the past two years, in spite of treatment. Six years ago the eyes were similarly affected. The present attack has lasted for a month; the child keeps indoors all day; there is marked conjunctivitis and photophobia, but no rhinorrhoea. There is no family history of tubercle, but of ten stillborn children. The eyes showed large phlyctenulae. She was treated in the usual way, and recovery was complete in a few days.

A. C. came with all the symptoms of a severe chronic catarrhal conjunctivitis, complicated by the presence of a septic ulcer on the left cornea. She gave a history of sore eyes for the previous year, but they had probably been in this condition for a longer period, as most of the cilia were missing, and some of those present were distorted. She was treated with boracic lotion, atropine, and fomentations, with the result that in three weeks the ulcer was healed and the conjunctivitis much lessened, but then some phlyctenular ulcers were seen on the outer side of the limbus of the left eye, thus showing the nature of the previous ulcer. A week later these ulcers, three in number, were markedly raised up from the surface of the conjunctiva and gave the appearance of tubercles rather than phlyctenulae. The treatment as indicated for this condition was continued. A week later these ulcers and swelling had resolved, but several miliary phlyctenular ulcers were now seen on the inner side of the cornea of the same eye. The treatment was persevered with, and the whole condition of the eyes vastly improved. A month later the refraction was examined under atropine, when compound hypermetropic astigmatism was found. Glasses were ordered, and up to the present her eyes have kept very free from inflammation.

L. J. came to hospital last year complaining of sore eyes of some considerable duration; she had intense photophobia and lacrymation; the blepharospasm was so marked that it was with great difficulty that I was able to inspect the cornea, even with retractors, and a nurse to hold the child. There was marked injection of the palpebral and ocular conjunctiva, and an ulcer on each cornea; she was treated without effect by ordinary measures for three weeks as an out-patient, then for the next month she became an in-patient, where the treatment, combined with cleanliness, fresh air, and good food, had a most beneficial effect in reducing the conjunctivitis and the accompanying photophobia and lacrymation; the corneal ulcer healed also. Then she was discharged, wearing dark glasses, owing to there still being some photophobia. Three weeks later she returned with the symptoms almost as marked, as in the first instance, and also a large granulating ulcer on the left cornea. Again out-patient treatment for nearly three weeks made very slight improvement, so she was admitted, but even then the condition resisted obstinately all our remedies, both local and general; she was given cod-liver oil, syrup of phosphate of iron, syrup of iodide of iron, and virol, alternately with no benefit; locally, atropine, both in solution and in ointment, was applied, hot and cold bathing, dionine by itself and in combination with the previous drug, but all to no purpose; finally, adrenalin solution was applied by itself; this turned the scale, and in a fortnight the eyes improved considerably, so that after two months' sojourn in the hospital it was possible to send her to a convalescent home; now she has very little photophobia, no lacrymation, in fact is almost well, but is still using dionine for the corneal nebulae.

Ophthalmia Neonatorum.

This is a purulent type of conjunctivitis found in the newborn, in which the conjunctiva shows a marked papillary development, and in which there is seldom any signs of scarring on recovery. The cause of this complaint in the great majority of instances is that micrococcus described by Nisser in 1879, and known as the *Diplococcus gonorrhoeae*; it is easily stained with methylene blue, and is decolorized by Gram's method. This micrococcus is unique in being able to penetrate intact epithelium, hence the importance of early and careful treatment. The other micro-organisms concerned are the pneumococci, streptococci, *Bacterium coli*, and others. The usual mode of infection is that during the birth of the child some vaginal secretion gets into the palpebral sacs, but definite cases of ante partum infection have been reported at times, and recently by Sidney Stephenson and Rosa Ford⁵ and by G. D. Robinson,⁶ in some of which apparently the infection took place through intact membranes.

The symptoms commence on the second or third day, rarely on the fourth; the lids become swollen, and may be markedly oedematous, there is inflammation of both palpebral and scleral conjunctiva, usually some chemosis, but not, as a rule, marked; there is free purulent discharge. On examining a case one usually notices the swollen lids glued together by a yellowish dried discharge adhering to them; on separating them a quantity of the discharge wells up from the palpebral sacs, the cornea is clear at first, but in untreated cases it is soon attacked. The treatment consists in the main in cleansing the palpebral sacs, and keeping them free from collections of the discharge. A useful lotion to use is 1 in 5,000

mercury perchloride, but it must be noted that one does not depend on the antiseptic properties of the lotion so much as on the mechanical effect of continually irrigating the eyes; this should be done every hour, or two at the least; then every day one performs savonnage with 2 per cent. silver nitrate. In this complaint prophylaxis is of the utmost importance. The majority of pregnant women have a vaginal catarrh, so antiseptic injections, immediately before parturition form the first step, then after the child is born the closed lids are wiped with a clean rag, and then after its first bath the eyes are carefully cleansed with boracic lotion, and then a drop of 2 per cent. silver nitrate solution is dropped on to each eye; this is the method advocated by Credé, who reduced the percentage of cases in Leipsig Lying-in Asylum from 10.8 to 0.1 or 0.2.

