LECTURES ON THE SURGERY OF THE SPINAL CORD AND ITS APPENDAGES.

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FIRST LECTURE.

In these lectures it is my intention to discuss the present position and future prospects of the surgery of the spinal cord and its appendages—that is, its meninges and its nerve roots so far as they lie within the vertebral canal. The present is a suitable time for such a summary, because we are now in a position to estimate with considerable accuracy the true value of the operation of laminectomy. Practised from the early part of the century—not to go further back to such operations as that of Louis, and such suggestions as those of Paulus of Ægina and others—this operation gained but little in favour, so that from 1814 to 1885 we find but 50 formal operations undertaken for injuries of the spinal cord. During the last ten years, however, we have seen a great development of this branch of surgery.

TERMINOLOGY.

The term "laminectomy" is itself a creation of the last few years. Until recently it was customary to speak of this operation as "trephining the spine;" but not only is the trephine seldom used in laminectomy, but the analogy between this operation and that of trephining the skull is at best a distant one. The term "vertebral resection" is cumbersome and not by any means explicit, the latter objection holding also in the case of the name "rachiotomy"—introduced, I believe, by Mr. Davies-Colley—which, although convenient, includes such operations as that by which we attack the anterior aspect of carious vertebrae. Laminectomy, on the other hand, is perfectly explicit and at the same time convenient, and, as it has been generally adopted in this country, I shall use it throughout. The only objection to it is its bastard derivation, and the purer "laminectomy" has therefore been substituted by Lloyd; but the latter term has not apparently found favour in England, although the fact that it is used in the recent elaborate work of Chipault probably indicates that in France at least it will now be generally adopted.

MORTALITY OF THE OPERATION.

At the present time we have extensive statistics, although these are not altogether easy of interpretation. Thus, in the admirable tables collected by Chipault, we find, after laminectomy for injuries, a mortality of about 48 per cent., or if we include only cases dating since 1885, 37 per cent., whereas in 1889 I estimated the mortality at 57 per cent., or if all cases in which the result was not stated were included as fatal, 67 per cent. In any case, this mortality compares favourably with that of cases not submitted to operation, which appears from the tables of Gurlt to amount to 80 per cent.; but it is so difficult to say how far the issue in each case was due to the operation and how far to the injury that these figures are of little real value. Their main interest lies in the fact that they demonstrate an improvement in the results, which is probably to be attributed partly to improvements in surgical methods, and partly to a more judicious selection of cases.

The operations for tuberculosis are a better test of the dangers of laminectomy, as the original lesion is here far less frequently fatal, and in this group of cases I believe that the true operation mortality is about 20 per cent, although here again it is often impossible to say how far the end was hastened by surgical interference. We shall probably obtain the fairest conclusions if we refer only to the statistics of a few surgeons, who have reported the whole of their cases,

and for this purpose I have added together the cases of Macewen, Horsley, Lane, and myself in this country, and of Abbé, Chipault, and Schede from abroad. We thus find a record of 70 cases, with 12 deaths due to or hastened by the operation, yielding a percentage mortality of 17.1. This being so, I think I may repeat the conclusion to which I arrived in 1889, namely, "The dangers of the operation are not great, especially in view of the conditions which it is intended to relieve."

The cause of death in these selected cases is important, and in the very great majority we find it to have been shock; septic troubles are practically absent, and hæmorrhage, formerly so much feared, is rarely serious. This fact is again an encouraging one, as it is by no means impossible that an increasing experience and perhaps an improved technique may lessen the one serious risk—that of shock.

PENETRATING WOUNDS OF THE SPINAL CORD.

Believing that, owing to the comparative simplicity of the lesion, cases of this nature would throw an important light upon the more common and more complicated fractures and dislocations, I have collected and analysed 40 published records, mostly stabs with the sword, bayonet, knife, or chisel.

