of cases (28) by a direct microscopical examination. In the majority of instances, however, this method is not applicable, for several hours elapse before the specimen is received, during which time the saprophytic organisms in the membrane or specimen have multiplied to such an extent that it is extremely difficult to recognise the diphtheria bacillus among the varied forms present. It has been necessary, therefore, to make cultivations in the majority of cases.

METHODS OF CULTIVATION.

For the cultivations tubes of Loeffler's blood serum have invariably been used, the agar and blood serum mixture of Wertheim and agar plates having proved less satisfactory in our hands. Desiccated specimens have always been moistened with sterilised water before inoculation, and from the results obtained there can be no doubt that desiccation, at any rate for short periods, does not influence the vitality of the bacillus. The cultures have been incubated at 37° C. usually for eighteen to twenty hours. Visible colonies of the diphtheria bacillus do not seem to appear under twelve to thirteen hours, though the organism has been found by microscopical examination in as short a period as seven hours.

EXAMINATION OF THE CULTURES.

Although in many instances it is possible to identify almost with certainty the colonies of the diphtheria bacillus, the diagnosis has been confirmed in every instance by a microscopical examination, for even to the practised eye colonies of torulæ and of certain staphylococci may be extremely deceptive. Loeffler's methylene blue has always been employed as the routine stain for the microscopical preparations, and seems to give the most characteristic appearances, but in doubtful cases it has been supplemented by Gram's method.

The result of the examination of specimens from 1,000 cases of suspected diphtheria forwarded and treated in the manner detailed above is that in 587 cases the diphtheria bacillus was

found, in 409 cases it was not found, and in 4 instances bacilli were observed, as to the identity of which with the Klebs-Loeffler bacillus or the distinction therefrom we were unable to satisfy ourselves. Thus 58.7 per cent. of the cases were true diphtheria. In 40.9 per cent., or about two-fifths, of the cases, the diphtheria bacillus was not found, and the majority of these were probably not diphtheria. A few may have been diphtheritic, though for some reason or other the bacilli were not found, but from a careful consideration of the cases, we do not think that the error so introduced would amount to more than 2 or 3 per cent. Granting that the majority of cases sent up for examination were doubtful ones, it is still apparent what a large number of non-diphtheritic cases must have been returned as diphtheria in the period before the days of bacteriological examinations.

ANALYSIS OF RESULTS.

In 25 cases out of the 1,000, no growth appeared on the surface of the blood serum.

In 600 cases notes have been kept as to the organisms present in the cultivations, and are set forth in the following table:

The following Organisms were present alone or associated with the B. Diphtheriæ.	Cases in which the Diphtheria Bacillus was present, alone or associated with other Organisms.	Cases in which the Diphtheria Bacillus was absent.
Bacillus diphtheriæ alone	216	Pseudo-Diphtheria 2
Streptococci	6	32
Micrococci	55	79
Bacilli	19	41
Torulæ	9	1
Sarcinæ	6	2
Streptococci and micrococci	2	23
Micrococci and bacilli	9	19
Streptococci and bacilli	1	5
Torulæ and bacilli	1	3
Sarcinæ and bacilli	0	3
Micrococci (including streptococci) and sarcinæ	6	8
Micrococci (including streptococci) and torulæ	4	14
Many forms present together	19	15
	353	247

These results are only approximate, as they are based on the more or less brief examination necessary to determine the presence or absence of the diphtheria bacillus, and no special pains were taken to observe all the organisms which might be present. It is noteworthy that the diphtheria bacillus was obtained practically in pure cultivation in no fewer than 216 out of the 353 cases in which it was found. In only 6 was it associated with the streptococcus alone, but too much stress must not be laid on this point, for in a number of instances the mode of transmission of the specimen was not favourable to the vitality of the streptococcus, and in others it was doubtless overlooked, or perhaps included among micrococci. All the forms of the diphtheria bacillus have been met with, but as we are alone concerned with the bacteriological examination we are unable to throw any further light on their clinical significance, or on the import of the so-called pseudo-bacillus.

CASES OF INTEREST.

Some cases examined present points of considerable interest.

Two specimens were from cases of conjunctivitis; in one the diphtheria bacillus was found; in the other, which was associated with faucial diphtheria, only the streptococcus pyogenes.

In one instance specimens were taken from the fauces and from the vagina of the same case, and bacilli of the same type were found in each. In another, a pure culture of the diphtheria bacillus was obtained from a severe case, followed by paresis, in which the infection of the throat probably originated from a diphtheritic wound of the finger incurred during laboratory work.

In a case of diphtheritic paralysis, typical so-called pseudo-forms were met with, and were non-virulent, and it is an in-

interesting question whether these bear any, and if so what, relation to the diphtheria bacilli originally present.

PERSISTENCE OF THE BACILLI IN THE THROAT.

The 1,000 cases on which our results are based are all primary examinations, but in several further examinations have been made to ascertain whether the diphtheria bacilli had disappeared, and the subjects were free from infection. From such "repeats" it would seem that the bacilli are commonly to be found in the throat two to three weeks after the attack, but that this period may be greatly exceeded. Thus in one instance the specific organism was found seven weeks, in another nine weeks, and in a third twenty-three weeks after convalescence. In the latter case, the virulence of the bacilli, as tested by inoculation, was maintained to the last, for a guinea-pig inoculated with 0.25 c.cm. of a forty-eight hours' broth culture died in thirty-six hours.

Another notable case was one in which virulent Klebs-Loeffler bacilli were found in the throat of a schoolboy, who, six months previously, had suffered from an illness which, from the occurrence of paresis, was evidently diphtheritic, though not diagnosed as such at the time; in all probability this case was the focus of infection from which originated a small outbreak of diphtheria among the class associates of the boy in question. These and many similar instances serve to illustrate the necessity for a bacteriological examination before a convalescent from diphtheria can be said to be free from infection.

