Sympathetic Ophthalmitis after Preventive Enucleation.

[illegible] Macpherson [illegible], M.A., M.B

December 1903

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

Abbreviations &c.

S.O. = sympathetic ophthalmitis or ophthalmia or inflammation

S.I. = sympathetic irritation

O.R. = Ophthalmic Review (new series)

T.O.S. = Transactions of the Ophthalmological Society of the United Kingdom.

The Abbreviations noted in the Official List of the Ophthalm. Soc.

Any other contractions or abbreviations are obvious, and in current use throughout Ophthalmic Literature.

Introductory.

At the next International Congress of Ophthalmology to be held at Lucerne in September 1904, it is proposed to open a special discussion — "To settle the question of indemnity as regards the value of an eye, lost or injured," a discussion, which, necessarily, will involve the question of sympathetic ophthalmitis. Having met in our private practice a case of this disease occurring after the preventive enucleation of an injured eyeball, a thesis based on such an eventuality seemed timely, practical, and full of interest from the medico-legal point of view.

For the purposes of this Thesis, S.O. may be defined as visible organic changes in the uveal tract of a sound eye as the result of injury to the first eye, that injury being of the nature of wound, rupture, or perforation of the coats of the eyeball, as a rule

involving the ciliary region. Dealing thus with traumatic cases alone, so-called idiopathic disorders of one eye giving rise to S.O. - a class of observations open to many doubts and objections - are left out of account. At the same time, all forms of mere sympathetic irritation or neurosis are excluded, and the many debateable forms of S.O., which have been advanced as true forms of sympathetic inflammation, do not come within such a definition, as, e.g.

Sympathetic conjunctivitis described by Webster, Brailey
" keratitis " " Rheindorf
" iridokeratitis " " Seggenbecher
" cataract " " Canuset
" glaucoma " " Abadie
" papillitis " " Dransart
" optic atrophy " " Knapp.

It is difficult to arrive at a proper estimate of the frequency of S.O., but, considering

how often the supposed conditions likely to cause it are met with, the disease is undoubtedly of rare occurrence. Ohlemann[a] only saw 2 cases out of 566 injuries likely to give rise to it, and Foster[b] only 2 cases out of 600 such injuries.

During 1902 there were at the

Manchester Eye Hospital	24,478 patients	& 4 cases of	S.O.
Birmingham "	24,561 "	" 8 "	" "
Bradford "	6,256 "	" 3 "	" "
Moorfields "	32,442 "	" 8 "	" "
St Thomas' Hospital	4,124 "	" 2 "	" "
Glasgow Eye Infirmary	22,596 "	" 8 "	" "

These figures only give a general idea as to its occurrence, and no reliable deductions can be drawn from them.

Many observers declare that S.O. is on the decrease. Percy Dunn[c] says that S.O. has gradually become more and more infrequent, until it might be described as an ocular pathological curiosity. This result he would,

(a) Archiv. für augenheilk. Wiesbaden August 1890
(b) Journ. Americ. med. Assoc. 1/1/98 (c) Lancet II/97 p. 1575

no doubt, ascribe to the newly introduced antiseptic, which he is recommending. Collins[a] notes a marked decrease in the number of cases of S.O. at the Royal London Ophthalmic Hospital during the past 15 years. Snell[b] Randolph[c], and others are of the same opinion. Panas[d] and Lagueux[d] likewise agree that S.O. is less frequent, and attribute the fact to the use of antiseptics; Panas believing in their direct action as the infecting agency, whilst Lagueux gives them credit for more rapid cicatrisation, and so preventing entry of septic agencies.

Our knowledge of S.O. is derived from three sources:

(1) Pathological examination
(2) Experiments on animals
(3) Clinical observation.

Complete pathological examinations (i.e. of both eyes, nerves, and intracranial connections) are rare, as S.O. is not a disease fatal to life. Such complete examinations have been recorded amongst others by Deutschmann, Zimmerman, Schirmer,

(a) Encyclop. Medica 1902 (b) Ophth. Review XVI p. 196
(c) Norris and Oliver. Vol III (d) Annales d'Oculistique 1896

Gruner, Welt, Asayama, but their value is problematical, the lesions found are variable, and in some of the cases the result of the examination is vitiated by the fact of general systemic infection having preceded death.

Experimental evidence, too, is not only contradictory but valueless.

Any advance, then, in our knowledge of S.O. must rest at present on a fuller study of the clinical facts, so that the rarity of the disease enhances the value of each case carefully reported and studied. This thesis deals with a special class of a rare disease, with many special features and characteristics of their own, and the occurrence of S.O. after a preventive enucleation deserves, in view of the large number of cases on record, a more prominent place in Ophthalmology than has usually been assigned to it. Further, the systematic study of recorded cases of this

special class, as here undertaken, will assist in settling some of the difficulties, that may arise, in compensation and other claims for lost injured eyes.

The history of S.O. is more or less a record of individual opinions and theories, and, before any attempt can be made to discuss such a subject, it is essential to have some idea of the views advanced on the nature of the disease. Hence, we prface our clinical studies with a brief historical outline of the speculations and facts recorded concerning S.O. in general.

Historical

This part of our Thesis comprises Six Sections

I Up to and including Mackenzie

II The Ciliary Nerve Theory
1858 - 1878

III The Optic Nerve Theory
1877 - 1882

IV The "Ophthalmia Migratoria" of Deutschmann

V Reaction against the Migration Theory:-
1. The Combined Theory
2. Revival of the pure Nervous Theory

VI Other Modern Theories:-
1. The Theory of Metastasis
2. The Theory of the Toxins
3. The Tubercular Theory of Peters

Careful research in the Hippocratic writings, the works of Galen, Celsus, and old medical authors has failed to

find any reference to Sympathetic Ophthalmitis, and it was not until the beginning of the nineteenth century that this affection began to be noted as a distinct morbid entity. That S.O. frequently occurred, there can be no doubt, especially when we consider the prevalence of conditions likely to give rise to it viz. the absence of antiseptics, the crude instrumentation, and the frequent performance of such operations as couching. The old writers when dealing with ophthalmic phenomena spoke of the "Consensus oculorum", and this term having for them, no doubt, a pathological as well as a physiological significance, would explain phenomena so similar in their localisation, symptoms, and progress as those seen in typical S.O. Previous to Mackenzie, there are cases of undoubted S.O. described in medical literature

Thus, Thomas Bartholinus[1] (latter part of the 17th century), Bidloo[1] (1649-1713), and Le Dran[2] (1737), who speaks of the "inflammation communicating itself to the good eye along the length of the optic nerve", and from whom Deutschmann took his view of the path of transmission, all report cases of the transference of traumatic inflammation from one eye to the other. On the other hand, many French and English treatises on diseases and injuries of the eye, which appeared in the 18th century, make no allusion to this complication of an ocular injury.

Beer[3] describes the symptoms of sympathetic irritation as heightened irritability, and asthenopia. He ascribes the occurrence of S.O. to a cerebral commotion. Demours[4] gives in detail three cases of S.O., dwells on the gravity

(1) Quoted in Laqueur's Thesis 1869 (2) "Traité ... sur les plaies ..." 1737
(3) Lehre von den Augenkrank. Wien 1813 (4) Traité des maladies des Yeux 1818

of the disease, but advances nothing towards its pathology beyond the "liaison sympathique". That S.O. was now beginning to attract the attention of surgeons is evident, for Wardrop (5) in 1818 suggests the suppurative destruction of the injured eyeball, as practised at that time by veterinary surgeons for a similar affection in horses. Wardrop remarked that S.O. did not arise in Suppurative panophthalmitis. In the London Medical Gazette. Oct^r. 28^th 1837. Crampton gives an account of seven cases in Barton's (Manchester) clinique of S.O. when an eye has been injured, and a portion of percussion cap lodges in the eye. He removes the foreign body by corneal incision and poultices, and obtains good results. The symptoms are given as dull yellow colour of sclerotic, change of colour of iris, adhesion of iris to lens capsule, irregular small pupil filled with dots, and

(5) Anatomy of the Human Eye. Vol. II Chap. II

he draws attention to the gravity of the affection. Mackenzie[6] in 1835 writes "he sometimes meet with severe sympathetic inflammation in the eye which has not received the injury, especially in subjects of scrofulous constitution", and cites a case of Sympathetic iritis.

These facts show that S.O. was being carefully studied, the symptomatology, aetiology, and prognosis noted, cases registered and tabulated, so that in 1844[7] we are presented with a full and detailed description of the disease by Mackenzie under the heading "Reflex or Sympathetic Ophthalmitis". The disease is characterised as a grave iritis rebellious to all treatment, and six cases, all traumatic, are reported which had been under treatment at the Glasgow Eye Infirmary, dating from as back as 1827. The main points noted by Mackenzie are :—

(6) Treatise on Diseases of the Eye. 2nd Edit. p. 560
(7) " " " " " " 4th " (Special Chapter)

Etiology:- Wounds of the Retina, Prolapse of Iris, and its entanglement and dragging in Cicatrix. Foreign Bodies inside Globe. Has not seen it after operations.

Symptoms:- due principally to inflammation of Retina E.g. Photopsia, Photophobia, Variable pain. Grave iritis.

Time of Onset:- Generally 5 to 6 weeks after accident. Sometimes some years after.

Termination:- Atrophy and Complete Amaurosis

Prognosis:- Grave. Mackenzie had only seen one case of recovery from S.O.

Treatment:- Suppuration destruction of injured eye.

Mackenzie was of opinion that the spread of the inflammation from one eye to the other might be effected in one of three ways:-

(a) Vessels on one side, being in a state of congestion, might transmit this state through their communication within the Cranium to those of the opposite side.

(b) The ciliary nerves might possibly transmit the disorder.

(c) The principal path is by way of the optic nerves, and their union through the chiasma.

This last is generally spoken of as Mackenzie's optic nerve theory, but it is necessary to understand exactly what he meant. S.O. in Mackenzie's opinion was a "reflex" or reflected irritation through the optic nerves and chiasma, and not a spread of inflammation by contiguity of tissue. His view was based on the then existing anatomical notion of fibres passing directly from one retina to the other. "The anterior border of the chiasma is composed of fibres, which seem to act as a commissure between the two retinae" (Carpenter's Physiology 1856 p. 586). "The injured eye" says Mackenzie (8) "is in a state of inflammation, which is propagated along

(8) Loc. Citat

the corresponding optic nerve to the chiasma, and that thence the irritation which gives rise to inflammation is reflected to the retina of the opposite eye, along its optic nerve."

Mackenzie evidently grasped all the possible paths of transmission as inculpated in the various theories since viz. the blood stream, the ciliary nerves, and the optic nerve; but his views of anatomy, physiology, and pathology being mostly erroneous, and very different from our own, little help is afforded towards the solution of the question.

Tavignot[9] in 1849, and White Cooper[10] in 1854 called attention to the fact that a lesion of the ciliary body was the most usual starting point of the disease, whilst the sympathising eye most commonly suffered in the anterior part — an iridocyclitis. Arlt[11] in 1855 suggested that inflammation of the ciliary nerves of the injured eye

(9) Gazette des Hôpitaux 1496 (10) Med. Times & Gaz. p. 301
(11) Die Krankheiten des Auges Bd 2 1855

produced an irritation of the nerve centre, which passes as a reflex to the ciliary nerves of the healthy side, and when three years later Heinrich Müller[12] brought forward anatomo-pathological proof in a case of S.O. when he found the optic nerve atrophied and sclerosed, whilst the ciliary nerves had their axis cylinder intact, the new ciliary nerve theory obtained a firm hold amongst ophthalmologists, and at the present day, in spite of the influence of Deutschmann and the infection theory, has many supporters

The term "reflex" as applied in this view of the cause of S.O. is unfortunate, and quite at variance with our ordinary physiological notions, when we use that term. The ciliary nerve theory meant to imply that the ciliary nerves - and more especially their rich ramifications in the

(12) Archiv f. Ophthalm. 1858 T. IV p. 367

ciliary body – of the injured eye were subjected to irritation as the result of the injury, of the plastic inflammation following the injury, of their inclusion in a cicatrix, of being dragged upon by prolapsed conditions of the uveal tract, of the presence of foreign bodies &c. This irritation was propagated along the ciliary nerves, some said by the short ciliary nerves through the lenticular ganglion, others, directly by the long ciliary and nasal branch of the Ophthalmic division of the fifth. Reaching the centre in the medulla, changes were there set up, which were reflected to the centre for the opposite side, and thence by the great Sympathetic reached the other eye. The vasomotors were the nerves chiefly involved, and as a result circulatory troubles arose. When the irritation was

increased in strength or duration organic troubles ensued E.g. haemorrhages, retinal, detachment, increased tension, plastic exudations &c. This view met with strong and immediate support from Pagenstecher (13), who denied the possibility of a nerve of special sensation like the optic nerve being the agency of transmission, and who also dissected enucleated eyeballs to find the conductibility of the ciliary nerves intact, but marked proliferation of cells collected in masses in their sheaths, a condition most likely to cause irritation. Pagenstecher maintained the path of transmission as being through the nutritive fibres of the sympathetic system via ciliary nerves. This position was later strengthened by Czerney's (14) anatomical examinations, who found intact axis cylinders, whilst

(13) Klinische Beobachtung. 1862 p. 75

(14) Bericht über die Wiener Augenheil.. 1867 p. 181

the nuclei and the connective tissue of the ciliary nerves were increased.

Bowman (15) brought forward a case in which the Sympathetic lesion corresponded accurately to the position of the injury in the exciting eye, and insisted on the intervention of the Vasomotor nerves. J. Vose Solomon (16) in a note on "Reflex disease of the Eye of traumatic origin" gave clinical proof of irritation of ciliary nerves in an ophthalmic wht as the primary origin of Sympathetic disorder.

Further support was given this view by the appearance of Brown Séquard's (17) book in 1860. His 6th lecture dealing with the "Influence of the Nervous System upon Nutrition and Secretion" takes S.O. as an illustration. There were also many physiological workers examining the influence of nerve section and irritation on the blood vessels, glands and tissues: amongst others may be noted Claude Bernard, who demonstrated

(15) Intern. Ophth. Congress 1862
(16) Dublin Quarterly Journal of Med. Science Feb. May 1863
(17) "Lectures on the Nervous System"

the existence of vasoconstrictor nerves in 1857.
To discuss all the work in this direction would take us too far afield into Experimental Physiology. Let it suffice to indicate a few of the problems raised, and not even at present-day settled e.g.

What is the relationship between the nervous system and the inflammatory process?
Can a reflex irritation produce a true inflammation?
Is the irritation conveyed through the sensory, vasomotor, or so-called trophic fibres?
Do these so-called trophic fibres Exist?
Is there a central trophic centre?

All this ground is again traversed thirty years later by Bach, when he attempts in 1896 to revive the ciliary nerve theory. His view practically only differs from the older one in regard to the path of transmission. According to Bach (18) the path of the irritation is from the 1st eye through the ciliary nerves to the ciliary ganglion,

(18) Société d'Ophtalmologie d'Heidelberg 1895 (Rapport)

through the sympathetic root of the latter to the carotid plexus of the same side, then through the circle of Willis to the carotid plexus of the other side, and then in a centripetal direction to the ciliary ganglion and the ciliary nerves of the second eye.

Meanwhile, the clinical history of S.O. was being elaborated. The introduction of the ophthalmoscope in 1851 discovered that papillitis was not always the first sign. R. Taylor (19) in 1854 called attention to cases of S.O. consequent upon idiopathic affections, and did not give such a grave prognosis as Mackenzie. Dr Brodhurst (20) differentiated sympathetic irritation from S.O., and believed the one form may pass into the other. In 1862, however, Donders (21) brought before the Heidelberg Congress his classical case of sympathetic irritation of long duration immediately cured by removal of the

(19) Med. Times & Gazette 2/54 pp. 439. 465
(20) Thèse de Paris, 1858
(21) Quoted in Ledoux' Thesis (1871). also Br. & For. Med. Chirurg. Rev. Jany. 1868 p. 7

exciting eye, and denied the transformation of S.I. into S.O. Bowman in the same year was the first to note the existence of a symmetrical point painful to pressure of the sympathising eye. This symptom was still further dwelt upon by Dr Graefe[22] in 1866, who had a special technique for seeking it in all cases of suspected S.O., and is thus often spoken of as "the Graefe point of de Graefe". At the Heidelberg Congress of 1863, Critchett noted the following characteristics of S.O.— its tediousness, its insidiousness, and its obstinate resistance to treatment. He also brought forward two cases following Cataract Extraction. Wecker[23] in his treatise insisted that iridocyclitis, not initis, was the most frequent form of the disease.

About this time the sections of S.O. became widened, and a large number of new forms were brought forward as

(22) Archiv für Ophthal. 1866

(23) Traité des maladies des Yeux. Paris. 1867 p. 413

examples of true sympathetic affections.
Activity in this line was specially noticeable on the Continent, and very few diseases of the eye escaped having their counterpart under the heading of Sympathetic. Thus in 1865 Rheindorf (24) described a new form as Irido-keratitis, Rondeau (25) and Mooren (26) described forms of Atrophy of Papilla. Cases of Sympathetic Retinitis and Retino-choroiditis appear in the works of de Graefe, Rondeau, Mooren and Galezowski, whilst Sympathetic Excavation of papilla is noted by de Graefe, Rondeau and Horner. Dransart (27) gives a good account of these forms in the part of his work dealing with "Formes Papillaires". Sympathetic Amblyopia was noted by Mooren, Dransart and Rosenmeyer.

