Observations ON THE TREATMENT OF GUNSHOT WOUNDS OF THE SPINE.

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WHEN considering the place in the theatre of war at which spinal injuries should receive operative treatment it is necessary to weigh the advantages of early operation, which will limit the spread of septic infection and relieve the central nervous system of deleterious pressure, against certain disadvantages. These injuries require careful examination, and in some cases prolonged observation, before they are submitted to operation; a specially trained staff is required for their operative and after treatment. It is usually considered desirable that the patients should remain in the hospital in which they are operated upon for a considerable time. I think it is extremely doubtful that transport will be more injurious after an operation than before it. Of one thing I am convinced, and that is that the relief from pain which follows successful laminectomy places the patient in a much better position to withstand the strain of the journey. It is inevitable that, with the exception of certain conditions in siege warfare, when special units can be organized for particular branches of surgery, the treatment of these cases will have to be relegated to the base hospitals.

The following case is not without interest from the fact that the missile was removed from a portion of the vertebrae inaccessible by laminectomy:

CASE I.

Pte. C. was wounded by a rifle bullet, which entered the right loin 2 in. below the extremity of the last rib, and fracturing the transverse process of the second lumbar vertebra, lodged to the right of the body of the same vertebra. The patient suffered from severe local pain, which radiated down the branches of the lumbar plexus. There was partial motor and sensory impairment of the right leg. Five days after the injury a long incision was made in the right loin and peritoneum exposed by muscle splitting. A hand was then inserted by a retroperitoneal route and the fractured vertebra felt for as a guide to the bullet. A scoop was passed down the same track and the bullet removed. A counter-incision was made from the back to the site of the bullet and the cavity drained by "salt sac"—a tube made of gauze and bandage filled with common salt. Pain disappeared after the operation. Fourteen days later the wounds were healed, full sensory and motor control had returned, and the patient had entirely recovered.

Wounds of the spine may be extensive, the whole section of the cord being involved, and conductivity of the cord lost. Such cases present all the unfavourable phenomena associated with fracture-dislocation of the spine as met with in civil practice, together with the additional danger of septic infection. These cases are obviously unsuitable for operative treatment, but it is otherwise with many cases of spinal injury.

The following case reported by Captain Hepburn illustrates a type of inoperable cases complicated by concomitant injuries:

CASE II.

Wounded by a fragment of high explosive shell; was admitted about three days later with an irregular wound which would admit two fingers, situated about 2 in. to the right of the second lumbar spine. The wound was very septic, with extensive surrounding cellulitis. X rays showed the shell fragment lying in front of the left margin of the second lumbar vertebra, with a fracture of the body.

The patient became very toxic and extremely jaundiced, with severe abdominal pain and vomiting, and died ten days after being wounded.

At autopsy the shell fragment was found between the two layers of mesentery of the small bowel, which was extremely thickened. There was extensive retroperitoneal effusion of blood, a fracture of the body of the second lumbar vertebra, laceration of the top of the right kidney, but no laceration of the peritoneum and no injury of the liver.

Considering the results of spinal injuries as a whole, it must be admitted that they have not been encouraging, but it will probably be found that better will be obtained in the future. At the present time improvement has been noticeable in the results of treatment in these injuries. The cause of disappointment in the past was partly due to a lack of differentiation between hopeless cases and cases likely to benefit by operative treatment and partly to

delay in operation. Spinal operations, to be successful, must be performed at an early stage before any vital changes have occurred in the cord. The earlier circumstances allow the cases to be operated upon, the better will be the results. By delaying the operation, cases lose their chance of recovery in two ways—sepsis spreads, and pressure upon the nerve tissue causes vital changes in the cord. An early operation will remove the septic focus and relieve the pressure upon the nerve tissue, thus obviating the main causes of permanent nerve tissue lesions.

We have had many opportunities of witnessing the relief which follows the removal of a foreign body from the central nervous system. A foreign body, whether a missile or a depressed fragment of bone, exercises a striking effect upon the circulation of the brain and cord, and coincident with its removal the previously non-pulsating tissues begin to vibrate. Good circulation is essential to the recovery of injured tissue, and early operation affords the best chance of relieving the interference in an injury to brain and spinal cord.

