to the left as he could and again measured by the light reflex on its cornea the position of the glass eye. As the artificial eye follows as well as it can the rotations of the natural eye, I believe these measurements thus obtained represent the extreme limits of motion the artificial eye was capable of in every case. The results of my tests are given in the following instructive table:

PERIMETRIC MEASUREMENTS OF THE LATERAL MOVEMENTS OF ARTIFICIAL EYES.

PATIENT'S AGE.	STUMP.	WHEN OPERATION WAS PERFORMED.	DEGREES OF ROTATION.	
			INWARD.	OUTWARD.
L. S., 45	Enucleation . .	10 years ago.	15	25
F. S., 21	Evisceration . .	3 months ago.	20	20
A. C., 21	Enucleation . .	1 year ago.	15	15
Mrs. M., 36	Evisceration . .	4 months ago.	15	25
Mrs. E., 50	Enucleation . .	5½ months ago.	20	25
G. L., 24	Enucleation . .	1 month ago.	20	20
M. J., 42	Atrophic Eye . .	20 years ago.	10	15
L. H., 22	Enucleation . .	6 weeks ago.	15	20
Mrs. L., 20	Atrophic Eye . .	10 years ago.	15	30

These measurements show there is absolutely no difference in the extent of the lateral movements of the glass eye, worn on an evisceration stump, and that worn on an enucleation stump; in either case the inward movements (adduction) varied between 15 and 20 degrees and the outward movements (abduction) between 15 and 25 degrees. These results were not surprising to me; for though I have heard so much about the larger, better stumps gained by evisceration I have found these stumps shrink away so much that three months after the operations there is no more of them left than what we find after a suppuration of the globe, and that it is difficult to tell by the stump whether enucleation or evisceration has been performed. This observation I have made not only in my own cases but also in eyes which had been eviscerated by other surgeons.

But even granting a larger permanent stump to the evisceration, I still maintain the artificial eye does not gain any material advantage by it. The largest and best movable stumps, superior to any furnished by evisceration, undoubtedly are those slightly atrophic eyeballs with well preserved vitreous, but complete loss of the cornea and iris (as the result of sloughing or surgical operation). Glass eyes can be worn over such atrophic globes, but they do not show any superior mobility. In my table there are two such cases; and we see that the one shows an unusually limited movement; and the other (the last in the list) shows no better adduction (15 degrees) than we get by enucleation or evisceration cases and exceeds their best abduction by 5 degrees only. These atrophic eyeballs had an excellent range of lateral rotation; and if the artificial eye could be cemented onto the atropic globe it would, of course, follow the rotations of the latter, and the cosmetic effect would be perfect, because the artificial cornea would describe lateral rotations as perfectly as the natural cornea. But as the artificial eye is not fastened to the stump, the latter does not impart its motions to the super-imposed glass shell and the axis of rotation of the glass eye lies much in front of the stump. When, therefore, the glass eye seems to turn to the right or left, its cornea shows very little real lateral movement, its principal motion being a rotation on its vertical axis so that its center faces to the right or left. On this account the movements of an artificial eye will always be confined to narrow limits, whether the glass shell be inserted after enucleation or evisceration.

If I sum up all the clinical facts, I should say evisceration has nothing to show in its favor, while it compares decidedly unfavorably with enucleation in the frequent violent reaction and slow recovery, and therefore does not deserve to take the place of enucleation.

PANOPHTHALMITIS—FATAL MENINGITIS FOLLOWING ENUCLEATION OF THE EYE.

Read in the Section on Ophthalmology at the Forty-fourth Annual Meeting of the American Medical Association.

BY S. D. RISLEY, M.D.