Already, too, experimental work

(24) Sur l'Ophtalm. Sympath. 1865 (25) Thèse, 1866
(26) Med. Chir. Centr. 1/68 p. 18 (Quoted in) (27) Documents pour servir à l'histoire des affect. Sympath. 1873

was going on with a view to elucidating the
question. Dr Haab[28] of the Netherlands Ophthalmic
Hospital in collaboration with Donders from
1863-66 had tried to produce S.O. experimentally.
In nine rabbits and two dogs various lesions
of the ciliary region were made, to imitate
as far as possible injuries likely to cause
S.O., but the results were negative in all
cases. Rondeau[29] similarly failed in his
experiments to produce S.O., the only result
obtained being some photophobia and
lachrymation.

In 1878 Reclus[30] after discussing
Mooren's[31] work he says "Nevertheless it
is necessary to acknowledge that the theory
of transmission by the ciliary nerves is at
the present time almost without contention
the predominant one in science." At the
same time he differs from the others by
regarding the disease as a true neuritis, citing

(28) Br. & For. med. Chir. Rev. 1868 p. 23 (29) Thèse, Paris 1866
(30) "Des Ophtalmies Sympathiques" 1878 (31) See further on-
pp. 43-68

the results of the examinations of Pagenstecher and Czerney — already noted — in support of his contention. This neuritis of the ciliary nerves, he says, ascends by way of ophthalmic branch of trigeminal to the medullary centre, thence by commissural fibres through raphé to centre for opposite eye, and becoming descending is continued to the sympathising eye. He further believes that trophic nerve fibres passout from medullary centre with the sensory and vasomotor fibres. Such a roundabout and farfetched view seems to us quite unnecessary, and without any possibility of anatomical proof. In order to have a reflex irritation we understand it as applied to S.O., it is not necessary to find marked changes in the ciliary nerves. In fact, if the changes are so marked as to render the axis cylinders incapable of transmitting irritative stimuli, the reflex theory is at an end. Further, in putting forward the theory of an

ascending neurites, Reclus takes for granted the existence of these problematical trophic fibres, and also the very doubtful existence of a trophic centre.

The significance of lesions in the ciliary nerves has been differently interpreted by different observers. For some, their presence confirms the ciliary nerve theory, whilst their absence is against such a view. Schmidt Rimpler,[32] Krause,[33] Uhthoff[34] Berger,[35] Poncet[36] and Alt[37] all found lesions in the ciliary nerves of eyes giving rise to S.O. On the other hand, Alt,[38] Brailey,[39] and Deutschman[40] amongst others report the ciliary nerves as sound and unchanged under similar conditions. The ciliary nerves must of necessity be involved in cases of plastic uveitis, and such lesions have nothing of pathognomonic value in them. Moreover, to detect such changes in the ciliary nerves is a very difficult matter, whilst an intact condition of the ciliary nerves is rather in favour of a nervous irritation as the cause of S.O.

(32) Heidelberg Congress 1871 Deutsch. med. Wochen. 1879 (33) Klinis. Wochen. 1882 July (34) Archiv f. Ophth. 1881 XXIX

(35) Beitrage Zur Anat. de Linse 1887 (36) Archiv d'Ophth. 1881 (37) Archives of Ophthalm 1876

We come now to the Intermediate period between the Ciliary nerve Theory and the publication of Deutschmann's early experiments. Although for the past 20 years (1858 - 1878) the ciliary nerves were by the majority believed to be the path of transmission, still there were some who thought that the optic nerves might be a possible road; and cases pointing in this direction had been reported, amongst others, by Mooren, Cohn, Dransart and Colsmann. Once again, we must clearly bear in mind that this was not a revival of Mackenzie's theory of the propagation of reflex irritation along the sensorial nerve, but indicated an extension by contiguity of tissue along the nerve itself or its sheath. In 1878, certainly, Manthner (41) did try to revive Mackenzie's creed, and noted as a proof of an irritation of the optic nerve

(38) Amer. Jour. of Ophth. in 1884 (39) Ophth. Soc. H. 1885 (40) Case of 1893 referred to later on. (41) "Die Sympathischen Augen" 1878

the following Symptoms – sensibility to light, rapid fatigue, photophobia and phosphenes –, but he did not adopt this view exclusively, nor did it receive much notice or support.

We have already noted Le Dran's view as far back as 1737. In 1843 Hinly (42) suggested the idea of S.O. being a propagated optic neuritis. Mooren (43) in 1860 met with a case of S.O. – taking the form of a papillitis followed by atrophy – due to contusion of the optic nerve at the time of enucleation, and referring to this case in his "Ophthalmiatrische Beobachtungen" he says "The facts show, at least, that sympathetic amaurosis from disease of the optic nerve must not be ranked among impossibilities or improbabilities." Alt (44) of New York also favored the optic nerve path of transmission, and

(42) Die Krankheiten - - - - Arch. Berlin 1843 p. 450
(43) Quoted in Med. Chir. Rev. 1868 p. 18
(44) Archives of Ophthalmol. and Otology Dec. 1876

As the result of examining enucleated eyes states that the optic nerve and retina showed pathological changes in 79% whilst the ciliary nerves were altered only in 16 2/3 %. The action of the optic nerve, he says, is "attributable as much to inflammation as to functional changes", and he recommends removal of a large piece of the optic nerve. From the fact of finding ciliary nerve changes in 16 2/3 % he was forced to give the ciliary nerve some position, and his final conclusion is that the entire nervous apparatus participate. Colomann (45) was another partisan of the optic nerve path, and in 1877 expressed the opinion that the inflammation in S.O. travelled up the nerve sheath to the chiasma, and thence down to the second eye. In 1879 Horner & Knies (46) bringing forward the result of a P.M. on a young woman who died whilst suffering

(45) Internat. Med. Cong. (46) Correspondenz Blatt für Schweizer Aerzte IX. Jahrg. 1879

from Sympathetic serous iritis and papillitis express the same view, as also did McGillivray at the International Medical Congress held at Amsterdam the following year, having found the characteristic changes of a perineuritis in the optic nerve. Further support was soon forthcoming from same experiments (47) of Horner and Kunes, who showed the possibility of injecting fluorescin into the subdural space of the cut nerve soon to reach the eye.

At this time Bacteriology was rapidly rising to the position of a distinct science, and the part played by Microorganisms as causal agents of disease being recognised, so that in 1881 the time was ripe for Leber's (48) view of the infective origin of S.O. through the lymph channels of the optic nerve and its sheaths. The spread of the disease was similar to the process seen in

(47) Heidelberg Congress 1882

(48) Archiv für Ophthalmen. XXVII. 1
L. 331

Erysipelas & S. by continuity and contiguity of tissue. At the International Medical Congress Snellen[49] and Woods[49] support this view, and in the later part of the year J.B. Story and Abrahams[50] made a joint communication to the Pathological Society of Dublin as to their finding small, round oval, micrococci in the vitreous, and optic nerve sheath of an injured eye.

The bacterial view of S.O. was still further strengthened by the appearance of Deutschmann's work in the next year - a work which had a far reaching influence, and one which stimulated enquiry in all directions.

(49) Trans. Internat. Med. Congress 1881 Vol. iii
(50) B.M.J. ii/81 p. 1019

Deutschmann's work began in 1882 (51) when he published his early experiments with the spores of the Aspergillus fumigatus — a purely mechanical agent. The following year (52) he employed a chemical irritant for his injections viz. varying proportions of croton and olive oils, and in 1884 (53) he substituted for these a culture of Staphylococcus Pyogenes Aureus. His book "Über die Ophthalmia migratoria" appeared in 1889, reviewing the whole question of S.O. and its forms, with much additional experimental work, and the record of numerous clinical cases, all tending to strengthen his theory, and in 1893 (54) appeared a report of the first case of S.O., where a complete anatomical and pathological examination of all the parts implicated was made, with the apparent result of entirely confirming his experimental and clinical work of the previous ten years.

(51) Archiv für Ophthalmol. XXVIII
(52) " " " XXIX
(53) " " " XXX

(54) Beiträge zur Augenheilk. 1893 † 4. 771

For our purpose, we will do best in briefly summarising Deutschmann's work and results :-

1. Rabbits were the animals used in the laboratory.
2. In his early experiments using chemical and mechanical injections into the vitreous or nerve trunk, he succeeded in producing cellular infiltration of the optic nerve sheath, with similar changes in chiasma, and second optic nerve. A certain amount of papillitis in the second eye was noted, and in some of the cases the inflammation spread to the ciliary body.
3. Using cultures of the Staphylococcus pyogenes his results were also nearly always uniform in producing distinctly recognised papillitis of the second eye in from 5 days to 2 or 3 weeks. The parts affected were the sheaths of the optic nerve

and of the vessels, the recent papilla and its immediate neighbourhood. The anterior part of the eye (iris &c) was not affected, due, as he would have it, to the death of the animal before full development of the S.O. To verify this latter point, he injected cut end of the optic nerve with the culture, and produced iritis with hypopyon in 3 days.

4. The Staphylococcus was found in the optic nerve sheaths, their sheaths, in chiasma, and papilla of the recent eye.

5. All his animals died, as a rule of general infection, after a variable period: in one or two cases of meningitis.

6. By injection of Chinese Ink, he concluded that the lymph stream proceeded from the brain to the eye.

7. He resected 2-5 mm. of the optic nerve, and found that after a time reunion took place, and that communication

was effected through the fibrous connecting band, which sometimes showed an Endo-
-thelial lining

8. Out of 14 human eyes causing S.O. which Deutschmann examined he found microorganisms in 13, from which he also produced typical cultures, and had successful inoculations.

On examining the fluid after paracentesis, or an excised piece of the iris, of the sympathising eye in 5 cases of S.O., he demonstrated the presence of the Staphylococcus Pyogenes Albus or Aureus, the former being more frequently met with than the latter.

9. He found no change of any significance in the ciliary nerves.

10. In his later experiments (55) he only produced S.O. in 2 out of 35 attempts, and admits that the microorganisms are difficult to stain, & small in size.

(55) Beiträge zur Augenheilk. 1893

In following Deutschmann's experiments with their abundant detail, the definite and in earlier experiments, almost constant pathological changes and findings, the frequency with which the Staphylococcus Pyogenes of Rosenbach is found in both eyes, the explanations with corroborative experimentation of any apparent difficulties or objections, and the mass of clinical demonstration with similar results, one almost sinks under such wealth of evidence, and accepts his migratory theory as the solution of the question. The apparent simplicity and definite results of these experiments, however, had the immediate result of stimulating other observers to repeat them, and to seek for the causative organisms. Let us then briefly consider those who brought forward any results tending to confirm Deutschmann's position.

In addition to Abrahams and Story already noted, both Snellen and Leber[56] in 1881 found what appeared to be micrococci in the optic nerve sheath. In 1884 Alt[57] made some experiments which seemed to confirm. He was able to produce, after an interval of 4 or 5 days, a neuro-retinitis of the second eye by passing a thread steeped in Croton Oil through the optic nerve of the first eye. He also injected septic material into the vitreous, and concluded from his results that a direct passage of the inflammation of the infected eye took place along the optic nerve and its sheath.

In 1889 Gayet[58] introduced into a rabbit's eye, anterior chamber, a piece of infected material. This was followed two months after by keratitis with pannus of the second eye, which Gayet regarded as sympathetic

(56) Locus Cit.

(57) Amer. Journ. of Ophthalm. 1884

(58) "Recherches Anatomiques sur une ophtalmie Sympath." (Extrait)

in nature. The animal was killed at the end of 3 months, and changes were found in both optic nerves, and in the chiasma, but there was no change in the neural tracts.

Parisotti[59] in 1890 reported some Experiments with rabbits, in which he obtained results similar to Deutschmann, but with this difference that he was in no case able to find microorganisms in the second eye.

In 1894 Pincus[60] reports finding microorganisms, chiefly bacilli, in two cases in the exciting eye, one a post operative case containing a cysticercus, the other a traumatic case. The bacilli were found in the posterior part of the eye, and the optic nerve sheaths.

In 1896 Zimmerman[61] relates a case of S.O., in which death from meningitis quickly followed enucleation. Examination was able to demonstrate microorganisms

(59) Internat. Med. Congress 1884
(60) Archiv für Ophthalm. XL
(61) " " " XLII

in the exciting eye & the optic sheaths, in the chiasma, and in the optic nerve sheaths of the opposite side.

The same year, Andogsky (62) of St. Petersburgh made some experiments to test the power of the different eye tissues in destroying pus organisms. In the course of these experiments he notes that cocci introduced into the posterior part of the eye may pass into the optic nerve sheath, but denies such a possibility when the cocci are introduced anteriorly. He does not deny the correctness of Deutschmann's experiments.

Angelucci (63) in 1897 writing on the origin of S.O. concludes that eyes affected with S.O. always contain micro-organisms analogous to those in the exciting eye - micrococci and diplococci - showing pathogenic properties on

(62) Quoted in Edin. Medical Journal 1897 p. 334
(63) Revue Générale d'Opthalm. 1898 p. 1

inoculation. His conclusion was based on the examination and preparation of cultures from the exciting eyes, and pieces of the iris excised from the sympathising eyes in 3 cases of sympathetic plastic uveitis. He differs from Deutschmann by denying that S.O. can be produced experimentally.

Vennemann (64) reports a case of neuritis of the second eye, the first eye being lost from panophthalmitis following purulent ulcer of the cornea. He regards such an occurence as a replica in the human subject of Deutschmann's experiments, and attributes a considerable share in the production of S.O. to the stagnant cerebro-spinal fluid, as a good culture medium.

There are several points to

(64) Société Française d'Ophtal. 1897
Ophth. Review XIX p. 150

be noted which detract from the value of the preceding observations and experiments as supporting Deutschmann. Thus, in the cases of Gayet & Vinneman the S.O. was of a debateable character, in the case of Zimmerman the patient died of general infection, in the cases of Pincus there was the history of perforation operative and traumatic, with the possible entrance of organisms, whilst Parisotti, Angelucci and Andogsky differ in essential points from the results of Deutschmann.

Turning now to those who have failed to confirm experimentally or clinically, we find an overwhelming array of evidence against Deutschmann's experimental results, findings, and view of the pathogenesis of sympathetic ophthalmitis.

Gifford (65) in 21 experiments, conducted on exactly similar plan, failed to get the same results, although in some of them he employed the same cultures for injection as Deutschmann himself, which were sent to him by the latter. Gifford also differs from the German in his view of the direction of the lymph stream, and, as the result of his experiments with the anthrax bacillus, is of opinion that the lymph circulates by way of the sheaths of the central vessels to the apex of the orbit, and there blends with the cerebro-spinal fluid.

Mazza (66), using both rabbits and guinea pigs, failed in every particular, in spite of careful ophthalmoscopic observation over a long time. He only found microorganisms, when the animals died of general infection.

Randolph (67) noting that the rabbits

(65) Archives of Ophthal. June & Sept 1886 (66) Internat. Ophth. Congress Heidelberg 1888
(67) " " " 1888 pp. 188-223

died of general infection, and desirous of keeping the process a local one as it apparently is in man, experimented with dogs as well, these animals being less likely to succumb to general infection. His cultures were made by Nordensen in Koch's laboratory, the experiments and tests carefully done, but the results were entirely negative. The same observer reports negative examination of two human eyes for bacteria:-

(1) Cultures and inoculation with an eye excised about 3 weeks after onset of S.O. in other eye. Results nil (68)

(2) Negative Examination of an eye excised 2 months after onset of sympathetic perves with in the other (69)

In 1890 Limbourg and Levy (70) published the result of long and carefully planned experiments in the lines of Deutschmann. Twenty four rabbits, and seventeen guinea pigs were

(68) O.R. xi p. 298 (69) Norris & Oliver "System of Dis. of Eye" Vol. III

(70) Archiv für Experim. Path. xxviii 1890

inoculated, but no changes of any note were observed in the second eye, and no organisms were detected.

Ulrich's[71] results were negative, and Schmidt-Rimpler's[72] found no bacteria in a case of S.O. after optico-ciliary neurotomy.

In 1892[73] Schirmer brought together all the arguments in favour of the bacterial origin of S.O., and himself regards the disease as a purely microbic affection. At the same time, he details the results of his inoculation experiments in rabbits with the Staphylococcus and the Streptococcus, watching them daily for months, but in not a single instance did the second eye show any change. He also in 1900[74] reported a negative bacteriological result from the examination of both the exciting and sympathising eyes in a case of S.O. shortly after onset of disease.

The most instructive work in this

(71) Bericht der Ophth. Gesellsch. 1891 (72) Deut. medicin. Woch. Oct 1891

(73) Von Graefe's Archiv. xxxviii p. 93. O.R. xii p. 83 (74) O.R. xx p. 206

direction which we have analysed is that of Dr Richard Greef (75) of Berlin. His examinations, cultures, experiments, and inoculations took place in Koch's Institute, and with all the best bacteriological assistance, and the most perfected technique. He points out the possibility of error in trusting to sections alone, and insists on anaerobic as well as aerobic cultures. Pieces of the resected optic nerve and the contents of one eyeball in three cases which had given rise to S. O. were examined, and emulsions made of these with bouillon and glycerinated agar. In all of these no colonies were produced, and the plates remained sterile. Inoculation experiments with same were likewise without result. Lest it might be objected that the microbes had got beyond the point of resection, Greef made a similar search in 15 cases where resection of the optic nerve had been done

(75) Reported in "Revue Générale d' Ophtalmol. Sept^r 1892

prophylactically. Here, again, no microorganisms could be detected. Following these results up, Greef repeated all Deutschmann's experiments with the greatest care, but no direct migration could be determined through the optic nerve from one eye to the other, and no microorganisms were found in the second eye, except when general infection by blood or meninges resulted.