We know that by operation planned to remove septic tissue and to relieve the pressure of fragments of bone or foreign bodies we can effectively deal with depressed compound fractures of the skull, and that by adopting the same principle we can excise a penetrating wound of the knee, remove infected bone, and obtain aseptic result. It would appear rational to apply the same principle to injuries of the spine, and, with certain reservations, this can be done. The spinal injury differs from the head injury in the greater susceptibility of the spinal cord and its lack of regenerative power. The small area of the spinal cord renders an injury to the cord of much more serious importance than an injury to the brain. An injured area in the brain may be recoverable, where an injury of corresponding size to the cord may destroy the whole section of the cord.

It would appear justifiable to operate upon spinal injuries when a foreign body is present and has been shown by x ray localization to be in an accessible position. Septic trouble is almost certain to follow a foreign body lodged within the spinal theca and its removal will not add materially to the patient's danger. Severe pain alone is occasionally a sufficient reason for operating.

The principal indications which make operative interference justifiable are evidence of some remaining conductivity of the cord, evidenced by the presence of some motor and sensory function in the part below the injury. Here the transverse lesion of the cord is incomplete, and the removal of pressure may be followed by great improvement. The circulation is restored and function is recovered.

CASE III.

Sgt. W. was wounded on October 24th and admitted to a base hospital on October 26th. There was a clean entrance wound at the back of the neck 2 in. to the right of the spinous process of the sixth cervical vertebra, and an exit wound in front, below the margin of the lower jaw on the left side.

The symptoms present were left hemiplegia and paralysis of the right arm, loss of sensibility on the left side, and hyperaesthesia of the right arm and foot. The presence of conductivity of the cord and the evidence of fracture of the fifth cervical vertebra were considered sufficient reason for operating.

A long incision was made over and down to the spine of the cervical vertebrae and the spinous processes cleared of muscles. Retractors were placed in the grooves on either side of the spines and the muscles retracted; the laminae were exposed and the fracture of the fifth vertebra discovered. The spinous process of this vertebra was fractured and the lamina on the left side was fractured near the articular process. The spinous processes of the vertebrae above and below were cut off. The right lamina was divided and the laminae of the damaged vertebra removed. A detached fragment of bone was found pressing upon the spinal theca. The dura was not lacerated and pulsed normally. The depressed fragment was removed and the wound sutured. The right arm recovered rapidly, and the following day sensation was normal. The patient suffered from considerable pain in the right arm after the operation. The operation wound healed by primary union.

The patient slowly recovered the use of his limbs, and three weeks after the operation had completely recovered, with the exception of partial paralysis of the left arm.

Cases of injury to the cauda equina have a much more hopeful outlook. The cauda equina bears a greater resemblance to the peripheral nerves than the spinal cord, and its nerve roots have been cut and sutured in animals, with complete recovery of function later. Tuffier

operated upon the first two lumbar roots, which had been divided by a bullet wound, and obtained perfect recovery.

The principal points by which injury of the cauda equina can be differentiated from injury of the cord are:

The position of the wound.

X ray may show a missile or fracture of the lower lumbar vertebrae.

Asymmetry of the symptoms.

Severe pain.

Pain and hyperaesthesia are indicative of injury of nerve roots rather than cord. Abolition of the deep reflexes points to a lesion of the nerve roots, either the efferent or afferent fibres being injured. The reflex centre in the cord may be injured in some cases, but the loss of conductivity will then be complete. Limitation of symptoms to a small portion of the segments of the lumbar-sacral region denotes a caudal lesion. A rapid increase of symptoms from segment to segment will denote a medullary lesion. A slow involvement of additional segments will point to a caudal lesion.

GENERAL CONSIDERATIONS AS TO TREATMENT.

Three lines of treatment are indicated—prevention of sepsis, removal of gross pressure upon the spine, and the prevention of complications which threaten life.

