SIX CASES of DISEASES

AFFECTING the HIP

in CHILDREN

Permission has been granted to comment on these six cases by the surgeons in charge.

The photographs illustrating the case of Congenital Dislocation of the Hip were kindly supplied by Mr. Mitchell.

The other photographs were reproduced from the X-rays under the supervision of my colleague Mr. C. Hope.

The script was typed (and no doubt much of it re-spelt) by Mrs. Marjory Law.

I wish to express my thanks to all the above.
Case 1 ... ... ... ... Annette Bowman.
Case 2 ... ... ... ... Margaret Hughes
Case 3 ... ... ... ... James Ramsay
Case 4 ... ... ... ... Mark Brannon
Case 5 ... ... ... ... William McBride
Case 6 ... ... ... ... Derek Reid

References.
A Case of Congenital Dislocation of the Hip.

CASE 1.

Name. ANNETTE BOWMAN.

Address. Moorings, Milton Place, Pittenweem.

Date of Birth. 11.8.57.

Date of Admittance. 16.3.60.

HISTORY.

On 4.3.60 this girl was sent to Anstruther Clinic because she was limping badly on the left leg, had a limitation of abduction on that side and had an asymmetry of the buttock creases. She was diagnosed as Congenital dislocation of the hip and admitted to the Princess Margaret Rose Hospital on 16.3.60.

0/E.

H.E.N.T. - Negative.

Chest - Symmetrical. There was a cystic bluish area over the left trapezius.

Lungs - Clear.

Heart - Regular rhythm, no murmurs.

Abdomen - Soft, no masses.

Extremities - Asymmetrical buttock creases limited abduction of the left hip. Positive Trendelenburg on left.

TREATMENT.

An arthrogram of the left hip was performed on 21.3.60 as a routine procedure. A posterior limbus obstructing reduction was found.

Annette was put into an abduction frame for 5 weeks until
when the limbus was removed from the left hip. After this the limb was held in 45° of abduction and full internal rotation in a single hip spica and on 14.5.60 Annette was allowed home until when she was re-admitted for bivalving of the plaster and a derotation osteotomy which was performed on 27.6.60 70° of derotation and some varus was maintained by a bent plate.

She was discharged on 2.7.60 and readmitted on 17.8.60 for removal of the spica and mobilisation after which she was discharged on 5.10.60 walking quite well.

Unfortunately, on 1.11.60 Annette fell at home and had to be readmitted with a supracondylar fracture of the left femur.

This had to be manipulated under general anaesthetia and Annette, after a period of three months, 6 weeks of which was at home, was discharged, again walking quite well, on 5.2.61.

By 23.3.61, when she was seen as an outpatient, Annette was walking quite normally.

**DISCUSSION.**

**Aetiology.**

This is unknown, but there is evidence of a pronounced hereditary factor. A dominant mutant gene has been suggested (1). The incidence in females is nine times that in males and is greater in some areas such as parts of France and Italy.

**Pathological Anatomy.**

Two major forms are described - subluxation and complete dislocation.
1. Complete Dislocation.

In this form the head comes to rest against the lateral wall of the ilium from which transmitted pressure causes the head to become flattened posteriorly and the femoral neck to increase its anteversion. The capsule becomes greatly hypertrophied and increased in extent. Both the capsule and the transverse ligament are pulled upwards, become adherent to the floor of the fossa and obstruct replacement.

Pressure on the capsule and periosstium causes them to differentiate into a fibrocartilagenous tissue which lines a depression in the ilium forming a false acetabulum. The reflected rectus tendon, the labrum glenoidale and sometimes a hypertrophied ligamentum teres may obstruct replacement from below. Further difficulty may be encountered from shortening of muscle and fascia lata. The glenoid cartilage and the immediately adjoining part of the capsule are together termed "the limbus" and it was shown by the arthrogram that it was the posterior segment of this that was largely responsible for preventing the reduction of Annette's dislocation. It is said that in this form of C.D.H. the socket is deeper and more fully developed - unlike Annette's poorly formed acetabulum in Fig. 1 (a). The above description is more fitting to a dislocation which has slid further up the ilium than in our case where perhaps the obliquity of the acetabular roof is to some extent due to pressure from the head on the upper margin.

Annette Bowman's acetabulum corresponds more/the picture
described as subluxation.

2. Subluxation.

Here the acetabular fossa is shallow and small, the roof oblique to vertical and the superior acetabular pole grooved and irregular. This atrophy of the cavity may be due to the lack of normal pressure of the head and if this is replaced early the acetabulum may reform. In both forms fibro-fatty material tends to fill the vacated part of the cavity and anteversion of the femoral neck is increased.

Clinical Picture.

The following typical features were shown by Annette Bowman:

She had an asymmetry of the folds of her groin and buttocks.

Trendelenburg's sign was positive on the left side with the associated limp. This is the result of the displacement of the insertion of the glutei so that their leverage is reduced and their powers of abduction weakened. When Annette lifted her right leg off the ground her left glutei were unable to prevent the pelvis tilting down to the right.

There was, again typically, restriction of abduction.

Amongst other signs found, but not noted in our case, is real shortening, a feature said to be present in all cases. Palpation of the head in its abnormal position is perhaps the clinical finding of most definite diagnostic value. Telescopic movement can sometimes be elicited by pushing and pulling the leg with the hip partly flexed. In bilateral cases lordosis and widening of the perineum are evident. Older children will complain of pain, weakness and fatiguability.
Radiography.

The X-ray taken when Annette was first seen (Fig. 1 (a)) shows the characteristic picture. The head is obviously displaced and the acetabulo-femoral space widened. The neck appears foreshortened, but in reality this appearance is due to anteversion. The acetabulum is shallow and the roof oblique. The angle between the horizontal line through the triradiate cartilage and the line along the roof of the acetabulum should, in children of 2 years, be about 20°. This is the acetabular index and in Annette's right hip (Fig. 1 (a)) was 21° but in the left was 30°. The last X-ray, 2.2.61 (Fig. 1 (e)) shows a marked improvement, the acetabular index on the left then being 23°.