Ohlmann[76] examined 30 eyes enucleated for acute S.O., but found no microorganisms.

W. J. Collins[77] excised an eye shortly after the appearance of S.O. The eye was carefully examined by Mr Cargill, and elaborate bacteriological search made for organisms, but in vain.

De Schweinitz[78] found no bacilli in 3 cases of enucleation for threatening S.O. following injuries.

Bach[79] failed to produce S.O. or to find bacteria after inoculations of Staphylococci,

(76) Arch. f. Augenh. XXII. (77) Lancet II/95 p. 122
(78) Journ. Amer. Ophth. Soc^y. 1895 (79) Von Graefe's Archiv. f. Ophthal. XL Heidelberg. Ophth. Soc^y. 1895

and Pneumococci – attenuated cultures of these being also used – into vitreous or directly into optic nerve sheaths. Bach also made cultures from 16 injured human eyes, from which 4 cases of S.O. had arisen, but got no colonies, and no microorganisms.

Bach[80], as also Velhagen[81] established the perfect impermeability after a certain time of the cut end of the optic nerve, and so refuted Deutschmann's view that S.O. after enucleation or resection is due to a permeable cicatrix.

Alt[82] gives the result of the histological examination of an eye enucleated shortly after undoubted S.O. had started in the other eye. He made a long and determined search for microbes with absolutely negative results, although there was intense uveitis with inflammatory foci suggesting microbes.

(80) O.R. xv p. 290
(81) O.R. xv p. 294
(82) Amer. Journ. of Ophth. Feby. 1898

Cecil E. Shaw (83) (Belfast) in a Special Research on S.O. examined eight injured eyes, four of which had already given rise to S.O. in the other eye. No microorganisms were found although carefully sought for.

Bagnis (84) examined 10 eyes without finding bacteria, and Amongst many other unsuccessful seekers may be mentioned

Gruner in 2 cases (O.R. XX p. 207 XXII p. 45)
Fromaget (Recueil d'Ophtal. Nov 1902 p. 680)
Stricker (Ref. Amer. Journ. Ophth. Sept. 1895)
Bourgeois (Recueil d'Ophtal. July 1895)
Ring. (Manhattan Eye & Ear Hospital Rep. 1895)
Berry (Berlin Congress. B.M.J. II/1890 p. 411)
Sutphen (Oph. Rev. Vol. XII p. 182)

Becker, (84a) as the result of a complete anatomical examination of a case of S.O., found that the intracranial part of the two optic nerves, and the chiasma showed no trace of alteration in their structure.

(83) B. M. J. June 15th 1898 (84a) Archiv. f. Psychiatrie XII 1
(84) Ibid.

The only conclusion that we can draw from all these researches is that Deutschmann's results are practically unique, and that they are of little value, being almost entirely without confirmation, although the modus operandi, as laid down by him, was simple, and the rabbits eye a specially easy one to make observations upon. Before countenancing his results, we must first be able to repeat his experiments with similar demonstrable changes, to find micro-organisms in the second eye, and to produce S.O. without general infection, and to explain away the fact that, clinically, the disease in the majority of cases shows itself first in the anterior part of the eye E.g. presence of Synechiae.

All this experimental work, however, is in our opinion practically useless so far as arriving at any conclusion as to the pathogenesis of the disease is concerned,

and that for two reasons:

I Pyogenic organisms never produce S.O., which is of a seroplastic or fibrinous type, and is not a purulent inflammation.

II S.O. has never been observed in any of the lower animals, and seems to be, as Angelucci says, "the unfortunate privilege of the human race".

On the other hand, all these negative experimental and clinical results do not affect the possibility of the disease having a specific or bacterial origin, and we will briefly summarise the main points advanced for and against the Infection Theory. In favour of such a view:-

1. S.O. does not start at once, but requires a certain time for its development — a period of incubation. This is in keeping with the life history of the majority of specific diseases.

2. S.O. sometimes follows Enucleation. The value of this point is dealt with in the clinical part of our Thesis.

3. We are acquainted with many forms of metastatic inflammations, and these have nearly all been proved to be due to the migration of bacteria or their toxins.

4. Simple wounds of the ciliary region—operative or accidental—when aseptic, also aseptic foreign bodies in this region or in the interior of the eye, do not produce much disturbance, and the inflammation arising therefrom is circumscribed, and not of that seroplastic type, which most usually gives rise to S.O. Experiments by Leber,(85) Knapp,(86) Randolph,(87) and Deutschmann(88) abundantly confirm this, as also do the many operations daily performed on the corneosclerotic margin, the iris, and the ciliary region.

(85) Archiv für Ophthalm. XXVII
(86) Archives of Ophthalmology XV
(87) " " " XVII
(88) Ueber die Ophth. Impfgal. 1889

A perforating wound, allowing entrance of organisms, seems generally the essential starting point of S.O., and the presence of a special type of inflammation.

6. Failure to find microorganisms is not against this theory, as we know nothing of the specific bacterium, its character, its growth, its life history, the best method of staining it &c. So far no one special microorganism has been found. Thus, Deutschmann reports finding micrococci very similar to the Staphylococcus Pyogenes Aureus, Staphylococcus Pyogenes albus[89], and the Gonococcus.[90] Gasparini[91] noted the presence of the Klebs Loeffl. Bacillus. This might support the view of a mixed infection, which has found favour with many Ophthalmologists during the last few years. Further, the spread of S.O. may be due to bacterial products - toxins - rather than to the direct migration of the bacteria themselves.

(89) Ueber die Ophth. Emigrat.
(90) Case published 1893
(91) O.R. XX p. 78

Against the Infection Theory:-

1. Why do the microorganisms, brought intimately in contact with the cerebral meninges, not produce meningitis?

2. Why does panophthalmitis, a disease in which germs abound, not produce S.O.?

Attempts have been made to explain these difficulties by Deutschmann,(92) Gifford,(92) Audoptry,(92) but without convincing us.

3. Cases without penetrating wounds have been reported, in which S.O. has arisen. Amongst many others Bronner,(93) W.S. Syn,(94) and Donaldson(95) report such cases of subconjunctival injuries, Nieden,(96) Holtz,(96) Brailey(96) &c report cases of intraocular tumours without a detected perforation, and Fromaget(97) and Guillonent(98) report cases of S.O. after subconjunctival dislocation of the lens.

This class of cases must be accepted with the greatest caution, before being admitted as a valid objection.

(92) Loc. Cit. (93) B.M.J. 14/7/94 (94) Edinb. Hosp. Reports 1900
(95) OR XVI p. 35 (96) These cases quoted in Bouteiller's Thesis 1899
(97) Recueil d'Ophtal. 1902 p. 680 (98) OR. XIX p. 293, XXI p. 328

In our opinion, the evidence weighs strongly in favour of a specific origin for S.O., but whether a special organism causes this disease alone, whether it has any relationship to pyogenic forms, whether there is a mixed infection, or whether one of the ordinary known forms acquires special characters through its sojourn in the eye tissues, there is at present no means to decide. Biassed in favour of this view, there is no more difficulty in accepting it for S.O. than for many other diseases e.g. trachoma, syphilis, and many of the common infectious fevers, in which the specific organism has not yet been isolated. Absolute certainty can only be reached, however, when we can recognise the micro-organism, when we find it invariably present in S.O., when we can cultivate it on artificial media through several generations, and when we can reproduce the disease by

inoculation, and recover the organism from the inoculated subject. Granted that we could recognise and easily stain the bacterium of S.O., the path of transmission could then be easily settled by the anatomo-pathological examination of a recent case.

The Metastatic Theory

owes its inception to Berlin[98], who assumed that the specific products or germs of the wound in the first eye passed into the general circulation, and being carried by the blood stream to the second eye find in its uveal tract a medium or conditions particularly suited for their growth, and developing there give rise to the sympathetic inflammation. A few years later Jonathan Hutchinson[99] propounded a similar view – being at the time unaware of Berlin's paper. He illustrated the

(98) Volkmann's Samml. Klin. Vorträge 1880 No. 185

(99) B. M. J. 23 May 1885

occurrence by a comparison with the transference of foci in multiple peritonitis, and maintained that tissue elements as well as bacterial products may be the agents. P. Romer (100) of Würzburg rejects and strongly champions the metastatic theory of Berlin. The organism, he says, is pathogenic for the eye alone; indifferent as regards the body generally. At the recent Heidelberg Congress (September 1903) Romer, in detailing some experimental work in support of his view, argues that the agent of sympathetic irido-cyclitis belongs to the group of invisible microbes - a hypothesis which will lead us still further from the solution of the path of transmission.

The theory of Metastasis has much to commend it from the clinical side, and would explain the appearance of the disease in the anterior (vascular) portion of the eye as a

(100) O.R. 1903 p. 138

first, and often only manifestation of S.O., but the total absence of General symptoms, so characteristic a feature of this affection, is against such an explanation of its origin, and we do not feel warranted at any rate in our present state of bacteriological knowledge in accepting the view of an organism, which can circulate in the body, act and develop in the eye tissues alone, and produce no constitutional disturbance. The only analogy is trachoma, and the specific nature of this, though strongly suspected, is still unproven.

Further, it may be objected that if S.O. is propagated by metastasis, we ought to find it developing after other wounds E.G. cutaneous.

The Combined Theory,

Closely allied to the Theory of Metastasis is what is known as the

Modified or Combined Ciliary Nerve Theory.
Instead of assuming that the special anatomical arrangements or histological elements are the cause of the specific products settling in the second eye, this view maintains that reflex irritation renders the uveal tract of the Sympathizer susceptible to the action of such products. In the report[101] of the Ophthalmological Society on the relative value of excision and its substitutes, six cases of S.O. after ophthalmic neurectomy are reported: one each by Clausen, Ohlemann, Trousseau, Schmidt Rimpler, and two by Lindo Ferguson. It was in bringing forward his case[102] in which S.O. occurred eighteen months after resection of 15 mm. of the optic nerve that Schmidt Rimpler[102] vigorously attacked the "Ophthalmia migratoria" of Deutschmann, and suggested his modified ciliary nerve[103]

(101) T. O. S. Vol. XVIII (102) Quoted in O.R. XVI p. 293
(103) Archiv für Ophthalm. XXXVIII.

theory. The globe had to be excised, and no bacteria were found either in the globe or in the resected portion of the optic nerve. The ciliary nerves were normal. According to Schmidt Rimpler the tissues of the second eye, by reflex irritation of the first eye, acting reflexly, were rendered susceptible or vulnerable to the action of an infectious agent, bacteria or their toxins, carried by the blood vessels or lymph channels from the exciting eye. Galezowski, Baquis and others supported this view. Panas (104) expanded the idea still further, and included not only bacteria or toxins from the injured eye, but also any microbe or toxins that might be present or introduced into the general system. Panas remarked the influence of dyscrasiae, and infectious states, and said that the possible source of infection must be sought for in all parts of the body, whilst the

(104) Archives d'Ophtalm. May 1897

differences of individual response to reflex disturbance of the nervous system was also an important factor.

With regard to the constitutional element, Mackenzie (105) remarked the occurrence of L.O. in the scrofulous, and also the influence of tobacco, alcohol, weakness and obstinate constipation. Wharton Jones, (106) Hayne Walker, (107) and others refer to the possible influence of a low state of the general health. Our late teacher Professor Coats (108) said "Predisposition or susceptibility seems to have considerable influence in determining the occurrence of L.O." Cross, (109) de Schweinitz, (109) others recommend careful research into the general state of patients suffering from L.O. by blood counts &c &c. Peters (110) sets forth the proposition that L.O. is probably tubercular in nature rather than of pyogenic origin.

(105) Loc. Cit. (106) Ophthal. Med. & Surg. 1855 (107) Textbook 1875
(108) Manual Pathol. 1889 (109) B. M. J. 23/9/99 (110) Zeit. f. Augenheilk. May 1st 1900

In support of Panas' view, Guibert (La Roche sur Yon)[111] relates four cases of S.O. arising in old wounded eyes as the result of general auto-intoxication from influenza or typhoid fever. In 3 of his cases it was a question of old stumps dating back 50, 30, and 14 years. The exciting cause of the outbreak of the S.O. was typhoid fever in one case, influenza in the two others. No other causes were found to account for the symptoms, and enucleation effected a cure.

Alfred Moll[112] of Berlin details some experiments in support of the combined Theory. He injected into rabbits by the blood path the bacillus pyocyaneus, a microbe easily and rapidly recognised. If, now, one eye is irritated or injured, the bacillus is found again after 24 hours in the anterior chamber of <u>both eyes</u>: if there is no irritation or injury, the anterior chamber remains sterile. Moll concludes that a persistent severe irritation of the

(111) La Clinique Ophtalm. 1901 p. 81 (112) O.R. x viii p. 36

first eye predisposes, by creating a locus minoris resistantiae, the second eye to receive the necessary infectious element, and thus S.O. is set up. Recent experiments made by Coburn (113) of New York in reference to the conditions under which serous and fibrinous cyclitis occur viz. that the intra-ocular circulation of certain substances Eg. mineral salts, alkaloids &c were able to produce these conditions, are of considerable interest in this view of the pathogenesis of S.O.

Against the Schmidt Rimpler and Panas view many objections may be noted. Thus,

1. According to the combined Theory S.S. would always precede S.O. This is disproved by reference to clinical facts.
2. We have innumerable cases of S.S. lasting months and years, and yet no S.O. develops, in spite of the occurrence from time to time in such cases of the presence of organisms

(113) American Annals of Ophthalm. April 1902

in the body.

3. No microbes are found on examining the blood. (Leber)

4. The absence of General Symptoms.

5. Most commonly the cases recorded of S.O. are in strong and robust individuals.

6. It rests on the Assumption that irritation, microbic or mechanical, in one eye causes by so-called reflex action, impaired nutrition of the other eye.

7. Schirmer (114) objects that the bacilli in Moll's experiments having appeared twenty four hours after in the anterior chamber, there is no analogy with S.O., which takes two or three weeks to develop.

8. Stock (115) repeated Moll's experiments in 32 rabbits, but noted that the appearance of the pyocyaneus was quite as frequent in eyes not irritated, as those which had been.

(114) Centralblatt f. praktische Augenheilk. Januar 1899

(115) Klinisch. Monatsbl. f. Augenheilk. Febr. 1903

Revival of Ciliary Nerve Theory.

The ciliary nerve irritation Theory or purely nervous view of the pathogenesis of S.O., although put aside by most observers after Deutschmann published his experiments, was not entirely discarded. Nettleship (116) reported a case, where the eyelashes of the sympathising eye turned white, and claimed this as a point in favour of the ciliary nerve theory. Schenkel, Jacobi, and Warren Tay (117) have recorded similar instances. Browne, Theobald (118), Galezowski (119), Boucheron (120), and others still clung to the view of the influence of reflex irritation on the sensory and trophic fibres of the ciliary nerves, and it was ingeniously assumed by Theobald that according to the predominance of these two sets of fibres in individuals we have the two forms of S.O. viz. Sympathetic irritation and inflammation.

(116) Lancet 2/83 p. 1092 (117) O.R. iv p. 68 (118) Archives of Ophthalm. 1884
(119) Recueil d'Ophtalm. 1890 p. 388 (120) Gazette des Hôpitaux 1890 p. 746

X T.O.S. Vol. XII p. 29

The general failure on all sides to verify Deutschmann's results, and also by Bach himself in 1895, together with the record of cases of S.O. after resection of the optic nerve which, he demonstrated experimentally, could not be due to a permeable cicatrix, led Bach (121) to return to the old Ciliary Nerve Theory. This view, with the exception of the route taken (see page 13) he adopted as laid down by Müller, Pagenstecher &c. He also brought forward in support some positive experimental (122) evidence. Irritating the ciliary nerves in various ways to imitate the various kinds of injury &c known to have given rise to S.O., Bach finds that definite changes follow in the other eye, viz. a fibrinous exudation, and even extravasation of blood corpuscles, into the anterior part of the vitreous, between the ciliary processes, and into the anterior and posterior chambers.

(121) Archiv f. Ophthalm. 1896 p. 298
(122) O.R. XV p. 289

The more intense and the more persistent the irritation, the more severe the sympathetic manifestations in the other eye: These changes observed in his experiments, when occurring in the human subject, are for Bach the first stage of S.O.

Wessely (123), however, in his experiments to control Bach's results, whilst admitting that the irritation of an eye causes alteration of its fluid contents (percentage of albumen &c) failed to prove that in the rabbit at any rate irritation of one eye produced such phenomena in the second eye. Shaw (124), likewise, was never able to produce in the eye of the rabbit by prolonged severe ciliary irritation the fibrinous or haemorrhagic exudates observed by Bach, although he found that a temporary irritation of one eye may result in a temporary exudation of fibrin and leucocytes in both eyes. Shaw, like Bach,

(123) Graefe's Archiv f. Ophthal. June 1900 (124) B. M. J. II/98 p. 1582

advocates a return to the old ciliary nerve irritation theory for an explanation of most if not all sympathetic phenomena. Stock (125), however, denies as the result of his experiments by aseptic or violent toxic irritation of one eye, that any pathological modification — albuminous exudation or cellular diapedesis — is found in the aqueous chamber of the opposite eye.