N. F., aged 14 days, was brought to hospital on account of a cold in her eyes, which did not get well. There was free purulent discharge; the lids were not much swollen; both palpebral and ocular conjunctiva were markedly injected. In the right eye the cornea was clear, but in the left there was a large central ulcer on the cornea, which had perforated, and the eye was already lost, being in a condition of panophthalmitis. The eyes were treated as indicated above, and now the conjunctivitis has quite resolved. The right eye is quite clear and well, but the left eye, although the conjunctivitis has resolved, is in a state of phthisis bulbi and is rapidly shrinking, there being very little sign of the cornea left.

REFERENCES.

¹ Parsons, *The Pathology of the Eye*, vol. i. ² Darier, *Leçons de thérapeutique oculaire*, second edition. ³ Leber, Wintersteiner, *Bericht der ophthalmologische Gesellschaft zu Heidelberg*, 1901. ⁴ V. Michel, *Zeitschrift für Augenheilkunde*, iv, 1900. ⁵ Sidney Stephenson and Rosa Ford, *Ophthalmoscope*, April, 1906. ⁶ G. D. Robinson, *Ophthalmoscope*, June, 1907.

A CRITICAL STUDY OF ORGANIC PREPARATIONS OF SILVER IN THE TREATMENT OF CONJUNCTIVITIS.

By JOHN MUIR KELLY, M.D. GLASG.,

CLINICAL ASSISTANT, GLASGOW EYE INFIRMARY.

(From Dr. Fergus's Clinic and the Pathological Laboratory of the Glasgow Eye Infirmary.)

SINCE the introduction of argyrol and protargol there has been among clinical observers a great difference of opinion regarding their efficacy in diseases of the conjunctiva. Many have described them as being superior to silver nitrate; but others, like Dr. Pooley of New York, have regarded them as "bland, harmless, and inefficient."¹

During the past year a series of experiments have been performed with these preparations and with silver nitrate to ascertain their relative bactericidal powers. One realizes that in a laboratory it is impossible to reproduce exactly the conditions found in Nature; but as the same methods were used with each substance the results have at least a comparative value. The organism used was *Staphylococcus pyogenes aureus*, because it was easy to identify and because it gave results that were remarkable for their consistency. A small number of experiments were performed with the *Streptococcus pyogenes brevis*, the pneumococcus, and the gonococcus, but the results obtained were not nearly so consistent as those obtained with the *Staphylococcus pyogenes aureus*.

Quantities of argyrol and protargol were bought from a wholesale chemist and were submitted to a gravimetric analysis. The percentage of silver was ascertained by incinerating the substance, heating with nitric acid, dissolving in water, and then precipitating the silver with hydrochloric acid and weighing the precipitate. As a result of two estimations with each preparation, it was found that argyrol contained 17.01 per cent., and protargol 7.03 per cent. of silver. These figures are to be compared with 68.6 per cent. of silver present in silver nitrate. The manufacturers state that these preparations deteriorate when kept long in solution. We had noticed that bottles in which the solutions had been kept for some weeks gradually acquired a coating of silver oxide. To avoid any errors from faulty solution or from deterioration the solutions were carefully made according to the methods described by the manufacturers, were kept in dark glass bottles, and were always used before the third day.

An emulsion was made of a three days' growth on agar-agar of *Staphylococcus pyogenes aureus*, and was then filtered

through a plug of glass wool placed in a sterilized filter funnel. One half c.c.m. of this emulsion was added to 9½ c.c.m. of solution of such strength that the 10 c.c.m. solution was of the required dilution. The solution was then shaken up to ensure thorough contact with the organisms, and at intervals of five, ten, and twenty minutes two loopfuls were taken and smeared over the surface of agar-agar slants. These were put into an incubator at a temperature of 37.5° C., and were examined every twenty-four hours for ten days. Control experiments were made with an equal volume of distilled water, and a growth was always obtained on the first day.

SILVER NITRATE.

As a result of fifty experiments it was found that a 0.0039 per cent. solution killed the organism in five minutes, and a 0.0019 per cent. solution killed it in ten minutes, but a 0.0009 per cent. solution did not kill the organism even after a twenty minutes' exposure.

TABLE I.—*Experiments with Silver Nitrate. Solutions of various strengths were used. When no growth was seen the tube was incubated until the tenth day.*

Number of Experiments.	Strength of Solution.	Duration of Exposure.	Result.
1	Per cent. 0.125	5 min.	No growth.
1	—	10 min.	No growth.
1	—	20 min.	No growth.
2	0.0625	10 min.	No growth.
2	—	20 min.	No growth.
1	0.0312	10 min.	No growth.
2	—	20 min.	No growth.
1	0.0156	5 min.	No growth.
1	—	10 min.	No growth.
1	—	20 min.	No growth.
1	—	20 min.	Few small colonies on 2nd day.
3	0.0078	5 min.	No growth.
3	—	10 min.	No growth.
2	—	20 min.	No growth.
1	—	20 min.	A few colonies on 3rd day.
4	0.0039	5 min.	No growth.
3	—	10 min.	No growth.
1	—	10 min.	A few colonies on 2nd day.
4	—	20 min.	No growth.
2	0.0019	5 min.	Growth on 1st day.
1	—	5 min.	A few colonies on 2nd day.
3	—	10 min.	No growth.
3	—	20 min.	No growth.
3	0.0009	10 min.	Growth on 1st day.
3	—	20 min.	Growth on 1st day.

