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Diphtheria of the conjunctiva.

By SYDNEY STEPHENSON, M.B.

THE following remarks are grounded upon forty-three cases of conjunctivitis, in all of which the Klebs-Löffler bacillus was demonstrated bacteriologically. The cases which form the basis of the communication have been relegated to an appendix. I purpose now merely to read a summary of the more important practical points brought out by the investigation.

1. FREQUENCY.—Diphtheria of the conjunctiva is thought by some writers to be rare in England. The figures at my command lend little or no support to that view. They are spread over a period of about five years, and have been collected from the ophthalmic departments of two hospitals for children, namely, the Evelina and the North-Eastern. During the period in question, amongst 3,412 out-patients, there have been forty-three instances of conjunctival diphtheria,—that is to say, a percentage of 1.26.

2. SEX.—With regard to sex, twenty-three of my cases were in males and twenty in females. This difference is so slight as in all likelihood to be nothing more than accidental.

3. AGE.—The youngest patient included in my series was six weeks of age, and the oldest ten years. The

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average age was 26·7 months. The annual periods of incidence were as follows :

Under 12 months	.	.	.	10
12 to 24	„	.	.	9
24 to 36	„	.	.	13
36 to 48	„	.	.	6
48 to 60	„	.	.	1
60 to 72	„	.	.	2
72 to 84	„	.	.	1
120 months	.	.	.	1

It is obvious from the figures quoted that no less than thirty-two of the cases, or nearly three-quarters, occurred in children under three years of age. The early age-incidence of the disease is more strikingly shown by the statement that 88 per cent. of the cases were met with in children under four years of age. My present figures support the general view, namely, that the ailment is commonest in young children.

4. SEASON.—Upon analysis the seasonal incidence of the forty-three cases came out thus:—January five cases, February five cases, March five cases, April nine cases, May four cases, June two cases, July two cases, August two cases, September four cases, October five cases, November and December no cases. So far as the above figures go, it would appear that the chief incidence of the malady falls in the first four months of the year, when twenty-four cases were met with. The figures for the corresponding periods (each of four months) were ten and nine respectively. With respect to individual months, April, with nine cases, was by far the most prolific. It is a significant fact that the stress of conjunctival diphtheria fell precisely upon those months when ordinary diphtheria was rifest in London. This observation appears to me to strengthen a conclusion that will be mentioned presently, *viz.*, that “croupous” and “diphtherial” conjunctivitis are one and the same disease, and that both are equally related to the prevalence of faucial diphtheria.

5. EXPOSURE TO INFECTION.—In a certain number of cases a history was forthcoming of exposure of the patients to diphtherial infection. Mildred M—, aged twenty months, was brought with diphtheria of the conjunctiva on October 12th, 1900. Her brother or sister (the notes do not state which) died from diphtheria of the throat in June, 1899. Robert M— came to hospital on April 12th, 1901, suffering from diphtheria of the right eye. His sister, aged ten years, had contracted faucial diphtheria some six months previously. Mary R—, ten months, seen on February 25th, 1898, affected with diphtheria of one eye. A brother, aged six years, had ordinary diphtheria in September, 1897. Louisa L—, nine months, was affected with diphtheria of both eyes. There had been recently a case of diphtheria in the same street, and the child's eldest sister had a "sore throat" about a week before the patient fell under my notice. Lastly, the series includes three cases in the same family, of which Ada developed conjunctival diphtheria in October, 1898, William John in October, 1901, and Mary Jane in January, 1902.

It may be said that some of the intervals in the cases quoted were so long as to exclude consecutive infection. I would forestall this possible objection by pointing to the recognised fact that the Klebs-Loeffler bacillus possesses very marked powers of resistance to desiccation. According to Loeffler, the organisms remain alive in gelatine cultures for 331 days. Diphtheritic membrane dried and kept in the dark is capable months later of producing cultures. Abel found the bacilli in a box of wooden bricks with which a child suffering from diphtheria had been playing six months before.

6. PREVIOUS AILMENTS.—The eye trouble was noted as coming on shortly after an attack of measles in six patients, of whooping-cough in one child, and of bronchitis in another. In the present state of knowledge concerning the microbic origin of diphtheria, we must assume that the illness in each case predisposed the conjunctiva to receive the specific bacterium of diphtheria. It is well known

that an unhealthy state of the fauces favours ordinary diphtheria, and in the same way a catarrhal condition of the conjunctiva paves the way for the diphtheritic invasion of that membrane. This association was noted years ago as regards conjunctivæ affected with trachoma. Something of the kind was observed in five of my cases. In one of these, Ada E—, the patient had been under treatment for relapsing eczematous conjunctivitis, and, finally, membrane was found upon the lids in association with a diffused phlyctenular condition of the limbus conjunctivæ.*

7. FEATURES OF THE ATTACK.—The features and associations of conjunctival diphtheria are best considered under several headings, as follows :

(a) *General condition.*—It is a striking fact that 40 per cent. of the patients were bodily ill, although the entire series included only three cases of what might be called very severe diphtheria of the conjunctiva. The systemic infection generally manifested itself by pallor, anorexia, languor, or wasting. A child was often stated to be "feverish," but the thermometer usually revealed a slight reduction rather than an actual heightening of the temperature. It may be added that in five cases (Nos. 9, 15, 22, 25, and 29) there was albumen in the urine, while in two (Nos. 25 and 27) the knee-jerks could not be elicited.

(b) *Relation to diphtheria elsewhere.*—Diphtheria of the fauces or nose preceded the conjunctival affection once, was associated with it twice, and followed it once. An interesting feature found in seven children was diphtheria of the skin. This occurred most frequently on the eyelids, scalp, and face, where it took the form of small round or oval lesions, often multiple. The spots were covered with

* A not uncommon statement was that the eyes had been more or less inflamed since an attack of measles, until a definite outbreak of conjunctival diphtheria supervened. The chronic catarrhal condition had doubtless predisposed to the reception of the *contagium vivum* of diphtheria. It should be noted that impetigo of the scalp or face was quite common in the cases.

a greyish-white and readily separable membrane, and were surrounded by an inflammatory areola. They seemed to originate in two ways: first, and most commonly, by an excoriation of the skin of the lids and face by ichorous discharge from the inflamed eye; and, secondly, by the inoculation of an impetiginous sore with the specific products of diphtheria. The nature of the cutaneous lesion, it may be added, was more than once confirmed bacteriologically.

(c) *Presence of membrane.*—In every patient, save one (No. 28), membrane was found either on the palpebral or the ocular conjunctiva. The exception was that of a puny, marasmic baby, aged six weeks, suffering from congenital syphilis. The conjunctival symptoms were mild, the corneæ were clear, and not a trace of membrane could be seen; but the secretion, examined by myself and by an independent observer, showed numerous Klebs-Löffler bacilli, with several contaminating micro-organisms. Recovery soon took place under simple treatment. Leaving out the foregoing case, the remaining forty-two cases may be classed into three main groups according to their clinical severity: the mild, twenty cases; the moderate, nineteen cases; and the severe, three cases. But, as anyone can convince himself by glancing over the appendix to this paper, the cases formed a continuous series, beginning with a mild—nay, insignificant—inflammation of the conjunctiva, and ending in a severe and complicated type. In truth, it may be said that practically every degree of severity was represented, a fact rendering it highly probable that the cases formed a truly homogeneous group.

(d) *Implication of glands.*—In almost all moderate or severe cases the pre-auricular and angular glands corresponding to the inflamed eye were more or less swollen, but in the milder forms of disease the glands often escaped altogether.* Once a marked enlargement of the

* Mild cases 35 per cent., moderate cases 55 per cent., and severe cases 100 per cent.

pre-auricular gland was associated with swelling of the same side of the face.

(e) *Character of secretion.*—This varied in accordance with the stage of disease, but generally had a puromucous character. A suggestive feature was that of several pale, tenacious, glutinous threads stretching between the edges of the eyelids when an attempt was made to separate the latter.

(f) *Eye affected.*—The malady was unilateral in no fewer than thirty-two cases, or about three-quarters of the whole number. This feature I have sometimes found helpful in making a rapid clinical diagnosis of the disease.

(g) *False membrane.*—The inner surface of both upper and lower lid was in the greater number (26) of cases coated by membrane. In thirteen instances the upper, and in three instances the lower lid was alone involved. In four cases membrane was also present upon the semilunar fold or other parts of the ocular conjunctiva, but it was never found on the cornea. A characteristic appearance, which could be seen without everting the eyelids, was that of a line of greyish-white membrane upon the intermarginal space of one or both palpebræ. The exudation sometimes formed a continuous sheet extending over the palpebral conjunctiva, but more usually it was in streaks or patches. Differences in thickness, according to location, were common. Thus it was sometimes thick upon the upper, and thin upon the lower lid. It was, as a rule, easy to wipe away the deposit from the palpebral, but, curiously enough, not from the ocular conjunctiva. The underlying parts were generally red and succulent, but three exceptions were met with where the subjacent conjunctiva was more or less lardaceous, bleeding little if at all after removal of the fibrinous deposits.

