TRAUMATIC

MATERNAL OBSTETRICAL PARALYSIS.

A Thesis

by

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TRAUMATIC MATERNAL OBSTETRICAL PARALYSIS.

This is a paretic condition of the mother attributable directly to pregnancy or labour. Its effects are confined to the lower limbs, only one being implicated as a rule. Usually the nerves involved are branches of the great sciatic, and that most frequently affected is the external popliteal.

In a typical case the patient complains, during the later stages of labour, of pains in one limb and a numbness in the affected member. If seen shortly afterwards, there is more or less complete "foot-drop," together with anaesthesia over the front of the leg and dorsum of the foot, corresponding to the musculo-cutaneous branch of the external popliteal nerve.

The condition has been reported sporadically over a very long period, but it is only within recent years that it has come to occupy a recognised place amongst obstetrical sequelæ.

One is aware that not all the cases that have occurred have been reported, and my own experience shows that many of the slighter types must pass almost unrecognised; but allowing for this discrepancy, it is still apparent that the condition is extremely rare.

It is interesting to note the gradual transition from the very bald statements of the early accounts to the detail of present day reports.

The first I have been able to trace was reported in the Edinburgh Journal of Medical Science in 1826 by William Campbell. He quotes the case of a woman in labour for the seventh time, who developed Surgical Emphysema of the neck and thorax. The labour was prolonged for four days. She was bled sixty ounces in all. The baby was stillborn, and afterwards she had "a lameness of the right leg." No other details are given.

There follows a gap of many years till in 1888 Otto Spiegelberg of the University of Breslau publishes in his Textbook of Midwifery a clear and rational account of the etiology and causation.

The case histories of my series are as follows:-

CASE 1.
Mrs. Lilian Hardy (a) aet 29, third pregnancy.
Previous pregnancies, first - full term normal labour;
second - full term normal labour;
There had been no antenatal supervision for the third, the labour in question.
The pelvic measurements were I.C. 10¾ inches, I.S. 10 inches, ext. conj. 8 inches.
She was a big, stout, strong woman.
Labour began at 1.a.m. on March 24th. 1926.
The membranes ruptured at 5.40.p.m. on the 24th.
She was admitted to Hospital about 5.p.m. on the 24th.

When examined after admission the umbilical cord was found prolapsed, and when seen by me some little time afterwards the os was dilated about 5/-, and about 4 inches of the umbilical cord and the right wrist and hand had prolapsed into the vagina. The position of the foetus was oblique, with the back anterior and the foetal head in the left iliac fossa. The cord was pulsating strongly. She was anaesthetised before my examination, and without difficulty the hand was replaced and the cord returned as high up as possible in the uterus, and the foetal head moved to the pelvic brim. The foetus fitted spontaneously into the second vertex and was left at that, the head being more or less freely movable above the brim.

She was seen again at 11.30.p.m. the same evening, and as far as it was possible to tell through the strongly contracting uterus, the foetus had slipped round into the posterior third position. A P.V. examination was not made at this time.

Pains went on strongly without a great deal of advance being made, and this was regarded as due to the unfavourable posterior position.

At 10.30.a.m. next morning she was seen again by me, and a brow presentation found. She was anaesthetised, and with two fingers P.V. the head was pushed up out of engagement with the brim: the head was well flexed and then pushed into engagement in the first vertex position. The

cervix was about three-quarters dilated at this time. Two hours later she delivered herself naturally of a live, healthy, eight and a half pound baby. Fifteen minutes afterwards the membranes and placenta were expelled intact. There was no perineal tear.

Some time after recovery from the first anaesthetic she began to complain of pains in the right leg and foot, down the front of the leg from just below the knee, and the dorsum of the foot. The pains became severe and went on all through the night of the 24th. and 25th., whilst she was in labour. When seen the following day, the 26th., she had marked diminution of cotton wool and pin point sensation over the front and outer side of the right leg, below the knee, and on the dorsum of the foot and toes. There was a complete right foot drop, with inability to extend the toes, and also a slight weakness of the right calf muscles, and a general flabbiness of the muscle tone in the calf and thigh, and slight weakness of the hamstrings and quadriceps group.

	Right.	Left.
Knee Jerks	+ +	+
Ankle Clonus	None	None
Achilles Jerks	None	None
Plantar Reflexes	Flexor	Flexor
	and equal.	

By April third - nine days after delivery - she had the pains in greatly diminishing degree, mainly in front of the right ankle. Sensation had improved, and only cotton wool sensation was lost over the dorsum of the foot, in front of the ankle and on the dorsal and plantar surfaces of the second, third and fourth toes. There was still the foot-drop and weakness of the calf and thigh muscles, and now slight wasting of the right thigh and calf was evident. There were vasomotor changes, as the right foot up to just above the ankle was slightly swollen and the skin was cyanosed and cold. Recovery was steady, and when seen in February 1930, no sensory nor vaso-motor changes were present. The foot could be raised, and walking was almost normal, though

there was still quite marked weakness of the anterior group of muscles. No anaesthesia was present. The puerperium was not quite afebrile - the highest temperature was 99.4°, but involution seemed normal, and there was no cause for anxiety. She has had two confinements since then in the same lying-in-hospital. There has been no return nor aggravation of the symptoms during labour or otherwise.

The first confinement after this mishap occurred on 17:2:27. It was a normal labour - nine and a quarter pound baby - and the presentation and position was first vertex.

The second confinement, after the above, was on 27-6-30 It was a normal labour, and the presentation and position was first vertex.

CASE 2.

Mrs. Church, aet 30. Primipara.

Labour pains became strong on the morning of August 25th. 1927. The membranes had ruptured three days previously. There was no apparent advance, and on the morning of the 26th. she had been anaesthetised and forceps extraction had been attempted, without success, by her own doctor.

She was admitted to hospital, and when seen by me at 4.30.p.m. on the 26th., the uterus was found firmly contracted down on the foetus; no liquor amnii was left. The presentation was a vertex, and the position seemed a first. The head was still above the brim, and both the brim and the outlet were markedly contracted. The pelvic measurements were I.C. 10¼ inches, I.S. 9¼ inches, ext. conj. 7 inches, but the degree of contraction of the true conjugate and the narrowing of the transverse diameter of the outlet were sufficient to have prevented any possibility of the birth of a normal foetal head. The cervix was fully dilated. She was anaesthetised, and the head was crushed, but on attempting traction a tear of the cervix running up into the uterus developed. Laparotomy with hysterectomy was performed. A gauge drain was left in the Pouch of Douglas for four days, and was

replaced by a rubber tube. The tube was removed on 3:9:27. Her convalescence was almost afebrile after the first week; but on recovery from the first anaesthetic, she complained of severe aching pain in the left leg, in the left calf and down the front of the left leg, and on the dorsum of the foot. When seen next morning, she had a complete foot-drop with paralysis of the muscles of the anterior group, and also marked weakness of the calf muscles. The foot was colder than the other; otherwise there were no vasomotor changes.

She left hospital on 30:9:27 - five weeks after admission. The foot-drop had improved to the extent of perceptible flexing of the ankle, but was still more or less complete. Sensation was not tested in this patient, unfortunately.

CASE 3.

Mrs. Lucas, aet 25. Primipara.

Pelvic measurements I.C. 10¼ inches. I.S. 9¾ inches, Ext. conj. eight inches.

She was seen at the Antenatal Clinic attached to the Hospital five times between 20th. June and 10th. October 1928. On the last occasion a first vertex was found, and a note was made that the cervix was beginning to dilate and the head to descend into the pelvis.

She was admitted into Hospital on October 27th. 1928, at 3.50.a.m. Labour had begun at 12.40 a.m. on the 27th. The membranes ruptured at 6.45.p.m. on the 27th.

The external os was 6d. at 4.5 a.m. soon after admission,
" " " " 2/- " 11.30.a.m. on the 27th.,
" " " " 6/- " 12.15.p.m. " " 28th.,
" " " " fully dilated at 8.p.m. on the 28th.

The baby was born normally at 3.30.a.m. on the 29th., weight 8 lbs., 2 ozs. The placenta and membranes were expelled normally and intact at 4.5 a.m. She had two hypodermic injections of Morphia gr.¼ during the long and tedious first stage, but otherwise there was no

interference other than the above vaginal examinations.

At the antenatal examinations the following facts were elicited:-

20:6:28 presentation and position not made out,
18:7:28 third vertex,
22:8:28 second vertex,
3:10:28 first vertex,
7:10:28 first vertex. Baby was born as a first vertex.

She complained during the first stage of pains in the right leg, below the knee and down the front of the right leg to her toes, and of loss of power in the foot and leg. Next day, when examined by me, there was found a complete right foot drop. paralysis of the tibialis anticus, the external hallucis longus and the external digitorum longus. She had anaesthesia to touch by cotton wool over the front of the lower third of the leg and the dorsum of the foot, and slightly on the dorsum of the second and third toes. Heat and cold sensation seemed unimpaired over the leg and dorsum of the foot, but slightly impaired over the dorsum of the second and third toes. The knee jerk was exaggerated slightly on the right side, compared with the left. There was no achilles jerk on either side; slight ankle clonus was present on the right side; the right plantar reflex was flexor, but less marked than on the left side.

She left the lying-in-hospital on 11:11:28, slightly improved, but still with foot drop. The power in the tibialis anticus and anterior group of muscles had slightly returned, and the anaesthesia was less in extent. The reflexes were I.S.Q. In the puerperium the temperature did not exceed 98.4° during the first fourteen days, except for four days when it was 99° or under, and one period of twenty-four hours when it reached 99.4°. Involution was normal.

CASE 4.
Mrs. Beatrice Berridge, aet 30. Secundipara.
Pelvic measurements I.C. 11¾ inches, I.S. 10¾ inches, ext. conj. 8½ inches.
She was seen at the Antenatal Clinic attached to the Hospital on 6:7:28 and 3:8:28, when position and presentation were not made out.
On 31:8:28 it was a second vertex.
Labour commenced on 18:11:28 at 3.p.m.
She was admitted to hospital on 18:11:28 at 3.p.m.
The external os was 9d. at 9.40.p.m. on 18:11:28;
The external os was fully dilated at 1.45.a.m. on 19:11:28.
The baby was born normally as a second vertex, at 2.a.m. on 19:11:28, weight seven pounds.
Placenta and membranes were expelled at 2.10.a.m., the membranes not being quite intact.