In all these cases the meninges were certainly wounded, by an instrument which was probably septic, and in spite of this, in 38 cases in which the result is stated, we find only 15 deaths, of which 9 only were due to septic infection. The usual form of septic disease has been a rapidly spreading meningitis, which in 2 of the cases extended to the cranial meninges, whereas in 1 case only was death due to a localised meningo-myelitis. Under these circumstances we can hardly regard the spinal meninges as peculiarly liable to septic inflammation. Again, there are 9 of the 40 cases in which there is a clear account of the discharge from the wound of cerebro-spinal fluid, which discharge was often profuse and prolonged, but this result gave no trouble save in one case, reported by Walshe, in which there ensued severe retching, readily arrested by closure of the wound, the patient making a good recovery. This being the case, it would appear to be good practice, in case of injury or suspected injury of the meninges, which is likely to be septic, to leave the wound open, and thus to allow of the escape of such discharges as may form.

The most important point, however, with regard to these penetrating wounds of the spinal cord, is the question of recovery of function after such a lesion, indicating, as it does, the power of repair of the human spinal cord. Of the 40 cases to which I have referred, 5 may be neglected, as there was evidence of injury of the meninges only, and one, that recorded by Parmentier, is, I believe, an example of section of the cauda equina. This leaves us 34 cases in which either the cord or the lower end of the medulla oblongata was wholly or partially divided. Many of these cases, it may be said in parenthesis, showed at first paralytic symptoms, which rapidly cleared up to some extent, leaving as the more permanent or typical condition a spinal hemiplegia. Thus they are not only excellent examples of the so-called Brown-Séquard's paralysis, but they illustrate the readiness with which the minor compression lesion of the uncut side of the cord clears up, the one side being subject no doubt to the destroying lesion of section, the other to the mere pressure of hæmorrhage.

Of the 34 cases comparatively few died; we have 21 non-fatal examples in which the ultimate result is recorded. In these 21 cases the opportunities for recovery of structure and of function are the best possible. It is obvious that there can have been no great separation of the cut surfaces—nothing, probably, beyond a slight layer of clot—no persistent compression of any kind, and no septic infection. Despite these most favourable conditions complete recovery of function occurred in but 3 cases; 16 had certainly persistent paralysis or anæsthesia, or both; and two were said to be improving when lost sight of. Further, of the numerous cases with permanent symptoms, very few showed any amelioration of the earliest condition. These facts appear to point strongly to there being little power of recovery of function after a destroying lesion of the human spinal cord, and although in a few cases such recovery was certainly

satisfactory, these are so few and so opposed to the general rule that we can hardly suppose that the original injury was of any serious extent.

The teachings of physiology upon the question of repair of the cord are, in spite of the number of researches into the subject, still uncertain. All the evidence is against the possibility of structural or anatomical repair in the higher animals—at least in adult life. On the other hand, numerous researches—as, for instance, the recent experiments of Turner—prove that section in the highest mammalia may be succeeded by recovery of function, provided that the section is not completely transverse; but the observations of Rossolymo, Mott, Turner, and many others show equally that such recovery is due to vicarious conduction by uninjured portions of the cord.

The general and most important conclusion is that in man we cannot hope for anatomical recovery; that vicarious conduction may allow of restoration of function to some extent, but that in the case of complete transverse lesions, in which vicarious conduction is manifestly impossible, no recovery whatever will take place. The basis of these conclusions appears to me to be so strong that in a case of reported recovery after section or a complete crush I should doubt the diagnosis of the lesion. For these reasons, also, I should regard as useless the operation of suture of the spinal cord, or rather of the pia mater, proposed by Chipault. This proceeding is certainly possible, and has been carried out by the French surgeon on the dead body; but I fail to see how it can be of any service, and it may be harmful, not only by necessitating some manipulation of the injured cord, but also by confining the effused blood and serum, and thus increasing the pressure upon such parts of the medulla as have escaped section.

The above remarks apply to the spinal cord only, but it is quite otherwise with its nerve roots after they have left its structure. These roots are now simply peripheral nerves, and nothing is more certain than that such nerves are capable of repair after section. Hence we may anticipate recovery of the nerve roots when divided within the vertebral canal. That such repair actually does occur in animals has been proved by Kahler and by Chipault, and, in man, Tuffier has sutured the first two lumbar roots after their division by a bullet wound, obtaining a perfect recovery. The importance of this distinction between the cord itself and its nerve roots arises only in the cauda equina, where we have only roots to deal with, and here we may expect a natural recovery if the ends be not too far separated, or if no mechanical obstacle intervene; and, failing this, we may hopefully cut down upon and suture these roots, as we should do in the case of any peripheral nerve.