(h) *Condition of cornea.*—The cornea was hazy or

ulcerated, generally the former, in thirteen children, or in 30·23 per cent. of the total number of cases.

(i) *Result of cases.*—Recovery took place in forty-two cases, and death in one case (No. 29). In the cases followed up, conjunctival cicatrices were noted in four, and corneal blemishes in eight. No case, so far as is known, was followed by peripheral neuritis.* But the value of that observation is naturally discounted by the fact that often the children did not remain under treatment long enough to exclude its possible occurrence.

8. BACTERIOLOGY.—As stated before, the Klebs-Löffler bacillus was demonstrated in every case included in the series. It was found in pure culture six times. In twenty cases it was associated with the *Streptococcus pyogenes albus*; in twelve with *S. p. aureus*; in six with *S. p. citreus*; in seven with streptococci; in two with the xerosis bacillus; and once with sarcinæ, streptothrix, *B. fluor. liq.*, and *Micrococcus candidans*, respectively. In addition, in five cases the diphtheria organism was found side by side with unidentified cocci, bacilli, and diplobacilli. It will therefore be evident that the infection was “pure” in 13·95 per cent., and “mixed” in no less than 86·04 per cent. of the cases. All varieties—long, medium, short, and “sheathed”—of the diphtheria bacillus were encountered. It is tempting to think that perhaps the short bacillus, generally acknowledged to be less virulent than the other forms, might cause the milder varieties of diphtherial infection. That speculation, however, was not substantiated by the results of my bacteriological investigations. I have many times found the long Klebs-Löffler bacilli in cases the clinical symptoms of which were slight, and *vice versâ*. Neither have I so far succeeded in tracing any connection between the associated micro-organisms and the severity of the case.

A few words with regard to technique may not be out of place. In several cases the specific organism

* For recent examples see Collins, W. J., *Lancet*, June 27th, 1896; Silcock, *St. Mary's Hospital Gazette*, December, 1896.

could be identified, almost with certainty, in cover-glasses smeared with membrane and stained in proper ways. This simple method of investigation has considerable value, since it sometimes allows the bacilli to be recognised then and there in the out-patient room. In this connection I cannot refrain from mentioning the practical value attaching to the systematic use of Neisser's stain with methylene blue and vesuvine. It differentiates in the clearest way the Klebs-Löffler bacillus from that bugaboo of ophthalmic bacteriology, the xerosis bacillus. The former shows two or three oval bodies of blue colour within the organism, which is coloured brown, while the latter shows no such appearance. In all my cases cultures were made in addition to cover-glass preparations. Blood-serum and agar-agar were the media usually employed, and I must express my personal preference for the latter. The xerosis bacillus, as well known, thrives upon blood-serum, but grows sparingly upon ordinary agar-agar. Hence, by employing agar-agar for our cultures, we are not so likely to mistake one organism for the other as when we use blood-serum. Apart from that, in the acid-producing properties of the Klebs-Löffler bacillus, we appear to have a perfectly trustworthy means of distinguishing one bacillus from the other. A tube of neutral laemoid bouillon, inoculated with diphtheria, and placed in the incubator for twenty-four hours at body temperature, will at the end of that time have become converted into a reddish liquid. That is not the case with the xerosis organism. Lastly, as I have pointed out elsewhere, while both bacteria stain by Gram, the xerosis bacillus holds the gentian violet much more tenaciously than the diphtheria bacillus in the presence of absolute alcohol. In short, in moderately expert hands, there should, in my opinion, be no confusion between the organisms named.

9. TREATMENT.—Before I had fully appreciated the bacteriological identity of the milder with the severer forms, my treatment consisted of the ordinary antiseptic

remedies, as silver nitrate, corrosive sublimate, boric acid, and quinine. Most of the patients did well enough in this way, even when treated as out-patients. Next, injections of antitoxin were tried, with no local treatment beyond ablutions of the eye with sterile water. But for some time now I have recognised that the rational treatment of conjunctival diphtheria must be twofold: first, the injection of a full dose of antitoxin, in order to neutralise the albumoses circulating in the blood; second, the use of local antiseptics, in order to get rid of the Klebs-Löffler bacillus itself and its associated microbes, shown to be present in 86 per cent. of my cases.

Antitoxin was administered in twenty-three patients, and in a few the dose was repeated later. The injection ranged from 1000 to 4000 immunisation-units. It is now admitted, however, that the dose must bear a relation to the severity of the disease rather than to the age of the child. If the cornea be hazy, a large injection will be called for. The remedy should, of course, be employed at once, without awaiting the results of a bacteriological investigation. It may perhaps be argued that as benign cases do well enough under local remedies, there is no need to resort to antitoxin. This is, I am convinced, a mistaken and thoroughly mischievous view. However mild a case may seem, there can be no guarantee that the process may not attack the fauces and thus even lead to the death of the child. That event actually took place in a case reported to the Society by Dr. John F. Bullar.* A baby of ten days developed a membranous conjunctivitis of one eye, the diphtheritic nature of which was apparently not suspected. A few days later membrane was found in the nose and fauces, and the baby died fifteen days after the beginning of the illness. It is possible in this case that had the diphtheritic character of the process been thought of, a timely injection of antitoxin might have saved the patient's life. I regret to say that a somewhat similar case (No. 29) will

* *Trans. Ophthalm. Soc.*, vol. xxi (1901), p. 9.

be found in my own series. A little girl, aged sixteen months, was admitted to hospital with an inflamed eye. The nature of the disease was not diagnosed. When I saw the child for the first time four days after admission there was typical diphtheria of one eye. Four thousand units of antitoxin were injected, but next day membrane was found in the throat, and the child died on the following day.

With respect to local treatment, in mild cases nothing is better than a 1 : 4000 or 1 : 5000 solution of corrosive sublimate, applied three or four times a day with a small spray apparatus to the everted conjunctiva freed from membranous discharges. In severe cases the lids may, in addition, be painted daily with a 15 per cent. solution of potassium permanganate. At a later stage, when secretion is profuse, a 1 per cent. or 2 per cent. solution of silver nitrate applied to the lids daily succeeds better than any remedy I have tried. Haziness of the cornea calls, of course, for atropine, and a spreading ulceration is best checked by a thorough application of the galvano-cautery to the lesion.

Cases are on record where a so-called "croupous" conjunctivitis gave faucial diphtheria to other children* or to their attendants.† My series includes no instance of the kind. The fact, however, should make one the more anxious to isolate even the mildest case of conjunctival diphtheria.

10. CONCLUSION.—In conclusion let me state that, broadly speaking,‡ I regard "croupous" and "diphtherial" con-

* Haab, *Zeit. f. pract. Aerzte*, 1897, No. 24.

† Schirmer, *Graefe's Archiv*, 1894, Ab. v, p. 160, Case No. 4.

‡ I should not be understood to make an universal affirmative proposition. There are, doubtless, a few instances where inflammation other than that due to the Klebs-Löffler bacillus is associated with membrane on the palpebral conjunctiva. In hospital work, however, during the period covered by the foregoing figures, I have found only five cases of so-called "membranous conjunctivitis" in which the diphtheria organism could not be demonstrated, but that, of course, is a very different thing from asserting its absence. No number of failures in attempting to demonstrate the presence of a micro-organism can really be held to disprove its existence.

conjunctivitis as one and the same disease, mainly for these reasons :

1st, that both ailments occur under similar general conditions as regards age, social state, and season of year.

2nd, that the most trivial "croupous" and the gravest "diphtherial" are linked together by a whole series of cases having intermediate grades of severity.

3rd, that a so-called "croupous" case may be preceded by, associated with, or succeeded by diphtheria of the fauces, skin, or elsewhere.

4th, that both affections are definitely influenced by antitoxin.

Lastly, that a common contagium, in the shape of the Klebs-Löffler bacillus, lies at the root of both maladies.

APPENDIX.

MODERATE.

1. William J. B—, æt. 2½ years. First seen on January 1st, 1896. Hackney, No. 11.

Present condition.—R.: symptoms of severe catarrhal ophthalmia, with swollen and violaceous upper eyelid, and with membrane on the inner surface of the lower palpebral conjunctiva. The membrane can be readily stripped off. Cornea clear.

Bacteriology.—In serum-cultures two organisms were identified, viz., (1) Klebs-Löffler bacilli, and (2) *S. pyogenes albus*.

Treatment.—Zinc sulphate drops.

N.B.—The child attended the hospital once only.

MILD.

2. Ada T—, æt. 1½ years. First seen on March 18th, 1896. Hackney, No. 130.

Eye bad for five days.

L.: symptoms of catarrhal ophthalmia with detachable membrane on the upper lid. Cornea clear.

Bacteriology.—Klebs-Löffler bacilli.