She stated that for the two months preceding her confinement she had pains in the left leg, at the back of the left knee and extending slightly down towards the calf and up towards the back of the left thigh, and also in front, down the front and outer side of the leg in the lower third and in front of the ankle joint. The pains were more or less continuous. She described the leg as "heavy and numbed," but she had not realised that muscular power was diminished.

When seen by me the day following delivery, the pains in the leg were diminishing in intensity, but she had quite marked muscular weakness of the whole left leg and thigh, compared with the right side. The anterior group of muscles supplied by the peroneal nerve were not more affected than the other muscles involved. She had weakness of the abductors and adductors and the internal and external rotators of the leg. the flexors and extensors of the hip and knee and foot. Eversion and inversion of the foot were less powerful, and the extensors of the toes weakened. The flexors of the toes of the left foot seemed equal to those of the right side. There was 1 cm. wasting of the left calf and left thigh, as compared with the right side.

	Knee Jerks.	Achilles Tendon.	Ankle Clonus.	Plantar Reflex.	Touch Sensation.	Heat and Cold Sensation.	Vasomotor.
Right.	Active	Good.	None.	Less active.	Normal.	Normal.	None.
Left.	Not so active.	Slight.	None.	More active.	Normal.	(Heat diminished over gt. toe and 1st. and 2nd. toes on dorsum.	

On 29:11:28, ten days after delivery, she had severe aching pain on the dorsum of the left foot, and up the front and outer side of the left leg. The toes were not affected. This was unusual, as her pain began to diminish almost immediately after labour.
By December 1st. 1928, she had ceased to complain of the leg and only felt it "heavy." She could walk with only a slight drag of the front of the foot, and left the lying-in-hospital on December 1st.

She stated that she had similar pains and numbness of the left leg after the first confinement on May 10th. 1925, but that she more or less disregarded them, and did not mention them to the nurses in the Home.

The first puerperium had been practically afebrile - 98.6° on three days and 98.8° on one day being the only rises during fourteen days. Involution was normal.

In the second puerperium the temperature was continuously never higher than the normal 98.4°. Involution was normal.

These four cases exhibit a difference in the time of onset of the symptoms. Case 4. began during pregnancy. Cases 1 and 3 began during the later stages of labour; and I think we may safely include Case 2 in this group, as she complained of the pains in her leg on "coming round" from the first anaesthetic, and it may

be assumed that the anaesthetic prevented her from being conscious of the leg symptoms during the crushing and traction operations.

Apart from this difference in the time of onset, there are salient features in common. All four were vertex presentations. Only one limb was affected in each. In Cases 2 and 3 the paralysis was confined to the anterior group of muscles supplied by the external popliteal nerve. In Case 1 the whole of the lower limb was affected, indicating that the lesions were not confined to the great sciatic nerve alone, but the muscles mainly involved were those of the anterior tibial group supplied by the external popliteal branch of the great sciatic.

In Case 4 all the muscles of the lower limb seemed equally involved, and the anterior tibial group was not specially affected.

With regard to sensory changes we find that in Cases 1 and 3 there was anaesthesia corresponding to the distribution of the musculo-cutaneous branch of the external popliteal nerve. In Case 4 the sensory changes were minimal. As previously stated the sensory condition was not tested in Case 3, but from the completeness of the motor paralysis, I feel sure that there would have been anaesthesia of the sensory fibres of the nerves involved. There is a definite association between the position of the engaging head and the limb affected. As already mentioned all four cases were vertex presentations. In Case 3 the position was a first - i.e. in the right oblique - and the limb affected was the right. In Case 4 the position was a second - i.e. in the left oblique, and the limb affected was the left. Case 1 seems more complicated, but really conforms to this finding. She did not complain of pains in her leg till some time after recovery from the first anaesthetic, and by this time the foetus had most certainly slipped round to the third position, in which it was found later in the evening, so we may say that the position was a third at the time nerve symptoms com-

menced - i.e. right oblique and right leg affected. Case 2 cannot be explained in this way, as the presentation was a first vertex before operative measures commenced. The explanation of this case is accordingly deferred till later on in this paper. (Please see page 14).

As regards parity: two were primiparae (cases 2 and 3) and two were multiparae (cases 1 and 4). In each of these groups one case had a normal unassisted labour, and the second of each group had operative interference, but it should be noted that in Case 1 this was only to correct malpresentation, and that the actual birth was spontaneous and unassisted, so that the figures should read - three unassisted births and one operative delivery. This latter - Case 2 - was in a patient with marked pelvic contraction. Cases 1 and 4 were normal sized pelves, and Case 3 was a slight generally contracted pelvis, but insufficient even with an 8 lbs.2 oz. baby to require help in delivery. The size of the babies seemed normal in all four:-

Case 1 - 8½ lbs.,
Case 2 - normal weight,
Case 3 - 8 lbs. 2 ozs.,
Case 4 - 7 lbs.

The labour in three was long, Cases 1, 2 and 3, and normal in Case 4.
Case 1 was in labour with strong pains in the third position, with extended head from say 8.p.m. till 10.30.a.m. next morning - 14½ hours.
Case 3 had a long, tedious first stage, from 12.40.a.m. on the 27th. to 8.p.m. on the 28th. - practically forty-three hours, and from 8.p.m. on the 28th. to 3.30.a.m. on the 29th. in the second stage - i.e. seven and a half hours. These times can be accounted for by the relatively large baby, 8 lbs. 2 ozs. in a slightly generally contracted pelvis.
Case 4 seemed normal, only eleven hours from commencement of pains till baby was born.

It has only been possible to follow up Cases 1 and 2, and neither of these has made an absolute recovery. There

still was in both - in 1930 - quite definite weakness of the anterior group of muscles, resulting in slight dragging of the toes on the ground in walking. Sensation has returned to normal in Case 1.

When we come to consider the causation of this condition we are forced inevitably to one conclusion - "Trauma."

For the purpose of this consideration, let us disregard Case 4 for the present.

The onset is rapid: it is associated with labour. The victims are all healthy, strong women, who suddenly, during parturition, develop their symptoms. Pains, numbness, heaviness and actual paralysis and anaesthesia succeed one another in the affected limb.

The lesion is of the lower neuron type, so that a cerebral lesion can be ruled out.

The time is too short for an infective process or a peripheral neuritis involving the nerves. Besides, the signs of nerve involvement come on actually before the birth of the child, and if due to an infection one would expect the onset in the puerperium.

There is an association between the pelvic diameter of engagement and the limb affected - i.e. in cases 1, 2 and 4 this rule held, i.e. that in a right oblique the right leg was involved, and in a left oblique the left leg was involved. All the cases presented by the vertex.

The external popliteal is mainly affected, but so also is the internal popliteal, and in the cases with weakness of the whole limb, there are involved, the quadriceps group supplied by the anterior crural nerve, the adductors, supplied by the obturator, and the hamstrings, supplied by their own branch of the great sciatic. Where could this injury of the nerves take place?

The only place where all these nerves are exposed to a common injury is inside the abdomen, in the pelvic portion of their course, and the obvious traumatising agent would be the hard foetal head as it is driven through the pelvic canal. The association, just mentioned, between the limb affected and the pelvic diameter occupied by the engaging head, clinches the point.

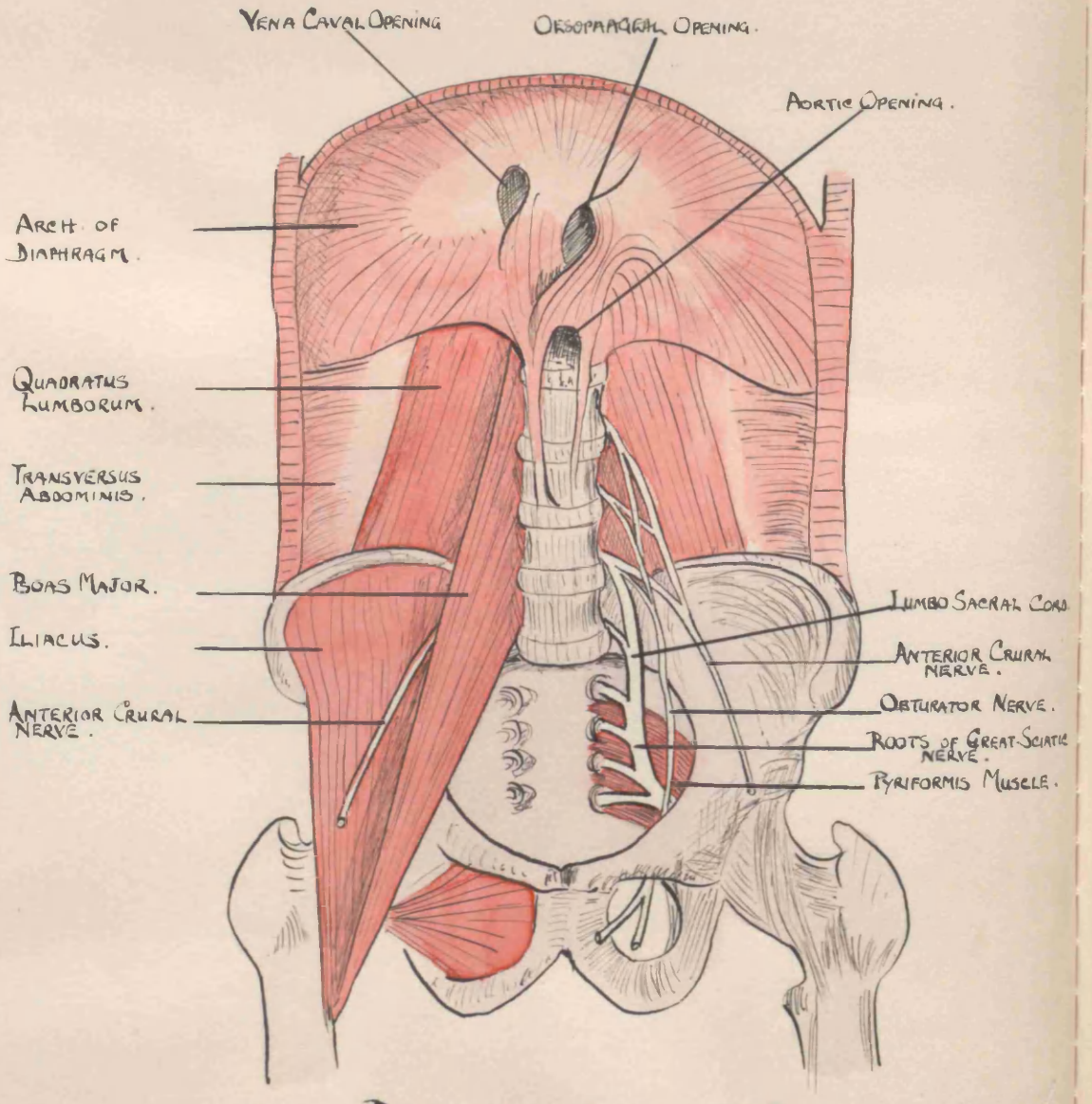


Diagram showing relations of the Lumbo Sacral Cord and the Roots of the Great Sciatic Nerve to the Pyriformis Muscle and the Pelvic Brim.

