shivering and headache; temperature 101.6°, pulse 120. Streptococci in lochial discharge. She was given an intrauterine mercurial douche. The puerperium was normal.

Latent Infection with B. coli.

CASE VIII.—A primigravida with a rickety flat pelvis. Diagonal conjugate $4\frac{1}{2}$ in. *Coli* bacilluria during pregnancy. The head did not fix. Caesarean section was performed and a child weighing 7 lb. delivered. The membranes were yellow and unhealthy. Some temperature during the puerperium with pyuria and unhealthy wound. *B. coli* isolated from urine and cervical discharge.

CASE IX.—A married woman, aged 28; one previous abortion. Diagonal conjugate $4\frac{1}{2}$ in. Occasional albuminuria during pregnancy. In labour twenty-four hours with ruptured membranes. Head above brim; liquor amnii offensive; cervix rigid. Temperature 103°, pulse 104. Caesarean section performed; placenta adherent; drainage. Infant (7 lb. 10 oz.) blue from asphyxia. On the following day the infant had blebs on the fingers and vaginal discharge. Febrile puerperium; rigor on the fifth day. *B. coli* septicaemia. Anticoli serum, 20 c.cm., given subcutaneously in saline. The patient recovered.

In this case, unfortunately, the cause of the albuminuria during pregnancy was not investigated. It is possible that a latent bacilluria was present.

Coli Infection.

CASE X.—A primigravida, aged 25. Diagonal conjugate $4\frac{1}{2}$ in. Head entering pelvis. Membranes ruptured forty-eight hours. Liquor amnii discoloured. Cervix one-third dilated. It was decided to do Caesarean section. A child weighing 6½ lb. was delivered; its head was much moulded. The patient was cyanosed and vomited haemorrhagic fluid in large quantities during the operation. The placenta and membranes were yellowish-green and adherent. The following day the infant's eyes were reddened and vulvitis was present. The mother's condition was serious. She had acute bronchitis with cyanosis, frothy sputum, and incontinence of urine and faeces. The pulse was very rapid and out of proportion to the temperature. Coliform organisms were present in the vaginal discharge. Anticoli serum, 10 c.cm., was given subcutaneously and she made a good recovery.

In this case it is probable that a *B. coli* infection from the rectum supervened during the prolonged labour with ruptured membranes. In one other case there was some morbidity, and the value of a few days' preliminary care in the home was demonstrated.

CASE XI.—A primigravida had been examined at the clinic and slight general contraction found, but it was thought that she would probably deliver herself. She came up in labour a few days before the expected date, the head above the brim. The membranes ruptured, but the head did not fix. Temperature 99.8°, pulse 100. The cervix was half dilated. Caesarean section was performed, and a living child, weighing 8 lb., was removed. The placenta was separated with difficulty. Post-operative bronchitis with rapid pulse and slight temperature occurred. Streptococci were found in the lochial discharge. The patient, however, made a good recovery.

In connexion with cases admitted in labour, the statistics of v. Buben² on the association of premature rupture of the membranes and diseases of the puerperium with marital relations shortly before labour need consideration.

CONCLUSIONS.

From such a small number of cases it is unwise to draw any definite conclusions. I am of opinion, however:

1. That latent or pre-existing infection, streptococcal, gonorrhoeal, or coliform, is responsible for a considerable percentage of cases of puerperal sepsis. That the organism may not infrequently be isolated by bacteriological examination of the urine during pregnancy, especially in cases of streptococcal or coliform infection. That intermittent albuminuria during pregnancy is an indication for a bacteriological examination of the urine, even in the absence of urinary symptoms. That with latent infection uterine inertia is more likely to occur, especially when associated with premature rupture of the membranes. That bacteriological facilities for the examination of discharges during pregnancy, if utilized, will enable suitable precautions to be taken and an appropriate serum to be obtained.

2. That for the prevention of puerperal sepsis cases should be removed from unsuitable surroundings, especially when difficulty is anticipated, and that ample accommodation should be arranged so that patients may be admitted a day or two before labour is anticipated.

3. That a rigidly aseptic technique is as important as for a surgical operation. The patient should be carefully prepared and the vulva shaved before any vaginal examination is made during or immediately before labour. That well trained midwives can deliver a very high percentage

of maternity cases if satisfactory ante-natal examination and care have been given by the patient's doctor, and if skilled medical help, and, if necessary, institutional treatment, can be obtained when required. Co-operation between midwives and doctors should be aimed at, and maternity homes should be worked in conjunction with hospitals where expert ante-natal and obstetrical treatment can be obtained.

4. That with a reliable technique in good surroundings operative measures need not cause puerperal sepsis.

5. That in view of the need for study of the origin and character of the infecting organism in cases of fulminating puerperal fever, such cases should be placed at the earliest possible moment under the care of an obstetrical specialist and bacteriologist with facilities for research on the special type of organism.