The arthrogram (Fig. 1 (c)) shows a filling defect suggestive of a small space-occupying lesion and corresponds in shape with the limbus removed from the left hip at operation (Fig. 1 (f)).

Treatment.

Initially

Generally, this is by closed reduction by means of traction and abduction, but if this fails open reduction should be undertaken as soon as possible. A further attempt at closed reduction, by gentle manipulation is sometimes made before deciding on open reduction. Arthrograms are felt to be unnecessary by many people, the failure of closed reduction being generally taken as the indication for open reduction. If a prolonged attempt is made, however, valuable time may be lost during which the socket should have been reforming. Once achieved, reduction is maintained by immobilising both hips in plaster with the legs abducted and internally rotated for 6 months.
in infants to as much as a year and a half in some older children. The frog position with medial rotation maintained for such long periods frequently copes with the anteversion defect.

Annette Bowman was treated under a somewhat different regime. Here arthrograms were done routinely and if a limbus is present the hip is assumed to have been dislocated and open reduction indicated. First the hip is reduced by divarication over about 5 weeks. Fig.1(c) shows the joint after this treatment. The head has been brought down but is held out of the joint by the obstruction. After this the limbus is excised and a month later a derotation osteotomy is performed. After a further month, 5 months after admittance, mobilisation is begun and the patient discharged walking, within seven months of being diagnosed.

The advantage of this vigorous approach to the disease is that the child is up and about much earlier. As well as the obvious advantage of this, the earlier a weight bearing head is replaced, the earlier the acetabulum is stimulated to reform. Also it is claimed that there is less avascular necrosis following open reduction. Certainly the manipulative reduction introduced by Lorenz at the end of the last century, although a great advance at the time, is well known to cause an osteochondritis resembling Perthes disease.

If there is no limbus seen, conservative treatment using divarication is indicated.

This system, however, depends on the arthrography which is a very specialised procedure requiring much practice both in technique and interpretation before accurate results can be achieved.
If dislocation presents too late or recurs, the acetabular roof does not reform and the upper lip may have to be brought down by operation. Other operations for unreduced cases include making shelves using massive bone grafts and sometimes making a new joint with a vitallium cup. A Lorenz bifurcation osteotomy is sometimes performed on older people.

**COURSE & PROGNOSIS.**

Since treatment is often so long and arduous, it is important to compare its result with the course in the untreated disease. An unreduced dislocation results in an ungainly gait and interferes with athletic prowess, but neither interferes with most occupations nor prevents women being chosen for marriage. Pain is unusual before twenty-five and indeed may never develop.

The good function for about 30-40 years permitted by a successful reduction usually makes this process well worthwhile. Unfortunately after this age osteoarthritis frequently develops. On the other hand, reconstruction operations after unsuccessful reduction are less clear cut.

Assuming that her hip does not redislocate, Annette Bowman should have perfect function in both hips, but may well develop osteoarthritis in her left hip when middle aged. Perhaps by that time some remedy or even prevention will have been found to save her from a crippled old age.
A Case of Coxa Vara.

CASE 2.

Name. MARGARET HUGHES.
Address. 15 Ballingry Road, Ballingry, Fife.
Date of Birth. 8.6.57.
Admitted. 6.12.60.
Complaint. Bilateral coxa vara.

HISTORY.

This child was seen as an outpatient on 29.6.60 with knock-knees with 1\(\frac{1}{2}\) in. between the malleoli. The mother was shown how to manipulate the knees and internally rotate the tibiae. On a subsequent visit a fortnight later there was an improvement in the knock knees and rotated tibiae, the distance between the malleoli then being \(\frac{7}{8}\) in. At this time a limitation in internal rotation of the hips was noted and X-rays ordered. These showed bilateral coxa vara and Margaret was admitted to the R.M.R. on 6.12.60.

O/E.

She was a friendly three year old, healthy, but a little thin. Her skin was pale, but her mucosae were of a healthy colour.

No abnormalities of note were found in the cardiovascular system, lungs or abdomen.

Orthopaedic Examination.

Her upper limbs and spine were normal. She walked on a wide base with her feet rotated out but without limping. She had a wide perineum. A slight knock-knee deformity was present. The buttock creases were level, there was no evidence of muscular wasting and the legs were of equal length.
Hips: There was no telescoping. The greater trochanters were at the normal level.

Movements of Hips:

<table>
<thead>
<tr>
<th>Movement</th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td>Flexion</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td>Extension</td>
<td>Full</td>
<td>Full</td>
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<tr>
<td>Abduction</td>
<td>15°</td>
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<tr>
<td>Adduction</td>
<td>90°</td>
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<td>External Rotation</td>
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<td>Internal Rotation</td>
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The knees possessed full movements. The tibiae were laterally rotated, so that the line joining the medial and lateral malleoli formed an angle of 45° with the coronal plane, the lateral being behind the medial malleolus.

Both feet were somewhat flat while weight bearing, but had perfect mobility.

TREATMENT.

19.12.60

Straight traction.

27.12.60

Bilateral gallows traction.

(Margaret got an ear infection on 22.2.61 which perforated her left drum.)

DISCUSSION.

This disease has been described as congenital coxa vara, developmental coxa vara and infantile coxa vara.

Aetiology.
Aetiology.

F. Campbell Golding (3) suggests that the short femur of micromelia and congenital coxa vara are variations of the same anomaly. Babb (4), however, suggests that two conditions exist, one truly congenital and usually associated with other congenital abnormalities and another, the more common form, differing pathologically and being an infantile lesion in the form of an aseptic necrosis. Comitz (1934) found it impossible to distinguish histologically this infantile coxa vara from osteochondritis. However, there never seems to be any suggestion of avascular necrosis of the head.

