A CRITICAL STUDY OF

ORGANIC PREPARATIONS OF SILVER

in the treatment of

CONJUNCTIVITIS

Being a thesis for the Degree

of M.D.

by

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A Critical Study of Organic Preparations of Silver in the treatment of conjunctivitis

(From Dr Fergus' 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."

During the past year a series of experiments has been performed with these preparations, and with silver nitrate, to ascertain their relative bactericidal powers. One realises 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 % and protargol 7.03 % of silver. These figures are to be compared with 66.6% 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 sterilised plug of glass wool placed in a sterilised filter funnel. One half cubic centimetre of this emulsion was added to nine and a half cubic centimetres of solution of such strength that the ten cubic centimetres was of the required dilution. The solution was then shaken up for twenty minutes 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°.cent., and were examined every twentyfour 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% solution killed the organism in five minutes and a 0.0019% solution killed it in ten minutes but a 0.000$\frac{9}{75}$% solution did not kill the organism even after a twenty minutes exposure.

Table 1.

Experiments with silver nitrate; solutions of various strengths were used. When no growth was seen the tube was incubated until the 10th day.

Number of. Experiments	Strength of Solution	Duration of Exposure	Result.
1.	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.

Number of Experiments	Strength of Solution	Duration of Exposure	Result.
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	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

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

Table 2.

Experiments with Protargol in percentage solutions of various strengths.

Number of Experiments	Strength of Solution	Duration of Exposure	Result.
1.	10%	5 min.	no growth
1.		10 min	no growth
1.		20 min	no growth.
1.	5%	.5 min	no growth.
1.		10 min	no growth.
1.		20 min	no growth.
1.	2.5%	5 min	no growth
1.		10 min	no growth
1.		20 min.	no growth.
3.	.1%	5 min	no growth
1.		5 min	a few colonies seen on 1st day.
3.		10 min	no growth
3.		20 min	no growth.

Table 2. (Cont)

Number of Experiments	Strength of Solution	Duration of Exposure	Result.
4.	0.5%	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.	0.25%	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 ist 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.

Argyrol.

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

Table 3.

Experiments with Argyrol in a fifty 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.

The bactericidal powers of these preparations have recently been investigated by[2] Drs Marshall and Neave, and by[3] Dr Derby. 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 & Neave

0.5 - 2 per cent for 2-5 min — Derby

0.0039 per cent for 5 min
0.0019 per cent for 10 min — present investigations

Protargol.

0.025 per cent for 10 min - Marshall & Neave

2-4 per cent for 3-5 - Derby.

1 per cent for 5 min

0.5 per cent for 10 min Present Investigations.

Argyrol. per cent for 24 hours - Marshall & Neave

- Present Investigations.

These results vary accordingly 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. In conjunctival infections the germs such as the Koch-Weeks bacillus and the Gonococcus are often intra-cellular 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% solution of silver nitrate for ten minutes all the organisms were killed, but when a ten day's growth was exposed to a 1.5% 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 sterilised water was run over the growths from the thickness of which agar-agar slants were inoculated. Altogether over seventy experiments were performed with the following results:-

Silver Nitrate.

A 0.5 per cent solution killed the organisms 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.

Table 4.

Experiments with Silver Nitrate solutions and growths of Staphylococcus pyogenes aureus.

Number of Experiments	Strength of Solution	Age of Growth	Duration of Exposure	Result.
1.	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.
2.	0.25 %	3 days	20 min	growth on 1st day.
2.	0.5 %	1 day	20 min	no growth.
3.		3 days	10 min	growth on 1st day.
2.		3days	20 min	growth but few colon ies.
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 coloni es on 3rd day.
4		3 days	30 min	no growth.
4	1%	3 days	10 min	no growth.

Table 4. (Cont.)

Number of Experiments	Strength of Solution	Age of Growth	Duration of Exposure	Result
2	1%	3 days	10 min	no growth
2.		3 days	30 min	no growth
2.	1.5%	3 days	20 min	no growth
2.		.	30 min	no growth
1	1%	6 days	10 min	growth seen on 1st day.
1	1.5%	10 days	10 min	growth seen on 1st day.

Protargol.

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

Table 5.

Experiments with solutions of Protargol and growths of Staphylococcus pyogenes aureus.