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John M., age 47, but appearing at least 67, presented himself at the Wills Eye Hospital Dec. 12, 1892, bearing a letter from his physician, Dr. D. T. Lainé of Media, Penn., under whose care he has been for a severe attack of iritis in the left eye. The disease proving rebellious, he was advised to seek hospital treatment. He was in feeble health, suffering from severe pain in the eyeball and with violent left hemi-crania; vision was reduced to quantitative perception of light. There was deep ciliary injection, small pupil, slight haze of the cornea and the remnant of a blood clot was still lying in the lower angle of the anterior chamber. There were numerous posterior synechia and dilated blood vessels could be seen coursing over the surface of the iris. Tension was normal but the anterior chamber shallow. He was placed in bed, blood extracted from the left temple and calomel and soda purge given, eserine being instilled locally. He experienced very prompt relief and one week later vision was somewhat improved, the blood clot absorbed, and the ciliary injection less marked but no view of the fundus could be obtained. There was simply a gray-red reflex from the pupil. When seen two days later, there was a fresh red blood clot lying in the pupil and on the upper and inner pupillary rim of the iris and a large blood vessel could be seen entering it from which the blood was apparently issuing. As yet there was no pain, but the hemorrhage was soon followed by decided increase of tension and the ball became tender to pressure and with it his headache returned. He lost appetite, became sleepless and the general health rapidly declined. Under a careful regimen, however, the health improved, the blood clot once more absorbed and the eye became quiet but showed a tendency to frequent recurrences of increased tension and ciliary redness. During one of the intervals of freedom from acute symptoms a broad iridectomy was made upward. The iris was found friable; the operation was smooth and successful, but bleeding was profuse and the eye was bandaged with the anterior chamber filled with blood. There was no undue reaction and the blood clot slowly absorbed, but the wound refused to heal. In ten days there was a pouting black mass lying in the wound, but slightly elevated above the corneal limbus, and occupying the entire line of incision. The operation was done under antiseptic precaution and the eye was subsequently kept bandaged, being thoroughly washed with bichlorid solution at each dressing and dusted with iodoform. There were no visible signs of suppuration but his health steadily failed, his hands were hot and there was a hectic flush on his cheeks, but only slight if any rise in his temperature. The eyeball was soft; there was no dread of light and no pain or headache. He was greatly depressed in spirits, felt that he was going to die and begged to be allowed to return to his home. The eye was then enucleated on Jan. 25, 1893, and found filled with pus. The nerve was severed well back, the orbit thoroughly drenched with bichlorid of mercury solution, well dusted with iodoform and bandaged for twelve hours. He made a rapid and favorable recovery without suppuration of the stump. The infiltration of the tissues of the orbit absorbed rather more slowly than usual but his health rapidly improved so that on the fourteenth day, February 7, he was discharged from the hospital apparently well, certainly with no symptoms to awaken apprehension regarding his future. One week later, February 15, twenty-one days after the excision of the eyeball, he sent for his physician, Dr. Lainé, but in his absence

was seen by Dr. J. H. Fronfield, to whom I am indebted for the following history: He complained only of weakness and disgust for food, the temperature was normal and throughout the subsequent history, remained either normal or sub-normal; although taken twice daily at no time was there any rise. There was at this time some suppurative of the stump, he was anemic, the tongue pale, large, flabby and indented. He was not considered seriously ill. Calomel and soda were prescribed to move the bowels and he received an elixir of iron, quinin and strychnia as a tonic.

February 18, 10 A.M. Bowels have been freely moved but can not take the tonic. Urine free from albumen. 7 P.M. Decidedly weaker; very melancholy; is sure he will die. No pain in the eye; pupil reacts promptly.

February 19. In bed; very drowsy; is aroused with much difficulty; rapid pulse; reflexes are normal. The right eye shows no muscular deviation; there is no ptosis or dread of light. There is no increased suppurative of the stump and no swelling of the orbital tissues; respiration very irregular, at times normal and then extremely rapid, subsiding once more to normal. No tenderness of the spine; hearing good; no pain and no vomiting. Obstinate constipation.

February 20. Only partially aroused and that with great difficulty and lapses immediately into unconsciousness. The head is drawn backward. From this time he remained in a state of profound coma with irregular breathing and the backward traction of the head developed into marked tonic opisthotonos, the man resting upon his heels and head until the 26th when he died.

No autopsy could be secured. At my request Drs. G. C. Ellet and W. R. Parker, resident surgeons at the Wills Eye Hospital, made for me a careful examination of the excised ball, and I append their report: "In the region of the corneal wound the epithelium has proliferated considerably and the superficial layers of the cornea are thickly infiltrated with round cells. There is no union of the lips of the wound, the space between them being occupied by iris tissue covered with organizing inflammatory products. The iris is pushed forward, adherent to the cornea by heavy organizing bands in the neighborhood of the wound, the anterior chamber being reduced to a slit. The portion of the iris which is not prolapsed is covered with a layer of lymph and pus, and where the pupillary space is visible it is filled with a heavy membrane continuous with that in the iris. This is continued backward on the under surface of the iris, filling the posterior chamber, and passing with a mass of pus which fills the vitreous chamber. The ciliary body seems but little affected, but the retina and choroid are thickly infiltrated with pus as far anteriorly as they can be identified. The inner layers of the sclerotic are also attacked. Further back, the retina is lost from the specimen. Toward the posterior part of the eye the choroid is represented by a thick layer of pus thrown into folds, and stellate pigment cells scattered through it serving to identify it as choroid, none of the vascular structures being visible. The optic nerve is in a state of inflammation, the round celled infiltration being pronounced as far back as the specimen shows. A few lymph corpuscles are present in the nerve. There are no changes in its vessels."