We have already in an earlier part of this thesis dealt with the ciliary nerve theory, and some of the difficulties, which at present exist, in accepting it as a final solution of the origin of S.O. Apart from the contradictory results of Bach, Wessely, Shaw, Stock &c we are not yet in a position to admit that any amount of irritation of sensory or vasomotor nerves can produce anything beyond oedema or hypertrophy. A true inflammation as the result of

(125) Klinisch. Monatsbl. f. Augenheilk. Februar 1903

direct or reflex irritation, mechanical or bacterial, has never yet been demonstrated. Clinically, too, we may ask why S.O. does not arise in such instances as Glaucoma or Panophthalmitis, where the conditions of severe persistent ciliary irritation are so constantly present, and why irritative Symptoms, recognised subjectively as pain &c., are so often in S.O. slight, indeed sometimes even absent. Many gaps in Anatomy, Experimental Physiology, and Pathology must be filled up, before the Ciliary Nerve Theory can again become the predominant view.

Theory of the Toxins

The reaction against the migratory view of S.O. owing to repeated failures to detect bacteria, and the conviction that the disease is in some way connected with bacterial

activity, have led recently to the view that the toxins or specific products, as the result of the physiological activity of certain bacteria, are the cause of S.O., and what may be termed The Theory of the Toxins has lately sprung up.

(126) At long ago demonstrated that an infusion of jequirity bean, i.e. what may be regarded as a vegetable toxin, injected into a rabbit's eye was able to travel by way of the optic nerves and chiasma, and to produce an optic neuritis in the second eye. De Graf (127) after failing to detect microorganisms in cases of S.O., and to produce that disease experimentally, advised that further experiments ought to be pushed as to the action of toxalbumins. Deutschmann (128) at the Berlin Congress of 1890 is reported to have said that "he did not assert that these cocci were the only cause of the disease. Possibly they

(126) American Journal of Ophth. T. 4. p. 98 (127) Loc. Cit.
(128) B.M.J. II/1890 p. 411

assisted in the elaboration of a chemical poison which was the real toxic agent.[129] Schirmer, in referring to the possibility of a primary sympathetic papillo-retinitis, says that such a form may depend upon the transmission of bacterial products rather than the bacteria themselves. Panas,[130] Griffith,[131] and others have also incriminated the toxins.

In 1900 some remarkable work in this direction was published by Selenkowsky.[132] He injected the filtered toxin of the Staphylococcus pyogenes aureus into the optic nerve and retina of dogs and rabbits. Changes similar to those seen in cases of S.O. were set up, and his results applied to man would seem to show that S.O. may be caused by toxins passing from one eye to the other via. the subvaginal spaces of the optic nerve. Gasparini[133] also advanced a similar view.

(129) O.R. XII p. 93 (130) Loc. Cit. (131) B.M.J. 16/7/98
(132) O.R. XIX p. 312 (133) O.R. XX p. 76
{Archiv. f. Augenheilk. XLIV.}

By injecting cultures of diphtheria bacillus into one eye of an animal Gasparini provoked a local inflammation in the other eye — an ophthalmic neuritis: sometimes, too, the choroid and ciliary body were involved. The following year (133), however, he combined the action of the toxins with the action of a reflex ciliary irritation in order to localise the toxins, and have inflammation set up.

While the Toxin Theory explains much of the experimental failure we have analysed, especially the non-finding of micro-organisms, it is hardly possible to expect much from the injection of filtered cultures. If S.O. is due to toxins circulating in the blood, one would expect the appearance of general symptoms in cases of S.O.. Further, the experiments of Gasparini, and also those of Selenkowsky in collaboration with

(133) Gould's Year Book 1903 p. 531

Bellarmino[f], have been repeated by Stock[134], who failed to find any inflammatory lesions in the other eye, after injecting into the vitreous of the rabbit variable doses of diphtheria toxin, staphylotoxin, or filtered cultures of bacterium coli.

From all this experimental work, and the number of theories advanced, it is only too evident that the pathogenesis of S.O. remains an unsolved problem, and, in our opinion, as S.O. is entirely confined to mankind, we must look for the final solution to some, as yet unknown, peculiarity of the human economy – anatomical, physiological, or bacteriological.

(134) Loc. Cit.

Treatment

We conclude the Historical Part of our Thesis with a very brief resumé of the different treatments of S.O., which for the most part have been prompted by the prevailing view of its causation, or by the fashion in therapeutics from time to time. To say that our treatment of a disease depends on our knowledge of its pathology is a truism well illustrated in the case of S.O.

Wardrop in 1819 was the first to suggest any treatment viz. to produce suppuration in the injured eye. This idea was adopted and carried out by Mackenzie. Incision of the cornea followed by poultice was Barton's[135] procedure. R. Taylor,[136] Stayner,[137] Walton, and White Cooper[138] favoured abscission. Dr Graefe recommended producing suppuration by means of a seton – a plan he very soon abandoned.

(135) Loc. Cit. (136) Med. Times & Gazet. ii/54 p. 439 (137) Ibid. p. 155
(138) Br. & For. Med. Chirurg. Rev. ii/59 p. 79

These methods being barbarous and painful, Pritchard (139) of Bristol in 1854 advocated Enucleation as the proper treatment as soon as the healthy eye showed signs of being affected. His first case was done on the 5th February 1851, and reported in the Provincial Medical and Surgical Journal. This method was instantly and universally adopted, and the Medical journals for the next few years contain many reports of cases showing the advantages of such treatment. Mitchell Clarke (149) of Bristol in an article "On the propriety of excising the eyeball immediately, when destroyed by an injury" strongly recommends preventive Enucleation. Warlomont at the International Medical Congress 1877 laid down the general principles for Enucleation, and dwelt strongly on preventive operation.

As the ciliary nerve theory began to be universally adopted, and the ciliary nerves

(139) B. M. J. Oct. 1854 (140) B. M. J. 1/62 p. 306

principally blamed for transmitting the disease, it occurred to surgeons that by cutting them beyond the site of irritation, they would effect the purpose of stopping the disease. This section, recommended by de Graefe in 1866, was first performed by E. Meyer (141) in 1867. J. Vose Solomon, (142) however, claims that he had successfully employed section of the ciliary nerves as far back as 1861. His case is reported in the Medical Times and Gazette 1861 v. 327. The operation of ciliary section, although revived and modified later by Abadie, (143) Galezowski (144) &c, has never received much serious support owing partly to the difficulty of complete section, and partly to the danger of prolapse of the vitreous.

The influence of Moore, Alt, and others discriminating the optic as well as the ciliary nerves led Rondeau in 1866 to propose section of the optic and ciliary nerves, and the central artery.

(141) Annale. d'Oculist. 1867 (142) Lancet 1/68 p. 747 (143) Two cases in Lorvet's Thesis, Paris 1889 (144) Recueil d'Ophtal. 1890 p. 388

This suggestion was first carried out by Bowman (145) in 1875, and this operation known as optico-ciliary neurotomy, though altered in details, has been warmly supported by many ophthalmic surgeons. Cases of S.O. following optico-ciliary neurotomy and necessitating enucleation, Schweigger (146) in addition to merely severing the optic and ciliary nerves, resected a piece of the optic nerve.

About the same time Prof. Graefe (147) of Halle, (to obviate in the first instance the danger of meningitis after excision for panophthalmitis), proposed the operation of Evisceration, a proceeding adopted by Mules (148) of Manchester, who also obtained a still better stump by inserting into the scleral cavity a hollow glass ball. Frost (149) and Lang (150) recommended excision of the eyeball, and insertion of

(145) Lond. Medic. Record 15/X/1876 (146) Heidelberg Congress 1884
(147) Centralbl. f. Augenheilk. 1884 p. 374 (148) T.O.S. V p. 200
(149) Brit. Med. Assoc. 1886 (150) T.O.S. Vol. VII

a glass globe into Tenon's capsule. To discuss the results obtained, and the relative value of all these operative procedures is beyond our present province. Suffice it to say that S.O. has followed them all, and none of them can supplant enucleation, although in special cases they have a limited application. A full report on the subject was published in 1898 by the Ophthalmological Society.

The Infection theory of S.O. led Abadie[151] to the use of local germicides. He injected, with excellent results, sublimate solution into both the exciting and the sympathising eye. Similarly, the insertion of iodoform into the anterior chamber was recommended by Haab.[152] This procedure has met with some success, but also many failures.[153] The administration of Mercury pushed rapidly by injections, frictions or fluids a strong

(151) Annales d'Oculist. Mars-Avril 1890 (152) O.R. XX/1. 204
(153) Annales d'Oculist. September 1903

advocate in Schirmer,(154) who reports some wonderful results from a prophylactic point of view in sever wounds of the eyeball.

Organic extracts of the Ciliary body of the Ox were tried in two cases by L. Dor(155) with some improvement in vision; these preparations continue to be advertised in the French ophthalmic journals by enterprising Teutonic chemists, but no further results have been recorded.

Gasparrini's experiments with the Diphtheria toxins led him to try the effect of antitoxin Serum. He claims a good result,(156) but the case is in our opinion a very doubtful one of S.O.

Recently, subconjunctival injections of Salt solution have been much in vogue. The effect of these injections in producing a real and marked, though temporary, improvement of the Visual acuity is well illustrated in a case of S.O. reported by Dr Delbés.(157)

(154) Opt. Rev. XXI p. 72 (155) Gazette Hebdomad. June 24th 1897
(156) Opt. Rev. XX p. 78 (157) La Clinique Ophtalmol. 1903 p. 277

Some of the firm advocates of the infectious origin of the disease have recommended repeated injections of a mercurial solution e.g. mercury cyanide, deep into the tissues of the orbit of the enucleated eye. In our clinical part we note this treatment in two cases of S.O. after Enucleation viz. Fage's (see page 39) and Abadie's (see page 124). Recently, Valois of Montlieu has reported two cases of ordinary S.O., where Excision of the exciting eye and the employment of these injections (1% of mercury cyanide) were followed by restoration of vision to normal. Such a method of treatment has much to commend it from a theoretical point of view, but has the disadvantage of causing much pain, and of being followed by considerable reaction.

Clinical

J — A — aet. 40 yrs. living at Awsworth nr Nottingham, a coal miner, at 9.30 a.m. on the 5th June 1901 was struck in the left eye by a piece of hard coal, with immediate total loss of sight. When seen by me at 12 noon, he was recovering from shock, which had been severe. There was no injury to the lids; the eyeball was collapsed from the escape of its liquid contents through an oblique lacerated wound about ½ in. long of the cornea and sclerotic. C. Bell Taylor of Nottingham saw the case with me, and at 5 p.m. — seven and a half hours after the accident — the remains of the left eye were excised, although with some difficulty owing to the state of the eyeball.

On examination of the enucleated eye a piece of "bird" pyramidal in shape, and measuring ⅓ in. in longest axis was found imbedded in posterior wall of globe, and impinging on the intraocular end of the optic nerve.

The socket suppurated freely for ten days,

and on the 19th June a small nodule of granulation tissue in the centre of the scar was snipped off. The wound then cicatrised well, and on the 3rd July an artificial eye was fitted, and the patient instructed how to care for it.

On the 20th July I met the patient, who expressed himself as being very comfortable, but complained his sight for the last 2 or 3 days was not so good in a dim light. This he noticed especially in the twilight. A casual glance at the eye showed no redness, nor other external abnormal appearance.

25th July:- Patient returned to work down the pit, but had to leave off in a few hours owing to the difficulty of seeing in the dull light. On examining him this day (i.e. seven weeks after the injury, and the excision of the eye), I found him complaining of some pain in and around the right eye, and also that his sight was at times blurred, as if there was a "thickish fog about"

He avoided strong light, the eye was watery, and pressure on the closed lids made him draw back. Ciliary injection was noted as a delicate rose pink ring. The pupil was contracted, but acted sluggishly to light and accommodation. The iris was of a dusky brown colour. No apparent change in the anterior chamber. Tension in my opinion slightly increased. V = 5/18

I ordered removal of the artificial eye, and as there was considerable seromucous discharge from the socket gave some hot sublimate douches. Into the right eye strong solution of Atropine (gr 4 ad ℥j) was instilled, and this was repeated every ten minutes. After the fourth instillation the pupil dilated irregularly - having a somewhat heart shaped appearance, and being fixed at one point in the centre of its upper segment. The atropine was continued every two hours, three leeches were applied to the right temple, and mercurial inunction with the oleate commenced. A pill containing

Hydrarg. c Creta gri and Pulv. Opii gr ¼, was ordered to be taken four times a day, and the patient was confined in a darkened room.

26th. July:- Imitative Symptoms quieter. Ciliary injection much diminished. The pupil now fully and regularly dilated, the posterior Synechia at upper part having quite disappeared. On Oblique illumination and use of a strong lens no deposits on Descemet's membrane are detected, but a dark pigmented coral spot on the lens capsule corresponding to the Synechia is noticed. With the ophthalmoscope there is seen a diffuse fine turbidity of the vitreous, but no large opacities. The fundus is seen as if through a haze, the borders of the papilla are more or less obscured, more especially so on the temporal side. This haziness is more marked over and round papilla, the vessels towards the periphery of the fundus being seen more clearly. The same treatment

is continued, but a weaker Solution of Atropine (gr$\frac{1}{4}$ ad $\frac{3}{1}$) substituted, simply to keep the pupil dilated.

27th July:- ciliary injection still marked. has had severe pain (forehead and temple) during the night. Two more leeches applied. Pilocarpin. Nitras gr$\frac{1}{6}$ hypodermically

29th July:- circumcorneal Zone paler.

Pilocarpin. Nitras gr$\frac{1}{6}$ hypodermically Inunction of Hydrarg. Oleat. and pills continued.

3rd August:- all the signs are decreasing. The deposit on the ant. Surface of capsule is only detected with difficulty, and the vitreous clouding has so far cleared as to allow the neurorrhinitis to be clearly seen. There is no elevation of the papilla, but the blurred edges are easily observed.

Owing to some tenderness of the gums, and slight salivation, the inunctions

are stopped, but the pills are continued three times a day, and a quinine mixture (gr ii doses) ordered.

15th August:- no pain. no tenderness. uveal deposit very faint. neuroretinitis subsiding. V = 5/9

The progress of the case continued uninterruptedly, and on the

1st Sept.: V had mounted to 5/5- and J1. The pupil is regular in outline, and reacts well both to light and accommodation. With the ophthalmoscope, no abnormal appearances are seen.

The family and personal history of this patient was well known to me - no syphilitic or gonorrheal infection, no rheumatism, no gout, no tuberculosis, and the urine was free from albumen and sugar.

The patient returned to his work as a collier at the end of October,

wearing the artificial eye, and the sympathising eye quite recovered. He has had no return of trouble in the right eye up to October 1903.

This personal record is, in our opinion, a genuine case of the milder form of S.O. The presence of the synechia, and the distinct neuro-retinitis mark all doubt of its being merely a case of severe sympathetic irritation, whilst it cannot, in the absence of every possible cause for the symptoms in the second eye, be regarded as a mere coincidence. Without the injury, the second eye would not have suffered the attack described above. Although at first much opposition was raised to cases of this class being regarded as truly sympathetic, it is now very generally recognised that S.O. may occur in an early and mild form, rapidly and completely recovering, being at the same time similar in character, aetiology and pathology

to the graver malignant type. This opinion has again and again been expressed at the various Congresses, Ophthalmological Societies, and meetings. The remarkable feature of this personal case is the short time that elapsed between the injury and the enucleation viz. Seven and a half hours. The interval, too, after excision before the appearance of S.O. is much longer than usual. In other respects it does not differ materially from the other cases reported, and tabulated hereafter. The main interest, however, centres round the fact that S.O. developed in spite of an almost immediate excision performed whilst the other eye was perfectly sound and normal in every way. An enucleation when the other eye is so circumstanced we call Preventive.

This occurrence of S.O. after preventive enucleation is undoubtedly one of the greatest rarity, so far as recorded cases are concerned, but it may be that -

many such cases being for the most part of a mild type, and possibly tending of themselves towards recovery, as described by that facile term "weakness", and supposed to be showing a kind of "sympathy" for their lost fellow. Were the termination always favourable, there would be no need to go further, but, seeing that such cases sometimes end disastrously, our thesis has a very important significance, and a very practical bearing in compensation and accident insurance claims. From 1892–1896 at Moorfields Eye Hospital 1596 eyes were excised, and in only one of these was S.O. known to develop subsequently. Critchett with at least 500 excisions has only seen two such cases: Argyll Robertson with at least 1000 excisions, only one case: Dransart[158] and Uhthoff[158] have each seen two cases: Brailey[159] notes two cases, one four weeks, the other seven weeks after enucleation.

(158) Internat. Med. Cong. Paris 1900 (159) Berlin Medical Congress 1890

performed within forty eight hours of the injury in one of his cases: and similarly, for other ophthalmologists. De Wecker, Dor, Truc, Trousseau, Valude, and Darier[160] have never seen S.O. arising after a preventive enucleation.

The statements and opinions formulated on this subject by surgeons and ophthalmic authors are somewhat vague, mostly evasive, and at times divergent. Thus:—

Schirmer.[161] — "There is no satisfactory evidence that true S.O. can be excited from an anophthalmic orbit."

Randolph.[162] — "We can never assert positively that S.O. will be surely averted if the injured eye be enucleated."

De Schweinitz[163] gives as a cause of S.O. "Pressure of an artificial eye or incarceration of the stump of the optic nerve in scar tissue after the operation of enucleation."