A. B. Le Mesurier (5) claims that the disease sometimes runs in families and is commoner in some districts. He found an equal number of boys and girls presenting with this condition and that the incidence was 13 times less than that of C. D. H.

PATHOLOGY.

The head is normal histologically. The gross pathology is best considered with the discussion of the X-ray findings.

CLINICAL PICTURE.

Margaret presented with knock-knees and it was while attending for this condition that a loss of internal rotation was noticed and the X-rays taken which led to the discovery of her coxa vara. She was, then, diagnosed before the full clinical picture had developed. Indeed, at the time there were no symptoms referable to the hips unless one indulges in the fanciful theory that the knock-knees were a result
of the adduction of the leg at the femoral neck. This would mean that there had been a compensatory abduction at the knee. More likely the knock-knees were of the idiopathic type due to the lateral side of the lower femoral epiphyseal disc producing a slower rate of growth than the medial side. This is usually only temporary and the defaulting part usually catches up again as appears to have happened here.

The clinical picture of congenital coxa vara in areas less happily supplied with orthopaedic surgeons generally develops as follows. There is a painless limp usually commencing at an age of about $3\frac{1}{2}$ - Margaret's age on admittance.

The lower extremity is shortened and the Trendelenberg sign is positive on the affected side. This is because the greater trochanter is above Nelaton's line and the glutei shortened. Below the neck, however, the femur is normal and not shortened.

In the bilateral case, and the condition tends to be bilateral, there is a moderate lumbar lordosis, waddling gait and widening of the perineum.

There is a progressive limitation of abduction and internal rotation. This limitation of movement and the widened perineum were the only signs which Margaret had of this condition.

CLINICAL COURSE.

The gap is present at an early age and without treatment the deformity and limp increases slowly at a varying rate and to a varying extent over a period of years till at about the age of 12 this increase
in severity ceases and some improvement may occur. Finally the gap
heals leaving a deformity which may be moderate, but is more often
severe and which predisposes to later degenerative changes.

Although there is no telescoping, there is a close similarity
between this infantile condition and C. D. H. The diagnosis is made
from the characteristic X-ray findings.

**X-RAYS.**

The radiographic findings are:

1. There is a defect in the femoral neck appearing as a gap
parallel to the epiphyseal line turning away from it at one end, usually
the lower end, where it sometimes divides into two, leaving a triangle
of bone appearing isolated.

   Such a triangle may be seen in Fig 2 (a).

2. There is a varus deformity.

3. The neck is shortened and appears

4. "fragmented" particularly just distal to the gap.

   These points are again demonstrated in the Figs 2 (a) and (b).

5. The greater trochanter extends upwards towards the ilium as
   a beak. This is not seen here as Margaret's greater trochanters are as
   yet unossified.

   Other changes said to occur are delay in ossifications in the neck
   and upper part of the shaft, secondary deformity of the acetabulum
due to the malposed head and shortening of the shaft of the femur.

**TREATMENT.**

There are two main lesions requiring treatment - the gap and the
varus deformity.
Traction.

A. B. Le-Mesurier (5) has found that strong traction and forced abduction did not change the angle of the neck in the slightest. He considered that the neck was too rigid at the gap to be bent by closed manipulation. From a consideration, however, of the two X-rays, Figs. 2 (a) and (b), Margaret seems to have responded to traction. As well as showing consolidation in the neck, the neck-shaft angle has increased. From measurements on Figs. 2 (a) and (b), on the left side on 14.12.60 the neck shaft angle was 100° and on 28.3.61 was 116°. The corresponding figures for the right side were 98° and 103°. It will also be seen that consolidation of the neck on the right is less than that on the left.

The right side, then, is not improving as well as the left and this has lead to the consideration of operative measures.

Philip wiles (1b) considers that the only treatment for congenital coxa vara is by abduction sub trochanteric osteotomy.

Abduction osteotomy.

The femoral shaft is cut through and the distal fragment abducted widely by about 60 - 70°. By this means the varus deformity and its associated shortening of the limb with weakened glutei and Trendelenburg limp are all corrected by the one procedure. A.B. Le Mesurier (5) reporting on 12 such cases claims that in all of these the osteotomies healed rapidly and the limp disappeared or improved markedly. Moreover in all but one the gap in the neck healed within one year of operation. This closure of the gap is thought to be due to the defect being disposed horizontally instead of vertically so that it is subjected to
compression instead of shearing forces.

Grafts and Nails.

Le Mesurier (5) suggests that grafting is the treatment of choice for patients diagnosed early and in whom the varus deformity has not gone too far.

The use of a Smith Peterson nail in an attempt to eliminate shearing forces failed to speed closure.

It is interesting to note that in all these cases the limp improved when the gap was closed (or, in the case of the Smith-Peterson nail, secured), although the degree of varus remained unaltered.

Le Mesurier suggests, therefore, that the limp is partly a direct result of an instability in the defect of the femoral neck.

The operations of subtrochanteric abduction osteotomy and bone grafting may be usefully combined.

The postoperative prognosis must be guarded since recurrence can occur slowly regardless of any method, but most particularly during the growth period and when bone grafts alone are used.

**SUMMARY & PROGNOSIS.**

Margaret Hughes is a case of bilateral coxa vara which is responding to conservative treatment, but which may yet require operative measures.

She was diagnosed very early and before great deformity had occurred, so that although she may yet have to pass more of her childhood in hospital, it can be hoped that the final outcome will be good.
CASE 30

Fig. 2 (a)

14/12/60

Fig. 2 (b)

28/3/41
A Case of Osteomyelitis of the Femur Affecting the Hip.