PROTARGOL.

Forty-nine experiments were performed, when it was found that a 1 per cent. solution killed the organism in five minutes, and a 0.5 per cent. solution in ten minutes, but a 0.25 per cent. solution even after a twenty minutes' exposure did not prevent a growth appearing on the first day.

ARGYROL.

After the organisms had been exposed to 50 per cent. solutions for one, two, three, and twelve hours, a growth was obtained on the first day, but after a twenty-four hours' exposure no growth was present even on the tenth day. Thus, a 50 per cent. solution required about twenty-four hours to kill the organism.

TABLE II.—*Experiments with Protargol in Percentage Solutions of Various Strengths.*

Number of Experiments.	Strength of Solution.	Duration of Exposure.	Result.
1	Per cent. 1.000	5 min.	No growth.
1	—	10 min.	No growth.
1	—	20 min.	No growth.
1	5.000	5 min.	No growth.
1	—	10 min.	No growth.
1	—	20 min.	No growth.
1	2.500	5 min.	No growth.
1	—	10 min.	No growth.
1	—	20 min.	No growth.
3	1.000	5 min.	No growth.
1	—	5 min.	A few colonies seen on 1st day.
3	—	10 min.	No growth.
3	—	20 min.	No growth.
4	0.500	5 min.	Growth on 1st day.
3	—	10 min.	No growth.
1	—	10 min.	Few colonies on 2nd day.
4	—	20 min.	No growth.
3	0.250	5 min.	Growth on 1st day.
2	—	10 min.	Growth on 1st day.
1	—	10 min.	Growth on 2nd day.
3	—	20 min.	Growth on 1st day, but colonies few.
3	0.125	5 min.	Growth on 1st day.
3	0.125	10 min.	Growth on 1st day.
3	0.125	20 min.	Growth on 1st day.

TABLE III.—*Experiments with Argyrol in a 50 per cent. Solution.*

Number of Experiments.	Duration of Exposure.	Result.
1	1 hour	Abundant growth on 1st day.
1	2 hours	Growth on 1st day.
1	3 hours	Growth on 1st day.
2	12 hours	Growth on 1st day, but fewer colonies.
3	24 hours	No growth.
2	48 hours	No growth.

PREVIOUS EXPERIMENTS.

The bactericidal powers of these preparations have recently been investigated by Drs. Marshall and Neave,² and by Dr. Derby.³ They also experimented with the *Staphylococcus pyogenes aureus*, but their methods differed. Drs. Marshall and Neave used the ordinary thread method and inoculated broth, whilst Dr. Derby mixed two loopfuls of growth in two cubic centimetres of the solution under examination, inoculated blood serum, and after twenty-four hours caused the water of condensation to again flow over the solid media. From the published records of their investigations we give below the strengths of the solutions and the durations of the exposures necessary to kill the organism.

Silver Nitrate.

0.0015 per cent. for 5 min.
0.0011 per cent. for 10 min. (Marshall and Neave).
0.5 to 2 per cent. for 2 to 5 min. (Derby).
0.0039 per cent. for 5 min. } Present investigations.
0.0019 per cent. for 10 min. }

Protargol.

0.025 per cent. for 10 min. (Marshall and Neave).
2 to 4 per cent. for 3 to 5 min. (Derby).
1 per cent. for 5 min. } Present investigations.
0.5 per cent. for 10 min. }

Argyrol.

50 per cent. for 24 hours (Marshall and Neave. Present investigations).

These results vary according to the methods employed, but they conclusively show that as a bactericidal agent silver nitrate is very strong and is superior to protargol, whilst argyrol has only very faint bactericidal properties.

ACTION ON INTRACELLULAR ORGANISMS.

In conjunctival infections the germs such as the Koch-Weeks' bacillus and the gonococcus are often intracellular and more or less deeply embedded in the tissues, consequently the bactericidal agent will not be efficient unless it has power to penetrate the tissues.

Accordingly an attempt was made to compare the combined diffusible and bactericidal properties of protargol and silver nitrate.

After immersing a one day's growth in a 0.5 per cent. solution of silver nitrate for ten minutes all the organisms were killed, but when a ten days' growth was exposed to a 1.5 per cent. solution for the same time a growth was obtained on the first day, so that the solution had not penetrated the growth deeply enough to come into contact with all the cocci. We are aware that the action of the silver salts on the cocci in an agar-agar growth is very different from that on germs in living tissue, but the results obtained in the following series of experiments are so marked as to warrant some deductions being based on them. From a culture on agar-agar a large number of tubes were inoculated, and when the growths were three days old the tubes were filled with solutions of protargol and silver nitrate. After certain periods the solutions were poured off, and a flow of sterilized water was run over the growths, from the thickness of which agar-agar slants were inoculated. Altogether over 70 experiments were performed, with the following results:

Silver Nitrate.