(160) Annales d'Oculist. Juin 1903 (161) O.R. XII p. 89 (162) Norris & Oliver "System of Dis. of Eye" Vol. III (163) "Diseases of the Eye" 1900

Noyes (164) gives as a cause of S.O. "Puckered cicatrix of the orbital tissues following enucleation."

Badal, Lapersonne, and Galezowski (165) have never seen S.O. after preventive Enucleation, but they admit the possibility of such an accident arising from irritation of the socket, fresh infection therefrom, or want of care or skill in enucleating.

Berry (166).— "S.O. never occurs if the first eye be removed within twenty four hours after it has been injured, and very rarely, if ever, if the operation is performed within the first week."

J.R. Cross (167).— "Still, I fancy that an injured eyeball, although enucleated without long delay, may render delicate its fellow, or even predispose it towards a destructive form of iridocyclitis, not easily distinguished from S.O."

Swanzy (168).— "Nearly every ophthalmic surgeon

(164) "Diseases of the Eye" 1894 (165) Annals d'Oculist. 1903
(166) "Diseases of the Eye" 1893 (167) Trans. Ophth. Soc. U. Vol. XVII
(168) Handbook 1903 Edit.

has seen cases in which S.O. has appeared subsequently to excision of the first eye, and in which, at the time of the operation, the second eye was perfectly sound."

Lawson.(169) — "There can be little doubt that if an injured eye be excised before symptoms of irritation occur in the other eye, then the sound eye is safe from S.O. There may be exceptions to this rule, but they are few."

The earliest recorded case of S.O. after a preventive enucleation, that we can find, is one of Moore's published in 1867(170), as follows:— In the spring of 1861 a weaver received a lacerated corneosclerotic wound of one eye. Two days later the eyeball was excised on account of pain, and during the operation the optic nerve was contused. A few weeks later he complained of increasing weakness of vision, photopsy, weight over brow, and

(169) "Diseases and Injuries of the Eye" 1903 Edit.
(170) Quoted in Medico-Chirurg. Review 1868 b. 18

the vision had declined to hs. 1/4(?). "To meet the possibility betimes" of sympathetic in this recovery did an iridectomy, but the final result owing to consecutive optic atrophy was bad. The form of the S.O., and the absence of iritis in this case might cast doubt on its purely sympathetic character, but we have considered it worth noting in connection with our Special clinical part. In 1877 Vignaux (171) in a foot note at page 72 of his work cites two cases. In 1878 Schweigger (172) had collected the only then recorded cases in which S.O. arose in an eye, absolutely healthy up to that time, 2, 4, and 9 days after enucleation. By 1880 Nettleship (173) was able to bring forward nine cases: six previously published, two personal cases, and one of Mr Cowell's. Following on this, cases began to appear in the Journals &c, and to be discussed at the Societies, so that in 1886 (174) the Ophthalmological Society of the United Kingdom

(171) "De l'Ophtalmie Sympathique" (172) Berliner Klinische Wochens. May 28th &c
(173) Transact. Clinical Soc. Vol. XIII (174) T.O.S. Vol. VI
pp. 206-219

was able to give an account of 30 genuine cases of S.O. after excision, some of these already published, others from private records. Since this report, cases have appeared from time to time both at home and abroad. Altogether we have examined the reports of close on 100 cases of S.O. after excision, and of these have summarised 29 cases gathered as follows:-

1 Personal Case see pages 73-80

3 from Transactions Clinical Society 1880

12 " Ophthalmological Society's Report 1886 (T.O.S. Vol. VI)

13 " various English, American, and French Sources since 1886.

We have selected only those cases in which the exciting eye was the subject of a traumatism, in which the excision was prompt i.e. (as already defined) in which the second eye was perfectly normal at the time of the excision - no S.I. being present, no dots on the posterior

surface of the cornea detected, and no optic neuritis or fundus changes (at least as far as visual acuity indicated, the eye not having always been examined ophthalmoscopically)—, in which the details are full and satisfactory, and in which the sympathetic disease involved the uveal tract conformably to our definition of S.O. (see page iii).

All cases of idiopathic affection of the exciting eye, all traumatic cases in which some subsequent minute operation was performed, all cases of the doubtful forms of S.O., and all cases with constitutional taint likely to raise dispute, have been excluded.

The cases are tabulated according to the duration of their first interval, and the following points detailed:- sex, age, nature and site of injury, first interval i.e. time elapsed between the injury and the enucleation, the state of the orbit after excision, the

second interval i.e. time elapsed between the enucleation and the first appearance of S.O., the symptoms, the treatment, and the final result.

The whole subject of S.O. after preventive enucleation of an injured eyeball is then dealt with, and the special features of such cases contrasted with ordinary cases of S.O. under the headings,

Aetiology
Symptomatology
The Intervals (with a note on cases of S.O. long after Excision)
Diagnosis
Prognosis
Treatment
Pathogenesis
Medico-legal Aspect.

No.	Sex	Age	Nature of Injury	First Interval	State of orbit after Excision	Second Interval	Symptoms
1.	M	40	Traumatic Rupture of Globe with lodgment of foreign body	7½ hours	Free Suppuration for ten days	42 days	Serous iritis no Kerat. Punct. retinitis
2.	F	45	Traumatic Rupture of Globe	a few hours	not noted	9 "	Distinct iritis fundus normal
3	M	Adult	Penetrating wound	a few hours	normal	21 "	fairly severe post. synech.
4	M	Adult	Large corneal wound Prolapse of Iris. Total loss of sight	<24 hours	Healed Naturally	7½ months	Kerat. Punct. vitreous clouding fields reduced
5	M	20	Globe burst by a blow	1 day	Healed well no irritation Glass shell after 2 weeks	149 days	Iritis. Pain Ciliary congestion affected
6	M	41	Contused wound of eye and orbit	<2 days	Suppuration pre. Tissues healed badly	30 "	moderately severe iritis with membrane

of S.O.	Treatment	Final Result	Remarks	Reference
Synechia Neuro-	Mercury by mouth & Inunction. Atropine Pilocarpine Leeches	Complete Recovery	Duration 6 weeks. Well 2 years after. No family or personal taint	Personal
No Kerat. punct.	Atropine	Complete recovery	Duration 4 weeks. No Syphilis or other cause	Little T.O.S. Vol. VI
Iritis Kerat. punct.	Atropine	Perfect recovery	Duration Short Healthy man	Devereux Marshall (Moorfields)
Post. Synech. Vision and Orbit tender	Portion of optic nerve sheath resected Mercury inunction atropine	Perfect recovery	Duration 2 months Perfect health. No constitutional taint	E. Meyer Revue Générale d'Ophtalmol. Nov. 1890
No Kerat. Punct Vision not	Atropine	Good V = 20/40	Duration a few days Relapse 7 months after lasting 2 months. No other cause found	Browne T.O.S. Vol. VI
Plastic much	Not noted	Good V = 20/40	No Syphilis. Vague history of some rheumatism	Nettleship T.O.S. Vol. VI

No.	Sex	Age	Nature of Injury	First Interval	State of Orbit after Excision	Second Interval	Symptoms
7	M	8	Sclerocorneal wound Prolapse of Iris	9 days	Healed normally No artificial eye applied	31 days	Ciliary injection several fine post. syn. marked photophobia secretion in empty
8	F	12	Rupture by Shuttle	11 "		21 "	Redness. Kerat. pupil Vitr. opacit.
9	M	30	Gunshot wound of ciliary region. Shot on retina	14 "		15 "	V dim plastic occlusion of
10	F	10	Wound of cornea, ciliary region and lens. Iris prolapsed	14 "	Healed quickly	17 "	Serous Iritis pigment on
11.	M	35	Rupture of Sclerotic	15 "	Healed well	41 "	Iritis. Vitreous V = p.l.
12	F	13	Wound of cornea & lens with iris entanglement	16 "	Healing Natural	26 "	Iritis. Post. Circumcorn. Inject. impaired. Tendern

of S.O.	Treatment	Final Result	Remarks	Reference
Pupil contracted Vitreous clouding muco-purulent orbit	Atropine. Quinine. Injection of Cyanide Solution into orbit	Excellent V = 2/3	Duration 3½ months No personal or family taint The orbital injection was followed by good result.	Fage (Amiens) Annales d'Oculistique 1897 p. 135
Funct. Sluggish V = 6/36	Not noted	Bad V = 6/36 J 20		Jones T.O.S. Vol. VI
Iritis and pupil	No mercury	Bad V = perceptes face	Six months after onset T+, and iridectomy	A. Critchett T.O.S. Vol. VI
Ruin of Sclerotic capsule	Leeches. Atropine Mercury	Excellent V = 20/20 J 1	Duration 2 months Healthy Girl	E.D. Bower B.M.J. 1/83 p. 1171
Opacities	Atropine Mercury to Salivation Blisters	Excellent V = 20/20 J 1	Duration 2 months S.I. 6 days after excision. No relapse at end of 4 months	Brudenell Carter Trans. Clin. Soc'y. Vol. XIII
Speech. V slightly normal	Atropine	Excellent V 20/20 J 1	Duration 2 months.	Cross T.O.S. Vol. XVIII p. 155

X. Incorrectly reported in Ophth. Society's Report

No	Sex	Age	Nature of Injury	First Interval	State of Orbit after Excision	Second Interval	Symptoms
13	M	19	Small shot through ciliary region, and passing through posterior pole	16 days	no pain and no special secretion	30 days	Violent irido-neuroretinitis at 2 metres
14	M	67	Rupture of Sclerotic with prolapse of Iris	19 "	Normal healing	23 "	Serous iritis opacities detachment
15	M	7	Wound of ciliary region by dirty steel pen. iris prolapsed	20 "	Recovery uneventful Socket White + dry	53 "	Ciliary redness Kerat. punct. Tension normal
16	F	33	Subconjunctival rupture of Sclerotic	20 "	no Suppuration	27 "	Iritis. Kerat. Vision dim neuritis
17	M	10	Corneal wound with prolapse of iris	21 "	Good Recovery	14 "	T-2 V=$\frac{6}{36}$ no optic neuritis Punct. till 16 days ribbons opacities

of I.O.	Treatment	Trial Result	Remarks	Reference
cyclitis and V = fingers	Atropine. Dark Room. Injection of Mercury Leeches	Perfect Recovery	Duration 6 weeks. Healthy man. Improvement maintained 7 months later	Nuel "La Clinique Ophtalmologique" 1903 p 101
Vitreous Retinal	Leeches Dubois-ie, then Atropine	Good with evidence of detachment	No rheumatism, Gout, or Syphilis	Nettleship Trans. Clin. Soc'y Vol. XIII
Post. Synech. O.D. hazy	Atropine Mercury by mouth	Perfect Recovery	No syphilis. Non lapse after 4½ months	Stephenson Oph. Rev. XX p. 240 & T.O.S. Vol. XXI
Punct. no optic	Atropine Mercury by injection	Bad	Good recovery in first instance, but relapses till V = 6/18 Good personal & family history	Donaldson Oph. Rev. Vol. XVI p. 35
Pupil dilated No Keratic later.	Atropine Mercury	Good Tn V = 6/9	Some post. Synech. and vitreous opacities still present.	Holmes Spicer B.M.J. 11/98 p. 1819 T.O.S. Vol. XIX

No.	Sex	Age	Nature of Injury	First Interval	State of Orbit after Excision	Second Interval	Symptoms
18	M		Piece of steel in the vitreous extracted by Hirschberg Magnet	21 days		63 days	severe plastic & marked retinitis
19	F	26	Ruptured by Shuttle	22 "		53 "	Vision dim Circle of pigment V = 6/12
20	M	11	Lacerated wound of the corneal margin	24 "	Coats of eye opened at time of operation — escape of Contents	25 "	Sclerotic iritis
21	F	16	Sclero-corneal wound. Iris incarcerated	30 "		5 "	Iritis. Hazy Vision reduced 3/
22	F	9	Cornea-sclerotic Wound	34 "		22 "	Mild cases Keratitis punct.

of S.O.	Treatment	Final Result	Remarks	Reference
irido-cyclitis neuro-		Recovery	Duration 4 months Optic neuritis was present in the enucleated eye	Lentmayer Oph. Rev. XIX p. 295
Kerat. Punct. on capsule	Atropine Exclusion of Light	Good $V_e = \frac{6}{12}$ J_1		Little T.O.S. Vol. VI
	Atropine Quinine Mercury later	Good (?) $V = J_{14}$ (?)	Iris was still bound down, when seen last	Cowell Tran. Clin. Socᵗʸ Vol. XIII
vitreous to fuger's at	Atropine Leeches Mercury Quinine	Perfect Recovery	3½ months after $V = \frac{20}{20}$. Iris active and free	Wood White T.O.S. Vol. VI
iritis. neuro-retinitis	Atropine and Mercury	Rapid Recovery		W.A. Frost T.O.S. Vol. VI

No	Sex	Age	Nature of Injury	First Interval	State of Orbit after Excision	Second Interval	Symptoms
23	M		Wound of lens and cornea by a nail	35 days		12 days	Iritis Vision = fingers
24	F	19	Perforating injury by scissors	35 "	Quick Recovery	47 "	Severe irido-lymphi in T-
25	M	31	extensive cornea-sclerotic wound with prolapse of iris	35 "		3 "	plastic irido- and ophi
26	M	33	Large cornea-Sclerotic wound	37 "		5 "	marked acute and some retinitis
27	M	18	Sclero-corneal wound	37 "		2 "	Iritis Punct. Vitrous

of S.O.	Treatment	Final Result	Remarks	References
	Atropine and Mercury	Vision restored to normal		Critchett B.M.J. i/96 p. 1204
-cyclitis pupil	Atropine and "in spite of all treatment"	Bad p.l. only	Young, healthy girl, no specific history, and no history of illness	Cecil Shaw B.M.J. ii/99 p. 1386 T.O.S. Vol. XX
-cyclitis recurrent	Leeches, Atropine Mercury	Good V = 6/18	Eye quiet two years after. Followed employment up to her death some years later	Bickerton Ophth. Rev XVII p. 249
cyclitis neuro-	Atropine Mercury Iodides	Did well		Reid T.O.S. Vol. VI
Kerat. opacities	Atropine	Bad J 16	Favourable progress for two months; finally complete post. synechia. Lymph in pupil	Evans Jones T.O.S. Vol. VI

No.	Sex	Age	Nature of Injury	First Interval	State of Orbit after Excision	Second Interval	Symptoms
28	M	15	Wound of cornea, iris, and lens	40 days		6 day	Mild Iritis
29	F	32	Large corneal Wound	42 "		11 "	Iritis T.n. Visus vix dim

of S.O.	Treatment	Final Result	Remarks	Reference
		Excellent Recovery $V = \frac{6}{6}$ fundus normal	S.I. for 2 days before Iritis. One relapse	Jones T.O.S. Vol VI
		Bad Bar p.l.	Relapse one year after. Iridectomy, and finally pupil blocked	Gunn T.O.S. Vol. VI

Aetiology.

This may be considered under three headings:-

1. Primary Causes
2. Predisposing Causes
3. Exciting or Determining Causes

The Primary cause holds for the most part to the traumatism, its condition as regards sepsis, its character, its position, or its being complicated by the retention or presence of a foreign body. The wounds were caused in many ways; by blows from the fist or blunt objects, by sharp pointed agencies (knife, scissors, screwdriver, nail, piece of steel, hard stone), by the bursting of a bottle, by a shuttle, by gunshot in two cases, by sardine tin, dirty blunt knife, and dirty steel file. The last three are typically septic in character, the others more or less so, except the gunshot wounds, which may be regarded as aseptic in nature and reaction. In all the cases — No. 16 subconjunctival

rupture of the sclerotic being a doubtful exception — Communication between the exterior and the internal tissues of the globe was rendered possible, and with the exception of the cases of Immediate Excision (See under Pathogenesis) sufficient time before excision had elapsed to allow of a seroplastic uveitis arising. In some cases a certain degree of purulent infiltration of the exciting eye was observed, but in no instance did true panophthalmitis precede the enucleation (Bickerton in the Ophthalmic Review XVII p. 247 reports a case of S.O. after preventive enucleation of an injured eye suffering from panophthalmitis).

The character of the wound was in one or two cases incised or perforating, in several contused, but in the majority the wounds were of a ragged, lacerated type. Excluding the burst, badly contused, and ruptured eyeballs (seven cases), the position of the wound involved the cornea —

sclerotic margin in sixteen cases, the cornea alone in one case, and the cornea with prolapse of the iris in six cases; the lens also being wounded in three of the latter. A foreign body complicates the traumatism in four cases, involving the optic nerve directly in case 1, the retina in 9 and 13, the vitreous in No. 18.

Predisposing causes include sex and age. There are 19 males and 10 females. The ages may be classed as follows:-

7 – 15	years	9 cases
16 – 50	"	16 cases
Above 50	"	3 cases

Many authorities E.G. Reclus, Lawson & Claim age as an important factor in the Aetiology of S.O., but, so far as the present cases are concerned, it may be concluded that that age or that sex is most liable, which runs the greatest risk of such injuries as are detailed above, viz. males and the active working period of life.