CASE 3.

Name. JAMES RAMSAY.
Date of Birth. 20.8.57.
Admitted. 21.1.61.

PAST HISTORY.

On 30.9.57, at the age of 1 month, James Ramsay was admitted to Dundee Royal Infirmary with an asymptomatic fluctuant swelling of the left thigh. This was found to be an acute osteomyelitis involving the whole shaft of the left femur. The aspirated pus gave a culture of penicillin resistant staph. aureus. James was treated in gallows traction with 50 mg. Erythromycin 6 hourly. The disease process settled down on this regime but left a pathological subluxation of the left hip and a restriction in adduction. At this stage abduction rings were fitted to prevent complete dislocation, but the head could not be completely reduced. This was the state of affairs when he was discharged.

Seen as an outpatient in Fife on 5.2.58 the X-rays of the left hip showed a mild subluxation tendency. The epiphyseal nucleus was present, but part of the neck destroyed. The subluxation was seen to correct on abduction and treatment on a Forrester Brown splint was commenced. After a year and a half of this treatment, (by 5.11.59), James had developed deformities in his left hip of 15° flexion and 15° abduction and the head was seen by X-rays to be trying to subluxate.

Treatment by osteotomy was planned and on 31.3.60 James was admitted to the P.M.R.
No abnormalities of note were found during examination of his chest, cardiovascular system, abdomen or E.N.T.

The left hip had a 15° flexion deformity and 15° abduction contraction with very little rotation. It flexed to 90°.

**PROGRESS.**

4.4.60

An arthrogram showed gross enlargement of the head and anteversion which could not be corrected because of contracture. There was a suggestion of a capsular fold obstructing the head. The best position was in 45° abduction and a Varising osteotomy of 45° was therefore suggested.

5.5.60

Treatment on an abduction frame was started.

6.6.60

An arthrotomy of the left hip was performed and a small posterior compressed limbus found and removed. After this the head sank deep into the socket on internal rotation. The hips were immobilised in a bilateral hip spica in internal rotation and abduction. 2 weeks later James was discharged to be readmitted after a further three months when his plaster was bivalved and his hip X-rayed. These showed that the hip remained in joint during abduction and so on

3.10.60

a Varising osteotomy of the left femur was performed. This took the form of an intertrochanteric wedge osteotomy, the fragments being fixed by a three holed plate bent to hold the fragments in a varus position. Figs 3 (c) and 3 (d) show the pre- and post-operative picture respectively.

It was found that the adductors of the right hip were extremely tight and a subcutaneous adductor tenotomy was carried out.

A double hip spica was applied. It was noted that there was fairly
common ages for it to occur are between 4 and 10. 15% of cases are bilateral. Although the cause is really not known it is thought that the necrosis of the head may be brought about by a vascular disturbance perhaps following an injury. Experiments in support of such a theory have been carried out in which the pathology has been reproduced by interference with the blood supply to the femoral head by ligation of the ligamentum teres sometimes combined with stripping the periosteum from the femoral neck (7 a).

Other factors of suggested aetiological importance are infection and pituitary and hypothyroid conditions.

PATHOLOGY (7b)

This is described in 3 stages.

1. The early stage. The femoral head undergoes bone necrosis and its marrow degenerates into an amorphous debris. The neighbouring bone becomes hypervascularised and therefore osteoporotic, especially in the metaphysis. In contrast, the necrotic bone appears increased in density.

The overlying cartilage continues to be nourished normally through the synovial fluid, but, although in itself not abnormal, is soft and yielding due to the changes in the underlying bone.

2. Regenerative stage. This entails the replacement of necrotic bone by viable bone.

There is invasion of capillaries, macrophages and giant cells, which absorb the debris and fibrose the marrow. Osteoclasts absorb the old trabeculae while osteoblasts form new osteoid.
epiphysis the knock-knee deformity would be progressive and should therefore be operated on soon.

This then was the position when James was discharged on 10.5.61.

**DISCUSSION.**

James is a case of osteomyelitis of the left femoral shaft which cleared up with conservative treatment but which left a subluxating hip with a partially destroyed neck and some alteration in the shape of the femoral head (Fig. 3 (b)).

Fig. 3 (a) shows the femur thickened, shortened and malformed. Perhaps this picture and the subsequent complications would have been avoided had the bone been drilled and free drainage ensured.

The treatment did, however, prevent the development of the full picture of an infantile acute suppurative arthritis of the hip which before the days of antibiotics, according to Phemister (1924) invariably resulted in complete destruction of the head and pathological dislocation. Treatment was then aimed at arthrodesing the joint in the best functioning position (6). The aim in our case, however, is to achieve a mobile useful joint and lengthen the shortened limb.

The head probably came out as a result of an effusion in the joint with stretching of the ligaments and capsule of the joint. Reduction was prevented by a small limbus and the fact that there was no neck shaft angle to bring the head into the joint so that after the limbus was removed reduction was only satisfactory in abduction (Fig. 3 (c)). To produce the effect of a neck-shaft angle a varising osteotomy was performed (Fig. 3 (d)). This is tending to straighten out slightly,
(Figs. 3 (f) and (g)) and may have to be repeated.

So with this and possibly further operative procedures to correct his knock-knees and lengthen his femur it seems that James Ramsay will have to pass a further considerable part of his childhood in hospital. It will be interesting to see how he walks after it all, but in all probability this left hip will suffer the degenerative changes of old age long before James Ramsay does.
A Case of Legg-Calvé-Perthes Disease.

CASE 4.

Name. Mark Brannan.
Address. 64 Boghall Drive, Bathgate.
Date of Birth. 21.5.55.
Admitted. 3.5.60.
Complaint. Limp for over 3 months.

HISTORY.