A 0.5 per cent. solution killed the organism in thirty minutes, a 0.75 per cent. solution killed them in twenty minutes, and a 1 per cent. solution required ten minutes to kill them.

Protargol.

A 5 per cent. solution and a 10 per cent. solution failed to kill the organisms in 30 minutes, but a 20 per cent. solution killed them in that time. A 30 per cent. solution killed them in 20 minutes.

Since the cocci were killed in twenty minutes by a 0.75 per cent. solution of silver nitrate and by a 30 per cent. solution of protargol, it would seem that in combined penetrating and bactericidal powers silver nitrate is about forty times stronger than protargol, but in the former series of experiments, where the antiseptic fluid came as much as possible in contact with the cocci, these were killed in ten minutes by a 0.5 per cent. solution of protargol, so that the bactericidal power alone of silver nitrate is 263 times that of protargol. We may thus conclude that protargol has greater powers of diffusion, but these do not sufficiently compensate for the superior bactericidal powers of silver nitrate.

In regard to argyrol, as it had previously been found to be almost inert a culture was immersed in a 50 per cent. solution for twenty-four hours and from it a growth was obtained on the first day. On several occasions the culture was immersed for forty-eight, seventy-two, and ninety-six hours, but no subculture could be obtained.

STAINING OF THE TISSUES.

It has long been recognized that one disadvantage of using silver nitrate is its tendency to stain the cornea and conjunctiva. Stephenson⁵ has reported a case where the scleral conjunctiva had become stained by using for several years, for darkening the eyelashes, a preparation which contained nitrate of silver. It was claimed for the organic preparations of silver that they did not stain the conjunctiva, but since they have been extensively used several cases of argyrosis have been reported. We have seen a slight staining of the conjunctiva in a boy who had been using drops of a 15 per cent. solution of protargol for about three weeks. De Schweinitz⁶ reports a case of

TABLE IV.—Experiments with Silver Nitrate Solutions and Growth of *Staphylococcus Pyogenes Aureus*.

Number of Experiments.	Strength of Solution.	Age of Growth.	Duration of Exposure.	Result.
1	Per cent. 0.0312	3 days	30 min.	Growth on 1st day.
1	0.0625	3 days	20 min.	Growth on 1st day.
1	0.125	3 days	20 min.	Growth on 1st day.
1	0.25	3 days	20 min.	Growth on 1st day.
2	0.5	1 day	10 min.	No growth.
3	—	3 days	10 min.	Growth on 1st day.
2	—	3 days	20 min.	Growth, but few colonies.
1	—	3 days	20 min.	No growth.
3	—	3 days	30 min.	No growth.
2	0.75	3 days	10 min.	Growth on 1st day.
1	—	3 days	10 min.	Growth on 2nd day.
1	—	3 days	10 min.	No growth.
3	—	3 days	20 min.	No growth.
1	—	3 days	20 min.	Few colonies on 3rd day.
4	—	3 days	30 min.	No growth.
4	1.0	3 days	10 min.	No growth.
2	1.0	3 days	10 min.	No growth.
2	—	3 days	20 min.	No growth.
2	1.5	3 days	20 min.	No growth.
2	—	—	30 min.	No growth.
1	1.0	6 days	10 min.	Growth seen on 1st day.
1	1.5	10 days	10 min.	Growth seen on 1st day.

TABLE V.—Experiments with Solutions of Protargol and Growth of *Staphylococcus Pyogenes Aureus*.

Number of Experiments.	Strength of Solution.	Age of Growth.	Duration of Exposure.	Result.
2	Per cent. 5	3 days	10 min.	Abundant growth.
2	—	3 days	20 min.	Abundant growth.
2	—	3 days	30 min.	Abundant growth.
1	7.5	3 days	10 min.	Abundant growth.
1	—	3 days	20 min.	Abundant growth.
1	—	3 days	30 min.	Abundant growth.
2	10	3 days	10 min.	Abundant growth.
2	—	3 days	20 min.	Growth less abundant
2	—	3 days	30 min.	Growth less abundant
3	20	3 days	20 min.	No growth.
1	—	6 days	60 min.	No growth.
1	—	6 days	60 min.	Moderate growth.
1	—	6 days	90 min.	Few colonies seen on 1st day.
3	30	3 days	20 min.	No growth.
1	—	3 days	30 min.	No growth.

dacryocystitis which had been treated with protargol. The lacrimal sac was excised, and on sections being made these were found to be stained with protargol. We have not seen staining of the conjunctiva by argyrol, but the most marked case of argyrosis we have ever observed was due to this drug. A woman, aged 45, had been suffering from dacryocystitis for a considerable time. A lacrimal probe was passed, and apparently a false passage was made, because on injecting a 20 per cent. solution of argyrol into the sac the solution was scattered through the adjacent tissues. Now, after a period of two years, there is very marked argyrosis extending from $\frac{1}{2}$ in. to 1 in. along the left lower eyelid.

PAIN ACCOMPANYING USE.