The immediate exciting cause of the sympathetic outbreak is of some importance, especially from the point of view of treatment. Mackenzie (4th Edit.) cites a case of a young man, whose S.O. developed after some hours close reading in a bright light, Fauchart in his thesis (1885) notes a case where exposure to the strong heat of a furnace seemed to precipitate the attack, and others have incriminated exposure to strong solar or artificial light, overuse of the eyes &c. In our own case the close, straining use of the eyes in a dimly lighted coal pit for some hours, in Imel's case the exposure to a bleak, cold, wet wind, in Shaw's case "continuous reading", and in Carter's case a heavy drinking bout are all possible exciting causes of the attack of S.O. Further, the operation itself of excision must not be overlooked as a most likely immediate determining cause of the appearance of the symptoms in the second eye.

The state of the orbit after excision is to

be considered in dealing with this class of cases, but, unfortunately, it is not recorded in many of the cases, where the information would have been of considerable value. Out of sixteen cases noted, the socket, in the first instance, healed naturally or well in thirteen: in Case 1 free suppuration followed the operation for some days, the tissues healed badly in Nettleship's case, and in Cowell's the operation was unfortunate, the eye contents escaping into the orbital structures. Generally, however, one may naturally conclude, where the globe was violently ruptured or contused, that the orbital tissues must also have suffered more or less.

To sum up, whilst the aetiological factors present no special distinguishing characteristics from ordinary cases of S.O., yet the wounds are in all the instances of a severe character, and in the majority they are of a ragged, lacerated type.

Symptomatology

Lagueur in his Thesis (1869) – the first to classify the forms of S.O. – divided them as follows,-

I Irido-choroiditis or Plastic Iridocyclitis.

II Serous Iridocyclitis.

These correspond to the later classification of Bailey, uveitis analigna and uveitis serosa, and are varieties of the same affection, differing only in degree. The clinical forms which S.O. takes in our cases are:

A. Simple Initis or Serous Initis in 24 cases
(Neuritis or Neuro-retinitis being also present in 4)

B. Plastic Initis or Iridocyclitis in 5 cases
(Neuritis or Neuroretinitis being also present in 2).

The form, then, most usually (83%) met with after spontaneous enucleation is that of so-called serous initis, a term which may be retained, as it has the sanction of long usage, although it far from expresses any true idea of the pathology. Serous choroiditis, serous cyclitis, serous iridochoroiditis, serous iridocyclitis, serous

uveitis, and lately catarrhal cyclitis — from the demonstration of gland like structures in the ciliary body — have all been applied to denote the same affection, according to the part of the uveal tract principally involved.

Prodromata are little marked. In two of the cases a varying period (2 and 35 days) of sympathetic irritation preceded the inflammatory outbreak. S. I. similarly sometimes precedes the inflammation in ordinary cases of S. C. Little's case was preceded by slight conjunctivitis for four days. The other premonitory symptoms mentioned viz. dimness of vision, asthenopia &c are best considered as the earliest symptoms of the disease itself.

The subjective symptoms are not pronounced. Pain, when present, is generally slight, although in Case I severe neuralgia like attacks were present, there is excess of lachrymal fluid, and generally some photophobia. Often the first

Complaint of the patient is dimness of vision, a fog or cobweb before the eye. In Case 4 vision was not affected, in 12 slightly impaired, in the others it was more or less reduced down to counting fingers, or mere perception of light as in No. 11.

On examination is found circumcorneal injection of a pale rose tint, which in Case 1, under the influence of Atropine, deepened in colour during the next few days. Tension in the early stage is generally normal, sometimes slightly increased. In cases 17 and 24 T was —. The anterior chamber may be deeper. The iris shows change of colour with loss of lustre, and instillation of Atropine usually reveals Synechiæ single or multiple, but nearly always easily broken down by the mydriatic, their presence being indicated by the deposition of pigment on the anterior lens capsule either as a complete ring or in isolated patches. This pigment may clear rapidly or last some months. Careful

Examination with a strong lens as a rule reveals the presence of deposits on the posterior surface of the Cornea. These deposits known commonly as Keratitis Punctata, and sometimes described under the term Descemetitis – both misnomers – are noted as being absent in three of our cases viz. Nos. 1·2·5. In all of these enucleation was done within twenty four hours of the injury, and the absence of the corneal dots has been used to discredit such cases as truly sympathetic. The diagnostic significance of Keratitis Punctata is still a disputed point, but it is generally conceded that the dots are always present in inflammation of the uveal tract – chorioiditis, cyclitis, or iritis. Their absence, however, may be due to several reasons:–

(1) They are, when minute, unpigmented, and scattered, very difficult to detect. In Brown's case the presence of white spots (traumatic in origin) on the anterior surface of the cornea may have

prevented their being seen.

(2) Their appearance may be early or late, and so they may have been present when not specially sought for. In case 17 they did not appear until sixteen days after outbreak of the disease.

(3) Brailey (175) says they may be absent altogether.

(4) Their absence is noted in cases which run an extremely mild course, so that the cyclitis may not have reached a degree of intensity sufficient to give rise to the shedding of epithelial cells &c. Such cases might be described as a very mild catarrhal cyclitis.

Turbidity of the aqueous, and the vitreous opacities, generally fine and diffuse, noted in the majority of the cases, are the usual accompaniments of a keratoiritis or iridocyclitis, irrespective of any sympathetic origin.

Neuritis or neuroretinitis accompanies the uveitis in six cases, and such an occurrence may

(175) Lancet II/07 p. 116

by actually more frequent. The advocates of the transmission of S.O. by the optic nerve tracts and clinicians claim this fact as a proof of their theory, and many, like Hirschberg, assert that an optic neuritis is always present in S.O., and, if not detected, the fault lies with the obscurity of the media by turbidity of the fluids, or the presence of opacities. Some support is lent to this view by the difficulty in Case I at an early period of stating quite sure whether the blurring of the fundus was due to vitreous clouding or oedema of the nerve and neighbouring retina, and also in Quel's case, where the neuroretinitis was only detected at a later period of the disease, when the media had cleared. It is, however, not present in all cases — in Nos. 2.12.16.17.20 there is no optic neuritis or the fundus is reported as normal. Does the neuritis precede the uveitis? The diminished retinal sensibility (nyctalopia) and fogging of sight as the earliest symptoms

in Case I might be urged in favour of such an event, and Ayres, Benson, Schenier with others have recorded cases which seem to demonstrate that the progress of the lesion was from behind forwards. The presence of neuritis or neuroretinitis is not, however, in our opinion necessarily a primary affection, and more especially if bacteria are claimed as the causal agents; for such a neuritis is usually of a temporary evanescent character, subsiding rapidly, and leaving no damage (e.g. atrophy of the optic nerve) behind. In all the cases, too, the uveal tract was involved, and the neuroretinitis, even when present as an early occurrence, is more likely due to a disturbance of the uveal tract e.g. a serous or exudative choroiditis. The further back the disturbance, the more likely are the optic nerve and the surrounding retina to be affected early. From an anatomical point of view every choroiditis is a chorioretinitis, and we often see a papillitis in cases of iritis,

and iridochoroiditis due to other than sympathetic causes. Papillitis has also been observed in tubercles of the iris in man, which disappeared on healing of the tubercles. Further, any part of the uveal tract may be attacked in the first instance or later, and S.O. does not necessarily begin in, or limit itself to the iris or anterior part of the tract. Fisher (176) records a case where the posterior part of the tract was affected, and cases of sympathetic choroiditis have been described by Stilling (177), Haab (178), Bach (179), and others, and of chorio-retinitis by A. Coppez (180).

The retinal detachment noted by Nettleship (Case No. 14) has no particular significance, and points probably to the uveitis being more intense at that point with considerable effusion between the choroid and the retina.

The severer form of this form (Serous iritis) of

(176) Royal Lond. Ophth. Hosp. Reports Vol. XV p. 81

(177) Centralbl. f. praktisch. Augenh. 1895 March (178) O.R. XVII p. 332

(179) O.R. XXI p. 226 (180) Coppez - Rev. Génér. d'Ophtal. XVII p. 298

S.O. after prevention enucleation is generally curable under appropriate treatment, and the duration of the disease as noted in eleven of the cases ranges from some days to 3 or 4 months the most usual duration being 6 weeks to 2 months.

Four of the cases of serous iritis suffered a relapse, but in two of these the final recovery was not affected. In case 29 a relapse at the end of a year ended seriously with V = perception of light only. In case 16 a relapse reduced vision to $\frac{6}{18}$.

To draw a distinct line between these serous forms and the second or plastic form is impossible, and some of the serous cases, in view of their symptoms, progress, and final result, may be more fitly described as sero-plastic in type. These seroplastic cases may either represent a transition stage from the serous to the plastic type, or else, adopting the view of those who maintain (Denders & others)

that the one form does not pass into the other, they have a plastic element from the beginning.

The S.O. is characterised as plastic in Nos. 6.9.18.24.25, but it is to be noted that the eye in three of these recovered with good vision — a very marked contrast with ordinary Sympathetic plastic iridocyclitis. The true plastic form is characterised by inflammatory effusion into the tissues of the uveal tract, with formation of unyielding synechiæ. This may lead to T+ (see no. 9), for which an iridectomy was performed, but resulted disastrously. Occlusion of the pupil or the presence of much exudation occurs, the tension lowers, subsequent organisation of the effusion with resulting contraction may lead to Atrophy, and the hopeless condition known as Phthisis Bulbi is established.

The symptomatology, then, of S.O. after preventive enucleation presents the following distinguishing characteristics, that

in a very high percentage (83%) the symptoms are those of the mild so-called Serous iritis, that neuroretinitis coexists in at least 21% of the cases, that the progress is generally favourable and of short duration, and that in cases described as plastic, recovery occurs in three out of five.

The Intervals.

With the exception of the first six cases, some days elapsed between the receipt of the injury, and the enucleation of the eyeball. This length of time is called the first interval. Excision was delayed for many reasons E.g. an attempt was made to save the eye by the use of antiseptics and the usual surgical measures, or through religious and other scruples patients would not give consent. Generally, it may be said that the dread of S.O. finally led the surgeon to enucleate, inflammatory reaction having ensued

and all hope of obtaining vision being removed, pus having appeared in the vitreous, or a plastic iridocyclitis having developed. The first interval is less than 10 days in seven cases (less than 24 hours in four, than 2 days in two), is between 10 and 21 days in eleven cases, and in the remainder between 22 and 42 days.

The second interval i.e. time between the operation and the earliest sign of S.O. ranges from 2 days to 7½ months. In eleven cases it is less than 3 weeks, in seventeen cases between 3 and 7 weeks. These figures differ markedly from those in the Ophthalmol. Society's Report when the second interval was

under 3 weeks in 25 cases
from 3 to 8 weeks in 5 cases.

This increased proportion of cases with a long second interval is partly due to the elimination in our statement of all cases where S.S. or other premonitory symptom was present in the

second eye at the time of operation. In dealing with the second interval it is well to remember that even the most careful examination can not always exclude the possibility of such an insidious disease as S.O. being present in an early stage, and that the time of the first appearance of the symptoms is sometimes difficult to fix, the earliest onset having passed unnoticed or undetected by the patient or Surgeon.

A study of the combined (the sum of the first and second) intervals i.e. the time between the injury and the earliest sign of S.O. is very suggestive. These range, excluding for the present Meyer's case, from 9 to 87 days, two having their combined interval under 4 weeks, thirteen between 4 and 6 weeks, thirteen between 6 and 9 weeks. In ordinary cases of S.O. uninfluenced by excision, the most usual time for the appearance of S.O. after injury is 4 to 8 weeks, so that it

would seem that excision of the injured eye has no influence on the time of appearance of the sympathetic symptoms.

The earliest appearance of S.O. after injury (Case 2) is 9 days - an interval which would be practically unique for an ordinary case of S.O., 14 days as in Barth's (180) case being generally considered the shortest. Cases, however, of shorter incubation - using this term for convenience sake - have been reported from time to time E.g. Vigneaux (181) records a case of S.O. ten days after the injury, Browne (182) a case of serous Iritis in the other eye forty eight hours after injury by a thorn, Lang (183) a case beginning ten days after a penetrating wound of the eyeball, and Badal (184) a case of severe S.O., though not of the usual form, beginning two days after a gunshot wound of the other eye.

(180) Med. Press & Circ. II/91 p. 287 (181) "Sur l'Ophtalm. Sympath." 1877
(182) T.O.S. Vol. VI (183) T.O.S. Vol. XIV (184) La Clinique Ophtalm. 10me Févr. 1897

Note on S.O. occurring long after Enucleation with illustrative cases.

Cases belonging to this category are possibly not so infrequent as what is usually believed, and have been the subject of much discussion at Ophthalmological Congresses. Many Surgeons are opposed to their being classified as true S.O., the occurrence of the inflammation in the second eye being regarded as mere coincidence, or as quite independent of the injury. Others maintain their sympathetic nature, and if we consider the great similarity which they present in their aetiology, Symptomatology, and progress to ordinary forms of S.O., they are entitled to the most careful consideration, and have a real practical interest when dealing with Compensation and other claims for an injured eyeball requiring excision. Only one such case examined by us Viz. No. 4

conformed to the conditions laid down at page 868. the eye was enucleated within 24 hours, S.O. did not appear until seven and a half hours after. Amongst others, Thompson (185) of Kansas City reported a case of S.O. fourteen months after enucleation of the exciting eye, Collins (185) mentions a case of iridocyclitis eight months after excision within four days of the accident, no other cases being assigned, Hern (186) brought forward a case of S.O. ten years after excision for an injury. The Committee in their Report (1886) detail four cases of this kind, but in three of these the first eye was lost from disease. The following eight summaries are typical of such cases, reported from time to time, and illustrate the main features of this class.

I Dreyer's case.

Detailed at pages 89. 90

(185) Ophthalmic Record. April 1894

(186) Oph. Rev. Vol. X IX p. 22 (187) Ophthalm. Society U.K. 1900

(188)
II Male

L.E. "reduced to a pulp"

Excised 4 days after

21 years later found artificial eye in lated socket and discontinued its use

R.E. in the following year showed well marked iridocyclitis

Sensitive on pressure. Neuralgic pain

V = fingers at 3 feet

Relapses

Final Result = fingers at 4 feet.

(189)
III Male, 28 years

L.E. wound of cornea, iris, lens.

Excised 5 days after.

Normal healing. Prothesis used.

R.E. 2½ years later V = $\frac{6}{36}$ (Had not seen so well for some time) Pupil active. Globe sensitive. Neuroretinitis. No pain of optic nerve stump.

Result. Bad. disc pale and atrophic. bright spots on fundus, and pigment disturbance. No albumen.

(188) Ferdinando. B. m. J. I/98 A. 1883

(189) Leopold Weiss. Archives of Ophthalmol. XXII. 1

IV Male

L.E. injured

Excised within one week

R.E. 9 months after showed

iritis, post. synech. kerat. punct.

lymph in A.C. Circumcorneal injection

Relapses.

Final Result = Blindness.

V Male, 45 years.

L.E. injured by piece of steel

Excised one month after

R.E. 7 months later showed

Iridocyclitis

$V \frac{3}{60}$ J_{20}

Final Result. Bad.

In IV and V no other cause is mentioned to account for the disease in the second eye

(J.R. Cross. Ophthalm. Society 1898).

(190)

VI. Female.

R.E. excised in infancy some time after injury on account of S.I. in the other eye

L.E. never strong

11 years after Operation on right socket, and prothesis applied

3½ " later L.E. showed

Injection. Kerat. punct. Iritis, pain, V = fingers at 2'

Relapses.

Final Result. Very bad.

(191)

VII Young Female.

L.E. Operation for congenital cataract followed by Sympathetic iridocyclitis.

Enucleation

R.E. recovered, and perfect for 11 years, when it became painful and injected with T+

Ordinary treatment ineffectual

Iridectomy - no change noted.

Intravenous Injection of HgCy - still no improvement

Deep Injections into left Socket of 10% Solution of HgCy rapidly effected a cure.

(190) Ferdinands. Loc. Citat.

(191) Abadie. Revue Générale d'Ophtal. 1900 p. 392

viii Male, 23 years

R.E. Blow causing rupture

Excised seven months for S.I. in c.E.

L.E. Quite sound for 9 years, when

fever plastic iritis supervened

Final Result – Bad

No other cause found.

(From the Committee's Report 1886).

In seven of these eight cases the primary cause was more or less severe injury of an eye necessitating its removal, in Case viii an operative traumatism was the factor.

The first intervals noted are 1, 4, 5, 7 days, 1 month, 7 months.

The second intervals are: 7, 7½, 9 months, 2½, 9, 14, 17 and 22 years.

The symptoms are those met with in ordinary S.O., and take the forms both of a serous and plastic uveitis; in Case iii an

of the neuritis followed by atrophy is more prominent than the uveitis.

The progress of the disease is similar to ordinary S.O., whilst the relapsing character - a feature of considerable diagnostic value - is well brought out.

The prognosis of these cases is very grave compared with those of S.O. arising within nine weeks of excision: only two recoveries, the other six ending disastrously.

The pathogenesis is dealt with later on.

Let us note some of the objections that might be raised to such cases. In the first place, the length of time after the injury before the appearance of S.O. has been made much of, but remembering that in the ordinary cases of S.O. the disease may lie latent or may not appear for months, or even many years - Vieth (192) records a case 61 years after injury - this objection has not any special weight.

(192) Journ. Ophth. Otol. &c. N.Y. 1891 iii p. 172

In cases VI. VIII Sympathetic irritation was present in the second eye at the time of excision, in case VII S.O. had already appeared although the sympathetics recovered and kept perfectly well for fourteen years, and in case VI the state of the patient's health was such as to render the probability of the symptoms being due to constitutional causes very great.