14.4.60. Mark was seen by Mr. Anderson in a Bathgate clinic. At that time he had had a left sided limp for three months. According to his mother he started walking at 16 months and had always walked funnily - a family failing on his father's side.

On examination there was discomfort in the left groin associated with fullness on that side. There seemed to be anterior displacement of the hip. There was no telescoping. Abduction was very limited, but flexion and extension were good. The muscles showed good control. At this stage it was thought that the condition might be due to a subluxation or a coxa vara perhaps associated with acute osteochondritis. The X-ray films (Fig. 4 (a)) showed osteochondritis and Mark was admitted to the P.M.R. on 3.5.60 diagnosed as a case of Perthes disease.

O/E

Mark was a fit looking boy.
Cardio-
Heart sounds normal. No murmurs heard.
Vascular System.

Respiratory System.
Normal.
Abdomen.
No abnormalities.
The pupils were of equal size and reacted to light.
The cranial nerves were intact.
There was no nystagmus.
Sensation seemed normal.
There were no obvious signs of muscle weakness or wasting.
The tendon reflexes were brisk and equal.
The plantar responses were flexor.

Orthopaedic Examination.

He walked with an unsteady gait with the feet well apart rather than with a limp.
The legs were of equal length and showed no deformity or wasting.

Hips: On the left side there was a limitation in abduction, especially noticeable when the limb was in the flexed position.
The greater trochanters were at the same level on both sides.

TREATMENT.

3.5.60
Temporary skin traction.

28.5.60
Onto-Jones Frame.

6.3.61
Pattern-ended caliper.

DISCUSSION:

Synonyms include coxa plana, osteochondritis deformans juvenelis, pseudocoxalgia and osteochondrosis of the hip.
The disease consists essentially of an aseptic necrosis followed by replacement of the femoral head.

Predisposing Factors and Aetiology.

Perthes is more than twice as common in boys as in girls and the most
common ages for it to occur are between 4 and 10. 15% of cases are bilateral. Although the cause is really not known it is thought that the necrosis of the head may be brought about by a vascular disturbance perhaps following an injury. Experiments in support of such a theory have been carried out in which the pathology has been reproduced by interference with the blood supply to the femoral head by ligation of the ligamentum teres sometimes combined with stripping the periosteum from the femoral neck (7a).

Other factors of suggested aetiological importance are infection and pituitary and hypothyroid conditions.

PATHOLOGY (7b)

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1. The early stage. The femoral head undergoes bone necrosis and its marrow degenerates into an amorphous debris. The neighbouring bone becomes hypervascularised and therefore osteoporotic, especially in the metaphysis. In contrast, the necrotic bone appears increased in density.

The overlying cartilage continues to be nourished normally through the synovial fluid, but, although in itself not abnormal, is soft and yielding due to the changes in the underlying bone.

2. Regenerative stage. This entails the replacement of necrotic bone by viable bone.

There is invasion of capillaries, macrophages and giant cells, which absorb the debris and fibrose the marrow. Osteoclasts absorb the old trabeculae while osteoblasts form new osteoid.
Vessels penetrate from all sides and are to some extent responsible for producing the fragmented appearance of the head which is also a result of subchondral fractures of the necrotic bone. The regenerative stage in Mark had probably started by the time he was admitted - see Fig. 4(a).

3. Healed stage. Newly formed bone is soft and easily compressed as a result of which there is flattening of the superomedial aspect of the head which assumes a mushroom or cup shape.

The soft tissues about the hip, initially swollen and hyperaemic, undergo a repair reaction. This subsides, leaving a variable degree of fibrosis and inelasticity.

CLINICAL PICTURE.

The duration of the above cycle is about 2 - 4 years.

Symptoms.

There are limp, pain and sometimes stiffness. The pain is in the groin, medial thigh and medial aspect of the knee and is generally aggravated by activity and subsides with rest.

Signs.

Movement may be limited in all directions, but especially abduction and rotation. Mark's very limited degree of abduction with good flexion and extension is typical.

X-Ray Findings.

The following points are illustrated in Fig. 4 (a), which is the picture with which Mark presented on 19.4.60.

1. The joint space appears widened. This is only apparent,
however, and is a result of resorption.

2. There is decreased density of the proximal end of the metaphyses.

3. The femoral neck is shortened and broadened - this is better seen in Fig. 4 (d).

4. The femoral head is flattened and widened.

5. There is marked fragmentation.

Other X-ray findings often said to be seen in Perthes disease but not obvious in these pictures are -

1. Prominence of the soft tissues over the capsule - due to synovitis.

2. The femoral head is said to appear increased in density.

The X-rays 4 (a) - 4 (e) show a progressive recalcification and recovery from fragmentation, but the shape of the head remains flattened throughout - the capital index* on the left being 26 on both the first and the last X-ray.

There seems to be a change of shape in the right femoral head, the capital index on that side being 52 on 19.4.60 and 45 on 6.3.61. This change might be explained by errors from a change in the angle at which the X-rays are taken or from the measurements made on these X-rays, but it must be remembered that the condition has a marked tendency (15%) to be bilateral.

*The capital index is the ratio of the maximum height of the femoral head to its width along the epiphysis multiplied by 100. In normal children this is just below 50.
TREATMENT.

The effect of treatment is not certain. Sometimes the condition leaves little deformity even without treatment, whereas distortion of the head may occur in spite of great care.

Treatment aims at preventing pressure on the femoral head while it is in a soft state. Pressure is from two sources - weight bearing and muscle pull. Bed rest with traction prevents both these forces while the pattern-ended caliper or Snyder sling prevents only the weight bearing force on the affected side. According to Wiles (1 c) recent follow ups show little difference between these methods so that prolonged bed rest for this condition is becoming less popular.