It is usually stated that protargol is less painful than silver nitrate, and if solutions containing the same percentage of the compound be used the statement is true. Protargol, however, is used in 5 to 20 per cent. solution, and silver nitrate in 0.5 to 2 per cent. solutions, and probably a 0.5 per cent. solution of silver nitrate is of the same therapeutic value as a 20 per cent. solution of protargol. We have tried these two solutions, and have found that they cause about the same amount of pain. In our own eyes the discomfort caused by the silver nitrate continued for twenty-five minutes, and that caused by the protargol for thirty-five minutes.

Argyrol in a 20 per cent. solution is quite bland and even soothing to the irritated eye. Stevens,⁷ however, has reported a case in which severe pain throughout the distribution of the fifth nerve followed each application of a 20 per cent. solution of argyrol.

Four different freshly prepared solutions were tried with the same result. We had not met with such an idiosyncrasy.

LOTIONS.

In the treatment of conjunctivitis a large number of lotions containing antiseptic or astringent drugs have been employed, either alone or as adjuvants to the treatment with silver nitrate and its preparations. Thus alum, zinc sulphate, boric acid, carbolic acid, permanganate of potash, chinolol, corrosive sublimate, and tannic acid have all had their periods of enthusiastic advocacy by ophthalmologists. The great variety of therapeutic agents used suggests that no one of them has much superiority over the others, and that the benefit derived from their use is due not to the drug but to the vehicle in which it is contained, and is obtained through the mechanical removal of organisms and inflammatory products rather than through any bactericidal action.

A large series of experiments was performed with twenty-four-hour growths on agar-agar of *Staphylococcus pyogenes aureus*. The tubes were filled with various solutions for measured periods, and then the solutions were poured off. A gentle stream of sterilized water was then run over the growth, from which agar-agar tubes were inoculated, and incubated for ten days at a temperature of 37.5° C.

The following results were obtained:

Carbolic acid in a 1 in 20 solution killed the *aureus* in twenty minutes, but not in a 1 in 40 solution.

Corrosive sublimate in a 1 in 500 solution killed the *aureus* in twenty minutes, but not in a 1 in 1,000 solution.

Alum, and zinc sulphate in a saturated solution did not kill the *aureus* in twenty minutes.

Chinolol did not kill the *aureus* in a 1 in 5 solution after twenty minutes.

Potassium permanganate in a 1 in 400 solution killed the *aureus* in twenty minutes, but not in a 1 in 800 solution.

The lotions most generally employed in the dispensary of the Glasgow Eye Infirmary are boracic acid lotion, tannic acid lotion, belladonna lotion, and MacKenzie's lotion.

Tubes containing twenty-four hours' growth of *Staphylococcus pyogenes aureus* on agar-agar were filled with these lotions and allowed to remain for twenty-four hours. The only lotion which killed the organisms even after that prolonged exposure was MacKenzie's lotion; the other lotions seemed to have very little effect on the organisms, as a subculture was easily obtained on the first day. Thus MacKenzie's lotion, which is essentially a 1 in 4,000 solution of corrosive sublimate, has greater bactericidal powers than a 50 per cent. solution of argyrol.

As the boracic acid, tannic acid, and belladonna lotions are ordered to be diluted before use, their bactericidal properties must then be only infinitesimal. The feeling of relief which follows their use must be due to the mechanical removal of accumulated discharges, which continually irritate the eye, rather than to any destruction or inhibition of the growth of the pathogenic organisms.

KOCH-WEEKS CONJUNCTIVITIS.

The influence of instillations of argyrol and protargol on the course of conjunctivitis due to the Koch-Weeks bacillus is shown by the results obtained in a series of 40 cases where both eyes were affected. In 20 cases a 5 per cent. solution of protargol was dropped into the right

eye night and morning, and in the other half of the cases a 20 per cent. solution of argyrol was used in a similar fashion.

The conjunctival sacs of the left eyes were more or less thoroughly washed out. Thus twenty patients were told to use boracic acid lotion four times a day, ten were given normal saline solution as a lotion, and in the remaining ten cases the conjunctival sacs were irrigated daily with about two pints of normal saline solution. Film preparations of the conjunctival discharge were examined periodically, and it was found that the duration of the attack as measured from the onset of the symptoms until no Koch-Weeks bacilli could be discovered varied from ten to thirty days, the average being fifteen days. In each group of cases the duration of the attack was practically the same, so that the form of treatment applied did not affect it. When protargol was used it irritated the eye, especially in children, and no compensatory advantage could be discovered. One case is worthy of remark.

A girl, aged 5, was brought to the dispensary suffering from acute conjunctivitis in the right eye of four days' duration. The discharge was profuse, and the conjunctiva was very hyperaemic but no swelling of the eyelids was observed. The mother was given boracic acid lotion, and a 5 per cent. solution of protargol to be dropped into the eye night and morning. She instilled the drops for two days, and on the third day she returned with the child, whose eyelids were markedly swollen and oedematous. A film preparation of the discharge was made and compared with the film made three days previously, when it was seen that the Koch-Weeks bacilli had actually increased. Sydney Stephenson⁸ has shown that if the conjunctiva be brushed with a 2 per cent. solution of silver nitrate, and the discharge be examined twelve hours afterwards the bacilli will be less numerous; but if the discharge be examined twenty-four hours afterwards they will be found in much greater numbers. The preparations of silver nitrate which possess strong bactericidal powers injure the conjunctiva as well as destroy the bacilli, consequently the bacilli which have escaped coming into contact with the silver salt meet with less resistance from the conjunctiva, and have greater opportunities of entering its tissues.