No other cause being brought forward to account for the attack, there are, in our opinion, very sound reasons for admitting at least cases I. III. IV. V and VIII as examples of a sympathetic iridocyclitis in the second eye at a considerable interval after severe injury, necessitating excision of the first eye, the condition being attributable to the accident in the first instance. The presumption is very strong that, had no accident occurred, the second eye would not have suffered. On the other hand II and VI belong more to that class of S.O. due to the wearing of an artificial eye, whilst VII may be regarded as an example of a relapse of true S.O. after a

long interval, but is interesting from the point of view of treatment, and pathogenesis.

Diagnosis.

To establish the diagnosis of S.O. after enucleation the absence of all other possible causes of the uveitis must be clearly proved, as it is only by this process of exclusion that a definite opinion can be reached. For this, and to meet the objections raised to this class of cases, a searching enquiry into the personal and family history is necessary, a point which observers have not always been careful to record.

No one of the symptoms per se can enable us to make the diagnosis, as they are in every respect similar to those met with in uveitis due to other causes. Marked ciliary tenderness, causing the patient in case 1 to shrink back in a characteristic manner, is significant, and, especially when symmetrical to the site of the original lesion, was regarded as almost patho-

-gnomonic of S.O. by Bowman, Dr Graefe and others. The corresponding tenderness in the exciting eye is, of course, wanting in these cases, but orbital sensitiveness affords assistance in the diagnosis, and Liebreich suggests ascertaining whether rather from pressure in the region of the optic nerve in the socket of the enucleated eye gives the patient pain. This condition of the cut optic nerve is noted in one or two cases. The state of the orbit may also help, and careful search for tender points in the line of union of conjunctiva, for evidence of vicious cicatrisation, of abrasions, excoriations, fistulae to must be made so affording evidence of a possible source of infection. The result of treatment has little value in the differential diagnosis, except in the true plastic form, when mydriatics are as a rule powerless to free the iritic adhesions.

We have, then, in making our diagnosis to fall back on the aetiology, and the history that, in a healthy subject with a good personal and family record, an eye previously strong and

remaining so for a variable period after a severe injury of its fellow, has, even in spite of enucleation having taken place, showed all the symptoms and usual progress of an ordinary Sympathetic (Serous or plastic uveitis.

Prognosis

Having decided that the cases cited are true S.O., their course and final result present many points of contrast with ordinary cases. Mackenzie in 1844 said that he considered S.O. even at an early stage, and however slight the symptoms, as one of the most disastrous affections with which the eye could be struck, and had only seen one case recovering. Permanent and established recoveries are rare, and cases claiming to be such are reported by Rogman,(193) Schirmer,(193) Hirschberg, Berman,(194) Carter,(195) de Schweinitz(196) &c. Shaw in his special research says "Even if the injured eye is enucleated,

(193) Annales d'Oculistique. August 1895 (194) J.O.S. Vol. III
(195) Clinical Journal 12th Sept 1894 (196) Ophthalmic Record August 1900

S.O. may appear at any time within a month of enucleation, its severity and duration being in no way affected, apparently, by the fact that the exciting eye is removed."

Nettleship,[197] on the contrary, noted six recoveries out of eight cases of post operative S.O., and the Ophthalmological Society's examination of thirty cases after excision showed

18 Complete recoveries
3 Partial recoveries
9 eyes were lost.

In our cases the final result is noted as follows:-

Perfect, Complete, or Excellent Recovery in	15
Good or Satisfactory (i.e. V = $\frac{6}{12}$ to $\frac{6}{18}$) in	7
Bad (J_{14}, $\frac{6}{36}$, $\frac{6}{18}$, J_{20}) in	4
Very Bad (p.l. in two, people's faces in no. 9) in	3

From this we gather that S.O. after preventive enucleation has an excellent recovery in 52%, a good recovery in 24%, whilst

(197) Transact. Clin. Soc. Vol. xiii

the remaining 24% end with more or less serious loss of vision.

Remembering the relapsing character of S.O., these results might have to be considerably qualified, especially when there is no information as to the permanency of the recovery. Thus, in cases 5 and 16, recovery was complete in the first instance, but relapses after some months are noted. Many cases of S.O. are reported as cured before sufficient time has been allowed to ascertain if relapses have occurred. Randolph (198) says that if the eye remains quiet for a year, the condition justifies a favourable prognosis. Lopman, (199) however, places the shortest limit for estimating the curability of sympathetic uveitis at two years. Unfortunately, in our cases except 1 and 25 the state of the patient twelve or more months after reported recovery is not recorded, but we may take it for granted, at least in the majority, that no further outbreak

(198) Norris and Oliver. "System of Dis. of the Eye". Vol. III
(199) Annales d'Oculist. August 1895

took place, otherwise the event would have been recorded by whatever surgeon the patient was likely to apply to.

Two interesting questions present themselves in dealing with prognosis:-

I Can we say that the prognosis is more favourable the earlier the appearance of the symptoms of S.O.? In cases 2 and 3 in which S.O. appeared within 3 weeks of the injury the disease was mild and the recovery complete, and the gravity of cases of S.O. long after enucleation (supra p. 126) might give an affirmative answer, but a critical study of the other cases as well as cases of S.O. uninfluenced by enucleation inclines us to the view of Gunn, (200) that the time of appearance of the Sympathetic symptoms has no influence on the prognosis.

II Does the length of the first interval influence the prognosis? In cases 1–7 the excision was practically immediate, and

(200) Royal London Ophth. Hosp. Reports Vol. xi pts 1 & 3

the recovery in all of these was excellent. This fact might justify a more favourable prognosis in cases of immediate excision; as for the others, when excision takes place after a variable interval of days or weeks, one is not in a position to answer the question definitely.

The prognosis, then, in cases of S.O. after preventive enucleation is decidedly favourable, and in 15 out of 20 cases recovery with useful vision takes place. At the same time, in view of these cases being truly sympathetic, and of the possibility of relapse, a guarded prognosis is a wiser course to adopt.

Treatment.

If one judges by results, the effect of treatment in S.O. after preventive Enucleation is highly satisfactory, and this would offer a marked contrast with the disease as usually seen. Treatment must be applied

to the wound and to the sympathising eye as well as to the injured eye and to the socket after excision, and may be considered under two headings:

I Prophylactic

Omitting all consideration of the conditions and circumstances which should decide for or against the operation of enucleation of an injured eyeball, as well as the various operative procedures devised to take its place, the first point under Prophylaxis is the necessity of every care and skill being used in the operation itself. Many regard an excision as the simplest of surgical performances, but, apart from the necessary aseptic and antiseptic precautions, perfected technique and thoroughness are essential. Especially is this so in cases of badly contused, lacerated or ruptured eyeballs, which present an especial anxiety; Nettleship,[201] Gunn,[202] Galezowski,[203] and others have pointed out the possibility of a portion of the

(201) T.O.S. Vol. vi (202) T.O.S. Vol. xix
(203) Annales d'Oculist. cxxix

uveal tract being left behind, and so favouring the development of conditions necessary for S.O. The particular method of excision, however, must rest with the experience of each individual surgeon. After operation, thorough irrigation with antiseptic solutions is important, and, if septic foci be suspected, deep injection of a solution of the Cyanide of Mercury with the orbit might be employed, in view of the favourable results recorded by Fage & Abadie. Our main aim in all cases ought to be an early, rapid, and sound cicatrisation - a so-called healing by first intention, and the wearing of an artificial eye should be postponed until all trace of inflammation or possibility of irritation has disappeared.

The sound eye, also, must receive some attention, and recalling the exciting causes noted under Aetiology, this eye should be protected from such. Thus, rest for a

considerable time must be insisted upon after apparent cure, and the dangers of exposure to strong sunlight, electric or other artificial light, of exposure to strong heat rays, of continuous reading or near work, pointed out to the patient. He, at the same time, should be placed under the best sanitary and hygienic conditions, both to secure local healing, and avoid the possibility of any "toxaemic" condition arising, to which Panas' reasoning points as a possible element in the causation of S.O. (see page 52).

II Curative

When S.O. has appeared, both the focket and the sympathising eye require attention. If an artificial eye has been worn, this should be at once removed, when some pleromenes or mucopurulent secretion is usually noted, due either to irritation

of the prothesis, or want of discretion on the part of the patient. These discharges require frequent irrigations with hot antiseptic lotions. In Page's case, no improvement followed the usual treatment, and a recrudescence having occurred, injections of Cyanide of Mercury (1 in 1000) were made into the orbital tissues. These speedily improved the condition of the sympathetic, and an excellent result was obtained. A painful cicatrix pointing to involvement of the ciliary nerves ought to be freed by plastic operation, and if deep pressure elicits tenderness of the ophic nerve stump, a portion of this must be resected.

All use of the sympathising eye must be suspended, and the condition of maximum rest aimed at. The patient ought to be placed in a darkened room, and treatment applied both locally and constitutionally.

(d) Local Treatment:-

Counterirritation is of undoubted benefit in these cases, and [illegible] or blisters applied to the temple or behind the ear have a most marked effect in relieving the irritative symptoms, and thus securing further physiological rest. Warm compresses effect a similar purpose, and have a grateful, soothing influence. Subconjunctival injections of Hg Cl solution was used by Fage, and, similarly, saline injections might be tried (see page 72).

Mydriatics, however, constitute the most important local treatment, and in nine of the cases, Atropine was the only therapeutic agent employed. In the early stage Atropine must be used in strong solution, and frequently applied, until any synechiae are broken down. This being effected, in view of the fact that the tension in serous iritis tends to rise and even in some cases is +, a weaker solution merely to keep the pupil dilated

and prevent the adhesions reforming, should be substituted. Should the tension become markedly increased, Para centesis repeated several times if necessary, is justifiable, but any other operative interference, such as iridectomy, is to be condemned. Iridectomy was done in two cases for a relapse at the end of five and twelve months respectively, and in both cases the final result, through effusion and blocking of pupil, was bad. A great part of such bad results might very rightly be attached to the operation itself, and until the eye has been quiet for a long time – say, two years – operation may be considered as more or less injurious.

(B) General and Constitutional Treatment:–

Pilocarpine was used in Case 1 to produce diaphoresis, and to promote the action of the mercury. Apart from its general diaphoretic and eliminating actions, this drug has been

extolled lately by many surgeons as directly beneficial to inflammation of the uveal tract by producing increased activity of the glands of the ciliary body, and relieving tension.

The use of Mercury in these cases – by the mouth, by inunction, intramuscularly, or by vapour baths – is quite apart from any idea of Syphilis, and is favoured for its so-called antiphlogistic, alterative, or resolutive actions. Passing aside the physiological aspects of this question, the effect of Mercury is, in our opinion, beneficial, and its administration ought to be rapid, and pushed to slight ptyalism. Tavignot in 1849 recommended calomel to salivation in cases of S.O., and since then its value has been variously estimated by Surgeons. Out of 50 recoveries from S.O. noted in the Ophthalmological Society's Report 25 had had Mercury, and 25 had none. Collins, Frost, Nettleship among others express

a very reserved opinion on its therapeutic value, whilst Carter, Schirmer, Abadie, believe that it has an action almost amounting to specificity in cases of S.O. Turning to our own cases, Mercury was used in 15 of these, and a bad final result was noted in only 2, whilst in 14 cases where Mercury is not stated to have been used we find the final result bad in 5. These results would confirm our favourable view of the action of Mercury in S.O. after previous enucleation.

The general health must not be neglected, a factor in treatment insisted on by Mackenzie, and important from the views recently advanced on the pathogenesis of S.O. Quinine was given in four cases, and is advocated for routine use in sympathetic inflammation by many surgeons.

Pathogenesis.

Cases of S.O. occurring after previous enucleation present some special features from the pathogenic point of view, and in approaching their study one must abolish any preconceived view of the causation of the disease. The pathogenesis of S.O. being still a veiled and unsolved problem, wanting in many essential clinical and experimental facts, we are entitled to speculate on its rise and progress in our cases, keeping in view, at the same time, the many theories and facts put forward in the historical part by eminent and skilled observers. To adopt and rigorously adapt any one theory to all cases of S.O. is quite unreasonable and unscientific, and at once stops all progress in our search. Further, in dealing with any new class of S.O., especially when the cases cited as genuine and universally admitted to be truly sympathetic, the study of their pathogenesis has not only a special value for that particular class, but is likely to result also in some advance, or,

at least, new light on the true and essential nature of S.O. in general. More real progress is likely to be made by the study of clinical facts than by laborious, painstaking, and rigorous laboratory experimentation on animals, which have never yet been known to suffer from such a disease as Sympathetic Ophthalmitis.

The pathogenesis of cases of S.O. after enucleation is for the most part lightly and casually treated by writers on Ophthalmology, many textbooks ignoring the matter entirely, others passing it by as difficult to fit in with the special host theory of the writer, others giving the occurrence but a half-hearted acknowledgment. When mentioned, they are generally assumed to be due to the fact that the infective microorganisms had already started on their way to the other eye, and got beyond the point of section of the optic nerve at the time of the operation. Such a view takes for granted that the migratory theory of S.O. is the correct one, and so begs the whole question

at issue. Further, if the migratory theory were the only and correct view, cases of S.O. following immediate excision could not be regarded as sympathetic at all, for it is inconceivable that within a few hours the microorganisms in the wound had settled, multiplied, and proceeded on their way as far as, and beyond the cut optic nerve.

Granting, however, that S.O. has a bacterial origin, that bacterial activity produces a certain kind of inflammation in the uveal tract of the injured eye, that the one condition necessary to start S.O. is the onset of a uveitis of a plastic type (which, necessarily, implies more or less lapse of time), and that this event is followed by migration to the second eye, it might be possible on this hypothesis to explain cases of S.O. arising two, three, or a few days after excision, but it can in no way be used to explain its occurrence when immediate excision has taken place, and, with equal improbability, those in which S.O. has arisen long after removal of the

injured eye i.e. the initial focus of the infection. The view that an infective virus was necessary as the starting point of S.O. led Nettleship (204) and others to make the suggestion that, in cases of a burst or ruptured eyeball followed by immediate excision, a portion of the uveal tract was left behind in the orbit.

By the term "immediate excision" we mean those cases in which excision has taken place not only at once i.e. in an interval measured by hours, but also within a certain time before which we cannot suppose the special type of inflammation necessary for S.O. to have developed. Up to what time can we reckon an excision as immediate? Two factors are to be considered in answering this:

1. The usual time for the appearance of S.O. This, as we have seen, is from 4 to 12 weeks, one or two cases of 14 days or less have been noted. "S.O." says Nettleship (205) "very seldom begins sooner than three weeks i.e. not until time has elapsed

(204) T.O.S. Vol. VI (205) "Diseases of the Eye" 6th Edit.

for well marked inflammatory changes to occur at the seat of injury." E. T. Collins[206] says "it is safe to deal with injured eyes on ordinary principles for ten days."

2. The time necessary for development of the plastic uveitis. This may develop at any length of time, but the minimum is difficult to fix. In Page's case (excision nine days after injury) there was pus in the vitreous, and infiltration of choroid close to the ciliary body, but no iridocyclitis was present. In Nettleship's case (Excision nineteen days after injury) there was no iridocyclitis. In the cases of Stephenson and Donaldson (excision twenty days after injury) a plastic iridocyclitis was found on examination of the enucleated eye.

Up to ten days at least it is, then, reasonable to assume that the usually supposed conditions for giving rise to S.O. are absent, and so we may regard as "immediate" any excision within

(206) Encycl. of Med. Art. "Sympathetic Ophthalmitis" 1902

ten days of the injury. Cases 1–7 fall under this heading.

The other class of cases to which the usual explanation or hypothesis is not applicable are those in which S.O. occurs some weeks or months after excision, to say nothing of those at very long intervals. Shaw, Berry, Swanzy, and others regard the appearance of S.O. on the aforesaid hypothesis as possible any time within four weeks after excision. Thus, Swanzy says "We cannot feel sure that our removal of the first eye has averted S.O. from the second eye until four weeks after the operation have elapsed." We will grant, again, that cases of S.O. arising within four weeks come under the usual explanation – although to our mind such a view is difficult to entertain for those beyond a few days –, there still remain in our list several cases (not of immediate excision) where S.O. has come on later,

and it is specially to the search for some explanation of these, as well as those of immediate excision, that we now turn attention.

The question may be raised as to whether the operation itself of excision is the starting point in these cases of the S.O. Were excision per se the primary cause, we would expect to find cases of S.O. following enucleation of a diseased eyeball. Such an event is practically unheard of, and in the one or two cases we have seen reported, a common constitutional element seems the more probable explanation of the symptoms in the second eye, as for instance, in the only case mentioned in the Ophthalmological Society's Report viz. case I (T.O.S. Vol. VI). I. M. Ray (207) cites a case which he thinks would seem to prove that S.O. may be originated by the operation itself. It is the case of a child, who had lost the left eye from purulent Ophthalmitis, secondary to infection. The eye was enucleated,

(207) Archiv. of Pediatrics August 1897

and in the course of the next three weeks the other eye became blind from S.O. The observation, however, appears to us of little value. In many of the cases the symptoms appear to [illegible] to be attributable to the operation itself. We cannot admit excision as the primary cause, but that it may act as an immediate exciting cause, there can be no doubt, just as operation on the iris of the exciting eye has been known to be followed by the outburst of the S.O. Fauchart in his thesis dwells on this point, Trousseau and Kalt have reported cases in illustration, and Wecker at the Paris Ophthalmological Society in 1895 drew attention to the danger of operative interference in determining S.O.