Mark was treated by bed rest and traction followed by a weight relieving pattern ended-caliper. This regime has been successful in that no further flattening of the femoral head took place. The head, however, was malformed before the condition was diagnosed and it remains to be seen what effect this will have on the function of Mark's left hip, if not resulting immediately in any deformity, then later on in connection with osteoarthritis.
Fig. 4 (a) 19/4/60

Fig. 4 (b) 26/7/60

Fig. 4 (c) 17/10/60
A Case of Tuberculosis of the Hip.

CASE 5.

Name.  WILLIAM McBRIDE.
Address.  50 Kirkland Drive, Methill.
Date of Birth.  19.5.49.
Admitted.  2.1.61.

PAST HISTORY.

11.4.51. William was thought not to be using his right leg properly and on investigation a tuberculous left hip was found.

He had pulmonary tuberculosis with collapse of the right lung and an area of infiltration in the left. A guinea pig inoculation showed the presence of Tubercule Bacillus. The hip was treated on a Jones abduction frame and William was given chemotherapy consisting of 40 G. Streptomycin.

After 3 years immobilisation the femoral head had been destroyed and the limb shortened by 1 in.

By 19.1.53 40° of flexion contracture had developed and on that date a V-shaped intertrochanteric osteotomy was performed.

One year later William was discharged with his hip apparently ankylosed in 35° flexion, but was found at a clinic one month later not to be completely fused and the flexion deformity gradually increased till on 8.1.59 the joint was curetted and packed with bone chips and a second corrective osteotomy performed, this time being subtrochanteric. Chemotherapy (Strep l G. PAS 10 G (d.) were given post operatively for one month.

It was 6 months before the hip was thought to be ankylosed and by
this time the left knee could only flex to 30°. After 1 month this knee flexed to 80°.

True shortening at this time was 2\(\frac{1}{2}\) in.

21.8.59

He was discharged walking on a shoe raised 1\(\frac{3}{4}\) in. in the heel and 1\(\frac{1}{4}\) in. in the sole.

13.7.60

William was readmitted for consideration of the possibility of leg lengthening being done and this was thought advisable because he was short for his age and also as he had an arthrodesed hip.

6.12.60

Pain had developed behind the left knee when the left hip was moved. The hip was thought to be more flexed and so readmittance was advised for revision of the hip and possibly leg lengthening. The X-ray of the hip at this stage is seen in Fig. 5 (a).

So, on 2.1.61 William was admitted once more to the P.M.R.

Summary.

11.4.51

Diagnosed T.B. left hip - chemotherapy and immobilisation.

19.1.55

Osteotomy to correct 40° flexion contracture.

6.4.56

Discharged, but a month later the ankylosis was found incomplete.

Flexion deformity increased and on 8.1.59 the hip was curretted and fused and a second correction osteotomy performed. True shortening was 2\(\frac{1}{2}\) in. It was 6 months before the hip was thought to be fused, but on 6.12.60 complete fusion was doubtful and so to survey this and the question of leg lengthening, William has been admitted again.

0/E.

An intelligent, self-sufficient boy.

Heart and lungs revealed no abnormalities; neither did the abdomen.
Lower Limbs.

The left leg was $2\frac{1}{2}$ in. shortened, all of this being in the femur.

Hips: The right hip and lumbar spine were normal and fully mobile. The left hip was soundly arthrodesed in $30^\circ$ flexion and no movement possible.

Knees: The right knee was normal. The left knee had full extension but lacked about $5^\circ$ flexion.

Feet: The feet were normal.

TREATMENT.

3.1.61.

The arthrodesis was suspected not to be solid and it was suggested that it be reviewed at operation.

10.1.61

William fell and developed a pain behind the knee.

23.1.61

The left hip was explored, scraped and rearthrodesed.

Considerable fibrosis was found round the hip. There was a pseudarthrosis with no solid bony union. The soft avascular bone was removed and a cavity in the region of the greater trochanter scraped out. There was no evidence of tuberculous infection, the soft bone merely being remains of bone chips.

In order to bring the femur into contact with the pelvis the leg had to be abducted, extended and externally rotated. It was fixed in this position by a bone peg from the upper end of the femur which was fitted into a slot made across the hip joint after cancellous chips from the bone bank had been used to fill in the gaps.

A subtrochanteric osteotomy, William's third, was carried out to bring the leg back to the neutral position.

A plaster spica was applied.
The post-operative X-ray is seen in Fig. 5 (b).

Two pints of blood were given during the operation.

**PROGRESS.**

Anti-tuberculous chemotherapy was given.

3.2.61

When the spica was changed the hip was found in 10° abduction and this may have to be corrected subsequently.

4.4.61

William was discharged in a weight-bearing pelvic spica and was readmitted on 26.4.61 for X-ray out of spica.

1.5.61

In spite of the X-ray appearance, Fig. 5 (c), the hip was found to be clinically not united.

**DISCUSSION.**

As in this case tuberculosis of the hip is invariably secondary to a primary site elsewhere. It is a disease of young children, 9 out of 10 cases occurring in the first decade of life and half of these between the ages of three and five. Boys are slightly more often affected than girls.

3 stages are described:-

1. Early.

This is before actual invasion of the joint has taken place, but when synovial irritation and effusion are present. The signs at this stage are limp and pain. Of these the limp is the more outstanding and is insidious in onset, at first being present only when the child is tired. Pain, when present, is referred to the front of the thigh and medial side of the knee as often as felt at the hip. On examination there is usually
some restriction of movement because of muscle spasm and Gauvain's sign may be positive. This is elicited when rotating the extended hip produces reflex contraction of the abdominal muscles on the same side. If diagnosed at this stage, destruction of the joint may be prevented. However, the diagnosis is often uncertain and during this period of uncertainty the child should be immobilised and if the Montaux test is +ve, Abbott & Lucas (8) claim that chemotherapy should be started without awaiting positive proof. This proof should, however, be sought and both they and Mercer (9) stress the use of biopsy of the deep inguinal lymph nodes. Mercer also advocates synovial biopsy.