Treatment.—Perchloride lotion, 1 : 5000, *ter die*.

March 25th, 1896.—Membrane has disappeared.

MILD.

3. John R—, æt. 3 years. First seen April 22nd, 1896. Hackney, No. 175.

Eye been inflamed for three days.

L.: œdema of the reddened upper lid. Great swelling of

the palpebral conjunctiva, which is covered with detachable membrane. Cornea not affected.

Bacteriology.—On blood-serum, *S. pyogenes albus* and diphtheria bacilli.

Treatment.—Silver nitrate (grs. 10) daily at hospital, and frequent washings of the affected eye with perchloride lotion, 1 : 5000.

Result.—This appears to have been satisfactory.

MODERATE.

4. Frank W—, æt. 2 years. First seen on June 17th, 1896. Hackney, No. 225.

The left eye has been inflamed for a fortnight.

L. : symptoms of rather severe catarrhal ophthalmia with membrane.

Bacteriology.—In cultures, Klebs-Löffler bacilli along with *S. albus* and *aureus*.

Treatment.—Silver nitrate, ten grains, daily at hospital. Perchloride lotion, 1 : 5000, three times a day at home. July 8th, 1896.—Silver thrice a week. July 22nd.—Silver to be stopped.

Result satisfactory.

MILD.

5. Elizabeth D—, æt. 2 years. First seen on September 15th, 1897. Hackney, No. 653.

Measles six months ago. A "humory eruption" noticed about eyes a fortnight since. A week ago the left eye got red and began to discharge. It has got perceptibly worse since then.

L. : the eye can just be opened. The lids are red and swollen. There is much muco-purulent discharge, with coagulated material—that is, membrane—on the conjunctiva of the upper and lower eyelid. This morbid product is readily detachable.

Bacteriology.—Klebs-Löffler bacilli side by side with xerosis bacilli.

Treatment.—Silver nitrate (grs. 10) daily at the hospital, and perchloride lotion, 1 : 5000, frequently at home. October 13th, 1897.—Case cured save for a little residual blepharitis.

MILD.

6. Arthur L—, æt. 1 year. First seen on February 9th, 1898. Hackney, No. 822.

Measles a week or two before Christmas, and eyes bad on and off ever since.

L. : lids puffy, with membrane on the upper lid. Symptoms generally those of acute catarrhal ophthalmia. Throat shows no changes.

Bacteriology.—Diphtheria and xerosis bacilli with staphylococci (*albus* and *aureus*).

Treatment.—Silver nitrate (grs. 10) daily. Lot. Hydr. Perchl., 1 : 5000, frequently. February 16th, 1898.—No membrane and but little photophobia. March 16th, 1898.—Conjunctiva almost well. A small "ruck" lies at the outer end of the left upper conjunctival fornix.

MILD.

7. Florence A—, æt. 4 years. Seen February 9th, 1898. Hackney. (Published *British Medical Journal*, June 18th, 1898.)

Left eye has been inflamed one week. The eyelids are stuck together, and there is much yellowish discharge, especially in the morning. Nobody else in house affected. No recent illness.

Present condition.—L. : eyelids red, swollen, and semi-closed. Mucous membrane of the lower lid is covered with a thick, semi-opaque membrane, detached and lying loose along the palpebral margin. There is a similar membrane over the superior cul-de-sac. No marked amount of conjunctivitis. Cornea clear. Glands under jaw equally enlarged on both sides. Throat, nose, and vulva normal. General state good.

Bacteriology.—Cover-glass preparations, stained with carbol-blue and with weak fuchsin, show a few cocci and diplococci, with a larger number of segmented organisms resembling the diphtheria bacillus. On agar at 37.5°, after forty-eight hours, two kinds of colonies, viz., (1) large yellowish, and (2) small greyish. The former made up of cocci, staining by Gram; the latter of bacilli, also staining by Gram. Sub-cultures on agar made from each kind of colony. From the grey, after two days at 37.5° C., about fifteen raised colonies, greyish white, with more opaque central portions, composed of diphtheria bacilli. From yellowish, after three days, abundant growth of *S. pyogenes aureus*. From a couple of tubes of blood-agar, after three days at 37.5° C., diphtheria bacilli, *S. pyogenes albus*, and *S. pyogenes aureus* obtained. Neutral broth, inoculated from pure cultures of the assumed Klebs-Löffler and placed in incubator one or two days, became acid in reaction.

Child admitted to hospital on February 12th. Temp. 99° F., pulse 100, resp. 28. General condition good. Mouth, nose, tonsils, and pharynx normal. Submaxillary glands enlarged on left, and just felt on right side. No other glands enlarged. Urine 1015, acid, urates, no albumen. Chest, skin, vulva, and right eye normal. Affected eye washed with quinine lotion (four grains to the ounce) every four hours; 10 c.c. antitoxin injected. Membrane on lids until February 16th, on which date a little mucous discharge only present from the eye. Knee-jerks present. Urine, tested repeatedly, never found to contain albumen.

Child discharged on February 25th.

March 23rd.—Left eye free from redness or discharge. Knee-jerks present. Urine acid, no albumen.

MODERATE.

8. Mary R—, æt. 10 months. First seen on February 25th, 1898. Evelina Hospital. (Published in *British Medical Journal*, June 18th, 1898.)

History.—Right eye red and swollen five days. No recent measles, whooping-cough, or scarlet fever. A brother, æt. 6 years, developed a diphtheritic throat in September, 1897, and was sent to an isolation hospital. He returned at Christmas, 1897, and had lived in the same house as the patient since.

Present condition.—R. : lids swollen and half-closed, with dried secretion about them. Threads of glutinous discharge stretched from one lid to the other. The palpebral conjunctiva was red and thick, and on everting the somewhat indurated upper lid, which could be done with more or less difficulty, a thin greyish pellicle could be seen to cover the upper cul-de-sac. The membrane could be easily wiped away, but was speedily reproduced. No chemosis; cornea clear. Right angular glands enlarged. No membrane on tonsils or uvula; colourless discharge from nostrils and ears. The child was fretful and looked ill. Temp. 98.6° F.; pulse 116; resp. 44. Urine acid, no albumen. Knee-jerks well-marked.

Bacteriology.—Cover-glasses smeared with detached membrane showed cocci and bacilli, but none of the last named were beaded. After twenty hours in the incubator, two serum tubes showed a few colonies, and later these were found to be (1) Klebs-Löffler bacilli, short form, and (2) *S. pyogenes citreus*.

Treatment and progress.—Patient placed on milk diet; nothing beyond distilled water used to the eye, and 4,000 units of antitoxin were injected. February 27th.—Membrane has disappeared from the conjunctiva. March 2nd.—No discharge from eye. Conjunctiva practically well. Child opens eye readily. Knee-jerks present. Child allowed to leave hospital. March 11th.—Right eye normal in all respects. Child in good health.

MODERATE.

9. Boy æt. 3 years. First seen on April 6th, 1898. Hackney. (Published in *Lancet*, January 28th, 1899.)

L. : upper lid red, swollen, and overhanging the lower lid. Thin muco-purulent discharge, with glutinous threads stretching between the lids when the latter were separated. Easily detachable membrane on the palpebral conjunctiva. Infiltration outer side cornea. Small impetiginous spots on forehead (? diphtheritic). Cervical and pre-auricular gland swollen. Temp. 99° F. Patient seemed quite well. No albumen in urine. Throat, nose, and larynx normal. 2,000 units injected, and eye kept

clean with perchloride lotion, 1 : 3000. On the 8th urine found to include a trace of albumen. Discharged on the 22nd with knee-jerks present and normal urine.

Bacteriology.—Klebs-Löffler bacilli.

MILD.

10. Alfred D—, æt. 3 years. In hospital from April 7th to April 22nd, 1898. Hackney.

History.—The lad has kept his right eye closed for about five days. General health said to be good.

Present condition.—General health good. Temp. 99° F. Knee-jerks present. Urine free from albumen. The pre-auricular and angular glands on the right side are somewhat swollen. Small ? eczematous spots about the right eye.

R.: upper lid red, swollen, and overhanging the lower eyelid. Membrane (easily detachable) on palpebral conjunctiva. Cornea clear. L. not affected.

Bacteriology.—The following micro-organisms were found in serum and agar cultures, viz., (1) Klebs-Löffler bacilli; (2) *S. pyogenes aureus*; and (3) streptococci. Pus-films showed bacilli, some of which were beaded, grouped and single, together with a few cocci.

Treatment and progress.—Antitoxin, 2000 units. Lot. Hydr. Perchl., 1 : 3000, every four hours. Pad and bandage. April 9th.—Eyelid less swollen, and discharge less. Cornea clear. Membrane still present. Urine normal. April 15th.—Lids not swollen. Cornea clear. Urine free from albumen. April 22nd.—Very slight discharge from right eye. Instructed to come daily to hospital for the purpose of having the lids of the right eye painted daily with silver nitrate, grs. x to the ounce.