In conclusion, I wish to thank Dr. Hope and Dr. Mussen for the extensive facilities they have afforded me; Miss Nicholson, M.S., who has assisted me indefatigably throughout; Professor Beattie and Dr. Ashcroft for their bacteriological reports; Dr. Capon and Mrs. Barton Hall for investigating most of the cases of stillbirth; and the matron, Miss Nicholson (Central Midwives Board), and Sister McCaughey (Central Midwives Board) for their invaluable and enthusiastic co-operation.

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FIBROCHONDROMA OF THE CAUDA EQUINA.

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TUMOURS of the caudal region of the spinal cord are by no means common in hospitals for nervous diseases; still less often are they encountered in general hospitals. On searching the clinical records of the Derbyshire Royal Infirmary we have been unable to find any other example of this condition.

Spinal cord surgery dates back some thirty-six years, when Horsley successfully removed a tumour from the dorsal region of the cord. It was in 1902 that the first lesion of the cauda equina was correctly diagnosed and successfully operated on.

In 1896 Dufour collected 21 cases of tumour of the spinal cord. Of these cases only one had been operated on, and that successfully. In 1908 Spiller² published an account of 9 cases, 3 of which had been operated on, and in one the tumour had been removed. There were 7 deaths, including all 3 who had been operated on.

Several other authors have published accounts of cases attended with greater success, including one of a cauda equina tumour.³ This was removed, and the patient made a complete recovery.

The literature on the subject of the spinal cord tumours was analysed by Steinhe⁴ in 1918; he collected accounts of 330 cases, among which were thirty tumours of the cauda equina. Of the latter, 5 were cured, 9 were improved, and 14 died early.

In the recent reports⁵ of the Mayo Clinic there is an account of 112 laminectomies for supposed tumour of the spinal cord in the years 1910-22. In 85 cases a tumour was found, but in 3 cases only was the lesion in the region of the cauda equina, and of these 2 were due to meningo-myelitis and 1 to a tumour.

The following account is of a patient with typical symptoms, and physical signs, of a lesion of the cauda equina.

G. C., aged 42, a miner, was sent by his doctor in February, 1924, to the Derbyshire Royal Infirmary. He gave the following history. In 1920 he began to suffer from a dull ache in the lower lumbar region, and shooting pains down the back of the right

thigh. These improved during the next year, when he underwent treatment at a spa, but they recurred in 1922 and gradually became worse. In 1923 he noticed that his right leg was becoming weaker, and that there was some numbness about the perineum. In December of that year he experienced a sudden pain in the suprapubic region, and inability to micturate. After relief by catheterization there was incontinence of urine. He also stated that he was very constipated, and had not proper control over his bowel.

He was a healthy-looking man who had not lost weight. He had difficulty in walking owing to marked weakness in the right leg. There was some slight muscular wasting, and loss of tone in the muscles of this limb, especially in the flexor muscles of the thigh. All movements of this limb could be carried out, but they were weaker than those of the left side. There was no

FIG. 1.—Area of loss of epicritic and protopathic sensation; also of superficial pain and temperature sense. The second, third, fourth, and fifth sacral roots are affected on the right side; on the left the fourth and fifth.

limitation of movement on bending the back, but there was some local tenderness over the lower part of the vertebral column. There was pain on pressure over the right sciatic nerve, which was increased on flexing the thigh on the trunk, and extending the leg on the thigh.

The most significant physical signs were those of disturbance in sensation. There was definite impairment and loss of epicritic and protopathic sensation, with superficial pain and temperature sense, which extended from the top of the back of the right leg up the thigh in a narrow strip, and over part of the right buttock, and to a lesser extent over the left one in a saddle-shape manner. Loss of sensation extended over the perineum, scrotum, and penis. Deep pain sense and joint sense remained natural.

The distribution of pain, sensory disturbance, and the loss of muscular power pointed to the involvement of nerve roots, the particular ones involved being the second, third, fourth, and fifth, and to a lesser extent the first sacral, on the right side, and the fourth and fifth sacral on the left. Testicular sensation had remained, since the normal nerve supply is from the lumbar plexus. The mucous membrane of the urethra and the lower part of the rectum and anus was insensitive, as the man could feel neither urine nor faeces when they were passed. On inserting the catheter it could not be felt.

On rectal examination the examining finger was not felt. The sphincter ani had lost tone, and on withdrawing the finger the orifice remained patulous.

The abdominal and cremasteric reflexes were active; the knee-jerks, though diminished, especially on the right side, could be elicited. Both ankle-jerks were absent, and the plantar response was flexor.