FRACTURES AND DISLOCATIONS.

In compound fractures, which are chiefly gunshot wounds, and are, therefore, rare in civil life, there can be no question of the advisability of removing all splinters and foreign bodies. No new danger of any kind is introduced by such an operation, which is merely of the nature of "wound toilet," and numerous cases, such as the classical one of Louis, illustrate the benefits which may be derived therefrom. Fractures of the transverse and articular processes are also of little interest from the present point of view; they are very rare, being due only to direct injuries such as gunshot wounds, and they do not involve the contents of the vertebral canal.

Fractures of the spinous processes alone are also rare, there being but 2 instances in Ashhurst's analysis of 394 cases, and 7 among Gurlt's 270 injuries of the spine. In the Manchester Royal Infirmary, where we meet with some 9,000 accidents yearly, I have found but 1 case in the last 10 years. On the other hand, I have been able to collect the records of 12 cases in which the diagnosis appeared to be beyond doubt, in 3 of which only was the cord injured. In such a case the removal of the depressed spinous process would be a simple operation, and one which should certainly be adopted, but, as yet, no operation of this nature has been recorded. The only difficulty will probably lie in the diagnosis, and for this purpose the most valuable indications will be the history of a direct blow, the mobility of the spinous process, and the fact that this is depressed below the level of its fellows, both above and below.

Fractures of the laminae are more important than any of the above, and have always been regarded as suitable cases for surgical operation, although they also are by no means common. Ashhurst, for example, found less than 1 per cent. in his analysis of injuries of the spine. I have analysed 10 published cases, in which the diagnosis was not open to question, and they lead to the following conclusions:

(1) The cause of this injury has generally been stated to be direct violence to the spine, but in 4 of my 10 cases there was certainly no direct violence, and in only 3 is such distinctly described. Further the frequency of this injury in conjunction with a fracture of the bodies indicates a similarity in the mechanism of their production.

(2) The symptoms of fracture of the laminae are by no means definite and the only case, in which we can be satisfied that the diagnosis was made before death, owed its detection to the distinct lateral mobility of a spinous process.

(3) The diagnosis is therefore difficult, and probably we can rely only on the following points: (a) The cause, if there be a clear history of direct violence; (b) the normal contour of the spine, and the presence of lateral mobility of one or more of the spinous processes, in conjunction with an obvious lesion of the spinal cord.

The treatment of these cases is very clearly indicated. We can hardly hesitate to perform laminectomy in such a case if there be any symptoms of pressure upon the cord. There is here no reason to anticipate a rebound of the bony fragment, such as that which we find in the case of fracture-dislocation of the bodies of the vertebrae. Then, again, the fragment is liable to be driven further inwards upon the cord, and to be moved about so as to plough up the soft structures beneath it. There is also at least a reasonable probability that the medullary lesion is not a complete crush, such as we are about to describe, but merely a more or less severe pressure. Lastly, the operation itself is in such a case of the simplest. In spite of this clear indication, which is generally accepted, I have found but three recorded operations in cases of this nature. The first, that of Péan, is briefly recorded, but appears to have been highly successful. The second, that of Mr. Allingham, was less satisfactory. The third case, reported by Schede, was one of complete paraplegia and anaesthesia with paralysis of the bladder and rectum. Sixteen hours after the accident the sixth dorsal arch was removed, and was found to have been broken off and depressed so as to press upon the theca. The patient made a steady recovery, and, eighteen months after the operation, he could walk for long distances without even requiring the assistance of a stick.

We may turn now to the far more common and more serious lesions of the bodies of the vertebrae. For our present purpose, we may treat fractures and dislocations together, and speak of them as fracture-dislocations; the commonest injury being a distinct luxation with but slight injury to bone.