FALLACIES IN THE BACTERIOLOGICAL METHOD OF DIAGNOSIS. There are certain sources of error in the bacteriological method which, if excluded, would perhaps have increased the number of positive results by 2 or 3 per cent. For example, the swab may not be representative, that is, may have been taken from a small area which happened to have no bacilli upon it. In other cases, when the specimen is moist, the profuse growth of saprophytes may crowd out the diphtheria bacilli, and one advantage of a small wool swab over membrane is that it dries quickly, and the development of the saprophytes is thereby prevented. The use of local antiseptic treatment is another source of error, and in all cases the specimen should be obtained if possible before its commencement. The influence of such treatment is well illustrated by the following actual example. A specimen was received cultures from which revealed no diphtheria bacilli. It had been taken shortly after the use of sulphurous acid, and so convinced was the practitioner that he was dealing with a case of diphtheria, that he submitted another specimen from which a profuse and pure growth of the diphtheria bacillus was obtained. On the other hand a tonsil has been received which had evidently been energetically treated with perchloride of iron; and on another occasion some membrane which had been placed for a short time in a weak solution of Sanitas, and still smelling strongly of this preparation, and from both profuse cultures of the diphtheria bacillus were obtained.

CONCLUSION.

In conclusion, we would emphasise the desirability of a bacteriological examination in every case in which the throat symptoms are at all doubtful, for many of our cases which were not regarded clinically as diphtheria have proved to be so. Secondly, since virulent bacilli may be met with in the throat for weeks after convalescence, partial isolation at least should be insisted upon until repeated bacteriological examination has shown the absence of the infective agent.

We have to express our best thanks to Dr. Ruffer and to Dr. Macfadyen, in whose laboratories the examinations were carried out, for permitting us to publish these results, and for advising us with reference to them.

THE German Public Health Association will hold its annual meeting this year at Kiel on September 10th and three following days. Among other subjects on the programme are the Repression of Diphtheria and Sanitary Conditions in the Mercantile Marine.

AN International "Thalasso-Therapeutic" Congress will be held at Tunis in April of the present year. Despite its formidable name, the Congress will deal with no more terrible matters than the advances of sea-bathing and marine climatology.

TREATMENT OF ASEPTIC WOUNDS WITHOUT BANDAGES OR DRESSINGS.

By JAMES MACKENZIE, M.D.,
Honorary Medical Officer, Victoria Hospital, Burnley.

THE object sought to be attained in the treatment of surgical wounds is the promotion of sound and rapid healing. The first essential is to maintain the wound in an aseptic condition during its exposure to the atmosphere. After the wound is closed the main requisites necessary to promote healing are:

1. To maintain the parts at rest and the raw surfaces that are intended to unite together in close and constant apposition.
2. To prevent contamination of the wound from external sources.
3. To get rid of excessive discharges.

The means usually employed to obtain the first and second of these requisites is by the use of sutures—varying much in amount and in position—dressings and bandages. So great, indeed, has the belief in the efficacy of the last-named become that surgeons of no mean repute swaddle a large portion of the bodies of their patients in dressings for the supposed protection of an insignificant wound. A great amount of unnecessary discomfort and even suffering is endured by the patient owing to his limbs and trunk being maintained in a stiffened and unnatural position. The movements made by the patient to obtain ease naturally tend to displace the bandages, and when these are employed to maintain the wound in apposition the healing surfaces are disturbed and the healing delayed. In addition, this method of treatment, to ensure success, often necessitates considerable expense for the material and the necessary skilled nursing to watch the dressings. It is a method that the vast majority of practitioners cannot achieve, inasmuch as their practices lie where the expense cannot be met, and where the skilled nursing cannot be obtained.

The first essential for healing is to retain the parts at rest and the parts intended to unite in close and constant apposition. This is effected by the systematic employment of buried catgut sutures. The flaps of a wound—be it of an amputated limb or the raw surfaces of an incised wound of the trunk—are laid together in the position they are intended to assume. The various points of contact are noted, and then sutures of catgut are inserted through the raw surfaces—never penetrating the skin—of sufficient depth to ensure a good hold, and the opposing surfaces firmly drawn together. This is done systematically from the bottom of a wound to the skin edges. The separate sutures are in rows, the number of sutures in each row and the number of rows varying according to the ease or difficulty with which the raw surfaces can be maintained together. When there has been great loss of skin, as in the amputation of a breast with the removal of much skin, the deepest buried sutures extend from the base of one flap to the base of the other across the bottom of the wound. These drag upon the tissues at a considerable distance from the skin edges of the wound. Rows of sutures inserted superficially to these gradually approximate the edges of the wound, till finally the skin edges of the wound come together without tension. The buried sutures of course never come outside the wound. In using the sutures care must be taken not to injure any important structures that may be lying in close proximity to the wound. Rather fine catgut will maintain the parts in contact long enough to ensure adhesion of the raw surfaces before the catgut is absorbed. One often observes the puckers produced in the skin by the buried sutures ten days after insertion.

After the deep sutures have been systematically inserted, the skin edges come easily together and are retained in apposition by a continued catgut suture embracing but a small extent of the cut edges of the skin. When the wound is thus closed in place of using dressings, a solution of celloidin is applied over the line of skin incision and for half-an-inch on either side. This solution of celloidin quickly dries, leaving a thin transparent film that adheres to the skin with great tenacity, and yet is sufficiently plastic to adapt itself to the wrinkles and inequalities of the skin produced by move-