ENTERED FOR
SIR ROBERT JONES PRIZE
SIX CASES

CONSTANCE HARDY.
INDEX OF CASES

I. Disease of Childhood,
   ANTENOR POLIOMYELITIS

II. Disease of Adult Life,
    OSTEOARTHRITIS

III. Congenital Deformity,
     ABSENCE OF RADIUS

IV. Acquired Deformity,
    HALLUX VALGUS
    HALLUX RIGIDUS

V. Trauma,
   OLD MALUNITED FRACTURE OF HUMERUS

VI. Trauma,
    OLD FRACTURE OF LUMBAR SPINE
    SPONDYLolisthesis

All cases have been written with the permission of the surgeons concerned.

They are all taken from Ward 2 of the Royal Infirmary with the exception of the first, which was taken from Ward 2 of the Princess Margaret Rose Hospital.
BIBLIOGRAPHY

Orthopaedic Surgery
W. A. Cochrane

Orthopaedic Surgery
W. M. Mercer

Deformities and Diseases of the Joints
A. H. Tubby

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IlIingworth and Dick

Textbook of Surgery
IlIingworth

All illustrations are drawn from life.
All X-rays are tracings taken from those of the cases concerned.

Typing by C. H.
Mr. Anderson's Case.

Robert Fraser, aged 8.


Complaint: Weakness and loss of power in limbs.

Duration: Three months.

History: About the middle of June, the boy's parents noticed that he was rather feverish, and not 'up to the mark'. On the 20th, a few days later, he found himself stumbling; he had no feeling in his legs, which seemed powerless, and rather warm. He managed to get upstairs very slowly, dragging himself up by the power of his arms, and gripping the bannisters.

Next day he got up, but went back to bed again as his legs felt so weak, there being no power or feeling in them. He stayed in bed, and a few days later his right arm was similarly affected, and so weak that he had to lift it with his left hand.

He was seen by Dr. Mackinnon of Skye, where the boy lives, who left him loose in bed, splints being applied to his arms at night, in the rest position.

He was then seen by Dr. Fraser, M.O.H. of Inverness. At this time he could not lift his head, and two weeks' later his left arm lost its use in the same way.

August 28th. Admitted to Princess Margaret Rose Hospital. He was carried in lying loose on a stretcher.

There was no history of any systemic upset previous to the onset of paralysis except what his parents had noticed.

He suffers from 'colds' readily, but could not remember having one before the attack.

At no time did he feel any pain in the affected limbs,
fected limbs, and they were never tender to the touch.

**PREVIOUS HISTORY:**
- Whooping Cough, aet 3.
- Scarlet Fever, aet 4-5.
- Chickenpox, aet 7.
- Frequent colds from no especial cause.

Sore throats occasionally accompany these.

**SOCIAL & FAMILY HISTORY:**
- A roomed house; warm, dry and comfortable.
- Parents alive and well; father is road surveyor for the island.
- Sister, age 2 of good intelligence.
- No history of nervous disease is known in the family.

**INFECTIVITY:**
Some Staffan children had apparently suffered from the same complaint a few months previously, but are now recovering. A nurse who was looking after him was affected within a month of her arrival, and is now in Glasgow, paralysis being fairly complete.

**ON EXAMINATION:**
The child is lying in bed in a plaster shell from the shoulders to below the knees: the legs are fitted with plaster splints, the feet being covered with wool, and bandaged to a right angle.

The arms are bandaged to a frame in the position of maximum rest, i.e. shoulders abducted to a right angle, elbows flexed at a right angle, wrists slightly dorsiflexed.

He is a fairly well-nourished boy from a comfortable home, his height being normal for his size, but he has lost weight through illness.

He is red-haired and freckled with a fine skin. His colour is good.

His circulation is good in those parts/
unaffected by the disease, but the limbs are cold and pale, and there is irregular wasting.

The trunk is thin, the ribs being very prominent; the breathing is abdominal, but he is capable of good chest expansion. On coughing, there is bulging of the upper abdomen, the muscles being fairly atonic. There is no myototic irritability present.

The intercostal muscles are working well, and there is no history of difficulty in respiration at any time.

Teeth: good.
Tongue: clean; breath sweet.
Heart: slight tachycardia present, and sinus arrhythmia. Sounds closed. B.P. 118/80. P. 120.
Chest: Well-formed; good expansion with effort. No increase of vocal resonance, or resonance on percussion. Breath sounds vesicular.

All systems other than nervous, N.A.D.

NERVOUS SYSTEM: Cranial nerves intact. Good intelligence, and answers well; memory good.
There is an account of an ? epileptiform seizure shortly after admission, of which patient remembers nothing (See progress notes.)

Child sleeps well. Right & Left.

Knee jerk. Slight response. Ankle jerks not attempted owing to stiffness.
Foot. Flexor response.

Lower Limbs.
The legs lie in the plaster shell, with the knees slightly bent. There is slight outward rotation of the right leg.