It is only in unilateral dislocations that these injuries present any special peculiarities, but the latter undoubtedly form a distinct class of injuries. Their essential peculiarity is that, owing to the fact that but one articular process is displaced, there is often either no injury to the cord whatever, or such injury, if present, is but slight; and again reduction is frequently possible and successful. In one case of this nature the patient made a good recovery, and lived for three years after his accident, at the end of which time he died of cancer of the liver, when I was able to obtain the specimen which I now show to you.

Leaving the less serious cases, we turn to the true dislocations, which are almost forwards and downwards. Indeed, the direction of this displacement is so common that all other forms may be regarded as pathological curiosities. In association with this lesion we may, however, note that it is probably not very rare to meet with diastases, that is to say, with dislocation in which the displaced bones have recoiled, so as to leave no permanent disturbance of their relations. In cases of this nature, despite the temporary displacement, the cord may be seriously injured, as in this case in which the disc between the second and third cervical vertebrae is torn across, and in which there was fatal hæmorrhage into the brachial enlargement at the level of the fifth cervical segment.

Fractures, on the other hand, may be oblique, transverse, or vertical; but here again they are by far most commonly oblique, from behind and above downwards and forwards, and, even if the broken vertebra be comminuted, the tendency to this obliquity of direction still remains.

Analogous to the distinction between a true dislocation and a diastasis is the distinction between those fractures in which the bony displacement remains and those in which it is succeeded by the recoil of the vertebrae, due either to the falling back of the head or to the elasticity of muscles and ligaments, and the question as to the relative frequency of such recoil has been much discussed.

Thirty years ago Mr. Jonathan Hutchinson wrote: "Permanent compression of the cord, or of any part of it, is a very rare event," and, again, "nothing is more rare than to find any degree of permanent compression." I have also expressed less strongly a similar view, based upon *post-mortem* experience, but Chipault, in his recent work, questions the conclusion, although certain experiments which he made on the dead body are in agreement therewith.

Under these circumstances I have re-examined the specimens which are now in my possession, and I find that in the cervical region I have 12 cases in which there is no permanent displacement and 6 in which there is such displacement, thus giving a 2 to 1 majority in favour of temporary compression of the cord. In the lumbar region, on the other hand, I find that in the whole of 10 cases there is more or less permanent displacement of the injured vertebrae, but it is by no means certain that the amount of this displacement was sufficient to cause serious pressure upon the spinal cord.

It is, however, to be remembered that the cases of permanent displacement, or of permanent pressure upon the cord, are naturally more serious than those of temporary crushing, and that therefore they will appear in greater number among our pathological preparations. This is probably the reason for the universal presence of permanent compression in lumbar cases, inasmuch as only the worst of these cases come under the hands of the pathologist.

NATURE OF INJURY TO THE CORD.

Such being the main varieties of injury to the spine, we may now ask ourselves what are the various methods in which the cord itself suffers, and we find these to be as follows:

1. By far most commonly there is approximation of the laminae of the vertebrae above to the body of that below, causing crushing of the cord. Such crushing may be associated on the one hand with permanent pressure, as in true dislocation and in fractures which do not recoil; or, on the other, with temporary compression, as in diastases and in fractures which do recoil.

2. A fragment of bone may be driven back upon the spinal cord, but such a condition is exceedingly rare.

3. Equally rare, if not more so, is a condition which I show to you in these two specimens, in which an intervertebral disc is, as it were, squeezed out from between the adjacent bones, so as to form a projecting shelf which compresses the theca.

4. And, lastly, the medullary symptoms may be mainly due to the pressure of hæmorrhage.

We have next to ask whether we can distinguish these varied lesions the one from the other. In the first place the strong presumption is that the injury is a crush by approximation of the affected bones; but whether such be associated with permanent or with temporary compression, we can as a rule judge only by our somewhat unreliable statistics, although the presence of a marked angular curvature would indicate the persistency of displacement.

Pressure by a displaced fragment of bone we cannot recognise, although asymmetry in the level of the nerve symptoms would be suggestive of such a condition, as in a case which came under my observation. With regard to hæmorrhage we might expect that the onset of symptoms after accident would be less immediate than in the case of true crushing of the cord; and this view is to a slight extent borne out by a case which came under my notice some few years ago.