The most dangerous complication associated with spinal injury is septic infection of the genito-urinary tract, and this can usually be prevented by adequate care in the passing of catheters and by the use of urinary antiseptics and twelve-hourly lavage of the bladder. A solution of quinine sulphate, 1 or 2 grains to the ounce, has been recommended for this purpose. It is important that a catheter should be passed when the patient arrives at or leaves a hospital, and that instructions be given for the passage of this instrument during transport. The risk of sepsis is not added to by irrigation of the bladder once it is necessary to catheterize.

The following classification of injuries may be used from the point of view of treatment:

1. Injuries which have perforated the spinal theca.
2. Injuries which have not perforated the spinal theca.
3. Concussion of the spinal cord, which may be produced by the passage of a bullet through the vertebrae without actual pressure of the missile or bone fragment.

A trauma of the spinal column, even of a comparatively slight nature, may produce injury to the cord itself. The differentiation of concussion from organic injury has an important influence on treatment. A bullet passing through the body of a vertebra or merely touching one of the processes may produce concussion of the spine, presenting symptoms almost indistinguishable from an organic lesion. Neurologists rely mainly upon the improvement of the symptoms when distinguishing between the two conditions.

In severe concussion, paralysis of the body below the lesion takes place, the reflexes are lost, sensation is diminished, and the sphincters are paralysed. The chief signs by which the lesion can be differentiated from pressure upon the cord are as follows:

The transient nature of the symptoms; soon after the injury the patient begins to recover and there is a gradual return of function.

The symptoms usually correspond to those of a complete transverse lesion, and there is a complete loss of conductivity of the cord.

An x-ray examination will be negative.

The careful examination of the nervous system, the observation of the cause of the symptoms, together with an x-ray examination, will usually differentiate cases of concussion from cases suitable for operation, and prevent an unnecessary operation being undertaken. In some cases the diagnosis will only be made in the course of an exploratory operation. In cases in which the symptoms are practically indistinguishable from gross injury, an operation would appear to be justifiable on the grounds that it will do no damage and waiting will inflict irreparable damage upon cases suffering from the effects of pressure. Moreover, when a bullet has caused concussion, it has in all probability depressed bone also.

Pressure upon the Spinal Theca by Missiles, Depressed Fragments of Bone, or Extra-dural Haemorrhage, without Perforation of the Theca.

Here the outlook is most hopeful if the operation is performed before the pressure has caused irreparable damage to the nerve tissue. Laminectomy should be performed, and the missile or depressed fragments removed.

Complete recovery occurred after the removal of a shell fragment which had fractured the laminae of the fifth cervical vertebra, and depressed bone to the extent of half an inch square. Signs of recovery began to appear the day after the operation. The patient left for England with complete recovery of function.

Spinal Haemorrhage.

Haemorrhage may be produced by indirect violence, such as fracture of the body of a vertebra by a high velocity bullet, or by direct injury to the theca by a missile or bone fragment.

Extra-dural haemorrhage or haemorrhage into the spinal theca may occur, and both conditions may be present in some cases. Cases of haemorrhage without other spinal lesions, such as concussion or pressure on the theca by foreign bodies or bone, are rarely seen, but haemorrhage in a degree sufficient to cause symptoms of pressure is often present with other lesions. In one case, operated upon for a bullet wound in the lower dorsal region, there was paralysis of both legs and of the sphincters; signs of conductivity of the cord were evidenced by the presence of sensation below the injury. Laminectomy was performed and a small fragment of bone discovered pressing upon the front of the cord. The dura was not lacerated and was pulsating feebly. When retracting the cord to remove the fragment of bone, a considerable amount of clot was squeezed out of the spinal canal, and at once the dura began to pulsate normally.

The treatment of spinal haemorrhage will usually form part of the treatment undertaken for the relief of pressure from some other cause. Cases in which spinal haemorrhage played an important clinical part have been rare in our experience. The optimistic view that haemorrhage into the spinal theca will recover spontaneously is more than doubtful, and such cases would appear suitable for exploration.