Dr. Fronfield's careful report leaves no room for question but that this man's fatal illness was due to cerebro-spinal meningitis. The consideration of great interest to the ophthalmic surgeon is its possible relation to his suppurative panophthalmitis and the enucleation of the eyeball. The exact character of the intracranial lesion must, in the absence of an autopsy, remain in doubt.

Two possible explanations are at hand: first, that the meningitis was a mere coincidence, having no relation to the ocular conditions; the other, that the

fatal meningitis was infectious and that it was set up by germs conveyed through the cut tissues and open vessels in the orbit to the membranes and venous sinuses of the brain. It would be a comforting view of the case could we feel assured that the first proposition was a correct solution of the unfortunate sequel.

The very close relation that exists between the eyeball and the intracranial mass would lead us to anticipate serious danger to life from its excision. Such expectation would moreover be greatly strengthened by the frequency with which we observe ocular disease as secondary to disease of the brain and its membranes. But however frequently we may witness ocular disturbances as secondary to intracranial inflammations, experience shows that the reverse is extremely rare, except in the case of malignant disease. Furthermore it has been shown by ample experience that excision of the eyeball is fraught with but little danger to the patient. That it is not entirely devoid of danger to life, however, is evidenced in the fact that there have been forty-six reported cases of meningitis, forty-two of which proved fatal. Four of these, all fatal, should possibly be excluded as having been subject to malignant disease.

These cases have been again and again tabulated and reviewed, so that it is not necessary for me to go over this well-known field again, except to add to the number already known. Individual cases were collected by Nettleship to the number of thirty-four in 1886, (*Transactions Ophthalmological Society United Kingdom 1886*) including a case occurring in his own hands at the Moorfields Hospital, and which he made the basis of an admirable review of the subject. In the discussion which followed, McHardy reported two cases of fatal meningitis following the removal of the eyeball, and a third where the meningitis and death followed suppurative panophthalmitis, the ball having been freely opened but not removed. Dr. Joseph A. Andrews, in the *New York Medical Journal*, Dec. 29, 1888, has again tabulated the cases, omitting the four non-fatal cases of Nettleship and adding others finding thirty six fatal cases. My own case here reported, Mr. McHardy's two cases and three others occurring in the practice of my colleagues in Philadelphia but not heretofore reported make a total of forty-six cases of meningitis following enucleation.

H. D. Noyes, M. D., has again briefly reviewed the subject in the *Transactions American Ophthalmological Society for 1888-89*, with the intention of studying the dangers attending excision in suppurative panophthalmitis. He there collects 3,742 enucleations at the various clinics with but one death, and suggests that the deaths which have occurred are probably about one for 4,000 enucleations. There have, however, been 1,131 enucleations at the Wills Hospital in Philadelphia in twenty years, eighty-five of which are recorded as for suppurative panophthalmitis, and one death here reported. Three of my colleagues report each one case of fatal meningitis as having occurred in their practice there during the years mentioned, but no details of them could be found on the hospital records by the House Surgeon, Dr. Parker who kindly went over the books for me. This would make a total of 4,873 enucleations and five deaths if these three cases and my own are included. On the other hand, there has been no case of meningitis at the large clinical service at the

University Hospital since it was established. In any case it is plain from these figures that the operation for excision of the eyeball is more free from danger than one would expect, having in view its critical anatomical relations.

The fear which is entertained regarding the danger from the excision of suppurating balls, moreover, does not seem to find support by reviewing the testimony furnished by the reported cases, since only half of the cases, where the point is mentioned were suppurating eyes. This statement, it is true, loses some of its force by the fact that the teaching of von Graefe as to the danger to be apprehended from excising suppurating eyes has doubtless had a restraining influence over the practice of surgeons in such cases. The fact that the excised eye had been opened, either by accident, operation or inflammation, as pointed out by Nettleship, seems to be of more significance than the presence of visible pus, for in a large majority of all the cases where the history is sufficiently complete to determine the point, the eyes had at some time been opened.

In the study of my own case here reported, in the light of the published experiences one finds much confusing testimony. In the first place the length of time which intervened between the excision and the onset of the meningitis favors the view which would regard the meningitis as a coincidence. The longest time heretofore reported is eight days while in mine it was twenty-one days. The rapid recovery, without orbital inflammation, together with his great improvement in general health immediately after the operation all seem to point strongly against any causal relationship between the enucleation and the meningitis.