After using argyrol the discharge diminished more rapidly than in the eyes which were simply bathed, the patients experienced a greater degree of comfort, and in young children the blepharospasm ceased first in the eye treated with argyrol. The following case illustrates its action:

December 5th, 1906. Mrs. B. consulted me about her baby, aged 10 months, who was suffering from acute conjunctivitis of five days' duration. The discharge was purulent and very profuse, the conjunctivae were very much injected, and the eyelids were slightly swollen. The eyes were equally affected. In the tenement in which the patient lived most of the children had had sore eyes. Bacteriological examination revealed the presence of the Koch-Weeks bacilli. Treatment commenced. A 20 per cent. solution of argyrol was dropped into the right eye night and morning. The left eye was irrigated with 2 pints of normal saline solution twice daily.

December 12th, 1906. The eyes are almost alike. The discharge is less, the conjunctivae are less injected, and the bacilli are less numerous.

December 15th. In the right eye the discharge is less than in the left one, and is more fibrinous in character. The patient opens this eye more readily. The discharge is less in the left eye than on previous date. Bacteriological examination shows that the bacilli are now comparatively few, but equally numerous in both eyes.

December 18th. Discharges ceased in both eyes; no bacilli can be found.

We conclude that in conjunctivitis due to the Koch-Weeks bacilli the duration of the disease is not shortened

TABLE VI.—Cases of Koch-Weeks Conjunctivitis Treated with Various Therapeutic Agents.

	Eyes.	Agent.	Average Duration.
First twenty cases	Right	Protargol 5 per cent.	15.5 days.
	Left	Boracic acid lotion	16 days.
Second twenty cases	Right	Argyrol 20 per cent.	14 days.
	Left, 10	Normal saline lotion	15 days.
	Left, 10	Normal saline irrigation	13 days.

by the mode of treatment; that protargol, on account of its irritating properties, often does more harm than good; whilst argyrol, being bland and mildly astringent, is beneficial, in so far as it lessens the patient's discomfort, and that all the treatment necessary for this form of conjunctivitis is keeping the conjunctival sac as clean as possible by washing it out frequently with normal saline solution.

MORAX-AXENFELDT CONJUNCTIVITIS.

In the treatment of conjunctivitis due to the Morax-Axenfeldt diplobacilli, protargol and argyrol proved to be quite inefficacious. Argyrol in a 20 per cent. solution was dropped into the eyes twice daily in 10 cases, and in each case the treatment was continued for about a month without any noticeable improvement.

Protargol in a 10 per cent. solution was used in a similar

fashion also in 10 cases, but after three to four weeks' treatment the organisms were still present in the conjunctival sac.

A series of 35 cases were treated with solutions of zinc sulphate dropped into the eyes night and morning.

When solutions were employed in the strength of 1 grain to the ounce the diplobacilli could be found in the conjunctival sac for about six weeks.

Ten cases were treated with solutions of the strength of 4 grains to the ounce. After the first week of treatment the patients generally felt their eyes more comfortable, and after the third week the bacilli could not be detected in the smears taken from the conjunctival sac. (The details of this series of cases are shown in Table VII.)

In the remaining 15 cases solutions of the strength of 8 grains to the ounce were used, when it was observed that the average duration of the presence of the organisms was

TABLE VII.

No.	Patient.	Eye.	Time of Disease.	Symptoms.	Diplobacilli.	No Diplobacilli on—
1	Man aged 22	Right Left	One week Two weeks	Slight Slight	Few Few	24th day. 23rd day.
2	Man aged 44	Right Left	About 3 months About 3 months	Very slight Very slight	Few Few	20th day. 20th day.
3	Man aged 28	Right Left	6 weeks 7 or 8 weeks	Slight Slight	Many Many	21st day. 24th day.
4	Girl aged 14	Right Left	5 days 10 days	Severe Severe	Very many Very many	19th day. 19th day.
5	Boy aged 12	Right Left	3 weeks 2 weeks	Severe Slight	Very many Many	18th day. 18th day.
6	Woman aged 23	Right Left	4 weeks 4 weeks	Slight Slight	Many Many	20th day. 17th day.
7	Man aged 30	Right Left	5 weeks 5 or 6 weeks	Moderate Slight	Few Few	23rd day. 19th day.
8	Girl aged 13	Right Left	12 days 12 days	Very severe Very severe	Many Many	16th day. 18th day.
9	Girl aged 10	Right Left	10 days 8 days	Slight Slight	Few Few	15th day. 16th day.
10	Boy aged 12	Right Left	12 days 12 days	Moderate Moderate	Many Many	21st day. 21st day.

TABLE VIII.