From Cunningham's Anatomy.

If we trace the course of the affected nerves from their spinal origin, we find that the outstanding features of the anatomical relations of the nerves involved, are that the external popliteal derives most of its fibres from the lumbo-sacral cord, and that the lumbo-sacral cord lies exposed on the bare bone of the ala of the first sacral vertebra, till it joins the sacral plexus which is cushioned on the pyriformis muscle. The fibres forming the external popliteal nerve are the posterior fibres of the lumbo-sacral cord and the first and second sacral roots, i.e. in the former they are those lying next the bone. The anterior fibres of the lumbo-sacral cord, and the first, second and third sacral roots are those of the internal popliteal nerve. A force acting on the lumbo-sacral cord, for instance, is more likely to damage the posterior fibres which will be crushed against the bone. The anterior fibres are, to some extent, protected by the posterior fibres acting as "padding."

A complete account of the anatomy of the lumbo-sacral plexus and the distribution of its nerves is given as an appendix at the end of Part 1 of this paper.

EC. External Cutaneous.

MC Middle Cutaneous.

IC Internal Cutaneous.

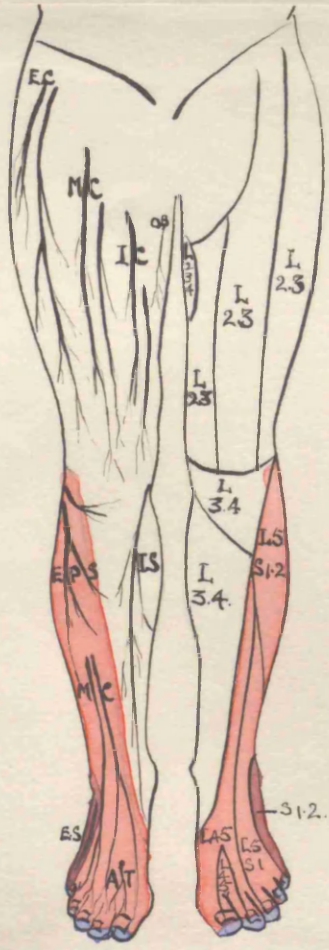
EPS Sural Branches of Peroneal.

IS. Internal Saphenous.

MC Musculo-Cutaneous.

ES External Saphenous.

AT. Anterior Tibial.



Cutaneous Distribution of External & Internal Popliteal Nerves.

RED - External Popliteal.
BLUE - Internal Popliteal.
PURPLE - Combined Fibres from Both Nerves.

From Sir James Purves Stewart.

Let us consider the symptoms exhibited by the four patients.

In the case of Mrs. Lucas, Number 3, the muscles paralysed were the tibialis anticus, the extensor digitorum longus and the extensor hallucis longus, all supplied by the external popliteal nerve.

The area of anaesthesia was over the front of the lower third of the leg and the dorsum of the foot, and slightly on the dorsum of the second and third toes. Heat and cold sensation was slightly impaired over the dorsum of the second and third toes only, and not elsewhere. The area of anaesthesia corresponds to the distribution of the musculo-cutaneous branch of the external popliteal nerve from the lumbar fourth and fifth mainly. The outer part of the dorsum of the foot shows no anaesthesia due to the presence of sensory fibres from other roots, i.e. the first sacral and the area supplied by the sural branch of the peroneal nerve escape because of the admixture of sensory fibres of the first and second sacral. This limiting of the area of anaesthesia is most valuable in localising the roots of the external popliteal nerve, which have borne the brunt of the damage - i.e. in this case the fourth and fifth lumbar or lumbo-sacral cord.

In the case of Mrs. Lilian Hardy, she felt pains in the leg, from just below the knee down the front of the leg and on the dorsum of the foot. She had anaesthesia from just below the knee over the front and outer side of the leg, the dorsum of the foot and the toes. Paralysis was complete of the tibialis anticus, the extensor hallucis longus, the extensor digitorum longus, and apparently of the extensor digitorum brevis, as no extensor movements of the toes were possible. These are supplied by the external popliteal nerve. The anaesthesia corresponds to involvement of the sural branch, the musculo-cutaneous and anterior tibial branches of the external popliteal. So that not even the sacral roots of the external popliteal have escaped. If the first and second sacral roots of the external popliteal have not escaped, we may expect to find evidence of involvement of the internal popliteal, and this we have in the weakness of the calf muscles. The hamstrings are supplied by the nerve to the hamstrings arising from the fourth and fifth lumbar and the first, second and third sacral roots on their anterior aspect. These are the same roots as supply the internal and external popliteal nerves. The weakness of the quadriceps group might have been due in part to the weakness of the opposing group of muscles, as it is difficult to see how actual trauma of the anterior crural nerve could occur. The weakness of the quadriceps group, in extending the knee, was quite definite, but not really very great, and there were no sensory changes over the cutaneous distribution of the anterior crural nerve. The sign which persisted was the slight foot drop, due to weakness of the anterior group of muscles supplied by the external popliteal nerve, most of whose fibres come from the lumbo-sacral cord. The vasomotor changes were due to the inclusion of the sympathetic nerve fibres in the lesion of the nerve roots.

With regard to Mrs. Church (Case 2): she had no symptoms previous to the anaesthetic for craniotomy. The forceps operation before admission had not damaged her nerve roots. She differs from the other cases in that, although a first vertex presentation, it should be her left leg that was affected; but I think the ex-

planation offered meets the case. Her pelvic brim was so contracted that traction by ordinary forceps failed to bring the foetal head down as far as the nerve roots. When, however, the head was crushed and traction by the powerful instrument was applied, the head was spread out into the bays of the pelvic brim, thus injuring the lumbo-sacral cord, and the selective action of a foetal head engaging in one diameter of the brim and injuring the corresponding lumbo-sacral plexus was lost. As the head was dragged down into the cavity of the pelvis, it injured successively the sacral roots. It could only be chance that determined the side of injury. In a case like this either side or both might have suffered. This is confirmed by the report of a breech case (Case 12), causing a bi-lateral injury. In this case there was difficulty in extracting the arms and one can imagine the foetus tightly wedged in the pelvis and exercising prolonged pressure in every direction.

The puerperium of Mrs. Church was not afebrile; and there was sepsis in the pelvis, but an infection could not have caused her condition, as she had the symptoms present on "coming round" from the anaesthetic for the craniotomy. This point will be discussed later.

She had complete paralysis of the anterior group of muscles of the leg supplied by the external popliteal nerve, and also marked weakness of the calf muscles supplied by the internal popliteal nerve, the main lesion being of the external popliteal nerve which derives most of its fibres, as we have seen, from the lumbo-sacral cord.

There is conclusive proof in these three cases that the lumbo-sacral cord fibres bear the brunt of the injury, and that direct pressure by the foetal head is the cause.

The fourth case was Mrs. Berridge (Case 4), who complained of pains at the back of the knee, extending slightly upwards and downwards, and also in front, down the front and outer side of the lower third of the leg, and in front of the ankle joint, corresponding to branches of the small sciatic from the first, second

and third sacral and the musculo-cutaneous branch of the external popliteal from the fourth and fifth lumbar roots. The muscles affected, i.e. the whole thigh and leg, all more or less equally, point to lesions of the whole sacral plexus, the lumbo-sacral cord and obturator nerves. We have seen how the lumbo-sacral cord and the roots of the sacral plexus may be injured. But the obturator nerve arises from the lumbar plexus, and its roots could not be directly pressed upon,as they are protected by the substance of the psoas muscle and lie at too high a level to be pressed upon by a foetal head in a vertex presentation. But the obturator nerve crosses the pelvic brim near to where it emerges from under cover of the psoas muscle, and then it passes forwards on the lateral pelvic wall, till it pierces the obturator foramen and enters the thigh. This pelvic portion is situated near the sacral roots and could easily be pressed upon by a foetal head. There is still the weakness of the quadriceps for which to account. It seems impossible to explain it by direct pressure, as the nerve roots of the anterior crural nerve rise high up from the lumbar plexus, and they and the nerve itself are well protected by the substance of the psoas muscle, in which it runs downwards till it emerges from its outer border in the false pelvis, and runs down in the groove between the psoas and iliacus to emerge into the thigh beneath Poupart's ligament. The quadriceps weakness was not great, and might easily be due to the weakness of the opposing hamstrings.