2. Intermediate.

Here there is involvement of the joint. Muscle spasm is more pronounced and produces a deformity consisting of flexion, adduction and internal rotation. Gauvain's sign is almost always positive and limitation in movement obvious.

3. Late.

Bone destruction is advanced and abscesses and sinuses may be present. There is gross wasting, swelling of the joint and real shortening.

X-Rays.

Although the joint space may be increased at first by effusion, the cardinal features are narrowing of the joint space, the outline of bone becoming indefinite, and rarifaction of bone on one or both sides of the joint for several centimetres.

Later cavities appear. These may coalesce and there is a variable amount of bone destruction. The whole head of the femur and the
acetabulum may be destroyed. The softened acetabulum may "wander" and the joint eventually dislocate.

**TREATMENT.**

The early case is treated by chemotherapy with immobilisation and traction in a Robert Jones abduction frame in a sanitorium. Healing with a full range of movement is hoped for. If healing is by fibrous ankylosis the joint should be arthrodesed since such a joint tends to harbour the tubercle and may become reactivated.

For the late case bony ankylosis in the best functional position is all that can be hoped for. Traction is employed in the active stage to prevent deformity. As soon as the disease becomes quiescent, an arthrodesis is carried out. Premature fusion of the lower femoral epiphyseal plate brought on by prolonged immobilisation may result in several inches of shortening as it has done for William. Because of this and the possibility of extreme atrophy, renal calculi and rarification, prolonged immobilisation should be avoided if possible.

The advent of chemotherapy has made for greater safety of operation during the active stage. Focal lesions in bone may be curetted and surgical evacuation of abscesses with removal of their walls and sinuses are being practised with increasing frequency.

The attempt to treat William McBride by chemotherapy and immobilisation was unsuccessful. Chemotherapy was not very well developed by 1951 and he was given Streptomycin alone. This is now known to produce a resistant strain probably by allowing the survival of the few insensitive organisms which multiply to produce a resistant infection. Nowadays P.A.S. would
P.A.S. would be given in addition and this prevented. Whether William's organisms became resistant to Streptomycin or not the duration of its administration as far as can be gathered from the notes (40 G.) would now be considered far too short. Mercer (9) suggests 1 year as a minimum.

The result of this ill-fated period of immobilisation was a short leg, destruction of the head and a flexion deformity. The fusion developed was also unsuccessful and after a corrective extension osteotomy the flexion deformity recurred, forcing William's readmittance. This time an intra-articular surgical arthrodesis was attempted. This type of operation, according to G. L. Turek, is known to produce a much lower percentage of successful fusions than the extra-articular or combined procedures. Another corrective osteotomy was performed at the same operation.

(8) Abbot and Lucas suggest that where the head and part of the neck are destroyed arthrodesis in wide abduction should be used. In this operation the acetabulum is debrided, the cortical bone removed from the upper and inner surfaces and the remaining part of the femoral neck, if any, is excised. The cortical bone is removed from the surface of the greater trochanter and adjacent shaft of the femur. This decorticated surface is brought into intimate contact with the acetabulum, this being optimal with the hip abducted between 30 and 80°. This tightens the adductors and the compression thus produced is claimed to play a substantial part in subsequent fusion. Bone chips are used to fill any gaps.
The corrective osteotomy is performed as a second stage 6 - 8 weeks later, if fusion is successful.

In William's second operation for arthrodesis made in January of this year the hip had to be abducted, extended and externally rotated to achieve contact with the ilium. A sub-trochanteric osteotomy had to be carried out at the same time presumably because the leg could not be left in this position. The compression produced by the tightened adductors, a feature of the arthrodesis by wide abduction, was thus lost. A bone peg, however, was fitted into a slot across the joint.

Unfortunately, 4 months later, although fusion appears complete on the X-ray, Fig. 5 (c), the left hip was found clinically still not to be united and so this long story of William McBride and his tuberculous left hip must be left as yet unfinished.
A Case of Slipping of the Upper Femoral Epiphysis.

CASE 6.

Name. DEREK G. F. REID.
Address. 91 Redhall Drive, Edinburgh, 11.
Age. 14.
Referred by Dr. McIntyre Munro.
Admitted. 30.3.61.

Removal of pins.

History. This patient fell and twisted his left leg while wrestling with a friend on 23rd July, 1960. He was given crutches and fell again a week later, but this time, he says, without sustaining any further damage. He was admitted to Ward 6 of the R.I.E. on 2.8.60 unable to use his left hip which clicked and was painful. X-ray at that time showed a slip of more than half a diameter and he was operated on without delay, the epiphysis being manipulated and pinned in position. There were no post-operative complications.

He was on a non-weight-bearing regime for three months, on crutches for a further fortnight and on sticks for one month.

O/E. He is a well built, intelligent boy and seemed a good witness.

His height was 5 ft. 3½ in. and his weight 9 st. 5 lbs.

Cardio-Vascular System. Pulse 84/min. regular in time and force. The volume was good and the vessel wall not palpable.

B.P. 120/70.

The apex beat was not palpable, presumably on account of a muscular chest.

Both heart sounds were closed.
Respiratory System.

Vesicular breathing was heard and no additional sound.

The other systems revealed no abnormalities of note and his extremities had full painless movement.

**DISCUSSION**

Synonyms are adolescent coxa vara, epiphyseal coxa vara and epiphyseolisthesis.

In this condition the upper femoral epiphysis is displaced downwards and backwards producing a disabling external rotation deformity of the lower extremity followed later by degenerative arthritis of the hip.