MILD.

11. Girl æt. 18 months. Seen April 20th, 1898. Hackney. (Case published in *Lancet*, January 28th, 1899.)

For ten days the eyes had been red, the lids swollen, and there had been a discharge from the eyes. The child had lost her appetite, become paler, and was "feverish" at night. Eyelids swollen, and a detachable membrane on the palpebral conjunctiva.

Bacteriology.—Klebs-Löffler bacilli found by myself, the Clinical Research Association, and by the Resident Medical Officer, Mr. C. G. Burton. Staphylococci were also reported by the Association.

Patient admitted on April 22nd. Glands enlarged. 2000 units of antitoxin injected into flank, and eyes kept clean with distilled water. Knee-jerks present; no albumen in urine. A second injection of 1000 units on the 26th. Antitoxin rash on the 28th. On May 1st silver nitrate (grs. x) and perchloride lotion (1 : 5000). Discharged on June 15th.

MODERATE.

12. Ellen E. R—, æt. 6 months. First seen on May 25th, 1898. Hackney, No. 978.

History.—The right eye was noticed ten days ago to be swollen and discharging. Since the eye became inflamed, the child has lost flesh and has not taken her food well. No diphtheria in the neighbourhood.

Present condition.—R.: lids red and swollen. The palpebral conjunctiva, which is in a similar state, is covered with a thin, greyish membrane, that strips off readily. Cornea clear. There is a reddish, serous discharge from the nostrils. The right pre-auricular gland is enlarged, and some occipital glands are swollen on both sides.

Bacteriology.—Film preparations of the eye-discharges showed, when stained and examined with the microscope, beaded bacilli and scattered diplococci. Tubes of agar-agar inoculated with discharge, and incubated for twenty-four hours at 37.5° C., contained diphtheria bacilli (long and short forms), along with cocci and diplococci (*S. pyogenes albus*).

MODERATE.

13. Beatrice S—, æt. 9 months. Hackney, July 19th to August 4th, 1898.

Seven days ago the left eye was noticed to be red and swollen. Four days ago child unable to open that eye. Since the eye began to discharge, the child has been "feverish" and "out of sorts."

Present condition.—Child pale and ill. Temp. 99° F. L.: upper lid swollen and red, with threads of pale, glutinous discharge stretching between the two eyelids. Detachable membrane on both lids, with reddened conjunctiva beneath. Throat, nose, tonsils, and vulva normal.

Bacteriology.—There were found in cultures made from the conjunctival secretions on serum and agar (1) Klebs-Löffler bacilli, (2) *S. pyogenes citreus*, (3) streptococci, and (4) sarcinæ.

Treatment and progress.—Antitoxin 2000 units. Distilled water to eyes frequently. July 22nd.—Membrane, peeling off readily, still present on eyelids. Urine normal. Child sleeps and eats well. July 23rd.—R. free from membrane. L.: a mere trace of membrane remains. Knee-jerks present. July 24th.—Urine normal. Trace of membrane on (?) left upper lid, the conjunctiva of which is red and thickened. Cornea clear. Left pre-auricular gland swollen. August 3rd.—Urine free from albumen. Knee-jerks present. Child well. No discharge from eyes, and conjunctiva pale. August 10th.—There is faint scarring of the palpebral conjunctiva of the left eye.

MODERATE.

14. Girl, æt. 8 months. First seen on July 19th, 1898. Hackney. (Published in *Lancet*, January 28th, 1899.)

For seven days L. had been red and swollen. For two days child feverish and very ill.

L.: lids swollen and red. Membrane on palpebral conjunctiva. Glands enlarged.

Treatment.—2000 units of antitoxin.

Bacteriology.—Klebs-Löffler bacilli found in cultures by myself, the Clinical Research Association, and at hospital. In latter *S. citreus* also demonstrated.

On the 22nd the urine contained albumen, and the knee-jerks could not be elicited.

MODERATE.

15. Stanley L.—, æt. 2 years. First seen on August 3rd, 1898. Hackney, No. 1088.

History.—No previous illness, except chicken-pox at the beginning of the present year. No history of diphtheria in the house. On July 20th—that is, fourteen days since—the left eye became red, the lids swollen, and there was a little discharge from the eye. The child was brought to the hospital, where some simple treatment was prescribed. On July 29th membrane was noticed on the eyelids by the hospital sister, and next day the cornea was cloudy.

Present state.—A well-nourished child. Temp. 98.4° F.; pulse 100; resp. 28.

L.: eyelids swollen. Conjunctiva of lower lid red and thickened. Thin detachable membrane actually seen. Ocular conjunctiva injected. Interlamellar abscess lower half of the cornea, with cloudiness of the rest of the cornea. R. healthy.

Impetigo of the scalp. Knee-jerks present. Urine acid, urates, faint trace of albumen, no sugar. The left pre-auricular gland and the glands on the left side of the neck somewhat enlarged.

Treatment.—Antitoxin, 2000 units at once. Admitted to hospital. Guttæ Atrop., grs. 2, left eye, thrice a day. Hot fomentations to left eye four-hourly.

Bacteriology.—On cultures, Klebs-Löffler bacilli, long form, and *S. pyogenes albus*.

Progress.—August 5th.—L.: no membrane. Lids not so swollen. Conjunctiva less red and thickened. Cornea clearer. Child appears well, appetite good. August 7th.—L.: small ulceration lower part of cornea noticed last night. Conjunctiva free from membrane, not so red. August 9th.—L.: the corneal ulcer has increased in size, but is not very deep. Lids still swollen. Slight photophobia. Urine contains no albumen. Cervical glands still felt. Knee-jerks present. Impetigo

almost well. Pulv. Iodoformi to left eye twice a day. August 16th.—Patient went home to-day. L.: corneal ulcer looking healthier. During his stay in hospital the temperature rose on one occasion to 100° F., the highest point recorded. September 14th.—L.: nebula lower third of cornea. Knee-jerks and palatal reflexes present.

MILD.

16. Louisa L—, æt. 9 months. August 4th to August 14th, 1898. Hackney.

Eyes bad about one week. Yellow discharge first noticed, and then lids became swollen. The eyes have got gradually worse.

Eldest sister had a "sore throat" about a week ago. There has recently been a case of diphtheria in the street, the drainage of which is said to be bad.

On admission.—A fat, well-nourished child. Temp. 98° F. Eyelids swollen, with yellowish discharge. Not much photophobia. Membrane present on the upper and the lower lid of each eye. It was thickest and most abundant in the left eye. From the right eye it peeled off readily, while on the left there remained a few bleeding points after its removal. The conjunctiva under membrane was red and thickened. Corneæ clear. Cervical and pre-auricular glands difficult to feel owing to the fatness of the child, but they appeared to be somewhat enlarged. Knee-jerks present. Urine acid; no albumen.

Bacteriology.—Report of Clinical Research Association: culture on agar. Strepto- and staphylococci, and a few short, straight bacilli. Klebs-Löffler bacilli.

Treatment and progress.—Antitoxin 2000 units. Eyes washed with distilled water merely. August 7th.—Lids not so swollen. Discharge less. Small piece of membrane still on left eye. Conjunctiva looks more healthy. Corneæ clear. A few small sores around eyelids. August 14th.—Child went home to-day. Conjunctiva normal. Eyes well opened. No albumen in urine.

MODERATE.

17. Cidric B—, æt. 1½ years. August 24th to September 7th, 1898. Hackney, No. 1122.

History.—Eyes well until four days ago.

Present condition.—Eyelids much swollen. The upper lids, when everted, are of a greyish colour. There is muco-purulent discharge. Ocular conjunctiva red but not chemosed. Right cornea clear, but left cloudy. There are sores upon the chin, head, and chest, some of which are coated with a greyish pellicle.

Bacteriology.—Klebs-Löffler bacilli in cultures on blood-serum, inoculated both from the conjunctiva and also from a sore upon the head.

Treatment and progress.—Nitrate of silver, 2 per cent., to everted lids once a day. Perchloride lotion, 1:5000, often to eyes. Ung. Hydr. Ammon. (grs. v) to sores. August 30th.—Lids less swollen, with less discharge from conjunctiva. September 4th.—Child opens eyes well. September 7th.—Sent home. It may be noted that no temperature higher than 100·2° F. was found during the patient's stay in hospital.

MILD.

18. Ada E—, æt. 6 years. First visit on October 28th, 1898. Evelina, No. 120.

This patient was originally seen on account of an attack of eczematous keratitis affecting her left eye. On September 7th, 1900, she was brought to the out-patient department with what her mother thought was a return of her late disorder. The left eye was stated to have become inflamed about a week ago, and her right eye a day or so later. Upon examination the R. showed phlyctenulæ diffused around the cornea in the limbus conjunctivæ. There were, besides, patches of a detachable greyish membrane on upper tarsal conjunctiva, and, to a less extent, on the lower tarsal conjunctiva.