Injuries to the Spine with Penetration of the Dura.

The condition is comparable to that of depressed fracture of the skull, with particles of indriven bone penetrating the cranial meninges and lacerating the brain. Sepsis is exceedingly likely to extend to the spinal meninges along the bullet track and depressed bone. The most excruciating pain may be caused by depressed particles of bone, and the advance of sepsis mercifully ends the patient's suffering by causing spinal meningitis.

The only successful treatment is the early removal of the peccant fragments. Expectant treatment allows the patient to run risks out of all proportion to the risk of an operation. If spinal sepsis does not end the patient's sufferings an infection of the genito-urinary tract usually occurs, and in those rare cases in which the patient survives these dangers he often remains a hopeless paralytic.

Undertaken at an early stage by specially experienced operators, the surgical treatment of this condition should prove if not brilliant, at least a means of saving a fair portion of the victims.

It is of the utmost importance that the operation be carried out under a local anaesthetic, or shock, haemorrhage, and chest complications will levy their toll. The operation begins as an ordinary laminectomy operation, except that if the bullet track be accessible it should be excised. In some cases the results can be obtained without any bone-cutting at all, the fractured lamina being merely removed with forceps and scissors.

Circulatory disturbances are at work in these cases, the pressure of the fragments upon nervous tissue exercising an untoward effect upon the circulation of the central nervous system. The importance of the early relief of this interference with the circulation must be fully recognized if a favourable result is to be obtained. The delicate nerve tissue of the cord rapidly receives irreparable injury from pressure, the patient is worn out by pain, and septic infection extends as a result

of delay in operation. Operative treatment may be contra-indicated in some cases. Severe injury to other organs and total loss of conductivity of the cord will usually negative operative treatment.

Foreign Bodies within the Spinal Theca.

In addition to any damage the missile may have inflicted on the cord or cauda equina, the danger of sepsis makes the injury most serious. The missile will almost certainly have carried septic matter into the wound, and will form a septic focus within the theca. Early removal of the missile gives the patient his only chance if the missile be septic.

The results of removing septic missiles from within the cranial meninges is sufficiently satisfactory to make such operations on the spine hopeful if performed within a reasonable time of the injury. In one case a shrapnel bullet was removed from within the spinal theca in the lumbar region seven days after the injury. The patient was paraplegic before the operation, and great improvement in motor power had taken place before he left hospital.

The interest of the following case lies in the fact that complete recovery followed an operation upon a septic wound complicated by a septic compound fracture in the vicinity of the spinal wound. The case appeared to be almost hopeless, as septic meningitis seemed almost certain to occur. In this case, as in all spinal cases, urotropine was administered from the beginning.

CASE IV.

Pte. M. was wounded in several places by fragments of high-explosive shell. Two fragments lacerated the skin over the fifth dorsal spine, fractured the spinal laminae, and entered the spinal theca. A larger fragment inflicted a large lacerated wound over and fractured the left scapula. Partial motor and sensory paralysis of both limbs was present, and the patient suffered from violent pains in the right leg. The bladder and rectum were normal. Five days after the injury the compound fracture of the scapula was in a most septic condition, and pus and cerebro-spinal fluid were exuding from the spinal wound. Two metallic foreign bodies were localized within the spinal canal. The septic compound fracture of the scapula was treated by dressing with gauze soaked with hypertonic salt solution, the dressing remaining in the wound, untouched, for four days. The perforating wound of the spine was excised, the track of the missile having been packed with gauze soaked with tincture of iodine. The laminae of the fifth and sixth dorsal vertebrae were exposed and a comminuted fracture of the fifth arch discovered; this and numerous depressed fragments of bone were removed. A laceration of the dura was present; a scoop passed through the laceration detected a metallic foreign body; this missile and some fragments of bone were extracted. The second foreign body could not be reached, so the laminae of the sixth dorsal vertebra were removed, exposing it; the remaining fragment was then removed from the spinal theca. Two small salt sacs were inserted down to, but not into, the spinal theca, and the muscles were drawn together by a catgut suture. The skin wound was partially closed. The spinal wound was well shut off from the septic compound fracture by impermeable material. The entire operation was performed under local anaesthesia.