A very important inquiry at this point is as to the possible secondary nature of the eye disease. In reviewing the man's history it now seems possible, if not probable, that his severe headache and impaired health may have been due to a low grade of meningitis, and that I was at fault in regarding the head symptoms as entirely due to his severe eye disease. Although I did not suspect any cerebral complication, nevertheless the treatment directed for his relief viz.:—local blood letting, the calomel and soda purge, potas. iod. et. bromid, and later mercurial inunctions were well devised to relieve a meningitis had they been directed with that purpose in view. Certainly they afforded him prompt relief from his very severe pain both in head and eye.

The absence of orbital symptoms at the onset of the meningitic symptoms affords but little comfort, since in only four of the cases as far as I can find was there any inflammation or irritation of the orbital tissues present, while in many more it is distinctly stated that no connection could be traced. The inflammation of the optic nerve and its sheaths is noted in four cases, three of which are the same as noted with orbital inflammation. The report of Drs. Ellet and Parker shows that in my case also the optic nerve was in a state of active inflammation as far back as the specimen extended. Whether this process had invaded the eye from within the cranium or had invaded the brain from the eye must forever remain in doubt. I am free to say that I incline to the first, for the reason besides those already stated that the symptoms which ushered in the fatal illness were the same as those I had observed in the hospital before the excision.

It must be remembered, however, on the other hand that all the conditions were here present which have in these cases seemed to favor the production of this disease. There was the inflamed and suppurating ball, and more than all a ball which had been recently opened, a condition, as has already been pointed out, which was present in nearly all of the reported cases where it was mentioned at all.

INTRA-OCULAR INJECTIONS OF SOLUTIONS OF VARIOUS ANTISEPTIC SUBSTANCES; AN EXPERIMENTAL INQUIRY.

Read before the Section on Ophthalmology, at the Forty-fourth Annual Meeting of the American Medical Association.

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A number of researches have been published concerning the effect of the introduction of various substances, solid and liquid, into the vitreous chamber. These may be summarized as follows:

1. The introduction into the vitreous of foreign bodies (pieces of wire, lead, glass, etc.), or of irritating liquids (croton oil, tincture of iodine, etc.); 2, the injection of sterilized blood into the vitreous humor; 3, intra-ocular injections of various antiseptic liquids.¹

Researches belonging to the first class, from the time of the publication of Pagenstecher's essay on the pathology of the vitreous² to Leber's superb work,³ are chiefly concerned with the behavior of the vitreous towards these foreign substances, and with the complex problems which surround the pathology of inflammation. Researches of the second class, which date from the imperfect experiments of Legros,⁴ to the thorough investigation of the subject of blood injections into the vitreous by Pröbsting,⁵ have been undertaken to study the deportment of the retina under these circumstances, and to add to our knowledge of the mechanism of retinal detachment and the production of proliferating retinitis. Researches of the third class have been conducted chiefly to test the therapeutic value of the injection of antiseptic fluids directly into the vitreous of an inflamed eye; for example, one suffering from hyalitis, or from sympathetic ophthalmitis, or to try their efficacy in preventing an inflammation of this character after the eye has been exposed to the influences likely to produce it.

Abadie,⁶ in 1890, suggested the propriety of injecting 2 drops of a solution of sublimate, 1 to 1000, into a wounded eye which has caused sympathetic ophthalmitis of the other eye, which should also be treated with a similar injection directly into the vitreous humor. According to him, these injections were of use in checking and ameliorating the inflammatory process. Subsequently he published⁷ three

¹ Experiments to determine the effects of injections into the anterior chamber, for example those performed by Nuel (*Revue Générale d'Ophthalmologie*, T. viii, 1889, p. 343) do not belong to the present classification. As Dr. Berry pointed out, injections into the anterior chamber and into the vitreous can scarcely be compared.

² *Archives of Ophthalmology*, Vol. I, p. 500.

³ *Die Entstehung der Entzündung und die Wirkung der Entzündungsregenden Schädlichkeiten*. Leipzig, 1891, p. 177 et seq.

⁴ *Journal de la Anatomie et de la Physiologie*, 1873.

⁵ *Archiv f. Ophthalmologie*, Bd. xxxviii, Abt. III, 1892, p. 114.

⁶ *Pathogénie et nouveau Traitement de l'Ophthalmie Sympathétique*. *Annales d'Oculistique*, Vol. ciii, 1890, p. 183.

⁷ *Nouveaux cas d'Ophthalmie Sympathique, Guéri par les Injections intra-oculaires de Sublimé*. *Annales d'Oculistique*, Vol. civ, 1890, p. 229.