Bacteriology.—The Clinical Research Association reported as follows:—"The growth on blood-serum after incubation consisted of the Klebs-Löffler bacillus ('sheath' variety) associated with staphylococci."

The child was sent to the Fever Hospital, where she remained for about three weeks.

MODERATE.

19. James C—, æt. 2 years 11 months. First seen May 10th, 1899. Hackney, No. 1444.

History.—The left eye has been inflamed for the last three days.

Present condition.—L.: the symptoms are those of severe catarrhal ophthalmia, with the addition of a thin, greyish membrane on the upper tarsal conjunctiva. No membrane on the ocular conjunctiva, nor in the fauces nor elsewhere. Child not ill in himself.

Bacteriology.—Pus films from the conjunctiva show Klebs-Löffler bacilli, which give a positive reaction with the Neisser stain. Cocci, which stain by Gram, are also present. On agar-agar and blood-serum, colonies were found of (1) diphtheria bacilli and (2) *S. pyogenes albus*.

Treatment and progress.—The palpebral conjunctiva was painted daily with a solution of silver nitrate, 2 per cent. The eye was kept clean with Lot. Hydr. Perchl., 1:5000, used six times a day. The child made a rather slow but perfect recovery.

MILD.

20. William R—, æt. $2\frac{1}{2}$ years. First seen on May 24th, 1899. Hackney, No. 1459.

The right eye is stated to have been bad for five days.

Present condition.—R.: eyelids swollen, and lower one distinctly brawny. There is a grey membrane on the inner surface of the upper lid, and this can be stripped off. The pre-auricular and angular glands on the right side are enlarged. No membrane can be found elsewhere, as in the throat or nares.

Bacteriology.—Klebs-Löffler bacilli, and streptococci, long.

Treatment and progress.—Lot. Hydr. Perchl., 1 : 5000, often. June 7th, 1899.—R.: a little swelling of the lower lid, but palpebral conjunctiva in fair order.

MILD.

21. Winifred C. B—, æt. 1 year 8 months. First seen on June 7th, 1899. Hackney, No. 1478.

Measles five weeks ago. The eye has been bad for a week.

Present condition.—R.: lids rather swollen, with muco-purulent discharge at the corners. Lower palpebral conjunctiva thick and red, and covered by a thick grey membrane. Upper lid mostly covered by a thinner membrane. No diphtheria elsewhere.

Bacteriology.—Klebs-Löffler bacilli and pyococci (*alb.*).

Treatment.—Admitted, and injected with antitoxin, perchloride lotion, 1 : 5000, being used frequently to the affected eye.

MODERATE.

22. Horace W—, æt. $2\frac{1}{2}$ years. First seen on September 28th, 1899. Hackney, No. 1584. (Published in *Lancet*, February 17th, 1900.)

History.—The left eye has been inflamed for five days.

Present condition.—Child apparently not ill, and certainly well-nourished. Thick, crusted impetigo of the hairy scalp, one spot being covered with an adherent grey membrane; a crusted sore is also present on the forefinger of the left hand. There was a serous discharge from the nostrils, but no membrane could be found either in the nose or throat. Left pre-auricular and the angular glands are somewhat enlarged. Knee-jerks present. Albumen in urine. Temp. 98° F.; pulse 104; respiration 24. L.: lids swollen and violaceous. Eye obviously inflamed. Abundant muco-purulent discharge. A membrane is present on the palpebral conjunctiva, being thicker on the lower than the upper eyelid. It is of grey colour, and can be detached with some little difficulty, leaving the underlying conjunctiva red and succulent. Chemosis of ocular conjunctiva, which is free from membrane. Cornea cloudy but not actually ulcerated.

Bacteriology.—Membrane smears, examined direct, showed

bacilli indistinguishable from the Klebs-Löffler. Cultures showed, besides diphtheria organisms, the *Staphylococcus albus* and *aureus*. In the membrane from coated sore on scalp were found staphylococci and (?) Klebs-Löffler bacilli.

Treatment and progress.—Lids to be painted daily with Pot. Permang., 15 per cent. Boric lotion often. Ung. Hydr. Ammon. (grs. v) for cutaneous sores. October 6th.—Circular ulcer of left cornea. October 11th.—Patch of diphtheritis on scalp healed. No membrane on the red and thickened conjunctiva. October 25th.—L.: lids somewhat swollen. Palpebral conjunctiva red. Slight mucous discharge. Cornea shows a nebula, the result of ulceration. November 1st.—Marked all-round improvement.

MODERATE.

23. Elizabeth L—, æt. 2 years 2 months. First seen on October 18th, 1899. Hackney, No. 1601.

On September 16th the child developed a rather severe attack of measles, for which she was kept in bed three weeks. On October 10th the right eye seemed to have developed "a cold," becoming bloodshot, etc. Two days later the lids and cheek became swollen, and the eye could not be opened. On October 14th child was brought to the hospital. The mother states that "since the eye has been affected, the child has become listless, and has gone to nothing." No cases of diphtheria known to have occurred in the house or street where she resides.

The child looks and seems ill. R.: unable to open this eye. Upper lid much thickened and reddish. Watering and muco-purulent discharge. On everting the greatly thickened upper lid, a thin fibrinous deposit, of unequal thickness, was found upon the palpebral conjunctiva. Lower lid free from membrane. Right pre-auricular gland enlarged. Cornea clear.

No membrane to be seen in the nose or throat.

Treatment.—Antitoxin, 2000 units, at once. Boric lotion often. Potassium permanganate, 15 per cent., to be painted on the conjunctiva once a day.

Bacteriology.—Klebs-Löffler bacilli, *S. albus* and *aureus* on blood-serum cultures.

MODERATE.

24. Walter P—, æt. 3 years. Hackney, No. 1695. Admitted January 10th, and discharged January 24th, 1900.

History.—Child knocked his right eye on December 23rd last, and since then has rubbed the eye a good deal. The eye has been definitely inflamed since December 26th, with swollen lids and profuse discharge. The child has not seemed "to be quite himself" since the eye got bad.

No other children have been ill in the same house.

Present condition.—No membrane in throat or elsewhere. Right pre-auricular gland enlarged. Child appears to be far from well in himself. No albumen in urine. Knee-jerks present. Temp. 98.6° F.; pulse 108; resp. 24. R.: upper lid red, swollen, and glossy, drooping over and partially hiding the lower one. Shreds of glutinous discharge adhering to the eyelids. The eye waters. The palpebral conjunctiva is red and thick, and covering that of the upper lid is a thin grey membrane, readily detachable. The cornea, which is universally cloudy, presents in its lower half several denser spots of infiltration. Pupil much contracted.

Bacteriology.—Cover-glasses smeared with membrane showed some cocci and a limited number of segmented bacilli, all staining by Gram. Blood-serum and agar-agar tubes streaked with membrane and incubated for twenty-six hours at 37.5° C. were found to contain (1) Klebs-Löffler bacilli, medium size; (2) *S. pyogenes aureus*; and (3) streptococci.

Treatment and progress.—2000 units antitoxin injected into abdominal wall. Boric acid lotion to affected eye, the lids of which, freed from membrane, were painted daily with a solution of Pot. Permang., 15 per cent. Atropine drops, grs. ij, to eye every six hours. January 17th.—R. looks much better, but a small piece of membrane is still present on the lower lid. A second injection of antitoxin, 2000 units, was administered. January 20th.—No discharge from eye, which child is able to open a little. January 22nd.—Cornea clearer and pupil well dilated. No discharge from eye. Knee-jerks present. Urine contains no albumen. January 24th.—Temp. 98.6° F. Child made an out-patient. January 31st.—R.: cornea apparently clear. Palpebral conjunctiva not scarred, and in good condition. Child not pallid. Knee-jerks present; no inco-ordination of movements. March 26th, 1900.—R.: cornea (examined under a mydriatic) shows a very faint central diffused opacity, the result presumably of the former conjunctival diphtheria.

MODERATE.

25. Daisy C—, æt. 5 years. Hospital from January 24th, 1900, to June 18th, 1900. Hackney, Index No. 45.

History.—The right eye has been red and watering for three weeks, and is said to be getting worse. There have been sores upon both legs for the last two years, and since the eye got bad another sore has appeared upon the left temple. The child has been languid and poorly lately.

Present condition.—Patient pale and evidently ill in herself. Knee-jerks absent. There is a small sore at the inner canthus of the right eye, covered with a deposit (? diphtheritic). The angular glands are enlarged upon the right side. No faucial

diphtheria. Vulva normal. Urine contains a trace of albumen. Temp. 99.4° F. R.: upper lid is thick, red, and swollen, so as to overhang and partly to conceal the lower one. Chemosis of the ocular conjunctiva. Cornea faintly hazy, but not ulcerated. There is a patch of membrane on the inner surface of the lower lid. On upper lid is a patch of membrane measuring about one third of an inch, and extending into and along the intermarginal space. When the membrane is detached, the palpebral conjunctiva is found to be red and thick.