The patient's limbs were massaged daily, and ten days after the operation he had regained complete motor and sensory functions. The spinal wound was dressed seven days after the injury, the salt sac came away quite easily, and the wound was afterwards dressed daily with 5 per cent. saline solution. A considerable amount of cerebro-spinal fluid escaped from the wound for a fortnight after the operation. The patient suffered from violent pain in his legs during convalescence.

Two months after the injury the patient was walking about completely cured.

Wounds of the Spine causing Total Loss of Conductivity of the Cord.

An irreparable injury has been inflicted upon the cord, and an operation will not lead to any improvement of the symptoms. These cases are comparable to the cases of fracture dislocation of the spine met with in civil practice. They are unsuitable for operative treatment. An exception to this may be made in cases in which the pain is so severe that an operation is worth undertaking for its relief alone.

Exceptionally, it may be possible to prolong a patient's life, although he is foredoomed to death, by undertaking an operation for the removal of sepsis.

INDICATIONS FOR OPERATION IN GUNSHOT WOUNDS.

Cases in which there is Evidence of some Conductivity of the Spinal Cord.—In all cases in which conductivity of the spine remains there is hope of improvement in the

functions. An operation will not harm the cases in which the damage to the cord is too extensive to allow of recovery, and will save the lives and functions of the slighter cases.

Pain.—The pain in some spinal lesions is so atrocious that an operation is justifiable, whatever the lesion of the cord.

CASE V.

Fracture dislocation of the first and second lumbar vertebrae, caused by the fall of a trench wall. Motor and sensory paralysis were complete with the exception of slight movement in the toes of the left foot. Retention of urine. The patient suffered excruciating pain. There was little hope of improvement in function, but a laminectomy was considered justifiable for the relief of pain. The pain was immediately cured by laminectomy, and considerable improvement in motor power resulted.

Operations upon Spinal Injuries.—The x-ray examination preceding the operation is of the greatest importance. A lateral as well as an antero-posterior plate is always necessary, and if a foreign body is present accurate localization must be carried out. The localization of the foreign body is so important and so difficult to obtain in this situation that special precautions must be taken. No reliance should be placed upon stereoscopic plates when used either in a stereoscope or by squinting. They are liable to represent a foreign body either deep or superficial to a known structure according to the preconceived idea of the observer. In the lumbar region the curve of the spine prevents the close application of a glass plate to the skin; a film should be employed in this situation. It is necessary to place beyond all possible doubt the level at which a foreign body lies. The surgeon must be able to attack the lamina concealing the foreign body with confidence that he is removing the right one. Unnecessary removal of the lamina and dangerous searching will be avoided if the following procedure be adopted:

Under local anaesthesia a deep silver suture is placed at the side of the spinous process of the suspected vertebra. The patient is then x-rayed and the wire left *in situ*. During the operation, whether the wire is next to the vertebra concealing the missile or not, it will be easy to identify the correct one, which if not opposite the wire is usually the one above or below. A similar method is to scratch the skin across the suspected spinous process, and lay a needle across the scratch before taking the x-ray plate. Some such precaution is to be recommended. Counting the vertebrae during an operation has caused doubt and difficulty even to experienced operators.