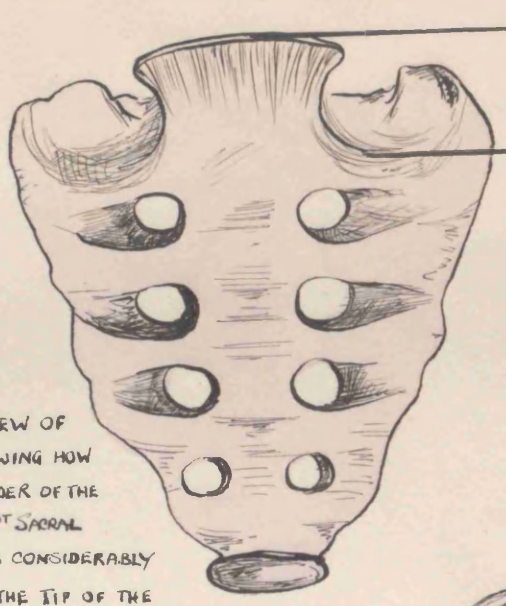
The lesions differ in no way from the preceding three cases, except that the time of onset was about two months before labour began. Labour did not increase the sensory or muscular disturbances, and soon after parturition the symptoms began to abate. They were at all times of a much slighter character than in the other three patients, and approximated more to the phenomenon we all have experienced when our leg "goes to sleep," through pressure on the sciatic nerve in the thigh. Her symptoms were much more long standing than this transient effect, but I believe they were due to a similarly mild pressure long applied. Her pelvic measurements were larger than normal, and her baby small - weight only seven pounds. This combination would allow the foetal head to lie low in the

pelvic brim in the late months of pregnancy (although the fact was not actually stated in the antenatal examinations). It is probable that in this case the lumbo-sacral cord was not pressed upon in its upper part, but that the fibres from this were compressed lower down in the pelvis, at the level of the sacral roots, where all the nerves could be encompassed at once. This conforms with the history, as pain at the back of the knee and up the back of the thigh from the small sciatic (first, second and third sacral) was one of the first signs. Whereas if the lumbo-sacral cord had been compressed in its upper part, there would have been the pain down the front of the leg first, and later on - as the head sunk lower in the pelvis - the sacral roots would have been pressed upon, with pain at the back of the knee, etc. The clinical picture agrees with the foetal head remaining low down in the pelvis in the one position for the last two months of pregnancy, and thus producing the nerve lesions by slight, long-continued pressure. Here we have the possibility of a lesion in an abnormally large pelvis, with a relatively small foetal head developing slowly during pregnancy, and this I shall call type (ii). In the other variety, type (i), the lesion is produced during labour. In this class, in my own series, the labour is prolonged: there is a relative disproportion between the foetal head and the pelvis, causing extreme pressure on the intra pelvic structures, and delivery may be operative.

In the whole series of cases quoted the onset seems more or less equally divided between multiparae and primiparae. The presentation is a vertex in practically a hundred per cent of cases. There is usually a disproportion, either because of a contracted pelvis or a large foetal head. Where there is a definitely contracted pelvis the parity is usually one, as is to be expected: where due to a large baby or extended head the parity may be any, as one would expect again.

It is obvious then that in the causation of this condition we have two factors with which to deal, (i) a maternal factor and (ii) a foetal factor.

The maternal factor is represented by the size and shape of the maternal bony pelvis and by the anatomical



Anterior View of Sacrum showing how the upper border of the Ala of the 1st Sacral vertebra lies considerably lower than the tip of the Promontory.

Fig 1.

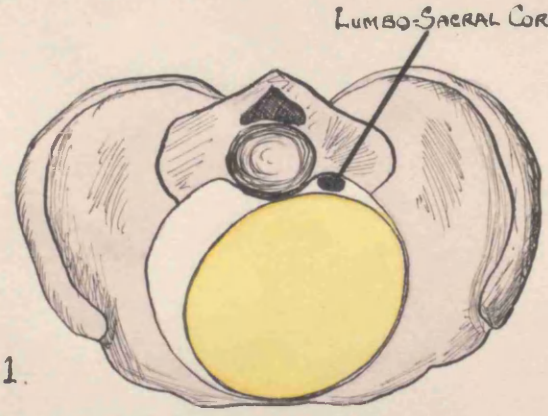


Diagram showing how the Lumbo-Sacral Cord escapes compression when the foetal head engages in the Brim.

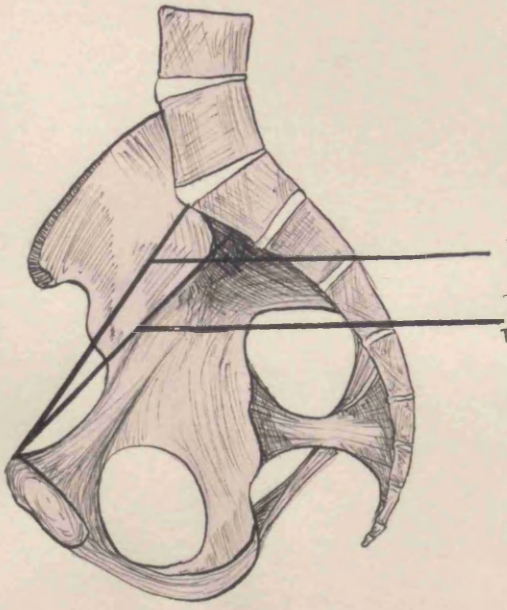


Fig 2.

relationship of the lumbar and sacral plexuses and those other nerves affected. The foetal factor is represented by the size of the foetus, but especially by the size and shape and degree of ossification of the foetal skull and its ability to respond to "moulding." The degree of flexion or imperfect flexion of the foetal head are also important.

For any given patient the maternal factor will remain constant in successive pregnancies, i.e. the size and shape of the pelvis and the relationship of the nerves will not vary (although it is conceivable that a previously normal pelvis may become abnormal through the presence of disease, such as Spondylolisthesis or an exostosis, etc.).

The foetal factor will vary in succeeding pregnancies. Indeed, it is this foetal factor which is responsible when the condition develops in a multipara, whose previous labours have been without incident.

We have already seen why certain nerves are picked out for injury, and it will be profitable to discuss why this condition does not occur more often, for superficially the extraordinary thing is not that these cases do occur, but that they do not occur much more frequently. Cases of Dystocia from contracted pelvis or difficult instrumental deliveries are with us daily, so to speak, and yet only very occasionally does obstetrical paralysis develop. The secret lies in the anatomical configuration of the maternal pelvis and the relation of the nerves to it. Figure (i) shows how the lumbo-sacral cord is tucked away behind and out of reach of the engaging head, and figure (ii) shows at (a) the plane of the pelvic brim, but the plane of the ala of the first sacral vertebra over which the lumbo-sacral cord passes is at (b) considerably lower and out of reach of the head engaging in the brim.

All the diameters of the pelvic brim are less than those of the cavity, so that no matter how great the pressure of the head on the structures of the brim, once past that plane it enters a region of safety - of greater diameters - where the pressure the head exerts on the walls must be a great deal less and unlikely to cause

damage. It is fortunate that the greatest pressure to which the maternal pelvic structures are subjected is at this plane of the brim, where the great nerve trunks cannot be pressed upon.

Another factor determining a lessened pressure on the intra-pelvic tissues is that the foetal head - unless it has ample room at the brim - is temporarily decreased in size by the process of "moulding," so that for the remainder of its passage through the birth canal it is of considerably smaller size, and unlikely to cause damage.

Difficult obstetrical cases are usually the result of a disproportion between the foetal head and the antero-posterior diameter of the brim, and up to a certain point it is true that the smaller the conjugate diameter - i.e. the more the sacral promontory projects - the safer is the lumbo-sacral cord from injury. This means, then, that in the type of case in which there is the greatest pressure on maternal structures, and in which one might expect pelvic injuries of all kinds, the one structure in any way protected is the lumbo-sacral cord. This accounts for the infrequency of the condition in circumstances which might lead one to expect it. In the cavity of the pelvis the roots of the sacral plexus are exposed to pressure, although cushioned on the pyriformis muscle. But it is unlikely that a foetal head, which has been "selected," so to speak, by an opening of smaller diameters than the cavity, and which has been diminished in size by "moulding," will cause serious pressure on intra-pelvic structures, unless something occurs to increase the size of its engaging diameters. The easiest thing that might do this is an extension of the head bringing about a considerable increase in the antero-posterior diameter.

The safety of the nerve trunks from pressure by the foetal head has been somewhat exaggerated in the above paragraphs, for the purpose of stressing the argument. The principle holds good, however. But it is possible to injure the nerve trunks, and I have experimented with plaster of Paris casts of heads of full-time still births. Using them in normal sized female cadavers the

mechanism permitting nerve trauma becomes evident. It was only after the plaster head passed the plane of the brim that the lumbo-sacral cord lying bare on the ala of the first sacral vertebra could become damaged. In no case would the points of engagement between the female pelvis and the plaster head allow me to completely crush the cord. In the cavity of the pelvis the plexus lies on the postero-lateral wall, and it was only by deliberately pushing the plaster head in that direction that I was able to compress, but not to greatly damage it. In the living person the normal movement of internal rotation tends to swing the long axis of the foetal head away from the direction of the sacral plexus into the antero-posterior diameter. Posterior positions with the occiput persistently posterior in one or other oblique, and the engaging diameter increased by extension of the head is a theoretical cause of injury, but fortunately the "drive" of the uterus is downwards towards the perineum, and not directly lateral on to the pelvic wall. Mrs. Lilian Hardy (case 1) is an example of this mechanism operating - a brow presentation, longer diameters engaged, with no advance over a long period, causing prolonged pressure in the one place. The pressure by the foetal head acting in the one place on the nerve roots, over a prolonged period, must be the main cause in non-operative cases. In these the only vis-a-tergo is the uterine contractions which only act for a few moments at a time, and then are relaxed. The conscious woman can also save herself, to some extent, by voluntarily lessening the straining and bearing down, if she is experiencing great pain. After all, almost all women in labour experience pain over the sacrum, the buttocks and back of the thighs, indicative of pressure on the sacral roots. In operative deliveries there is more apt to be greater pressure from powerful traction on the head, and this traction does not copy nature in being applied for seconds only at one time, and in being regularly remitting with considerable intervals.

No post mortem examination has been recorded in any of these cases, but as most recover considerably, and some completely, the actual nerve lesion can only be a physiological interruption without actual severance

of the nerve fibres. In the cases that do not recover completely some nerve fibres must have degenerated.

The consensus of opinion on the causation is that it is due to pressure by the foetal head on the lumbo-sacral cord as it crosses the brim of the pelvis. Strictly speaking, it is really after the cord has crossed the brim and is lying exposed on the ala of the first sacral vertebra.