The patient suffered from retention and overflow of urine. The urine, on admission, was alkaline, and contained some pus cells and blood, and a growth of *Bacillus coli*. After regular catheterization, and with urotropin and acid sodium phosphate taken internally, the urine became sterile, and remained so during the time he was in hospital, with the exception of a slight attack of cystitis for a few days after operation.

An x-ray examination of the lower part of the vertebral column and sacrum showed no evidence of disease or injury of the bones. Lumbar puncture was performed, the needle being inserted in the space between the spines of the third and fourth lumbar vertebrae. The cerebro-spinal fluid was not under increased pressure, was colourless, and contained no cells or excess of albumin. The Wassermann reaction in this fluid and in the blood was negative.

There was no evidence of any disease of the abdomen or pelvis, or of any other part of the body.

The diagnosis of a lesion of the cauda equina in this case was made on the long history of pain in the back and down the right thigh, involvement of definite nerve roots, muscular weakness, loss of control of the sphincters, and the absence of any other nerve signs. These symptoms distinguished it from peripheral neuritis, or a more generalized disease of the nervous system. Disease of the vertebral column, abdomen, or pelvis could be excluded.

As regards the nature of the lesion, it might be due to a chronic inflammatory state or a growth, but it could not, in view of the history, be caused by a vascular or acute inflammatory condition. The commonest chronic inflammatory condition is a syphilitic meningo-myelitis, a gumma, or even a tuberculoma. Against the two former was the negative Wassermann reaction in the blood and cerebro-spinal fluid, and the absence from the latter of any lymphocytes. Were the lesion a meningomyelitis we should have expected the physical signs in the legs to be symmetrical instead of being more advanced on the right side. It was more likely, then, to be a growth of a non-malignant type, for were the growth a sarcoma we should have expected a shorter history, more advanced signs, and a greater involvement of the cord.

The next point to be determined was the level of the upper part of the tumour. It was likely to be below the third lumbar intervertebral space, since the cerebro-spinal fluid from this space showed no evidence of compression of the cord elements. The fact that the fifth lumbar root on either side was not involved made us think that the upper limit of the growth was situated below the point at which this root left the cauda equina—that is, about the level of the upper part of the sacrum. But since lesions of the spinal cord tend to be located too low, we considered that the upper border was situated about the level of the fifth lumbar vertebra.

As regards the treatment, if nothing was done the patient's condition would gradually get worse, paraplegia would develop, he would become bedridden, and would die of cystitis and infection of the kidneys, or septic absorption from bedsores. This case, however, seemed a very hopeful one from the operative point of view. We had enough facts to justify us in thinking that we had diagnosed the possible nature and the level of the lesion; but in planning the operation it had to be borne in mind that lesions of the spinal cord tend to be situated higher up than the symptoms and physical signs indicate. Owing to the uncertainty, in any given case, of the obliquity of the course of the sacral nerves, and remembering the massive backward projection of the transverse processes, it was determined to remove the laminae of the fourth and fifth lumbar and the first sacral vertebrae, and further bone if found necessary.

Operation.

The operation took place on March 1st, 1924. An incision of the skin was made over the spinous processes of the fourth and fifth lumbar and the first sacral vertebrae, the cut edges being protected with tetra towels. The muscle layers were elevated from their bony attachments by means of a sharp periosteal elevator. The bleeding was controlled quite satisfactorily with pads of gauze, wrung out in hot saline solution, held in place by the retractors; no vessels were tied at this stage. The bony arches of the fourth and fifth lumbar and first sacral vertebrae were then removed, and a very good exposure of the thecal sheath was thus obtained. At the level of the upper border of the fifth lumbar vertebra a well marked narrowing of the theca was seen; above this narrowing pulsation under the dura could be seen and felt; below it there was no pulsation. On palpating the dura a definite hard nodule could be felt under the membrane lying to the right of the middle line. The dura was incised in the mid-dorsal line for about 1½ inches. No cerebro-spinal fluid escaped until the obstruction was divided, when immediately cerebro-spinal fluid, perfectly clear in appearance, started to flow. It did not appear to be under any great pressure. Fine catgut sutures were inserted on each side of the cut edge of the dura, to act as retractors. The cauda equina was now well in view, and a mass was seen lying to its right side, pressing the cauda equina to the left. The tumour was shaped like a leech, having its head downwards, and a long granular-looking tail extending upwards just out of sight. On carefully lifting up the tumour, which was quite hard, the head and body were found to be lying free in the subdural space, but the tail was attached. Extending the thecal incision slightly, the attachment was found to be to the inner side of the dura, and not to any of the nerve roots. With very slight traction the whole tumour came away. The dural incision was closed with the finest catgut. Pulsation throughout the exposed length of the theca was restored. The wound was then closed in layers, a few bleeding points being picked up with forceps, and ligatured. No drainage of the wound was employed. Except for firm bandaging over large pads of wool, no splinting was adopted. The patient was laid on a flat mattress, and sandbags were placed on each side of the pelvis to keep him still, whilst the foot of the bed was raised on blocks.