**Predisposing factors and aetiology.**

Most cases are found in boys between the ages of 10 and 17. These boys are often of the Frölich type, obese with underdeveloped genitals, or of the long slender type. Derek, then, is the right sex and age, but although 1½ st. overweight for his height and age, is well built rather than obese. Unlike Derek's case trauma is usually absent or trivial, normal weight bearing often being sufficient to displace the weak epiphysis.

**Hormone Theory.** (10)

The line of separation always passes through the layer of maturing hypertrophied cartilage cells in the epiphyseal plate. The area of these hypertrophied cartilage cells is increased by the growth hormone from the anterior pituitary which increases the rate of proliferation of chondrocytes. On the other hand the sex hormones and especially the oestrogens inhibit the growth hormone and decrease the rate of growth
and thickness of the plate. They also stimulate endochondral bone forma-
tion and the new trabeculae tend to be thick and strong. Harris
postulates, then, that in the adiposo-genital syndrome epiphyseal slipping
is a result of the sex hormones being below normal while in the tall
rapidly growing boy susceptibility to this disease is due to a high
level of growth hormone. Slipping is confined to the upper femoral
head because this is the only epiphyseal plate subjected to shearing
stresses.

PATHOLOGY. (11) & (12)

The epiphyses displaces inferiorly and posteriorly and the femoral
neck moves upwards and rotates anteriorly to an antiverted position.
There is a varus deformity and adduction and external rotation of the
femur. The full pathological picture was not allowed to develop in
Derek's case but in a more gradual slip is as follows:— The interval
produced by separation is filled by fibrous tissue, callus and embryonic
cartilage. The head remains attached by soft tissue, notably the
posterior periosteum through which it receives its major blood supply.

Early on, the synovial membranes are swollen and hyperaemic, but
later become less vascular and more fibrotic and inelastic.

Decalcification and hypervascularity are found at the junction of
the femoral neck and epiphyseal plate.

After several months the epiphyseal junction heals and the
exposed portion of the neck becomes covered with fibrocartilage. This and
the thick periostium firmly anchor the head posteriorly.
At the end of the growth period the epiphyseal cartilage closes. Eventually the displacement of the epiphysis leads to degenerative changes in the joint.

Forceful manipulation frequently leads to avascular necrosis because of tearing of the posterior epiphyseal attachment and its blood vessels.

**CLINICAL PICTURE.**

Unlike Derek's case the onset is usually insidious and progressive. The disease may be arbitrarily but usefully divided into three stages. **I. Preslipping Stage.**

Although no objective findings are apparent, the patient may have vague symptoms. He may complain of discomfort in the groin, usually worse after activity and subsiding at rest. There may be stiffness, a slight limp and pain radiating along the anterior and medial thigh to the inner aspect of the knee. **II. Chronic Slipping Stage.**

The findings in this stage are more definite. There is pain and limp. Tenderness over the hip is elicited and an adduction and external rotation deformity found to develop gradually. There is real shortening due to upward displacement of the hip and apparent shortening due to adduction. In a bad case the Trendelenburg sign is positive. **III. Stage of Fixed Deformity.**

The pain and muscle spasm eventually disappear, leaving the limp, shortening and external rotation and adduction deformity.
X-RAY FINDINGS.

Derek's X-ray picture fig. 6 (a) shows an obvious and gross degree of slipping. In the early stages of a gradual displacement, however, the diagnosis is often not so obvious and more subtle radiological changes must be sought. Sometimes although nothing abnormal is seen on an A. - P. picture the lateral view shows slight lateral rotation of the neck in relation to the head. Shenton's line, i.e. the curve of the upper border of the obturator foramen and the lower border of the neck, is broken by the displacement. The curve of the head is continuous with the upper border of the neck in fig 6 (b) instead of the head overhanging laterally as it should. There is said always to be some change in the structure of the metaphysis varying from a band of rarefaction to a cystic appearance. This is not evident in Derek's picture.

TREATMENT.

Conservative measures including bed rest, crutches, slings, casts and braces, traction and sex hormones have been found to be inadequate and surgery is indicated in all types as soon as the diagnosis is made.

A slight displacement of less than 1 cm. may be accepted and treated by internal fixation without opening the joint. Moor's pins are preferred to a Smith-Peterson pin for which the head is too hard and which has been found more likely to cause avascular necrosis.

A displacement of over 1 cm. requires reduction. As indicated by the pathology, this is very difficult if slipping has been gradual and
is attended by danger of tearing the posterior periosteum with the later development of avascular necrosis.

Acute traumatic slips like Derek's may be manipulated by the Leadbetter manoeuvre for reduction of a fractured neck and Derek's operation was as follows:

The fracture was reduced on a Charnley table. The femoral epiphysis slipped back into place on manipulation. Two guide wires, working through an incision over the greater trochanter, were driven up through the neck of the femur into the head.

After X-ray the better was selected and three Moor's pins driven alongside. Their position was regarded as good, their ends cut and the incision closed. Fig. 6 (c) shows the picture two days after this operation.

It is, however, unusual for this procedure to be as easy and successful as in this case and open reduction and fixation under direct vision is more often indicated. Before this, skeletal traction is sometimes attempted.

Where it is decided that these methods will prove too difficult a subtrochanteric osteotomy is used to correct the external rotation and adduction deformities, while at the same time replacing the head to its proper position in the acetabulum.

SUMMARY & PROGNOSIS.

Derek had an acute slip which was successfully reduced within 10 days. His future is brighter than that of most patients with
slipped epiphyses. Perhaps he fractured a normal epiphysis, and in any case there was no time for the full pathology of a gradual displacement to develop. The result then was an easy manipulation with, so far, no evidence of avascular necrosis and there is no residual malformation to predispose to osteoarthritis. So, while the other side must still be watched for slipping, Derek has, and can confidently look forward to, perfect function in both hips. (Fig. 6 (d) taken 2nd Nov., 1960).
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