Number of Experiments	Strength of Solution	Age of Growth	Duration of Exposure	Result.
2.	5%	3 days	10 min	Abundant growth.
2.		3days	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	90min	few colonies seen on 1st day.
3.	30%	3 days	20 min	no growth.
1.		3 days	30 min	no growth.

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 48, 72, and 96 hours, but no sub-culture could be obtained.

Staining of the Tissues

It has long been recognised that one disadvantage of using silver nitrate is its tendency to stain the cornea and conjunctiva. [5] Stephenson 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% solution of protargol for about three weeks. [6] De Schweinitz reports a case of dacryo-cystitis which had been treated with protargol. The lachymal 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 dacryo-cystitis for a considerable time. A lacrymal probe was passed, and apparently a false passage was made because on injecting a twenty 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 half an inch to an inch along the left lower eyelid.

The pain accompanying their use.

It is usually stated that protargol is less painful than silver nitrate, and if solutions containing the same per centage of the compound be used the statement is true. Protargol, however is used in 5-20% solution, and silver nitrate in 0·5-2% solutions, and probably a 0.5. per cent solution of silver nitrate is of the same therapeutic value as a 20% 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 twenty per cent solution is quite bland, and even soothing to the irritated eye. Stevens, however, has reported a case in which severe pain throughout the distribution of the fifth nerve followed each application of a twenty per cent solution of argyrol.

Four different freshly prepared solutions were tried with the same result.

We had not met with such an idiosyncracy

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, Chinosol, Corrosive Sublimate, and Tannic acid have each 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 sterilised 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 1000 solution.
Alum, and Zinc Sulphate in a saturated solution did not kill the aureus in 20 minutes.
Chinosol did not kill the aureus even 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 hour's 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 sub-culture was easily obtained on the first day.

Thus MacKenzie's lotion which is essentially a 1 in 4000 solution of Corrosive Sublimate has greater bactericidal powers than a fifty 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 installations 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 forty cases where both eyes were affected. In twenty cases a five per cent solution of protargol was dropped into the right eye night and morning and in the other half of the cases a twenty per cent solution of argyrol was used in a similar fashion.

The left eyes had their conjunctival sacs 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 five, 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 five 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 pf 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. [8] Sydney Stephenson has shown that if the conjunctiva be brushed with a two 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.

5th Dec., 1906. Mrs B. consulted me about her baby, aged 10 months, who was suffering from Acute Conjunctivitis of five day's 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% solution of Argyrol was dropped into the right eye night and morning The left eye was irrigated with two pints of normal saline solution twice daily.

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

15th Dec , 1906. In the right eye the discharge is less than in 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.

18th Dec., 1906.

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 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.

Table 6.

Cases of Koch-Weeks conjunctivitis treated with various therapeutic agents.

	Eyes	Agent	Average Duration.
First twenty cases.	Right	Protargol 5%	15.5 days.
	Left	Boracic acid lotion	16 days.
Second twenty cases.	Right	Argyrol 20%	14 days.
	Left. 10.	Normal Saline Lotion	15 days.
	Left. 10.	Normal Saline irrigation	13 days.

'Morax - Axenfeldt Conjunctivitis

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

Protargol in a 10% solution was used in a similar fashion also in ten cases, but after three to four week's treatment the organisms were still present in the conjunctival sac.

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

When solutions were employed in the strength of one grain to the ounce the diplo-bacilli could be found in the conjunctival sac for about six weeks.

Ten cases were treated with solutions of the strength of four 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 6.

Table 6.

Patient	Eye	Time of Disease	Symptoms	No Diplobacilli	Diplobacilli on.
1. Man aged 22.	Right	one week	slight	few	24th day
	Left	.two weeks	.slight	few	23rd day.
2. Man aged 44.	.Right	About 3 months	very slight	few	20th day.
	Left.	About 3 months.	very slight	few.	20th day.
3. Man aged 28.	Right	6 weeks	slight	many.	21st day.
	Left	. 7 or 8 weeks.	.slight	many.	24th day.
4. Girl aged 14.	Right	. 5 days.	severe	very many	19th day.
	Left	10 days.	.severe	very many	19th day.
5.Boy aged 12.	.Right	. 3 weeks.	severe	very many	18th day.
	Left	2 weeks	slight .	many	18th day.
6.Woman aged 23	.Right	4 weeks	slight	many	20th day.
	Left	4 weeks	slight	many	17th day.
7. Man Aged 30.	Right	5 weeks.	moderate	few.	23rd day
	Left	.5 or.6 weeks.	slight.	.few	19th day.
8. Girl aged 13.	Right	12 days.	very severe	many	16th day.
	Left	12 days	very severe	many	18th day.
9. Girl aged 10.	Right	10 days	slight	few	13th day.
	Left	8 days.	slight	few	15th day.
0. Boy aged 12.	Right	12 days	moderate.	many	18th day.
	Left	12 days	moderate	many	21st day.