Bacteriology.—Report by the West-End Pathological Laboratory:—(1) *B. diphtheriæ*, and (2) *S. aureus, albus, and citreus*.

Treatment and progress.—Antitoxin 2000 units on admission, and also on January 26th. The eye had meanwhile been treated with boric acid lotion, atropine drops, and the daily application to the conjunctiva of a 15 per cent. solution of potassium permanganate. January 30th.—There are still patches of membrane on the palpebral conjunctiva, and the cornea is cloudy. Child very pale. Temp. 100.6° F.; pulse 156; resp. 28. Throat ulcerated, but no distinct membrane is present. February 3rd.—There are a few ulcerated patches on the soft palate and tonsils, but no membrane. Knee-jerks still absent. February 6th.—Lids less swollen and less discharge from eye. Cornea is hazy, with a small infiltration at one spot. Urine contains no albumen. February 7th.—R.: an oval infiltration in lower third of cornea surrounded by a hazy zone, but none of the cornea can be said to be clear. February 12th.—R.: cornea ulcerated in lower third; marked ciliary congestion. Knee-jerks absent. Heart rapid; no bruit. Temp. 100.6° F. February 14th.—Under chloroform, the ulcer of the right cornea was cleansed, and thoroughly touched with the galvano-cautery, and iodoform was applied locally. Scrapings from the ulcerated surface were inoculated into tubes of nutrient agar-agar and blood-serum. After twenty-three hours in the incubator, the serum tube contained many small, greyish-white, raised colonies, circular, none exceeding .33 mm. in diameter, and often discrete. The agar tube showed, clustered along the two streaks that had been made, numerous delicate greyish-white colonies. In each case the microscopical findings agreed, *viz.*, cocci, diplococci, and many short chains, staining by Gram. Some of the diplococci had a lanceolate shape. Capsules not recognised. The organisms were *pneumococci*. After forty-eight hours one agar tube contained, besides, a minute colony of *S. pyogenes aureus*.

The cornea soon healed after the little operation, but the child's general condition grew worse. The temperature remained high, and the child wasted. The spleen was somewhat enlarged. For a time typhoid was suspected, but later several external glands became enlarged; crepitation and impaired resonance were found about the lungs; there were nodules in the abdomen;

and sores continued to appear in various parts of the body. A diagnosis of *Tuberculosis* was made. The child was eventually discharged from the hospital on June 18th, 1900, "relieved."

MODERATE.

26. Sarah E—, æt. 6 months. First seen on February 11th, 1900. Hackney, No. 1780.

History.—As far as the mother knows, the child has not been exposed in any way to the contagion of diphtheria. About four days before admission to the hospital, the eyes began to discharge and the lids became swollen.

Present state.—Temp. 99.4° F. Fairly profuse muco-purulent discharge from the eyes, the lids of which are œdematous. R.: there is a thin transparent membrane on the conjunctival surface of both lids. It can be stripped off without causing any bleeding. Slight conjunctival congestion. Cornea clear. L.: thick membrane on upper lid, and thin filmy membrane on lower lid. The membrane can be peeled off without causing bleeding. Some conjunctival redness. The cornea is slightly hazy, but devoid of definite infiltrations. No membrane seen in throat.

Bacteriology.—On blood-serum, after twenty hours' incubation, an almost pure culture of the Klebs-Löffler bacilli was obtained. Neisser's stain gave positive results. Neutral broth was rendered acid in twenty-four hours.

Treatment and progress.—Antitoxin, 2000 units, injected. Pot. Permang., 15 per cent., used to paint lids after stripping off the membrane. Atropine, grs. ij, four times a day to left eye. February 12th.—The antitoxin injection repeated. Temp. 100.6° and 99.2° F.; pulse 136. February 14th.—Left cornea still rather hazy, but neither infiltrated nor ulcerated. Membrane is still present on the palpebral conjunctiva of both eyes. February 20th.—Both corneæ now quite clear. No discharge. A small piece of membrane present on the conjunctival surface of the upper lid of the left eye. The swelling of the lids is markedly reduced. February 23rd.—Child discharged from hospital. The conjunctiva, although still thickened, shows no serious changes, and is free both from membrane and discharge. March 21st.—The palpebral conjunctiva is now white and in good condition.

MILD.

27. Florence W—, æt. 2 years. First seen on March 21st, 1900. Hackney, No. 1805.

About six weeks ago the child developed a slight attack of measles, but was not confined to bed with the disorder. She has not seemed so strong since. On March 15th—that is six days ago—the right eye became inflamed, and its condition has got worse day by day.

A thin and pallid child, with swollen cervical glands and flea-bitten body. Temp. 98.2° F. No sores present. (? Knee-jerks.) R.: lids swollen and violaceous, but can still be opened a little. Chemosis exists. There is a membrane on the palpebral conjunctiva. Cornea clear.

Child was in hospital twelve days, and, when discharged, swelling had subsided and membrane gone.

Klebs-Löffler bacilli and *S. citreus*.

28. Lilian O—, æt. 6 weeks. First seen on March 23rd, 1900. Evelina.

History.—Born at the seventh month, after a labour lasting five hours. Presentation natural. Eyes stated to have been red at birth, but at no time have the eyelids been swollen. The mother says that the baby's eyes "have been discharging on and off" for about a week. The father, aged twenty-eight years, is stated to enjoy good health.

Present state.—The child presents a wretched and marasmic appearance, and is almost certainly the subject of inherited syphilis. The eyelids, preternaturally small, have muco-purulent discharge about them. The eyelashes of the right upper lid are turned in upon the corresponding eyeball. The palpebral conjunctiva is rather red and thick, *but shows no trace of membrane*. Corneæ clear. No obvious glandular enlargement. No regurgitation from tear-sacs.

Bacteriology.—Cover-glasses were smeared and serum tubes inoculated with muco-pus from the conjunctiva. The former, when stained with (a) carbol blue and (b) Gram, showed cocci and bacilli, both of which retained the last-named stain. The serum, after twenty-four hours at 37.5° C., contained numerous colonies of what appeared to be Klebs-Löffler bacilli, along with pyococci. Sub-cultures on agar were obtained of the organisms.

The case, however, seemed important enough to obtain independent bacteriological evidence. Accordingly the original cover-glass preparations and serum cultures, as well as the agar sub-cultures, were forwarded to the West-End Pathological Laboratory, at 55, Weymouth Street, W. Beyond stating that the specimens were obtained from conjunctival discharge, no information was vouchsafed. The report obtained in due course was as under:—"The microscopical result of examining the cover-glass preparations of the conjunctival discharge was a few scattered bacilli and cocci, which were unidentifiable, and numerous highly degenerated pus-cells. The serum culture was one of a mixture of *B. diphtheriæ* with *S. pyogenes albus*. One of the agar sub-cultures was a nearly pure diphtheria culture with a few pairs of cocci (not pneumococci), and the interesting contamination of a single colony of *B. fluorescens liquefaciens*.

Another agar culture contained the diphtheria bacillus with much more numerous staphylococci (also *albus*) and a very distinct contamination (one colony) of *M. candidans*, like the *B. fluorescens liquefaciens*, probably of aerial origin."

Progress and result.—March 30th, 1900.—My colleague, Dr. Soltau Fenwick, to whom I had referred the case, to-day diagnosed congenital syphilis, and placed the child on appropriate treatment. April 20th.—Eyes stated to have improved quickly under treatment. No discharge was present. Cornea clear. Palpebral conjunctiva in good order. No inversion of the cilia; the eyes, in short, are practically well. The infant weighs under five pounds, and is a wretched-looking object. She snuffles all day long. There are sores on the labia.*

SEVERE.

29. Mary B—, æt. 1 year 4 months. Admitted March 24th, and died March 30th, 1900. Hackney, No. 181.

History.—On March 19th—that is, five days prior to admission—the mother noticed a watering of the child's left eye, which by the 22nd instant had become so much swollen that it could not be opened. A quantity of yellowish discharge has run from both nostrils since the eye has been bad. Since March 19th the child has been feverish and unwell in herself, and for the last two days has seemed to suffer from pain in her head. The other children of the family are in good health.

Present condition.—The patient is clearly very ill. Her mouth is dirty, and her lips covered with dry scabs. Purulent discharge from both nostrils. No membrane in throat. The glands on both sides of the neck are markedly swollen. Temp. 99.6° F.; pulse 132; resp. 48. Albumen in urine. L.: eyelids much swollen and inflamed. They are stuck together by purulent discharge. A membrane is present on the upper palpebral conjunctiva. This can be removed (not readily), leaving a surface that bleeds but little and is distinctly lardaceous. The cornea is diffusely hazy. Pupil small. On pressure over the region of the lacrymal sac, pus exudes from the puncta lacrymalia.