Many of the authors on the subject quote the explanation given by "Hünermann" in 1900. The following is a free translation of this, given by "WHITRIDGE WILLIAMS" in his Textbook of Obstetrics:-

"Hünermann" says - "The chances of injurious pressure "are greatest where the pelvis is generally contracted, "and less so in the rhachitic varieties, inasmuch as "the projecting promontory in the latter tends to "prevent the head from coming in contact with the "nerve. In the majority of cases the injury is the "result of direct pressure exerted by the child's head "and only exceptionally is caused by the forceps."

"In view of the fact that only one oblique diameter of "the superior strait is occupied by the greatest dia-"meter of the head, it is readily understood why the "paralysis is usually limited to one leg, Thomas's "case being the only instance on record in which both "legs were affected. The paralytic symptoms usually "appear immediately after delivery, and may become "permanent unless suitable therapeutic measures, more "particularly the use of electricity, are promptly "instituted. In other cases, paralytic symptoms accom-"panied by intense neuralgic pains following the course "of the sciatic nerve, follow pelvic inflammatory "troubles. The condition is sometimes due to the "development of a neuritis affecting certain branches "of the sacral plexus, while in other cases pressure "exerted by an inflammatory exudate is responsible. I "have seen a case of the latter character which per-"sisted for years, in spite of continuous treatment, "and which disappeared as if by magic after laparotomy "and the separation of the adherent appendages from "the posterior and lateral portions of the pelvic wall."

"WHITRIDGE WILLIAMS" himself says that:-
"Paralytic conditions may develop in either mother "or child during the puerperium, and that branches "of the sacral plexus sometimes suffer from pressure "during labour is demonstrated by the fact that many "patients complain of intense neuralgia or of cramp-"like pains extending down one or both legs as soon "as the head begins to descend into the pelvic canal. "As a rule, of course, the compression is rarely "severe enough to give rise to grave lesions. In "some instances, however, the pain continues after "delivery and is accompanied by the development of "paralysis in the muscles supplied by the external "popliteal nerve - the flexors of the ankle and the "extensors of the toes - the gluteal muscles occasion-"ally becoming affected to a lesser extent."

"THOMAS" mentioned"Hunermann's" explanation, and then goes on to say that:-

"In ten per cent of individuals the internal and "external popliteal nerves are separate right up to "their respective origins in the sacral plexus. "Usually the external popliteal arises from the fourth "and fifth lumbar and first and second sacral nerves - "most of the fibres coming from the fifth lumbar and "first sacral, and most of the fibres of the internal "popliteal come from the first and second sacral. "This explains why often only a partial paralysis and "anaesthesia are present, as not all the roots supply-"ing fibres to the various nerves may be injured. "The upper roots of the sacral plexus do not lie on "the pyriformis muscle, but against the bone of the "pelvis, and hence they are easily injured. It is the "dorsal offsets of those roots which lie against the "bone, and the external popliteal nerve is made up "chiefly from these dorsal offsets. This explains why "the paralysis is often localised to this nerve."

He shows a tendency also to ascribe the paralysis to septic inflammation propagated directly to the nerve trunks from a metritis or perimetritic cellulitis.

"THOMAS" explains his second case (page 29, number 10), in which there was a bilateral affection by the changes in the position of the head and the frequent

changing of the forceps grip (they were re-applied five or six times). This is quite rational, as if the head be moved from one oblique to the other, there seems no reason why injurious pressure should not have been exerted in both positions.

"WINDSCHEID" quotes "Hünermann's" explanation. "SCHWENKENBECHER" says - "Such cases are mainly after the application of high forceps to a large head in a generally contracted pelvis. Paralysis follows immediately or soon after. The peroneal nerve is usually affected owing to the lumbo-sacral nerve (from which most of the fibres of the peroneal nerve come), which runs over the brim of the pelvis, not being protected by the pyriformis muscle as are the rest of the sacral plexus nerves."

His statement that the paralysis follows immediately or soon after labour is important, as some cases are recorded as first appearing on the second day or the third, or not till the ninth, as in one of Howell's cases.

"JACK," writing of his first case, concludes that the symptoms are due to pressure on the nerves, and not to inflammation as the onset was within twelve hours after labour. In his second case he mentions that the patient was suffering from Phthisis, and says that "many cases of neuritis are reported after Tuberculos-"is;" and "SUCKLING" reports a similar case of peroneal paralysis in a phthisical patient.

"ARMITAGE WHITMAN" reports a case, and goes on to say that - "The diagnosis lies between two possibilities, "i.e. injuryof the main nerve trunks, as they cross the "pelvic brim, by the foetal head, or forceps or peron-"eal injury at the neck of the fibula by a leg-holder." He explains the selection of the external popliteal nerve on the same lines as "Hünermann."

"HOWELL" in the St. Bartholomew's Hospital Report records three cases. In the first he gives the date of onset of paraesthesia as the sixth day, followed "shortly" by weakness of the leg. In the second case the onset of pain was the second day, and weakness of

the muscles was not noticed till "a day or two later" by the patient herself. In the third case numbness and pain made their appearance on the ninth day, and foot-drop not till "a few days later." His case histories seem to differ in no way from all the other cases recorded, except in this matter of date of onset. When we consider the cause of these paralyses it seems impossible to believe that his three cases did not conform to the usual time of onset. His own wording of the reports leads us to think that the true time of onset may not have been sought for. He is vague in his statements of times. In his first case he uses the word "shortly." In his second case "a day or two later." In his third case "a few days later." In the second case, although severe pain had been present in the right leg since the second day of the puerperium, it was only "a day or two later" that "the patient noticed that her leg was weak, and that she could not move the foot properly." My own experience (in Case 4 of my series) shows that the milder types may be overlooked. Patients expect pains, and during labour the majority experience pains and cramps in the limbs, so that they may not draw attention to continuing pain in a limb or some degree of numbness. In the typical case, limited to the anterior group of muscles of the leg, they can still move the affected limb about and flex the hip and knee, and paralysis under these circumstances does not occur to them. Examination, however, would show the weakness of the anterior group of muscles of the leg. I believe that the above is a reasonable explaination of the supposed late onset in "Howell's" cases.

"KLEINBERG" says that in all but three cases he has ever read of, there is proof of intra-pelvic pressure due to one of the following:- (i) disproportion between the foetal head and pelvis; (ii) prolonged or difficult labour; (iii) instrumentation. The three possible exceptions are:- (i) a case of obstetrical paralysis in a woman six months pregnant; (ii) "Howell's" two cases of paralysis in apparently normal labours. "Kleinberg" says that the theory of direct pressure on the nerves cannot be true, as most of the cases are bilateral. "The fact that the pressure is "not of the same intensity on all the nerve bundles "accounts for the peculiar and irregular distribution "of the motor and sensory symptoms."

"There is always a bilateral lesion, although the "symptoms are more pronounced on one side. The "lesion is at or near the promontory and consequently "the lower lumbar and upper sacral nerves are in- "volved." He quotes other authors, especially "Thomas," as saying that the nerve fibres of the external popliteal lie close to the bone of the pelvis, and so are easily damaged, whereas the rest of the plexus is cushioned on the pyriformis muscle. He concludes that - "The paralysis is due to increased intra- "pelvic pressure causing trauma to the sciatics. The "symptoms usually appear immediately after delivery, "but they may be delayed. They are bilateral, and "include motor and sensory changes. No curative "measures."

A survey of the literature shows his statement, that most cases are bilateral, to be incorrect. Although he uses the idea of pressure on the sciatics to explain these cases, he apparently does not believe it due to direct pressure, by the foetal head, for instance. He gives a clue to his line of thought, however, in discussing the case occurring in a six months pregnant woman. He says - "It need not be an except- "ion to the usual causes, as there may have been an "unusual amount of Liquor Amnii."

"M. ANDÉRODIAS" explains his two cases by saying that - "Some post-partum uterine infection was pres- "ent." He, therefore, attributes the condition to an inflammatory neuritis, and not to direct trauma. He gives the time of onset as five and eight days after confinement.

"LLOYD" records a case where symptoms were not complained of till the ninth day, but the patient stated that they had been present since the birth of the child. He also discusses the puerperal paralysis in animals, due to Metritis.

It seems fair to add that long before "Hünermann" wrote his paper in 1900, "Professor Otto Spiegelberg" of the University of Breslau, in 1888, gave to the world a correct account of the causation of the paralysis. His name seems to have been forgotten, as most of the writers quote "Hünermann." "Spiegelberg" said:-

"The pressure associated with parturition most "frequently acts on the lateral branch of the "sciatic, i.e. the peroneal nerve, whose fibres "come from the lumbo-sacral cord, and this is the "only nerve which can be pressed on at the pelvic "brim, where the pressure during labour is most "severe. This pressure acts at the point where "the nerve turns downwards and backwards from the "posterior edge of the brim in order to form the "sacral plexus. Consequently, this traumatic "neuralgia and paresis are mainly observed where, "owing to pelvic contraction and especially to the "head engaging in an unfavourable manner (face and "brow presentations, extra median entrance) pro- "longed unilateral pressure has been exerted at that "spot. In whatever way the affections mentioned may "have arisen, complete restoration of the normal "function usually occurs, though not uncommonly there "is considerable delay. The prognosis is worst with "traumatic paralysis. Here complete loss of power "may persist if the lumbo-sacral nerve has been so "seriously bruised that no recovery can take place."

Little or nothing is said regarding treatment. In severe cases a back splint, with foot piece to prevent the drop-foot, and regular massage and electrical treatment to prevent wasting of the affected muscles, would hasten recovery. In the less severe cases a bed cage to prevent the weight of the bedclothes accentuating the drop-foot, and daily massage and passive movements would seem sufficient if electrical stimulation of the affected muscles were not practicable.

I believe that a certain amount of prevention could be exercised by the medical attendant in some cases. I refer to those like Mrs. Lilian Hardy (Case 1), where with a normal pelvis, the causal factor was the extended head resulting in no advance, and hence prolonged pressure at one point. This state of affairs could be remedied, as was actually done, but in her case it was too late - the damage was already done. Obviously, nothing can be done when the lesion occurs during the course of a forceps or operative delivery conducted under anaesthesia, because there

will be no indication from the patient until her recovery from the anaesthetic. In that other group, where there is a slightly contracted maternal pelvis, or a large foetal head causing a very tight fit, the symptoms may come on in the conscious woman. In this and the preceding group, the only measure likely to be of any help would be to make certain that the foetal head was well flexed, so as to have the smallest possible diameters engaging, followed by forceps at the earliest possible moment, so as to limit the time the nerve roots were exposed to pressure. I do not think Caesarian Section or Craniotomy have a place amongst measures designed to limit the extent of a lesion that has obviously begun. We cannot estimate the possible severity of the lesion, and the greatest disability that can occur is slight compared with the gravity of the two operations mentioned.