In the remaining fifteen cases solutions of the strength of eight grains to the ounce were used. when it was observed that the average duration of the presence of the organisms was only 13.5 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 7.

Table 7.

Patient	Eye	Time of Disease	Symptoms	Diplobacilli.	No Diplobacilli on.
1. Woman aged 35.	Right.	5 days.	Severe	many	8th day.
	Left	5 days	less severe	many	10th day.
2. Man aged 22.	Right.	1 month	Slight.	few	10th day.
	Left.	3 weeks.	slight	few	10th day.
3. Boy aged 13.	Right	2 weeks.	moderate.	many	14th day.
	Left	3 weeks	slight	many	11th day.
4. Girl aged 6½.	Right	2 weeks	severe. small ulcer.	very many.	15th day
	Left	2 weeks	severe.	many	12th day.
5. Man aged 20.	Right	6 months	slight	many	14th day.
	Left.	6 months	slight	many	16th day.

Table 7. (Cont).

atient.	Eye.	Time of Disease.	Symptoms.	Diplo-bacilli.	no. Diplo-bacilli on.
Woman aged 30.	Right.	1 week.	moderate	many	16th day.
	.Left	1 week	moderate	many	16th day.
Man aged 30.	Right	3 weeks	severe	many	16th day.
	Left	2 weeks	severe	many	13th day.
Man aged 22.	Right	7 days	slight	few	14th day.
	.Left	10 days	slight	few	14th day.
Man aged 26.	Right	2 weeks.	slight	few	19th day
	Left	3 weeks	slight	few	19th day.
.Man aged 56.					
	Right	5 months	moderate	few	17th day.
	Left	5 months	moderate	few	15th day.
Boy aged 12.	Right	1 week	severe	many	10th day.
	Left	2 weeks	severe	many	12th day.
2. Boy aged 10.	Right	12 days.	severe	very many	12th day.
	Left	14 days	moderate	many	11th day.
3. Boy aged 16.	Right	4 days	slight	few.	10th day.
	Left	7 days	slight	few.	10th day.

Table 7. (Cont).

Patient.	Eye	Time of Disease	Symptoms	Diplobacilli.	no Diplobacilli on.
14. Woman aged 32.	Right.	3 weeks	moderate	many	12th day.
	.Left	2 weeks	moderate	many	12th day.
15. Girl aged 15.	Right	10 days	severe	many	13th day
	.Left	10 days	severe	many	13 days.

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

While these observations were being made we received a small quantity of a new preparation called 'NIZIN' which is a Sulphanilide of Zinc. Five cases of 'Morax-Axenfeldt conjunctivitis' were treated with a 6 grain 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 eight grain to the ounce solution.

Butler 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."[9.]

A woman aged 48 consulted Dr Fergus at his clinic in December 1906. She had sub-acute conjunctivitis in both eyes of about four week's 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.[10.]
One cannot but agree with the opinion expressed by Dr Fergus that in an ophthalmic clinic an oil immersion LENS is just as necessary a part of the apparatus for diagnosis as is the ophthalmoscope.[11.]

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. ~~nitrate~~. In some of the recent text-books 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.[12].

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 five cases we had under treatment irrigation was performed in the right eyes, and bathing with normal saline lotion and instillations twice daily with 20% 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 two feet 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 one foot 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 two pints of normal saline solution at a pressure of one foot 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 nine cases in two and a half years,[14] ----------

and Inglis Pollock in an examination of 362 cases found only 8 due to the staphylococci.[13]

We have had only four cases and these were treated by irrigation in one eye and by instillations of a twenty 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.

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.

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