No.	Patient.	Eye.	Time of Disease.	Symptoms.	Diplobacilli.	No Diplobacilli on—
1	Woman aged 35	Right Left	5 days 5 days	Severe Less severe	Many Many	8th day. 10th day.
2	Man aged 22	Right Left	1 month 3 weeks	Slight Slight	Few Few	10th day. 10th day.
3	Boy aged 13	Right Left	2 weeks 3 weeks	Moderate Slight	Many Many	14th day. 11th day.
4	Girl aged 6½	Right Left	2 weeks 2 weeks	Severe small ulcer Severe	Very many Many	15th day. 12th day.
5	Man aged 20	Right Left	6 months 6 months	Slight Slight	Many Many	14th day. 16th day.
6	Woman aged 30	Right Left	1 week 1 week	Moderate Moderate	Many Many	16th day. 16th day.
7	Man aged 30	Right Left	3 weeks 2 weeks	Severe Severe	Many Many	16th day. 13th day.
8	Man aged 22	Right Left	7 days 10 days	Slight Slight	Few Few	14th day. 14th day.
9	Man aged 26	Right Left	2 weeks 3 weeks	Slight Slight	Few Few	19th day. 19th day.
10	Man aged 56	Right Left	5 months 5 months	Moderate Moderate	Few Few	17th day. 15th day.
11	Boy aged 12	Right Left	1 week 2 weeks	Severe Severe	Many Many	10th day. 12th day.
12	Boy aged 10	Right Left	12 days 14 days	Severe Moderate	Very many Many	12th day. 14th day.
13	Boy aged 16	Right Left	4 days 7 days	Slight Slight	Few Few	10th day. 10th day.
14	Woman aged 32	Right Left	3 weeks 2 weeks	Moderate Moderate	Many Many	12th day. 12th day.
15	Girl aged 15	Right Left	10 days 10 days	Severe Severe	Many Many	13th day. 13th day.

only 135 days. The pain caused by a solution of this strength is not excessive, and only in one or two instances did patients complain of it.

Further details of this series of cases are given in Table VIII.

In the examination of many of the films numerous cocci could be seen after the diplobacilli had disappeared, so that zinc sulphate seems to have a specific action on the Morax-Axenfeldt diplobacillus.

While these observations were being made we received a small quantity of a new preparation called "pizin," which is a sulphanilide of zinc. Five cases of "Morax-Axenfeldt conjunctivitis" were treated with a 6 grains to the ounce solution, but after continuing the treatment for a month the bacilli could still be seen in the smears. We conclude that protargol and argyrol are not beneficial in this condition, but that zinc sulphate quickly cures the disease, and that the most brilliant results are obtained with an 8 grains to the ounce solution.

Butler,⁹ in describing his experience with this disease in Jerusalem says, "I do not think that in Palestine a weaker solution of zinc sulphate than 1 per cent. is of much use, and I have used 2 per cent. with great advantage."

A woman, aged 48, consulted Dr. Fergus at his clinic in December, 1906. She had subacute conjunctivitis in both eyes, of about four weeks' duration. Her doctor had treated her with protargol used as drops night and morning. Her condition became more troublesome, and when she came to the Eye Infirmary her conjunctivae were deeply injected, and somewhat swollen. A bacteriological examination was made, and the Morax-Axenfeldt bacillus was found in great abundance. The protargol was stopped, and a solution of zinc sulphate ordered instead. In about three weeks her eyes had recovered.

As a case of acute conjunctivitis due to the Morax-Axenfeldt bacillus cannot be diagnosed clinically from a case due to the Koch-Weeks bacillus a bacteriological examination is necessary. The above case shows the necessity of making such an examination before beginning treatment.

One cannot but agree with the opinion expressed by Dr. Fergus¹⁰ that in an ophthalmic clinic an oil immersion lens is just as necessary a part of the apparatus for diagnosis as is the ophthalmoscope.

GONORRHOEAL OPHTHALMIA.

We have not had a sufficient number of cases of conjunctivitis due to the gonococcus to allow of a thorough investigation of the therapeutic value of the organic preparations of silver. In some of the recent textbooks of surgery we are informed that the proper treatment for a fresh attack of urethral gonorrhoea is to cause an abundant diuresis by giving plenty of bland fluids and so wash out the urethra frequently, and, further, that no local treatment is necessary.¹¹

We treated gonococcal infections of the conjunctival sac on the same principles. The mothers were given normal saline solution as a lotion, and were told to bathe the eyes every half-hour. Then twice daily we irrigated the conjunctival sac with 2 pints of normal saline solution. In 5 cases we had under treatment irrigation was performed in the right eyes, and bathing with normal saline lotion and instillations twice daily with 20 per cent. solutions of argyrol were used for the left eye. In all of the cases both eyes were equally affected.

When irrigation was done only once a day both eyes made the same progress, but when the irrigation was performed morning and evening the irrigated eye recovered more rapidly. In performing irrigation we used a siphon tube of soft rubber with a glass nozzle. When the water had a fall of 2 ft. the cases did not seem to do so well, possibly because the force of the water opened up the inflamed tissues, and so facilitated the entrance of organisms. The best results were obtained when the water had a fall of 1 ft. only, and that pressure of water was quite enough to permit of the thorough cleansing of the conjunctival sac.