FIG. 2.—Photograph of the tumour after removal.

After-history.

The patient did not suffer to any extent from shock, although the operation lasted over two hours. The further surgical history of the case was uneventful; the wound healed by first intention, and there was no leakage of cerebro-spinal fluid through it. There were no post-operative symptoms attributable to loss of cerebro-spinal fluid during the operation. Previous operators have called attention to the serious consequences which may ensue if much fluid is drained away. For the first few days after his operation the pain down the right thigh was worse, being complicated with severe and painful flexor spasms. The right leg was also weaker. By the end of a week these symptoms began to improve, the pain slowly left him, and the power of movement increased in his leg. At the end

of a month he was out of bed and walking about. The anaesthesia was slower in clearing up, but improvement also occurred with regard to this, and has continued slowly up to the present. The slowest improvement of all was that of control of the bladder and rectum. Catheterization was still necessary, and he developed a mild attack of cystitis, which was, however, quickly overcome by the usual remedies. About the end of the third week he experienced slight feeling when the catheter was passed, and appreciated the passage of flatus. It was not till April 24th that he managed to pass urine spontaneously, this being helped by the pressure of his hands on the lower abdomen. This he did every hour, and so managed to keep the bladder empty, but if he went longer than an hour involuntary dribbling occurred.

Pathology of Tumour.

The pathology of this tumour is very interesting, and is unique according to the literature on the subject to which we have had access.

Dr. Hugh Barber, pathologist to the hospital, who cut a section of the growth, reported that it was a fibrochondroma. Professor Dudgeon also cut and examined several sections for us, and he says:

"This is a very interesting specimen. It is largely a chondroma with areas of necrosis, and at the periphery some calcification. There is a fibrous covering in places, and the fibrous tissue runs

bladder will empty itself. He is just conscious of the flow of urine. There is practically no dribbling between these times, so that he has been able to discard the absorbent bag which he formerly had to wear. He has educated his lower bowel to act once in the twenty-four hours at a certain time, but he is almost insensitive to the passage of the motion. The sphincter has regained most of its tone.

The prognosis in this case is good. Since the growth is non-malignant there is no likelihood of recurrence, which, of course, is not the case with the sarcomata. In Warrington's¹ case, for instance, part of a sarcoma of the cauda equina was removed, with improvement of symptoms, but after three months recurrence took place, and the patient died. The same, though to a lesser degree, may happen to the endotheliomata.

Finally, although there has been pressure on the cauda

FIG. 3.

FIG. 4.

Microphotographs of a section of the tumour (Fig. 3, low power; Fig. 4, high power), showing large number of cartilage cells, with some calcification at the periphery, and strands of fibrous tissue which run into the tumour.

into the cartilaginous tumour. The fibrous tissue shows extensive old haemorrhage with tissue reaction, and marked phagocytosis of the blood pigment by the tissue cells. This would suggest that the tumour had become twisted. There are no other elements present. The cartilage cells are of the large type, such as we see in articular cartilage."

Having regard to the fact that at the operation we found that the tumour was attached only by such a narrow tail, we think Professor Dudgeon's surmise as to the twist is correct.

The nature of this tumour must be very rare. Steinhe,⁴ in his analysis of the pathology of 330 tumours of the spinal cord, reports 26 cases of fibroma, 6 of chondroma, 2 of chondrosarcoma, but none of fibrochondroma. The commonest tumours are sarcoma (112 cases) and endothelioma (28 cases). The 3 cases of caudal tumours of which Percy Sargent⁶ has given an account all proved to be sarcomatous.

The after-history of this case has been one of great though slow improvement. At the present time (February, 1925) his right leg is almost as strong as his left. He can walk several miles each day without undue fatigue, and is doing light work. He complains of no pain. The area of hypaesthesia is less, but it has been stationary for the last two or three months. The part involved now is over a small portion of the right buttock and perineum. Sensation in the urethra and anal canal is still impaired, especially in the latter. He can retain his urine for about three hours, then with an effort, helped by suprapubic pressure, the

equina for some considerable time in our case, we hope that we have interfered before degeneration has occurred, and that restoration of function may be complete.

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IRRADIATION OF MILK AND THE HEALING OF RICKETS.

BY

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THE two processes of growth and bone calcification in young animals are intimately connected, as has been repeatedly stressed by E. Mellanby.¹ An adequate supply of fat-soluble vitamin in the food is essential if the animals are to grow normally and to have their bones normally calcified. But it has been shown recently that if a minimum amount of fat-soluble vitamin is present in the animals' food or tissues, exposure of the animals to ultra-violet rays will, up to a certain point, make good the deficiency of vitamin, thus promoting both good growth and good bone calcifica-