The patient was a man who, for a few minutes after an injury to the neck, noticed only local pain. His legs then began to feel weak, and he lay down. Ten minutes later he was totally paralysed. After his

admission to hospital there was slight but continuous improvement both in paralysis and anesthesia for about a month, at the end of which time the man died from pneumonia. At the *post-mortem* examination we found a very slight displacement forwards of the fifth cervical vertebra, with no permanent pressure upon the cord, but with more clot round the theca than is usually present in cases of this nature. The cord itself was flat and pale.

On these grounds I was again led to make the diagnosis of hæmorrhage in the case of a woman who was admitted to hospital under my care two days after the accident. She had fallen downstairs, and then, getting up unaided, had walked into an adjoining room, when she became paralysed and again fell to the ground, remaining paralysed from that time. There were no local signs of injury to the neck, but she had complete paralysis and anesthesia. I operated, hoping to find a blood clot, but without success, and the patient died 16 days later.

I fear, therefore, that the diagnosis of these various forms of injury to the spinal cord is as yet impracticable.

In two recorded instances there have, however, been excellent results from operation for hæmorrhage into the spinal canal. The first of these is recorded by Church and Eisen-drath, there being a fracture-dislocation of the tenth dorsal vertebra with complete paraplegia, and laminectomy revealing the fact that the spinal canal was filled with a firm extradural blood clot, which was easily broken down, and which had arisen from tearing of the anterior and posterior longitudinal spinal veins. The clot having been removed by the finger and by irrigation, and all hæmorrhage having been controlled, the displaced vertebrae were reduced, and the patient recovered almost completely. The second case, published by Wagner, was one of hæmorrhage at the level of the ninth dorsal vertebra, due to a bullet wound, and causing paraplegia. Three months after the accident there was removed a firm fibrous tissue which had formed in the clot, there being again an excellent recovery.

There is, however, one unusual lesion which can be recognised, and which, perhaps, we may call "gravitating hæmorrhage." A case of this nature, of which I have no detailed notes, was admitted to the Manchester Infirmary some ten years ago, the patient having sustained an injury to the neck, followed by paralysis, which spread rapidly up the body from the lower limbs onwards, until in an hour or two he died from respiratory failure. The diagnosis then made was that of hæmorrhage into the theca or perithecal tissue, the blood finding its way to the lower part of the vertebral canal, and thus causing ascending symptoms. A similar case, with full details, has recently been recorded by Mr. Bennett; and Lidell reports another example, with a *post-mortem* examination, in which there was found a tear in the theca in the cervical region, the dura mater being full of, and distended with, blood. In such cases the diagnosis is comparatively obvious, and, although we have as yet no facts upon which to build, we are surely justified in hoping for benefit from operation.

As to what operation is most likely to be successful there may be some difference of opinion; but I should be inclined, did I again meet with such a case, to perform laminectomy at the seat of injury and endeavour to arrest the hæmorrhage, or at least to give exit to the blood, combining this procedure in the first instance with paracentesis of the meninges in the lumbar region after Quincke's method, or, if the result were not satisfactory, a secondary laminectomy at the lower part of the spine.

For all practical purposes we have, however, three varieties of injury which call for treatment, namely, permanent pressure upon the cord, temporary crushing of the cord, and hæmorrhage. The latter is so rare and so little likely to be diagnosed that we are almost justified in neglecting it. As regards the two former, it is clear that in cases of temporary compression—which constitute the majority—laminectomy is necessarily useless. The crush is over; the cord has already sustained its maximum of injury, and it lies in the best possible position for recovery, if such be possible. In cases of permanent compression, on the other hand, we may certainly restore the normal lumen of the vertebral canal, but we can hardly hope to do much, if any, good to our patient; in the first place because, as we have already seen, the injured cord will not be capable of regeneration, and in the second place because the extreme mortality—or at least persistency of symptoms—in the cases of temporary compression is such that we can hardly hope for benefit in the more severe cases in which the compression has been permanent.