Bacteriology.—In cultures were found (1) Klebs-Löffler bacilli, and (2) streptococci. (1) killed a guinea-pig in two days.

Treatment and termination.—Eye and nostrils treated with boric acid lotion. Brandy and milk diet given. March 28th.

* This example of conjunctival diphtheria without membrane is not unique; vide Sourdille, *Rev. des Méd. de l'Enfance*, 1895, p. 68: Aubineau, *Essai sur l'applic. de la sérothérapie dans le traitement de la diphthérie conjunctivale*, Paris, 1895: H. Coppez, *Rev. gén. d'Ophthalmologie*, 1896, p. 51.

—L.: eyelids hot, hard, red, and so board-like that they could not be everted. It could be seen, however, that the conjunctiva was covered with a thick greyish membrane, and, when this was stripped off, that the underlying mucous membrane was lardaceous. Cornea generally was hazy, with a large ulcer towards its centre. Temp. 101° — 104.4° F.; pulse 144; resp. 44. 4000 units of antitoxin injected. March 29th.—Erythematous rash present on body and legs. The tonsils are now covered with a thick white membrane, which has also spread to the soft palate and uvula. Temp. 105° — 105.4° F.; pulse 160; resp. 48, noisy but not distressed. March 30th.—Child dangerously ill. Great dyspnoea. Discharge from nose profuse and offensive. Temp. 105.8° F.; pulse 156, and respirations 52, both irregular. Child died at 4.30 p.m.

Pathology.—Left eye removed after death for pathological examination. The cornea was infiltrated and devoid of its anterior epithelium. Bowman's membrane present, except over a deepish and very definite ulceration towards the centre of the cornea. Intense purulent inflammation of the iris and ciliary body, the vessels of which are markedly distended. Uveal pigment of iris adherent in places to the anterior capsule of the crystalline lens. Abundant fibrino-purulent exudation into the anterior chamber, and many inflammatory cells and pigment particles are entangled in the meshes of the zonule of Zinn. Retina, choroid, and optic disc normal.

MODERATE.

30. John E—, *æt.* 7 months. Admitted April 4th, and discharged April 11th, 1900. Hackney, No. 1830.

History.—Impetigo of scalp four months. Bronchitis one month. The eye has been "bad" for fourteen days. Child not exposed to diphtheritic infection.

Present condition.—Impetigo of scalp. Slight bronchitis. No faucial diphtheria. R.: eyelids are very tense, œdematous, and violaceous. Membrane present on lower lid, and (to a less extent) on upper lid, and over the semilunar fold. Cornea clear. The right pre-auricular gland and the angular glands are enlarged.

Bacteriology.—Klebs-Löffler bacilli and *S. pyogenes albus* and *S. pyogenes aureus* on agar and serum cultures from conjunctival membrane.

Treatment and progress.—Antitoxin, 2000 units, on admission. Pot. Permang., 15 per cent., daily to everted lids. Boric lotion often to eye. Ung. Hydr. Nitr. Dil. to scalp. April 9th.—Swelling lids considerably reduced. No membrane seen. Cornea clear. April 11th.—Child has developed whooping-cough, and was discharged. Temperature has never risen above 98.8° F. during stay in hospital. April 18th.—No

swelling or redness now about right eye, which appears quite normal.

SEVERE.

31. Albert F—, æt. 4 months. Admitted April 6th, 1900, and discharged April 23rd, 1900. Evelina Hospital.

History.—Some three weeks ago the mother noticed "corruption" about both eyes. The eyes were treated at home with milk and warm water, but on March 27th lotion was ordered at the St. Francis Hospital, but that seemed to make matters worse almost at once. On April 3rd a doctor at the hospital named is stated to have said that "nothing was the matter with the sight, the inflammation affecting the eyelids only."

Present condition.—The baby is pallid and evidently very ill. Temp. 97.2° F.; pulse 119. The lids of both eyes are swollen and inflamed. There is muco-purulent secretion at the canthi. A thick greyish-white membrane coats the inner surface of all four lids, and extends to the intermarginal spaces. The membrane can be stripped off, leaving a surface that is lardaceous in places. A similar membrane is present upon the ocular conjunctiva, especially of the right eye. Both corneæ are very hazy, and in the case of the right cornea there is, in addition, a crescentic infiltration in the outer third of the cornea, which may be due to pus between the corneal lamellæ. The pre-auricular and angular glands are markedly enlarged.

Bacteriology.—Cover-glass preparations of the membrane show cocci and bacilli, both of which stain by Gram. The bacilli are long, segmented, and tend to be clubbed at the ends. They give a positive reaction with Neisser's stain. They are almost certainly Klebs-Löffler bacilli. Subsequently, on media, were identified (1) diphtheria bacilli, long form, and (2) *S. pyogenes aureus*. (1) was lethal as regards guinea-pigs.

Treatment and progress.—Antitoxin (R.C.P.), 4000 units, injected. Atropine ointment, grs. 2, *ter die*. Milk diet and brandy. April 7th.—Breathing irregular. Discharge from nose. Temp. 98° — 100° F. April 10th.—Urine acid, no albumen, no deposit. Temp. 98.6° — 99° F. April 12th.—Rash around site of injection. April 14th.—Much discharge from nose. Lot. Hydr. Per., 1:4000, every four hours to eyes. April 23rd.—Made an out-patient. May 25th.—R.: palpebral conjunctiva smooth, with a small scar on upper lid. Cornea wholly opaque, with a denser spot at its centre. Iris cannot be distinguished. L.: palpebral conjunctiva smooth. Leucoma lower third cornea. Said to see with this eye. June 1st.—R.: cornea clearing, so that upper margin of iris can be seen through it. October 12th.—R.: upper half of cornea tolerably clear, lower half leucomatous. Palpebral conjunctiva obviously scarred. L.: faint haze lower third cornea.

The child died from whooping-cough and bronchitis on November 29th, 1900.

MODERATE.

32. Arthur W—, æt. 2 years. Admitted April 25th, and discharged May 8th, 1900. Hackney, No. 1801.

History.—The child's right eye became affected six days ago, and his left eye four days ago. They are getting worse. The child suffered from a sore throat a fortnight since, but that recovered in a few days. So far as the mother knows, the child has not been exposed to diphtheritic infection.

Present condition.—Child looks ill. Glands not enlarged. Throat shows no changes. Temp. 98.6° F. B. E.: membrane on all four eyelids, as well as on the intermarginal spaces and the ocular conjunctiva. Yellow discharge from the eyes. Corneæ clear.

Bacteriology.—Nothing beyond a vigorous growth of *S. pyogenes albus* on cultures incubated at the hospital. On others, however, examined by me there were in addition a few colonies of the Klebs-Löffler bacillus. These stained by Neisser, and gave a well-marked acid reaction to neutral litmus broth in twenty-four hours. Positive reaction as regards a guinea-pig.

Treatment and progress.—Antitoxin, 2500 units, injected at once. Eyes kept clean with boric acid lotion. April 27th.—Eyes better. No membrane on conjunctiva, which presents a bleeding smooth surface. Corneæ clear. May 2nd.—There is still a little discharge from the eyes, causing the lids to adhere. Arg. Nitr., 2 per cent., daily to everted lids. May 8th.—Child discharged with normal eyes. Temperature rose on a single occasion to 101° F. during stay in hospital.

SEVERE.

33. Mildred M—, æt. 1 year 8 months. First seen on October 12th, 1900. Evelina, No. 528.

The R. has been inflamed for six days and the L. for four days. It is somewhat significant that a brother or sister (notes do not state which) died from faucial diphtheria in June, 1899.

Present condition.—Obvious muco-purulent discharge from the eyes. There are small excoriations, each covered with membrane, along the edges of the lids, especially on the left side. The eyelids are red, hot, swollen, closed, and stiff. They can be everted with difficulty. There is marked chemosis, particularly of the left eye. Corneæ clear. The palpebral conjunctiva is thickened, inclined to be lardaceous, and covered with membrane, which is thin on the lower and thick on the upper lids. No changes in fauces, nose, or vulva. The child is ill in herself. Temp. 99.8° F.; pulse 120. Pre-auricular and angular glands enlarged.

Bacteriology.—In cultures on blood-serum and agar-agar were found (1) Klebs-Löffler bacilli and (2) *S. pyogenes albus*: also found in pus smears.

Result.—Patient remitted to Fever Hospital, where she remained one month. When examined soon after her return her condition was as follows:—Conjunctiva of eyelids rather red and thick. No discharge from eyes. Corneæ clear.

MILD.

34. Thomas N—, æt. 10 years. First examined on October 17th, 1900. Hackney.

The left eye has been inflamed for fourteen days. Pediculi pubis on eyelashes, eyebrows, scalp, and neck. Membranous sore on face.