Shaving the skin area, cleansing with ether and biniodide, the application of a sterile dressing two hours before the operation, and painting the skin with iodine at the time of operation, has given satisfactory results. Local anaesthesia has usually been employed, in some cases combined with a slight degree of ether or chloroform anaesthesia. The use of local anaesthesia has been found to be so advantageous that other methods have been abandoned. The success of the operation depends largely upon its use. Several cases suffering from severe chest complications have had no ill effect from the operation. Either the prone or the lateral position may be employed; the prone position gives the better exposure of the vertebrae. When the lateral position is employed the lower leg is placed in the extended position, the upper leg is flexed, the knee being bent to a right angle, and a thick hard pillow is placed beneath the bent knee and leg. In this position the patient rests comfortably and firmly on his side. An incision is made in the middle line down to the spinous process. The incision should be a long one, about 8 inches in length. The retraction of the soft parts and exposure of the laminae are much facilitated by a long incision, and the whole operation can be carried out with greater ease. The spinous processes are then cleared on both sides by cutting downwards close to the spinous process, to the laminae through the whole length of the incision. With a pair of strong scissors the remaining muscles attached to the spinous processes are cut and cleared away. When the soft parts have been cleared from the spinous processes throughout the whole length of the wound it will be possible to pass a pair of retractors down to the laminae in the grooves on either side of the spine and retract the erector spinae muscles.

The vertebrae can now be examined; if a depressed fractured lamina is discovered, the spines of the fractured vertebra above and below are cut off and the fracture examined. In some cases the fracture involves the laminae at each side, and these can be removed when the ligamenta subflava have been divided.

The lamina of one side may be fractured, and it may only be necessary to divide the uninjured side, or both laminae being fractured they can be removed without cutting any bone.

The most difficult step in the operation is the division of the first lamina. The lamina must be removed as far as the articular process, but it is not necessary to commence the section at this difficult spot; the lamina may be divided nearer to the spinous process and the remainder of the lamina removed with bone forceps. There are three well-known methods of dividing the laminae, of which the use of the cutting bone forceps is probably the easiest and most convenient. A saw may be used either of the guarded pattern, or a Hey's skull saw. The cut is made with an inward direction in order to avoid the articular process, and the section is completed with forceps. The drilling or trephining method is carried out by cutting a hole in the middle of the lamina with a drill or burr, and completing the section with De Vibiss or other suitable forceps. The entire division by forceps is rapid and sufficiently easy. Laminectomy forceps, Sargent's craniectomy forceps, or Jansen's bone forceps may be used. Whatever forceps are employed, the surgeon must be practised in the use of the instrument. With well-devised bone forceps the lamina may be bevelled until the edge is very thin and easily elevated. The spinal dura is separated from the lamina by tissue, and is not easily injured with ordinary care. The infiltration of the tissues with adrenalin solution, a long incision permitting easy retraction, and a good exposure of the laminae will greatly facilitate this difficult stage of the operation.

When the spinal canal is opened the condition of the fracture can be further investigated, detached fragments of bone or the missile may be discovered. The spinal canal will sometimes be found to be filled with effused blood, and a continuous stream of saline may be commenced at this stage. The dura is examined, and if uninjured and pulsating normally is not opened. If lacerations are present, depressed fragments of bone or missiles are sought for. The operation is completed by suturing the spinal muscles by one continuous catgut suture and suturing the skin without drainage. The wound is invariably painted with mastisol wound varnish.

Secondary infection and death from meningitis is very apt to follow drained laminectomy wounds when incontinence of urine or faeces is present.

At the conclusion of the operation, and for some days afterwards, the patient is placed flat on his back. The pressure upon the wound is advantageous.

In the dorsal area it is comparatively easy to explore the spinal canal anterior to the cord. One or two nerve roots may be divided with safety in this region and the theca gently retracted. The nerve roots are afterwards sutured with fine catgut. Operations for injury to the cauda equina have given the best results. Any division of the cauda which is discovered should be sutured. The probability of regeneration and recovery of function is considerable.

CONCLUSIONS.

1. The majority of cases of gunshot injury to the spine require excision of the wound and exploration at the earliest favourable opportunity.
2. The diagnosis is not so gloomy as past experience teaches.
3. Local anaesthesia is practically essential.
4. The administration of urotropine should be begun as soon after the injury as possible.
5. The presence of a missile together with severe pain are indications for immediate operation.
6. Accurate localization of foreign bodies is of the utmost moment. A lateral as well as an antero-posterior view is desirable.

REFERENCE.

1. A. J. Hull: *Surgery in War*, Chapter III.

THE TOXIC EFFECTS OF ETHYLHYDROCUPREIN ON THE EYE.