So much being premised, I will now relate the details of 7 cases in which I have performed or assisted at laminectomy for injuries of the cord, 5 of these cases having been under the care of my colleagues and 2 only being my own operations:

CASE I (under the care of Mr. Hardie).—Total paraplegia and paræsthesia below fifth cervical roots, with loss of reflexes. Operation twenty-four hours after accident; removal of fifth and sixth cervical arches; theca appeared perfectly normal. Death in twenty-four hours; no compression, but cord flattened.

CASE II (under the care of Mr. Hardie).—Similar symptoms and operation at same level. Death forty-eight hours later. Complete smash of fifth cervical vertebra, cord crushed. The specimen shows that no good would have been done by removal of anterior prominence.

CASE III (under the care of Mr. Jones).—Incomplete paralysis and anaesthesia below sixth segment. Improvement for some weeks, which then ceased. Patient was going down hill. On fifty-sixth day removal of fifth and sixth cervical laminae; dura appeared slightly distended, but was not opened. Death in eight days. Specimen showed diastasis higher than level of cord lesion, and no pressure.

CASE IV.—History of delay in onset of paralysis; no local signs; diagnosis hæmorrhage. Symptoms: Total paraplegia and paræsthesia below sixth cervical segment, with loss of reflexes. Patient first seen forty-eight hours after accident. Removal of fifth and sixth laminae *all*. Slight improvement; primary union; renal hæmorrhage, which was apparently the direct cause of death. Death fourteenth day (sixteenth from accident).

CASE V.—Young man with symptoms of total crush in mid-dorsal region. Not at first under my care. After seven weeks removal of sixth and seventh dorsal arches. Cord reduced to a cicatricial mass of the thickness of a goose quill. Good recovery of wound, none of function.

CASE VI (under the care of Mr. Jones).—Last dorsal; complete paralysis and anaesthesia. On day of admission extension; slight improvement in sensation during succeeding weeks. After four months and a half removal of last dorsal and first lumbar arches, between which was a thick cicatrix, compressing theca and almost cutting it across. Good healing of wound, but very slight further recovery of sensation.

CASE VII (under the care of Mr. Hardie).—Injury at dorso-lumbar junction. Unrelieved.

Looking at these seven cases collectively, we find that in the first, third, and fifth there was no permanent pressure, and that the operation met no indication whatever. In the second and fourth cases there was pressure upon the cord, but this was not removed by laminectomy, and even had it been removed by chiselling away the bony prominence on the anterior aspect of the theca, the injury done to the cord was such that the operation would probably have been useless. In the sixth and seventh cases the extent of the dissection does not allow us to say with absolute certainty what the pathological condition really was. In none of the cases did any real benefit result; all those in which the injury was in the cervical region died; all those in which it was below the cervical lived, but did not recover from paralysis. And, lastly, in all those cases in which death did not cut short its progress the wound healed readily.

The published cases, of which there are about 200, show to my mind no better results, if we exclude injuries of the laminae, hæmorrhage, and operations upon the cauda equina. I have, indeed, not satisfied myself that there have been any successes as regards recovery of function, save such as may be attributed to the regeneration of nerve roots only, or to the natural recovery of a cord which was but very slightly injured. This, I am aware, is a broad statement, but an analysis of the recorded cases would occupy far too much of our time. And, further, if it were shown that in one or two instances among the 200 published cases there had been a definite improvement or recovery, I should be inclined to regard such as the sequel of some error in the original diagnosis, rather than to allow a single instance to invalidate a rule based upon such extensive premises.

The only question, therefore, which remains to us is, Are we justified in expecting in future any better results than those which we have met with in the past? There appear but two directions in which we may hope to improve the operation. The first is by operating at an earlier period—immediately after the accident; the second is, by extending our laminectomy to the chiselling away of the bony projection on the anterior aspect of the theca, as is so strongly urged by Urban and Chipault. On the *a priori* grounds which I have already mentioned, I fear, however, that we have little to hope for in either direction, and that we are not yet able to treat with success the common injuries of the spinal cord.

INJURIES OF THE CAUDA EQUINA.