CASE 5.

"William Campbell" in the Edinburgh Journal of Medical Science, 1826, Vol. 1, p. 108,

quotes the case of a woman in labour, seventh pregnancy, who developed Surgical Emphysema of the neck and thorax. Labour was prolonged four days. She was bled sixty ounces in all. The baby was stillborn, and afterwards she had a lameness of the right leg. (No other details given of presentation, or position, or pelvic measurements, or size of baby).

CASE 6.

"Fleetwood Churchill" in the Dublin Quarterly Journal of Medical Science, 1854, May 1st., Vol. xvii, p. 257,

describes two cases. (a) A primipara, age 21, in labour seven hours. The child was born alive. He states that on the second day afterwards she was unable to move the right leg. Sensibility in the affected leg was less and she had foot-drop. Three months afterwards there was considerable improvement, but not complete recovery. (No details of measurements, presentation, position, or forceps).

CASE 7.

(b) A third pregnancy case, age 33. In "heavy labour" for twelve hours ; forceps delivery. During labour she had spasms of pain in the left leg, and after confinement she could not move the left leg and foot properly. There was diminished sensation on the dorsum and sole of the foot, together with foot-drop. She was well in one month. (No details of position, or measurements, or size of child. As forceps were applied, it is presumed it was a vertex).

CASE 8.

In the same Journal is recorded a case of a woman in second pregnancy, age 28. Labour lasted twelve hours, and for the last three hours there were strong pains and no advance. No anaesthetic was given, but forceps were applied. During delivery there were severe pains and cramps in the right thigh till the birth of the child. Next morning she had paralysis of the whole limb. It was cold, but not painful. Seven days later there was some sciatica, and two days later still there was swelling of the ankle and dorsum of the foot. Seven weeks after delivery her condition was:- wasting of the whole of the right thigh and leg, especially the calf muscles.

The next in order of wasting were the hamstrings, and then the gluteus maximus. Foot-drop was almost complete - flexion at the ankle being very slight. Sensation of the whole leg was normal, except over the front of the ankle, where much pain was felt. The reflexes were normal; no reaction of degeneration, but less reaction present than on the left side.
Six months after labour she had quite recovered.

CASE 9.

"Thomas" in the John Hopkins Hospital Bulletin, 1900, Vol. xi, p. 279,

quotes two cases (a) a secundipara, in 1899, age 26.
The membranes ruptured at 7.a.m. on the tenth of May. Labour pains did not begin till about 1.p.m. About 3 or 4 p.m. pains began in the back of the right leg, between the knee and hip. There were no muscular spasms and not much progress was made. At 9.a.m. she was anaesthetised and forceps were applied. The child died soon afterwards. Next morning she had severe pain in the whole right leg and the whole leg was paralysed and numb. In July there was still complete paralysis of the muscles supplied by the external popliteal nerve, and there was weakness of the calf muscles and the flexors of the knee. The reaction of degeneration was present in the distribution of the external popliteal nerve. There was a distinct dulling of touch temperature and pain sensation over the outer half of the leg, below the knee, but not complete anaesthesia. The knee jerks were plus. There was no achilles jerk on the right side, but it was present on the left side. Plantar reflex was flexor on both sides. Measurements were normal (not given). The child was large. Her late condition was atrophy of the right leg below the knee, i.e. 3 - 4 cms. less than the left calf, and the degree of anaesthesia was less. Coldness and blueness of the leg were present.

CASE 10.

(b) A primapara, age 25. When seven months pregnant she had pains in the lower abdomen and the front of both thighs. She started labour at 4.a.m. on February 2nd., 1900, when the labour pains were severe. At 6.p.m. no progress had been made, and the labour pains were weak. She was anaesthetised; forceps were applied, and with great difficulty a twelve and a half pound child was extracted. The intercristal diameter was 25 cms., interspinous diameter 22½ cms. and the diagonal conjugate was 11 cms. The pelvis was generally contracted and the vertex

presented (position not given). After recovering from the anaesthesia she had pain in both legs below the knees. The puerperium was normal. There was complete paralysis of the anterior group of muscles of the left leg and very little power in the corresponding group in the right leg.

Toes. Flexion was good on the right side. Weak on the left. Extension weak right side. Nil on left.

Knees. Extension strong both sides. Flexion strong on right side. Weak on left. Knee jerks both plus.

Hips. Flexion strong in both. Extension weak, especially on left side (gluteus maximus). Adduction fair and equal. Abduction weak, especially on left side (gluteus medius). Internal and external rotation equal, but only fair (gluteus medius).

There was partial reaction of degeneration of the muscles of the right external popliteal, completely so on the left side. In the other muscles there was none.
No sensory changes were present, but swelling of the dorsum of the left foot was present. There was no achilles jerk on either side. Plantar reflexes were equal and flexor. There were no vasomotor changes.

CASE 11.

The Journal of Obstetrics and Gynaecology of the British Empire, 1913, Vol. 24, p. 37,

quotes from Staude (monatsch für Geburtsund, Gynaec.) 1913, Ht 5, who records two cases:-
(i) A primipara, vertex presenting, difficult forceps delivery. Shortly after delivery she complained of pains in one leg, and the muscles supplied by the external popliteal were paralysed, and the electrical reactions altered, especially the faradic reaction. She recovered in eighteen months.

CASE 12.

(ii) A multipara, breech presenting. Shortly after labour she had anaesthesia on the outer side of the leg and dorsum of the foot, and paralysis of the limb. The adductors of the opposite thigh were affected. There had been difficulty in extracting the foetal arms. Recovery took place in six months.

CASE 13.

The Journal of Obstetrics and Gynaecology of the British Empire, 1902, Vol. 2., p. 66,

quotes from"Windscheid,"Cent. für Gynak. No. 19, 1902, the case of a primipara aged 23, who had a small round pelvis - the diagonal conjugate being 4.4 inches. She had two eclamptic attacks during labour. Delivery was by forceps. She was seen one month after labour, when right foot-drop and paralysis of the right peroneal nerve were present. Abduction of the foot was perfect; adduction was defective. Extension of the foot was impossible; there was no anaesthesia; the leg was wasted. He quotes"Hünermann"for the explanation - i.e. that the fibres of the peroneal come from the fourth and fifth lumbar, and that these lie on bone, whereas the remainder of the plexus is protected by the pyriformis. He says that "Zangemeister" had seen only two cases in fifteen hundred confinements.

CASE 14.

The Journal of Obstetrics and Gynaecology of the British Empire, 1903, Vol. 3, p. 268,

quotes from"Schwenkenbecher,"Deutsches Archiv für Klinische Med. 1903, Bd. 74, p.504.
He gives details of cases:-
(i) A primipara with a generally contracted flat rickety pelvis. The true conjugate measured 3 inches. Forceps were applied; the child was stillborn. A few hours later it was found that she could not move her right foot. There was no pain, but partial anaesthesia of the leg was present. Five months later there was typical peroneal paralysis, with inability to raise the forepart of the foot or to evert it. There was no pain and no actual loss of sensation, although a feeling of numbness was present. The condition was much the same after a year and a half. She had scarring of the cervix and upper part of the vagina on the right side.

CASE 15.

(ii) A primipara, whose external conjugate measured 9 inches. The sacral promontory could not be reached. Forceps were applied, and a living child, weighing seven pounds, was born. She had severe pain during the forceps operation. Three days after delivery she had pains in the pelvis, extending down into the right leg, and difficulty in moving the leg. There was no pyrexia, but a burning and numb feeling of the right knee and

foot, and weakness of the right hip, and wasting of the leg. Dorsiflexion and eversion of the right foot were diminished. There was a large scar in the right lateral fornix and pressure over the right sacro-iliac synchondrosis, and palpation of the right sacral foramen per rectum caused severe pain. She improved greatly, but two toes remained paralysed, and she could only walk for less than half an hour at a time.

CASE 16.

"Dr. Jack," in the Practitioner, 1911, LXXXVl, p. 586,

records the case of (i) a primipara in labour on July 27th., 1910. The pelvis was generally contracted; there was a large head; a high forceps operation was performed; the baby was still-born. Next morning she felt her left foot was "dead." There was anaesthesia over the lower leg and foot, and paralysis not strictly outlined. Ten days after labour she had a burning pain below the knee. Anaesthesia extended from two inches below the neck of the fibula to the external malleolus, and all over the dorsum of the foot, and posteriorly to the middle line, and anteriorly as far as the edge of the tibia. Pain sense remained over this area. There was complete paralysis of the tibialis anticus, the extensors of the toes and the peronei. There was tenderness in the sciatic notch and along the course of the nerve. Per rectum the left side of the pelvis felt tender.

CASE 17.

(ii) His other case was age 46. She had numbness of the outer side of the left leg after labour. Severe pain from the great toe came on two hours after labour and lasted five hours. Above the foot the leg seemed "dead." The severity of the pain diminished, but two weeks after her confinement she noticed paresis and foot-drop. The left leg was atrophied, and there was slight swelling and erythema at the ankle. Touch sensation was lost over the external popliteal distribution. Pain sensation was dulled, and heat and cold were not differentiated over this area. She was suffering from Phthisis at the apex of the right lung, and when aged 32 she had had inflammation of the womb. Treatment was rest in bed and electrical treatment. After six weeks the anaesthetic area was smaller and pain was less, and she could extend her toes. A year after confinement her power and sensation were normal.

CASE 18.