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CONSIDERABLE interest has been aroused lately regarding the therapeutic value of the alkaloids and derivatives of cinchona, and attention has been drawn to this in recent numbers of the *BRITISH MEDICAL JOURNAL*.¹ In a paper by Morgenroth and Levy² on the chemo-therapy of pneumococcus infection, the process by which they arrived at the conclusion that the pneumococcus can be destroyed or rendered inert by quinine or its derivatives is described. They showed that in certain infections induced artificially by virulent strains of the pneumococcus the micro-organisms can be destroyed and the lives of the majority of the animals saved by the administration of ethylhydrocuprein. Fränkel³ used this drug, which is a quinine derivative, in a number of cases of pneumonia, which was then epidemic in Berlin. In describing his results, he said:

As with the serum therapy of pneumonia, which does not promise much, so with ethylhydrocuprein. This does not appear to be the thing we want, chiefly because it produces a very disagreeable complication, which, though it occurs in a small number of cases, yet is so evident that the drug cannot be recommended for use in practice. This complication is the occurrence of amblyopia, which we observed in 14.3 per cent. of our cases. The single dose prescribed was 0.5 gram, and from 1 to 2.5 grams were administered internally daily. After we became aware of this effect of the drug we did not give above 2 grams a day. The amblyopia disappeared rapidly (two days) on stopping the drug. I have no doubt that, had we continued this treatment, permanent visual defects would have followed. You know that in simple quinine intoxication complete amaurosis occurs. Ophthalmoscopic examination showed well-marked narrowing of the retinal vessels, chiefly the arteries, with reduced visual fields. When at the worst, the patients were able to make out fingers at 1 or 2 metres only.

The complication here described has occurred in a case in which I am interested, but with disastrous results. In the early part of 1915 I was called in consultation to see a man, aged 40, who a month before was extremely ill with pneumonia. His medical man, with the consent of the consulting physician, prescribed ethylhydrocuprein in 5-grain doses, to be taken every three hours. The patient took in all 120 grains.

The day previous to the discontinuance of the drug the patient complained of roaring in the head, partial deafness, and a feeling as though a dark blind had been drawn over his eyes. He was so ill and difficult to understand that these symptoms were considered to be due to meningeal complications. The drug was stopped next day, when it was found that he was quite blind and could not distinguish light from dark.

I found that he had bare perception of light; the right pupil reacted very slightly to light, the left not at all. Pupils two-thirds dilated. Ophthalmoscopic examination showed that the vessels were reduced to fine threads, the arteries being made out with difficulty in the left eye; both discs were quite white. This was in February, 1915, one month after the commencement of the symptoms. I saw him again on March 11th, 1915. My notes are as follows:

Considerable improvement in vision; can find his way about inside and outside the house, and can distinguish such articles as a knife, fork, or spoon at three metres.

On April 3rd, 1915, there is much improvement; V. = R. $\frac{1}{5}$, L. $\frac{1}{4}$; reads J. 4 slowly & L. E. and & R. J. 14; both fields very much contracted; pupils react to accommodation and slightly to light. Colour vision obliterated. Right disc not quite so white, but vessels still attenuated, more so in left eye.

On June 5th, 1915, V. = R. $\frac{3}{8}$, L. $\frac{3}{8}$. Ophthalmoscopic examination: Right eye, faint blush on temporal side of disc. Left disc quite white and vessels reduced to fine threads. Pupils both oscillate in a remarkable manner, synchronously, in day and gas light.

August 25th, 1915. V. = R. $\frac{6}{10}$, L. $\frac{7}{10}$; near vision = J. 4 & R. and L. Complains of severe pains in the back, which have troubled him more or less since convalescence set in. Attacks last a few days, during which visual acuity is considerably lowered and fields much more contracted, with immediate restitution to former level when pain ceases. Small coloured objects 2 mm. to 3 mm. in diameter not spotted, but with larger objects, such as postage stamps, red and green colours are easily named.