Bacteriology.—In smear preparations, both from the skin and from the conjunctiva, beaded bacilli, indistinguishable from those of diphtheria, were found in small numbers. The preparations also contained cocci, staining by Gram. On blood-serum, after twenty hours in the incubator at 37.5° C., cultures were obtained of (1) Klebs-Löffler bacilli and (2) *S. pyogenes aureus*. Similar micro-organisms were got from the patch of cutaneous diphtheria.

MILD.

35. Herbert H—, æt. 2 years 4 months. First seen on February 13th, 1901. Hackney, No. 2214.

History.—Measles Christmas, 1900. The eyes were then bad, but got well. They have now been inflamed for "a few days."

Present condition.—Child ill in himself; pale. Temp. 99.8° F. No membrane in fauces or nose. R.: slight discharge with a patch of thin grey membrane on inner end of upper lid. The membrane can readily be wiped away. L.: upper lid purple and swollen. Membrane present on the intermarginal space of the upper lid. When the lids are everted, there is some membrane on the lower and much on the upper lid. The membrane is detachable, and the underlying conjunctiva is red and thick. Muco-purulent discharge.

Bacteriology.—In cultures on agar-agar and blood-serum, Klebs-Löffler bacilli, associated with some larger diplobacilli, the exact nature of which was not recognised.

MODERATE.

36. Walter W—, æt. 3 years 5 months. First seen on March 22nd, 1901. Evelina, No. 611.

Since March 17th the left eye has been "discharging fearful," and the child has been unable to open that eye, and has been poorly ever since it got bad.

Present condition.—L.: diphtheritic ulcerations along edges of lids. The palpebral conjunctiva is red, thick, and in-

flamed, with a few small patches of membrane on the lower lid. The membrane can readily be wiped away, as with cotton wool. A line of haziness crosses the cornea at the junction of the middle and lower third of the latter.

Bacteriology.—Klebs-Löffler bacilli along with streptococci.

MODERATE.

37. Robert M—, 2 years. First seen on April 12th, 1901. Evelina, No. 616.

The child developed whooping-cough about two months ago, but is now almost well. The right eye has been inflamed for two weeks. A sister, aged 10 years, contracted faucial diphtheria in September, 1900, and was returned from the Fever Hospital, whither she had been sent, on October, 1900.

Present condition.—R.: upper lid violaceous and drooping over the lower lid. There are patches of membrane on the palpebral conjunctiva of both eyelids, and also of the ocular conjunctiva, just below the cornea. The cornea is hazy, but not actually ulcerated.

Bacteriology.—On culture, the following micro-organisms were identified, viz., (1) *S. albus*, (2) streptothrix, (3) some long and thick diplobacilli, and (4) Klebs-Löffler bacilli. (Dr. D. N. Nabarro and myself.)

Treatment.—1000 units of Behring's antitoxin injected at hospital, and the patient then sent to the Fever Hospital. He was returned from the latter institution on June 4th, 1901, and when seen on June 21st his condition was as under. R.: a circular leucoma, lower third cornea, with some surrounding haziness. Faint scarring of the upper retro-tarsal fold of conjunctiva.

MILD.

38. Ernest O—, æt. 3 months. First seen April 13th, 1901. Evelina, No. 622.

The lids of both eyes puffy, and the palpebral conjunctiva coated with a grey, easily detachable membrane. Corneæ clear.

Bacteriology.—On blood-serum, after cultivation, many colonies of diphtheria bacilli, and a solitary colony of *S. pyogenes albus*. The former killed a guinea-pig in thirty-six hours.

MILD.

39. Henry M—, æt. 2½ years. First seen on May 15th, 1901. Hackney, No. 2346.

History.—Measles began three weeks ago. The left eye got bad on the 12th instant.

Present condition.—L.: upper lid is red and swollen, and overhangs the lower one. There is purulent discharge about the eyelashes. The left side of the face is swollen, and the corresponding pre-auricular gland is as big as a bean. A thick, grey, detachable membrane covers the conjunctiva of both lids.

Ocular conjunctiva is red, but free from membrane or chemosis. Cornea clear. No membrane in throat. The anterior part of the nares looks whitish, but the presence of membrane cannot certainly be proved.

Bacteriology.—Membrane-smears, when examined microscopically, show a few cocci and bacilli. The last-named are beaded, and tend to parallel grouping. They resemble Klebs-Löffler bacilli. They give a positive reaction with the Neisser stain. On blood-serum, after twenty-four hours, there were numerous colonies of diphtheria bacilli, with a single colony of *S. pyogenes aureus*. Pathogenicity of diphtheria organisms proved on guinea-pig.

Treatment.—3000 units of antitoxin injected, and child sent to the Fever Hospital.

MILD.

40. Lilian H—, æt. 5 years 9 months. First seen on September 18th, 1901. Hackney, No. 2493.

Eyes said always to have been "weak," but they have become much worse lately.

Present condition.—L.: membrane in the sulcus of the left upper lid, and also on the free margin of the lid towards its outer part. There is a nebula in the right cornea, probably old. The left pre-auricular gland is slightly enlarged. No membrane in throat. Nares macerated. Child said to be in good health.

Treatment.—Antitoxin, 4000 units, injected. Boric lotion for home use.

Bacteriology.—Klebs-Löffler bacilli, *S. pyogenes citreus*. The pathogenic nature of the former organism proved by inoculation.

MILD.

41. William John E—, æt. 1 year 6 months. First seen on October 24th, 1901. Evelina, No. 717.

The left eye stated to have been inflamed for five days.

Present condition.—L.: the lower lid is red and somewhat everted, and its anterior half is covered with a definite grey detachable membrane. No membrane is present on the inner surface of the upper lid. Symptoms are not severe. Corresponding pre-auricular gland enlarged. Pupil larger than the right one.

Bacteriology.—A serum tube was inoculated from the affected eyelid and sent to Dr. D. N. Nabarro, the Pathologist to the Hospital. His report was as follows:—"Culture grown well in three days. White raised colonies stained by Gram and by Neisser. Typical *B. diphtheriæ* (long forms). Inoculated into litmus broth; acid production, one day." This result was further confirmed by myself.

Treatment.—Antitoxin, 3000 units, injected, and child sent to Fever Hospital.

MILD.

42. Charles T—, æt. 1 year. First seen on January 1st, 1902. Hackney.

Since the eyes got red and began to discharge, now six days ago, the child has been ill.

The lids of the R. are stuck together and much swollen. There is a very definite membrane on the palpebral conjunctiva. Palpebral conjunctiva much thickened and congested; ocular conjunctiva reddened. Cornea clear. Condition of the left eye very similar to that of the right.

Bacteriological report.—After incubation for thirty hours, one serum tube contained a pure culture of a bacillus which had every characteristic of the *Bacillus diphtheriæ*, but was of a shorter form than the ordinary bacillus. These bacilli produced acid in neutral broth. The other tube had a much more scanty growth of the same organism, with two colonies of foreign (? aërial) bacteria (West-End Pathological Laboratory).

The case was treated with boric lotion and boric fomentations. On January 8th, 1902, the following note was made:—Much better; keeps both eyes open; palpebral conjunctiva still congested, but no membrane seen. On January 22nd, 1902, no trace of membrane; lids still a little swollen; both eyes wide open. On January 8th, 1902, the lids were directed to be painted daily with largin, 10 per cent.

N.B.—This case was not seen originally by me, but by Mr. Cullen, House Surgeon to the North-Eastern Hospital for Children.

MODERATE.

43. Mary Jane E—, 3 years. First seen January 24th, 1902. Evelina, No. 764.

R. inflamed for about ten days. Child brought to casualty department on the 15th January, where corrosive sublimate lotion, 1 : 5000, was ordered, but evidently the nature of the affection was not recognised. The eye has got worse since then, and the child has seemed poorly in herself.

It is to be remarked that an elder sister (see Case No. 18) developed diphtheria of the conjunctiva in October, 1898, and a brother (see Case 41) in October, 1901.

Present condition.—R. : skin of lower lid excoriated in small spots, devoid of membrane. Upper lid violaceous, and overhanging the lower. The palpebral conjunctiva of both lids is very thick and red, and a trace of membrane exists in the subtarsal sinus of the upper lid. There is also a roundish patch of membrane, which cannot be detached, in the ocular

conjunctiva, not far from the lower edge of the cornea. The cornea is so hazy as to permit the pupil to be seen only indistinctly. The cornea shows no definite infiltrations or ulcerations, and, as said above, is merely cloudy. The right preauricular and the angular glands are enlarged. The patient looks poorly in herself. Temp. 98.4° F.

Treatment.—4000 units of antitoxin injected beneath the skin of the abdomen.

Bacteriology.—Two serum tubes streaked with a wire rubbed over the membrane present on the ocular conjunctiva. Dr. D. N. Nabarro, Pathologist to the Hospital, reported as follows:—“Pure culture of the Klebs-Löffler bacillus (long variety) grown in twenty hours.”

(March 14th, 1902.)

P.S.—Since this paper was read I have met with six new cases, in all of which the diphtheria organism was demonstrated bacteriologically.—S. S.