"Armitage Whitman," Journal of Surgery, Gynaecology and Obstetrics, Chicago, 1922, Vol. XXXIV, p. 32,

reports the case of a Jewess aged 43, who had had seven previous children and two stillbirths - all easy labours. In the case in question labour began on the Friday night and continued till the Sunday morning, 10.a.m., when forceps were applied. A ten and a half pounds baby was born dead, with the head lacerated. After recovering from the anaesthetic the patient complained of great pain in both legs and inability to move the left foot. There was left foot-drop and complete paralysis of the left leg below the knee. The pain gradually wore off, and at the end of one month she had complete paralysis of the extensors of the toes - the tibialis anticus and posticus and the peronei. The flexors of the toes and calf muscles were normal. The reflexes on both sides were normal, and there were no disturbances of pain or temperature, superficial or deep. The outstanding points are the pain in both legs and the rapid recovery of the muscles supplied by the internal popliteal. He goes on to say that as the tibialis posticus was paralysed, then the tibialis nerve was involved, as was also shown by the total paralysis below the knee (which cleared up). Dorsiflexion of the left foot and extensor proximal phalanges of the toes was impossible, showing paralysis of the extensors longus and brevis digitorum and the extensor hallucis proprius. It was impossible to abduct the foot, showing paralysis of the peroneus longus and brevis. The knee, ankle and plantar reflexes were normal, and there was no anaesthesia, showing that the nerve had recovered. The muscles of the antero-external position of the leg were atrophied and showed no reaction to faradic or galvanic currents.

"Whitman" says - "The diagnosis lies between two possibilities, i.e.injury of the main nerve trunks,as they cross the pelvic brim, by the foetal head or forceps, or peroneal injury at the neck of the fibula by a leg holder."
The reason why only the external popliteal is involved is that the fibres composing this nerve lie directly on the bony brim of the pelvis, whilst the other branches of the sacral plexus are protected by lying on the pyriformis.

CASE 19.

"Howell," in St. Bartholomew's Hospital Report 1908-09,

reports the case of (i) a primipara aged 40. The vertex presented. She was in labour twenty-six hours. Forceps were not used; the afterbirth was retained four hours. On the sixth day there was

paraesthesia of the right instep and ankle, followed shortly by weakness of the right leg. On admission to Hospital, five weeks later, she had wasting below the knee, especially of the anterior tibial group and the peronei. It was not possible to dorsiflex nor evert the foot. She was able to feebly extend the foot. There was slight contracture of the hamstrings, and there was one inch of wasting on the right thigh and calf, as compared with the left side; there was no sensory loss. The right knee jerk was increased, but no achilles jerk was present on the right side.

Two months after labour there was:-

R.D. in the tibialis anticus and external hallucis longus.
Partial R.D. in the extensor longus digitorum, the peronei, the tibialis posticus and the gastrocnemius.
Electrical reactions in the other muscles were normal.

Three months after labour there was still foot-drop and partial R.D. in the affected muscles, but she was able to walk about.

CASE 20.

(ii) A primipara aged 26. Labour was normal. Two days after confinement she complained of severe pain in the right leg. A day or two later the patient noticed that her leg was weak, and that she could not move the foot properly. She had pain and weakness for two months. No sepsis was present in this case. Movements at the hip seemed normal.
At the knee, flexion was weak; extension was good. Complete foot-drop was present, and no eversion of the foot was possible. No real extension of the foot was possible - only a flexion of the toes actually. Over the dorsum and sole of the foot there was a slight loss of tactile and pain sensation. There was R.D. in all of the anterior tibial group of muscles and peronei, also in the extensor brevis digitorum. There was a diminished response to faradic and galvanic current in the calf and hamstrings. The right knee jerk was double plus: there was no achilles or plantar reflex in the right leg, and these were normal in the left leg. After four months of electrical treatment there was only slight improvement from the above.

CASE 21.

(iii) A tertipara aged 35.
In her first pregnancy she was in labour for forty-eight hours, and delivered herself normally of a nine and a half pounds baby. Her second pregnancy was terminated by forceps delivery, after being in labour for thirty-six hours. The child was large. In her third labour she had strong pains from the beginning, and at

the end of the first stage the membranes were ruptured, and forceps were applied without result. There was no pelvic contraction; it was a first vertex, and the head had engaged in the brim but was not fixed in it. The delay was said to be due to a large foetal head. Caesarian section was performed after she had been thirty-six hours in labour. The child weighed ten and a half pounds, and lived eleven days. Nine days after the operation she had numbness and pain in the right foot, and a few days later there was foot-drop and R.D. in the muscles supplied by the external popliteal nerve. The right thigh and left leg were normal.
Five months after labour, the muscles of the right hip were weak. Adduction was weaker than abduction. The extensors of the leg were strong, but the hamstrings were weak. The peronei were paralysed, and there was complete foot-drop, only the toes being able to be flexed. Extension of the foot was much weaker than on the left side. There was partial loss of cotton wool sensation in the first sacral nerve distribution, and less in the fourth and fifth lumbar root distribution. There was a slight disturbance of heat and cold sensation in the same areas. The right knee jerk was double plus. No achilles jerk was present on the right or left side. The right plantar reflex was absent; the left plantar was flexor. In the left leg the electrical reactions were rather diminished in the anterior tibial group. There was R.D. in all the muscles below the right knee, and partial R.D. in the glutei, adductors and hamstrings, but brisk reactions in the extensors of the leg.

Summing up, he says - "There were no contracted pelves and no sepsis in any of the three cases."

The onset in the first was six days after the confinement;
The onset in the second was two days after the confinement;
The onset in the third was nine days after the confinement.

He suggests the lesions were due to delayed rotation of the foetal head.

CASE 22.

"Kleinberg" of New York, in the Journal of Surgery, Gynaecology and Obstetrics, 1927, Vol. 45,

records two cases.

His first case was a primipara aged 28. Labour was difficult owing to a large foetal head. The foetal head engaged in the pelvic brim, but it was too large to pass the outlet. The maternal pelvis seemed normal, and this was confirmed by X-Ray. The application of forceps was unsuccessful, and craniotomy was done. The foetus weighed fourteen pounds. On recovering from the anaesthetic, she experienced severe pains in both legs and feet, and could not move either limb. After one day she could move the thighs and knees, but there was a bilateral foot-drop. The paralysis of the left foot disappeared after a short time, but that of the right foot persisted.
Five months after the confinement she still had pains in both legs, and a right foot-drop. There was an inch wasting of the right leg (? calf meant here), with complete paralysis of the peronei and tibialis posticus, and weakness of the flexor hallucis longus. Both ankle jerks were absent, and there were no sensory changes present in the right leg, but slightly diminished sensation was present over the outer margin of the left foot. There was diminished response to galvanic and faradic current in the peroneal and anterior tibial group of muscles of the right leg, and slight weakness to faradic in the posterior tibial groups of both sides. Two years after labour there was complete paralysis of the right external popliteal nerve distribution cum right foot-drop. Two years and two months after confinement she had no limp, but the paralysis of the tibialis anticus and extensor hallucis proprius was still present. There was a certain amount of power in the extensor longus digitorum and the peroneus tertius and the peronei. Sensation had quite recovered.

CASE 23.

(ii) A primipara aged 23. After being in labour thirty-six hours, with practically no progress, forceps were applied and a dead baby - eight and a half pounds - was born. After recovery from the anaesthetic she felt "coldness and numbness" of the left lower limb. On the third day there was great pain of the left buttock, leg and foot. Pain was still severe on the seventeenth day of the puerperium, especially over the outer aspect of the left leg and foot. It was less severe in the right leg. Sitting and lying down were very uncomfortable. She only became aware of the weakness and footdrop on the third day. Three months after labour the tibialis anticus and all the thigh and leg muscles of the left leg were weak. The left thigh was wasted one and a quarter inches, and the left calf three quarters of an inch. She had a bilateral contracted pelvis. Thirteen months after labour there was no limp and no pain, but still wasting of the left leg and thigh, and a

slight dulling of sensation on the outside of the left leg and the dorsum of the left foot. No left ankle jerk was present.

CASE 24.

"Bull," Soc. d'Obstets et de Gyn., October 1928, Vol. XVll, p. 744 - 46,

recorded the case of Mme B --------- aet 28, a tertipara (first forceps, second normal). Labour was normal till full dilatation, when there were no more pains. The presentation was occipito-posterior. (Apparently no anaesthetic was given) Forceps were applied. The first blade was applied behind and to the right; the second blade - the left - above and to the left. At that moment, and before traction was made, she complained of severe pain in the whole of the left leg from foot to thigh. The pains in the leg gradually lessened, and disappeared by the twenty-fifth day; but she had foot-drop and paralysis of the anterior group of muscles of the leg, and slight diminution in power in the quadriceps, but no diminution in power in the other muscles of the leg. After four months the condition was the same.

CASES 25 and 26.

Gazette Hebdomadaire des Sciences Médicales de Bordeaux. M. Andérodias relates two cases, 1919, Vol. XL, p. 152,

where external popliteal paralysis, motor only, came on at five and eight days after confinement, the first in a long labour with a large baby, the second a contracted pelvis. No other details are given, and he explains them by saying that some post-partum uterine infection was present.

CASE 27.

New York Medical Journal, 1906, Vol. LXXXIV, p. 1,209, "Lloyd" discusses the puerperal paralysis in animals due to Metritis.

He records a case aet 23, a primipara. Forceps were applied. The position of the head is not given. The pelvis was generally contracted (this apparently was the cause of the forceps). On the ninth day numbness and tingling of the left leg were complained of. There was anaesthesia over the dorsum of the left foot and the anterior part of the leg. She stated the condition had been present since the birth of the child, but she had not called attention to it at the time. Seven weeks after confinement there was improvement, but she was not completely well.

APPENDIX.

D. J. Cunningham's Textbook of Anatomy describes the lumbar and sacral plexus as follows:-
"The lumbar plexus is formed by the anterior primary divisions of the first three and a part of the fourth lumbar nerves, with the addition, in some cases, of a small branch from the twelfth thoracic nerve. The nerves increase in size from above downwards. The plexus is placed deeply in the substance of the psoas muscle, in front of the transverse processes of the lumbar vertebræ. The nerves, on emerging from the intervertebral foramina, are connected with the sympathetic system and then divide in the following manner in the substance of the psoas muscle. The first and second nerves divide into upper and lower branches. The upper branch of the first, which may be joined by the branch from the twelfth thoracic, forms two nerves, the iliohypogastric and the inguinal. The lower branch of the second, the whole of the third and that part of the fourth taking part in the constitution of the plexus, divide each into two unequal parts - small anterior and larger posterior parts. The smaller anterior portions combine to form the obturator nerve, which is thus formed by the second, third and fourth lumbar nerves. The root from the second nerve is not always present. The larger posterior portions of the same nerves combine to form the anterior crural nerve.