Our experience thus leads us to think that gonorrhoeal ophthalmia in infants would be best treated by irrigating the conjunctival sac every two or three hours with 2 pints of normal saline solution at a pressure of 1 ft. of water.

STAPHYLOCOCCIC AND STREPTOCOCCIC CONJUNCTIVITIS.

Conjunctivitis due to the *Staphylococcus pyogenes albus* and *aureus*, and to the *Streptococcus brevis* and *longus* is not

a very common condition. Poulard saw only 9 cases in two and a half years,¹² and Inglis Pollock in an examination of 362 found only 8 due to the staphylococci.¹³

We have had only 4 cases, and these were treated by irrigation in one eye, and by instillations of a 20 per cent. solution of argyrol in the other. The irrigated eyes improved more rapidly than did those treated with argyrol. The following case is worthy of note:

A girl, aged 5½, had acute conjunctivitis in both eyes of three days' duration. The bulbar and palpebral conjunctiva was swollen and injected. The eyelids were oedematous. In the smear numerous groups of staphylococci were found. Irrigation with normal saline solution was done every morning, and the mother was told to bathe the eyes every hour with (normal saline) lotion. After the treatment had been continued for seven days the discharge had disappeared, and an agar-agar tube was inoculated from the conjunctival sac with a negative result.

The eyes treated with argyrol were three or four days later in becoming cured of the condition, but the argyrol lessened the discomfort and blepharospasm.

I have pleasure in acknowledging my great indebtedness to Dr. Fergus, who gave me every possible facility for making full use of the large amount of material at his clinic. I have also to thank Dr. Inglis Pollock for the liberty of working in the Pathological Laboratory of the Glasgow Eye Infirmary.

REFERENCES.

- ¹ *Trans. Am. Ophth. Soc.*, vol. ii, part i, p. 51. ² Marshall and Neave, *BRITISH MEDICAL JOURNAL*, August, 1906, p. 359. ³ Derby, *Trans. Am. Ophth. Soc.*, vol. ii, part i, p. 21. ⁴ Bishop Harman, *The Conjunctiva in Health and Disease*, p. 107. ⁵ Stephenson, *Contagious Ophthalmia*, p. 61. ⁶ De Schweinitz, *Trans. Am. Ophth. Soc.*, 1906. ⁷ Stevens, *Ophth. Record*, July, 1906, p. 354. ⁸ Stephenson, *Lancet*, June 6th, 1897. ⁹ Butler, *The Royal London Ophth. Hosp. Reports*, vol. xvii, part i, March, 1907, p. 115. ¹⁰ Fergus, *Edinburgh Medical Journal*, February, 1906, p. 106. ¹¹ Rose and Carless, *Manual of Surgery*, 6th edition, p. 131. ¹² Poulard, *Archives d'Ophthalmologie*, October, 1905. ¹³ Inglis Pollock, *The Bacteriology of Conjunctivitis*, p. 3.

AN INVESTIGATION

INTO THE

FREQUENCY AND SIGNIFICANCE OF OPTIC NEURITIS AND OTHER VASCULAR CHANGES IN THE RETINAE OF PATIENTS SUFFERING FROM PURULENT DISEASE OF THE MIDDLE EAR.*

WITH THE RESULTS OF THE EXAMINATION OF THE EYES AND EARS IN 100 CONSECUTIVE CASES.

BY

J. STODDART BARR, and JOHN ROWAN,

M.B., CH.B.,

M.B., F.F.P.S.G.,

ASSISTANT SURGEON, GLASGOW HOSPITAL FOR DISEASES OF THE EAR, NOSE, AND THROAT; EXTRA-DISPENSARY SURGEON, GLASGOW WESTERN INFIRMARY, ETC. OPHTHALMIC SURGEON, GLASGOW ROYAL INFIRMARY; OPHTHALMIC SURGEON, GLASGOW HOSPITAL FOR DISEASES OF THE EAR, NOSE, AND THROAT, ETC.

In entering upon this investigation, our objects were to determine (1) whether the condition known as optic neuritis occurs with any frequency in cases of simple purulent otitis media, where there is no evidence of intracranial or vascular complication; (2) whether, short of an actual optic neuritis, vascular changes in the fundus of the eye of a less marked character are common in such cases.

Already Politzer and Barker have referred to the occasional occurrence of optic neuritis in simple purulent ear disease, and Tenzer and Espenschied have recently reported on its frequency in cases of otitic intracranial complications, and also mention that vascular changes of a minor character sometimes occur in uncomplicated cases, passing away, however, with the cessation of the active aural mischief. No systematic examination, however, seems hitherto to have been made to determine the frequency of these changes.

The 100 cases, which were all cases of purulent otitis media, mostly of the chronic variety, were taken consecutively without selection, the examination of the eyes either immediately preceding or following that of the ears.

* Read before the Glasgow Medico-Chirurgical Society, October 18th, 1907.