In 1888 I advocated operation in intractable injuries of the cauda equina, mainly upon two grounds, namely: (1) that we may here expect a regeneration of the nerve roots, the physio-

logical evidence being strongly in favour of such regeneration and not against it, as in the case of the cord; (2) that the absence of spontaneous recovery in such cases in itself indicates the presence of a mechanical obstacle, such as permanent compression by bone, blood clot, or cicatrix; otherwise we should expect the roots of the cauda equina to recover as other peripheral nerves after severe bruises. In the following year I was able to show that the cases published up to that date confirm this view, and many other cases since recorded have placed it beyond question.

The only point which we need now discuss is that of the most suitable time for operation. We must remember that some cases will recover spontaneously—cases probably in which there has been no extensive tearing of the roots or intervention of tissue between their ends. Hence, then, we must not operate too early. On the other hand, should we delay too long, secondary degenerations will render the ultimate prognosis bad. Between these two difficulties we can hardly dogmatise as to the most suitable time for interference. Personally I have taken as a rough rule that we should operate at the end of six weeks, if there has been little or no recovery, or if recovery has ceased to progress. Other surgeons would, however, limit the period to a month, and the point is one which we are hardly likely to carry further at the present time.

In conclusion, I may mention two cases illustrative of the benefits of operation in injuries of the cauda equina which have come under my observation, although I have not personally been called upon to deal with any such cases.

CASE VIII (under the care of Mr. Jones).—A lad injured four months before admission to hospital; at first quite paralysed and anæsthetic in lower limbs. On admission prominence of third lumbar sp. proc.; complete paralysis of muscles moving ankle and foot, weakness of other muscles of lower limbs, of cauda equina type; marked atrophy, especially of gluteal and leg muscles; obtuse sensation over genitals, gluteal region, back of thighs, back and, to a less extent, front of legs, and whole of feet; cystitis. This condition proved to be stationary. Then removal of second lumbar arch, which was pressing firmly on the theca. Steady recovery. In three months could walk, and in about eighteen months again at work as a collier, and could walk several miles. The only permanent trouble was some contraction of hamstrings and paralysis of muscles moving the toes.

CASE IX (under the care of Mr. Southam).—Admitted for fracture of the lumbar spine. Had prominence of second and third lumbar spinal processes; complete paralysis of lower limbs, but no loss of sensation and no vesical or rectal trouble. No improvement during eight weeks; then removal of third and fourth lumbar arches, which showed that the theca was pushed backwards by the angle formed by the bodies of these two vertebrae; pulsation was, however, quite distinct, and there appeared to be no further pressure. On fourth day slight movements in feet; on sixth, at ankle and knee. Then very slow progress; after six weeks could only raise legs from the bed. Two months after the operation he could still not stand, and was sent home. Returned a few months later able to walk (hearsay).

CONCLUSIONS.

I may summarise this long discussion in a few words. In compound fractures operate. In fractures of the spinous processes and laminae, with injury to the cord, we also operate. In simple fractures and dislocations of the bodies of the vertebrae, if there is a reasonable probability that the injury is due to hæmorrhage, operation is advisable; but in all other cases of this nature we cannot hope to do good save where the injury is below the level of the first lumbar vertebra. In such cases, however, laminectomy is an eminently valuable surgical procedure.

THE GERMAN ASSOCIATION OF SCIENTISTS AND MEDICAL MEN.—Preparations are in active progress in Vienna for the sixty-sixth annual meeting of the German Association of Scientists and Medical Practitioners which is to be held in the Imperial city in September next (24th to 30th). Professors von Helmholtz and Leyden, of Berlin; Forel, of Zurich, and other leading representatives of German medicine have intimated their intention of taking part in the proceedings. The Austrian Government has granted a subvention of 10,000 florins, and a ladies' committee, with Frau Rosa von Gerold at its head, has been formed to make arrangements for the entertainment of the scientific visitors and ladies accompanying them.

DONATIONS AND BEQUESTS.—The Ironmongers' Company have sent a donation of ten guineas to the North-Eastern Hospital for Children, Hackney Road.