The sacral plexus is usually formed by the anterior primary divisions of a part of the fourth lumbar, the fifth lumbar, the first and parts of the second and third sacral nerves. Each of these nerves is connected to the sympathetic nervous system. The plexus is placed on the back wall of the pelvis, between the parietal pelvic fascia and the pyriformis muscle. In front of it are the pelvic colon, the internal iliac vessels and the ureters. The plexus is constituted by the convergence of the nerves concerned towards the lower part of the great sacro-sciatic foramen -------- and their continuance through the foramen below the pyriformis muscle into the buttock, as the great sciatic nerve.

The great sciatic nerve ends in the thigh by dividing into two large nerves, the internal popliteal and the external popliteal. In many cases these two nerves are distinct from their origin and are separated sometimes by fibres of the pyriformis muscle. In all cases, on removal of the sheath investing the great sciatic nerve, the external and internal popliteal nerves can be traced up to the plexus from which they invariably take origin by distinct and separate roots. The descending branch of the fourth lumbar, after emerging from the inner border of the psoas muscle internal to the obturator nerve, divides behind the ilial vessels into anterior and posterior parts, each of which joins a corresponding part of the fifth lumbar nerve. The anterior primary division of the fifth lumbar nerve descends over the ala of the sacrum and divides into anterior and posterior parts, which are joined by the corresponding parts of the fourth lumbar nerve. The two resulting trunks, after junction, are called the lumbo-sacral cord."
This lumbo-sacral cord passes over the brim of the pelvis and lies exposed on the bare periosteum covered bone of the sacral ala till it joins the sacral nerves in front of the pyriformis muscle.

"The first and second sacral nerves pass almost horizontally outwards from the sacral foramina, and divide in front of the pyriformis muscle into similar anterior and posterior parts. The third sacral nerve divides into upper and lower parts. The lower part is concerned in forming the pudendal plexus. All these trunks combine to form the sacral plexus and its main subdivisions in the following way. Lying in apposition and converging to the lower part of the great sacro-sciatic foramen, the posterior trunks of the fourth and fifth lumbar nerves (lumbo-sacral cord) and of the first and second sacral nerves combine to form the external popliteal nerve, and the subordinate nerves arising from the posterior aspect of the plexus. The anterior trunks of the fourth and fifth lumbar nerves (lumbo-sacral cord) and the first and second sacral nerves, together with that part of the third sacral contributed to the plexus, unite to form the internal popliteal nerve and the subordinate nerves arising from the front of the plexus.

Branches. The nerves of distribution derived from the sacral plexus are divided, according to their origin, into an anterior and a posterior series. Each set comprises one of the two essential terminal parts - external and internal popliteal nerves - of the great sciatic and numerous smaller collateral branches.

Anterior Branches.	Posterior Branches.
Internal Popliteal,	External popliteal,
Nerves to hamstrings,	Nerves to shorthead of biceps,
" " quadratus femoris,	" " pyriformis,
" " gemelli,	" " superior gluteal nerve,
" " obturator internus,	" " inferior gluteal nerve,
articular branches to hip joint.	articular branches to knee joint.

The external popliteal nerve, as we have seen, arises from the fourth and fifth lumbar and the first and second sacral nerves. Most of its fibres are derived from the lumbo-sacral cord (formed by the fourth and fifth lumbar nerves). Its branches can be divided into two varieties:- (a) those arising from the roots or trunk of the nerve, whilst it is in combination with the tibial nerve in the great sciatic trunk. These are (i) the muscular branch to the shorthead of the biceps and an articular branch to the knee joint; (ii) those arising in the popliteal space, i.e. a sural branch, and the peroneal communicating - both are cutaneous branches. The sural branch is distributed to the skin on the outer aspect of the back of the leg in the upper two-thirds (see figure).

The peroneal communicating nerve joins with the tibial communicating nerve after piercing the deep fascia in the middle third of the back of the leg. These two form the external or short saphenous nerve, which winds round the back of the external malleolus and supplies cutaneous branches to the outer side and back of the lower third of the leg, the ankle and heel, and the outer side of the foot and little toe, as well as articular branches to the

ankle and tarsal joints. Frequently the tibial and peroneal communicating nerves do not unite, and in such cases the usual arrangement is for the tibial communicating nerve to form alone the external saphenous nerve, the peroneal communicating nerve extending only to the ankle and heel. It is less usual for the peroneal communicating nerve to form alone the external saphenous nerve, the tibial communicating nerve in these cases ending at the heel.

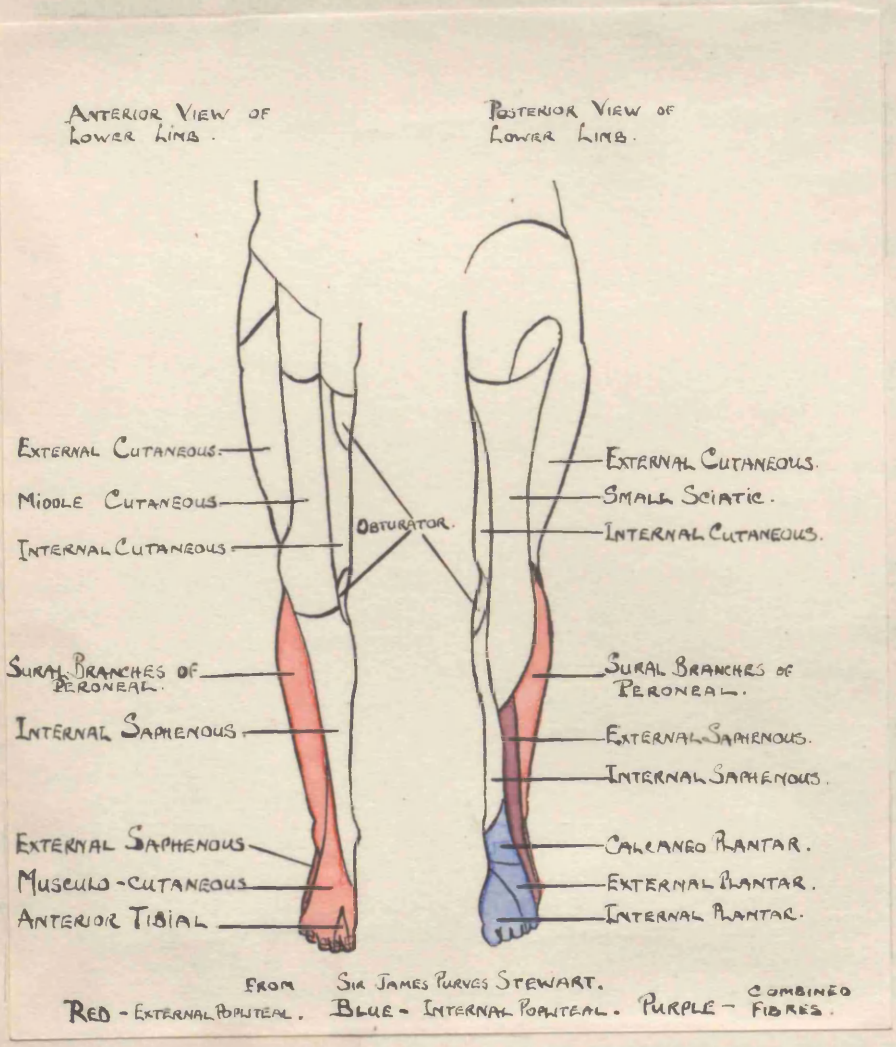
The terminal branches of the external popliteal nerve are (a) the recurrent tibial, (b) the anterior tibial, (c) the musculo-cutaneous.

(a) the recurrent tibial is the smallest branch, and supplies the upper fibres of the tibialis anticus muscle, the tibio-fibular articulation and the knee joint.

1. Muscular Branches.
(b) The anterior tibial nerve supplies the tibialis anticus, extensor proprius hallucis, extensor digitorum longus, and peroneus tertius. A fine articular branch supplies the ankle joint.

2. Terminal Branches on the foot are internal and external. The internal branch supplies the skin of the outer side of the great toe and the inner side of the second toe (see figure). Each of these communicates with branches of the musculo-cutaneous nerve. It also gives off one or two dorsal interosseous branches supplying the inner tarso-metatarsal and metatarso-phalangeal articulations, and also enters the first dorsal interosseous muscle. The external branch supplies the extensor brevis digitorum, along with branches for the tarsal, tarso-metatarsal and metatarso-phalangeal articulations. There are also dorsal interosseous branches sending fibres to the second and third dorsal interosseous muscles, and also to the tarso-metatarsal articulations.

(c) The musculo-cutaneous nerve divides into muscular branches to the peroneus longus and peroneus brevis and terminal internal and external cutaneous branches. The internal terminal branch, after supplying offsets to the skin on the lower third of the leg and dorsum of the foot, divides into three branches (i) the internal branch



From Sir James Purves Stewart.

Red - External Popliteal. Blue - Internal Popliteal. Purple - Combined Fibres.

supplying the skin of the dorsum of the foot and the inner side of the great toe, and communicates with the internal saphenous nerve; (ii) the intermediate branch passes to the interval between the great toe and the second, and divides into two branches which communicate with the internal branche of the anterior tibial nerve; (iii) the external branch passes to the interval between the second and third toes, and divides into two digital branches to supply the adjacent sides of these toes. The external terminal branch supplies branches to the lower part of the leg and the dorsum of the foot, and divides into an internal and an external part, which, passing to the interval between the third and fourth and fourth and fifth toes, respectively, divide into dorsal digital branches for the adjacent sides of these toes. These branches communicate with offsets of the external saphenous nerve. The above arrangement of the various branches of the musculo-cutaneous branch of the external popliteal nerve is subject to variations which need not concern us further.

Pictorially, the areas of distribution of the cutaneous nerves supplying the skin of the thighs and legs may very conveniently be shown, and their root origin indicated in the accompanying diagrams. The areas supplied by the external popliteal are washed in red, and those by the internal popliteal are washed in blue.

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