In our opinion, a very large share of the pathogenesis of the cases under consideration must be ascribed to the an ophthalmic orbit; after dealing with the orbit generally, we will consider the possible agencies at work, the most

likely theories, and the possible paths of transmission. To apply the term "Sympathetic" to a diseased condition of an eye dependent on an orbit is to a certain extent a misnomer, but, if we consider the structures that make up an orbit after excision, we may regard them as more or less the continuation of ocular structures - conjunctiva, lymph channels of Tenon's Capsule, optic and ciliary nerves with their sheaths, spaces, lymphatics, the retinal and the ciliary vessels.

S.O. does not occur after excision of a diseased eyeball, and the cases now dealt with are those of a more or less severe injury to the globe. In all traumatisms the supposed causative agent must reach the orbital structures as well as the eye tissues, and this applies not only to the cases of immediate excision where the wounds are generally of the nature of contusions or bruises with much bruising and laceration of the whole contents of the orbit and consequently damage to

structures outside the globe, but it also to injuries of the eyeball resulting in inflammation of the coats. Brailey and others have demonstrated from pathological examinations that the inflammatory (lymphoid) cells after injury of an eyeball were found not only in the uveal tract, but also on the exterior of the sclera, along the ciliary nerves and arteries, and in the intervaginal space of the optic nerve. It is only natural to expect that a severe traumatic inflammation of an eyeball involves also the extension of this process to structures continuous with it in the orbit by the lymphatic spaces and channels, by the nerves and their coverings, by the vessels &c. Hence there may be present in the orbit affected tissue or tissues liable to be roused to activity even after excision of the globe, and without any part of the uveal tract. The cause of S.O. would, therefore, lie in the socket outside the globe, and enucleation would thus fail as a preventive.

The following personal case seems to illustrate well the part played by the orbital structures in producing, what may be regarded as, sympathetic disturbance, but, as the case is incomplete in details, and the symptoms of unusual form, it is not claimed as a case of true S.O., and merely noted to show reaction of enucleated socket on the other eye. J—M— 44 years, engineer's labourer, was struck in the right eye by a sharp piece of hot metal on the 8th April 1896. The wound was in the upper and outer corneosclerotic margin, and the iris projected into it. Vision was reduced to fingers at 3 feet. The wound was treated on the usual surgical principles with strict antisepsis, and an attempt made to save the eye. Strong reaction ensued, all hope of restoring vision was abandoned, and on the 16th April (i.e. eight days after the injury) the eye was excised — the other eye being in every respect normal.

Orbital cellulitis and free suppuration followed, and up to his death from disseminated (cerebrospinal) Sclerosis this autumn the socket has continued to discharge more or less ever since. Shortly after enucleation, we lost sight of the patient, and did not see him again until November 1897 when we found his vision reduced to hand-movements, T+3, and violent neuralgic pains causing intense suffering, and forcing his return to seek advice. An immediate large iridectomy was performed. This relieved pain and reduced the tension, but the visual acuity was but little improved. The patient was a careless, indifferent person, of unsteady habits, and his story of the intervening period is as follows. He says that his good eye never seemed strong after the excision, but for four months after the operation he returned to work. A few days later he received a blow on the remaining left eye followed by redness and some pain

which passed off in a few days. From this time, however, he had frequent attacks of redness, pain, and a feeling of tightness in the eye, lasting a few days, during which his sight was not so good. These attacks were ascribed by him to "catching cold" in the empty socket, which discharged freely at such times, just before the symptoms described were noticed in the second eye. Since the iridectomy we have had frequent opportunities of observing the patient, and were struck by the influence which an increase of inflammatory action in the socket had in causing ciliary injection, severe pain, and still further loss of sight, until total perception of light reflected by the ophthalmoscopic mirror was impossible. There was no rheumatism, and no syphilis. Was the glaucoma primary and a mere coincidence, or secondary to a sympathetic serous uveitis?

Vose Solomon (208) in 1863 published a case showing the influence of irritation of an orbit, from which an injured eye had been removed, in causing sympathetic disturbance (possibly more of the nature of S.I.) viz. pain, dulness and clouding of sight, photopsy &c. Division of a cicatricial band was followed by improvement. The introduction of a glass mask rekindled the disturbance, which again subsided on its removal.

Sulphen (209) reports a case of true S.O. due to similar cause, and caused by adhesion of eyelid to the stump, which recovered after operation.

The influence of an artificial eye placed over a shrunken stump in producing S.O. was first noted by Lawson (210), and Ferdinands (211) cites two cases in which a roughened artificial eye in an empty socket caused inflammation in the remaining eye, with all the characters

(208) Dublin Quart. Journal - February.
(209) Trans. Amer. Opth. Soc. VIII p. 428
(210) Opth. Hosp. Reports VI p. 123 (211) B.M.J. 1/98 p. 1583

of a typical S.O.

Ayres (212) records a case of S.O. following enucleation of an inflamed staphylomatous eye. There was much pain in the socket, and operation on the cicatrices, and removal of a piece of the optic nerve was followed by good recovery.

Terrasseau (213) in a case of S.O. after optico-ciliary neurectomy found on subsequent enucleation that the orbit contained some small clots and serous fluid, which he believed might have acted as foci of infection.

Alt (214) reports a case in which the left eye was removed for tumour (glioma retinae). After removal the orbit was apparently normal. Some months later the right eye underwent an attack of sympathetic iridocyclitis, and on examining the enucleated orbit several small tumours, which proved to be gliomatous, were discovered.

Abadie has demonstrated (see page 124) that an injection into the tissues of the orbit after enucleation

(212) Archives of Ophthalmology Vol. XI
(213) Revue générale d'Ophtal. March 1891
(214) American Journ. of Ophthalm. 1899 Vol XV p. 238

of an eyeball has an effect on the tissues of the sympathising eye. Darier (215) and Page (216) come to the same conclusion.

Maitland Ramsay (217) mentions a case of S.O. following enucleation and paraffin injection.

Nettleship, Brailey (218) and others have expressed the opinion that injection giving rise to S.O. may take place from orbital structures.

Such illustrations suffice to show that to the orbit some importance must be attached in causing the affection of the second eye in cases of S.O. after enucleation, and the following questions arise. What is the agency at work? If injection, is it a bacterium or a toxin? Is it purely a nerve irritation? What is the path of transmission - optic or ciliary nerves, or their sheaths and lymph spaces? Is there a special lymph circulation between the two orbits? Is there a central cause at work?

The view that S.O. arises in these cases by

(215) Rev. General. d'Ophtal. Sept 1900 (216) See ante p. 91 92
(217) Opth. Rev. xxvii p. 185 (218) Lancet ii 83 p. 1092

infection through the orbital tissues is at the outset met with the difficulty that normal healing instead of being the exception seems, so far as noted in our cases, to be most frequently the course of events after excision. Every ophthalmic surgeon, however, is conscious of the fact that strict asepsis is difficult to secure in wounds of the conjunctival sac. When existing, the presence of orbital cellulitis, of bruised and contused tissue, of healing by granulation, of free suppuration, are all conditions most favourable for the entrance of organisms, or for rapid growth and development of those introduced by a traumatism. The orbit itself favours such growth, consisting as it does of delicate tissues, endothelial spaces, and affording an ideal moist warm chamber. The transference of the disease – bacteria or toxins – under these circumstances could be effected by the open lymph channels or sheaths of the divided optic nerve, which remains permeable for a certain length

of time (Deutschmann, Velhagen, Bach), or by the direct lymph circulation between the two orbits. That such a lymph connection exists is claimed to have been proved by certain anatomists. Its existence is highly probable from such experiments as those of Gifford (see page 35) conducted with the anthrax bacillus, and it is not a rare clinical fact to observe effusion of blood into one orbit — accidental or operative — reaching the lids and conjunctiva of the other eye. In cases of immediate excision with normal healing, such a view is more difficult of application, unless we suppose that the specific infection introduced by the traumatism has rapidly reached the deeper structures, and develops there even in spite of normal healing.

The infection theory can also be applied to cases of S.O. occurring some time after excision, if we can find that the conjunctival cicatrix is weak or vicious, that it has become

abraided or excoriated from mechanical (e.g. artificial eye) or other causes, or that healing by granulation has given rise to a fistulous opening favouring the entrance of the necessary infectious agency into the orbital lymph channels. Several (219) analogous cases of S.O. after Exenteration have been reported, in which, as pointed out by Mott, a fistulous opening or incomplete inclusion of the artificial Vitreous is the most likely determining factor. Such cases of relapsing S.O. after Excision and Exenteration are very similar in nature to the form of ordinary S.O. recently described by Abadie (220) as "Ophtalmie Sympathique infectieuse chronique", in which operation carried closure of the external communication brings almost immediate improvement.

Another explanation that might be given to these cases at long intervals is that the foci of infection introduced as the result of the injury or ocular inflammation have lain dormant in the

(219) T.O.S. Vol. XVIII

(220) Annales d'Oculist. 1903 May
Opt. Rev. XXVII p. 262.

orbit, and have only later been roused to activity by causes which as yet are difficult to define. Thus. general states by lowering the vitality and resistance, or local conditions e.g. changes of temperature, traumatisms &c may set up fresh inflammation resulting in the propagation of the infection. Tuberculosis affords an analogy of foci lying dormant for long periods.

When the conjunctiva has cicatrised quickly and naturally, the question may be raised whether bacteria or toxins might not be absorbed from the conjunctival sac, and so reach the deeper parts and lymph channels of the orbit, just as alkaloid solutions instilled into one pass to the deep ocular structures. The experiments of Bono and Frisco, Coppez, Morax and others seem to demonstrate such a possibility for the eye, but Randolph [221] in a recent paper on "The role of the Toxins in Inflammation of the Eye" failed to get any results from instilling filtered cultures

[221] Americ. Journal of Medical Science, November 1902

of pus and other organisms into the conjunctival sac.

Finally, if the agent is an infectious one, is it a bacteremia or a toxin? The mildness of the symptoms, and the large percentage of complete permanent recoveries, the frequency of neuritis or neurasthenia without consecutive atrophy, seem to point to the action of mild pathogenic agencies i.e. bacterial products rather than to the microorganisms themselves.

The Optic Nerve.

Mackenzie insisted on the danger of wounds of the retina in causing S.O., and Stanley spoke of the disease as being due to a propagated optic neuritis. The experiments of Deutschmann (page 26), Alt (page 30), and others demonstrate that mechanical agents may set up a neuritis which is propagated to the other eye. Three of our cases are significant, and might support such a view. In case 1 a piece of stone was imbedded in the optic nerve for

nearly eight hours, and neuroretinitis was present in the second eye; in Buel's case a small shot passed through the retina close to the posterior pole, possibly also injuring the optic nerve, and neuroretinitis was also observed in the Sympathetiser; in Leutmayer's case a piece of steel with the vitreous gave rise directly to an optic neuritis of the exciting eye, and a marked neuroretinitis was noted as a symptom of the S.O.

Contusion of the optic nerve at the time of excision was incriminated by Mooren (see page 84), and Dr Schweinitz, Noyes, Gross, and others have hinted to the possibility of optic nerve inclusion during the process of cicatrisation, by bands, compression &c. as the cause of the S.O. Case no. 191 in the Society's report with the result of treatment seems to confirm this view, and in Meyer's case (see page 91) where S.O. did not occur until nearly eight months after an immediate excision, the orbit in the region of the cut optic nerve was tender

on pressure, and resection of this tender portion was an important element in the treatment, followed by perfect recovery.

The Ciliary Nerves.

The theory which would seem best to explain cases of S.O. after enucleation is that of ciliary nerve irritation, the conditions for such being present in all the cases, and if we could only satisfy ourselves, like Bach, that a reflex nerve irritation can give rise to a true inflammation, this view might be urged as the common cause in all. Irritation of the ciliary nerves, which are present not only as fine ramifications and delicate plexuses in the ciliary body, but also as innumerable branches and fine terminations in the enucleated pocket, may originate in many different ways. Thus:—

1. At the time of the accident these nerves are cut, contused or lacerated.
2. They are necessarily involved in the

subsequent inflammation of the eye, and the orbit.

3. During the excision they are further liable to traumatisms.

4. They may be irritated by the products of septic or other inflammatory processes, when present, either in the eye or orbit.

5. The fine twigs are directly irritated by rough or badly fitting artificial eyes.

6. They may be entangled, strangulated, worried, and irritated in the process of cicatrisation, and this could account for cases occurring some time after enucleation. (Cf. Myers' case page 157).

The conditions of ciliary nerve irritation being present, the combined Theory of Schmidt Rimpler could also be applied with equal facility, and the influence of "toxaemic" or general states as dwelt upon by Panas is worthy of some recognition.

Finally, might S.O. in these cases be due to a central cause, arising either directly or indirectly? The affirmative to this would rest

on the demonstration of the so-called trophic fibres and centres. If such a centre does exist, the vicinity of the injury, involving as it did in Case 156 severe shock or cerebral concussion, might easily be supposed to cause nuclear disturbance, and interference with the vasomotor and trophic nerves of the eye, or the injury may directly implicate the nerve tracts within the cranium as a bullet in Quel's case. Beer in 1813 ascribed S.O. to a "cerebral commotion", and Réclus, as we have seen, regarded it as a trophoneurosis, due to disturbed innervation from the propagation of a ciliary neuritis to the trophic centres of the eye. The value of this view of S.O. has already been discussed, and at the April meeting of the Société Belge d'Ophthalmo. M. Rutten revived it again to explain the occurrence of S.O. after enucleation in a case which he brought before the Society: starting as a local neuritis in the ciliary nerves of the injured eye, the alteration, he says, is propagated to the

trophic centre, extends thence from the centre of one eye to the centre of the other eye, affecting only the fibres destined for nutrition, and so producing S.O.

The result of these speculations on the pathogenesis of S.O. is a feeling of utter hopelessness of at present arriving at any solution of the question, and the need of avoiding any dogmatic attitude, or preference for one or other possible view. None of the many theories mentioned, although more or less applicable and plausible, suffices for all, whilst the close study of such cases leads one to the irresistible conclusion that a common cause is at work, a cause which, in our opinion, will only be discovered, when we become more fully acquainted with the connection, direct and indirect, anatomical as well as physiological, between the two eyes, and the two orbits in man.

Medico-legal.

From a medico-legal point of view several questions may be presented e.g.

Can we certify that a patient whose injured eye has been excised - the second eye being in all respects normal - is free from all risk of S.O.?

If not, what time after excision must elapse before we can guarantee such freedom from risk?

Whether, after a preventive enucleation in a healthy patient, an affection in the remaining eye is sympathetic at all i.e. directly attributable to the accident in the first instance?

If the symptoms are those of an uveitis, according to our definition of S.O., this last question presents less difficulty than those of the unusual forms. Amongst the latter, the recognition of sympathetic amblyopia as a true form of S.O. presents an awkward

medico-legal problem, as this affection is easily simulated, and might lead to malingering. Hooper and Dawsart spoke of sympathetic amblyopia as a true form of S.O.. Rosenmeyer at the Berlin Congress 1870 reported a case of optic atrophy from retro-bulbar inflammation due to sympathy without any papillitis. Nuel cites several cases, and shows that the condition is uninfluenced by enucleation. Rutten (see page 167) brings forward a case of sympathetic amblyopia without appreciable lesions after preventive enucleation of the exciting eye which had been injured (perforation of cornea with iris prolapse) three weeks previously. The vision became reduced to fingers at 2 m., the visual field was contracted, and the eyeball was tender to pressure. Under treatment V remounted to $\frac{5}{30}$, when there was a relapse accompanied with frontal herpes. The evidence in favour

of such unusual forms as being truly sympathetic in nature is, in our opinion, wanting, and the occurrence is more likely due to natural causes.

Cases of S.O. long after enucleation are also open to many objections, and each case of this class would have to be dealt with on its own merits. That there is a type of destructive iridocyclitis, which may arise in the remaining eye some months or even years after a preventive enucleation of an injured eyeball is evident from our study of Cases I-VIII, and should this occur in an absolutely healthy subject, whose vision was perfect before the accident, the responsibility of denying its primary cause as the result of the injury to the first eye is very great. The fact that a skilful excision with normal healing took place is no argument against such

an occurrence, and if we admit the views expressed as to the pathogenesis of these cases, the presence of the necessary orbital conditions would explain their occurrence. Orbital conditions, however, may arise from factors that might be urged as contributory negligence or causes independent of the original injury. Thus, the wearing of an artificial eye, if proved as the cause, would not enter into a claim for compensation, and careless, unclean habits of the individual, leading to septic conditions in the socket, would be regarded under the head of contributory negligence.

The class of cases, however, most likely to confront us are those of S.O. arising a few weeks after enucleation (S. cases 1–29, except Meyer's which is dealt with in the preceding paragraph. It has been usual to regard four weeks as the limit for

the appearance of S.O. after enucleation, but out of the 28 cases just referred to, we record eleven in which that interval is exceeded, amounting to 47, 49, 53 and in Leutmayer's case to 63 days. So that we may conclude with confidence - at least, so far as recorded cases are concerned - that, if the second eye has continued to be normal for nine weeks after removal of its injured fellow, the patient is entirely protected, and free from all risk of S.O. arising.

Many other points of medico legal importance might be noted, but to discuss them at length simply means a reiteration of the contrasts, inferences, and conclusions drawn from our previous study of the Aetiology, Symptomatology, Intervals, Diagnosis, Prognosis, Pathogenesis and Treatment of such cases.