LEFT LEG.
Active and passive movements.
Active

Hip and knee can be flexed in a range almost equal to that found in passive movement.

Foot. Some anteflexion.
No dorsiflexion.
No eversion, inversion

Passive

Knee can be flexed to nearly a right angle. Hip flexed to 70°; further flexion elicited pain over the insertion of quadriceps into the patella, and over the insertion of hamstrings. Adduction good; abduction limited.

Foot can be brought to a right angle; further flexion elicits tightness of Tibialis Posterior. There is pain over the front of the great toe on its dorsiflexion.

RIGHT LEG.

Active

Hip 120°
Knee 100°

Foot. Same as left.

Passive

Hip to 100°
Knee to 90°
Abduction, adduction good
Lateral rotation good
Medial rotation diffident.

Foot is good in all ranges.

Upper limbs.

Passive movements were possible in a large range on both arms. Active movements were not attempted at this stage.

For groups of muscles primarily affected, and their progress, see following charts.
KEY TO MUSCLE CHARTS

**Inactive** - I. A. 0.—No appreciable motion.

*Action Weak* - A. W. 1.—Definite muscle contraction.

**Fair Minus** - F. M. 2.—Definite muscle action without much influence on the joint.

**Fair** - F. 3.—Well defined muscle action almost up to movement of the joint.

**Fair Plus** - F. P. 4.—Beginning action of joints but not against gravity or friction.

**Good Minus** - G. M. 5.—Beginning action against gravity or friction.

**Good** - G. 6.—Well defined control over gravity or friction.

**Good Plus** - G. P. 7.—Beginning power against added resistance.

**Normal Plus** - N. P. 8.—Increase against resistance but not quite normal.

**Normal** - N. 9.—Normal.

* Between I. A. and A. W. is fibrillation or questionable contraction.

Figures in **RED** denote improvement on last reading
An outside margin in **GREEN** denotes return of muscle to normal condition.
## MUSCLE TEST

**CASE** ROBERT FRASER

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### RIGHT SCAPULA

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### SHOULDER

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### FOREARM

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### FINGERS

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**KEY TO MUSCLE CHARTS**

<table>
<thead>
<tr>
<th>Rating</th>
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<tr>
<td>INACTIVE -</td>
<td>I. A. 0.—No appreciable motion.</td>
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<tr>
<td><em>ACTION WEAK</em></td>
<td>A.W. 1.—Definite muscle contraction.</td>
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<tr>
<td>FAIR MINUS</td>
<td>F. M. 2.—Definite muscle action without much influence on the joint.</td>
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<tr>
<td>FAIR -</td>
<td>F. 3.—Well defined muscle action almost up to movement of the joint.</td>
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<tr>
<td>FAIR PLUS</td>
<td>F. P. 4.—Beginning action of joints but not against gravity or friction.</td>
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<tr>
<td>GOOD MINUS</td>
<td>G. M. 5.—Beginning action against gravity or friction.</td>
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<tr>
<td>GOOD -</td>
<td>G. 6.—Well defined control over gravity or friction.</td>
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<tr>
<td>GOOD PLUS</td>
<td>G. P. 7.—Beginning power against added resistance.</td>
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<tr>
<td>NORMAL PLUS</td>
<td>N. P. 8.—Increase against resistance but not quite normal.</td>
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<tr>
<td>NORMAL -</td>
<td>N. 9.—Normal.</td>
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* Between I. A. and A.W. is fibrillation or questionable contraction.
# MUSCLE TEST

**CASE**

**ROBERT FRASER**

<table>
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<tr>
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<td>Int. Rot.</td>
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<td>Ext.</td>
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<tr>
<td>E. P. H.</td>
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<td>Ext.</td>
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<td>Lateral.</td>
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<tr>
<th>ABDOMEN</th>
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<tr>
<td>Rectus.</td>
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<td>Obliques.</td>
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PROGRESS NOTES:

On admission: The following muscular condition was noted.

Latissimus Dorsi, Rhomboids, and abdominal muscles.

Marked loss of voluntary power in

The abdominal wall was atonic.

Arms: Extensors and supinators very weak.

No functioning intrinsic musculature of hands.

Right leg: Extensors of knee, ankle and toes not functioning.

Plantar flexors and intrinsics weak.

Left leg: Glutei, adductors, flexors and extensors of the knee not functioning.

Intrinsic muscles of the knee very weak.


Vomited slightly a few hours later.


12.45 p.m. With no preceding aura, the patient went into a convulsion of an epileptiform nature, lasting two hours. He was quite unconscious.

The face twitched, there was foaming at the mouth, and incontinence of urine. Respirations were very shallow and slow, and there was cyanosis.

A hot bath was given, and cold compresses applied to the head.

1.15 a.m. H.I. Camphor 1% in almond oil 90% given.

1.30-2.30 a.m. Intranasal oxygen with 5% carbon dioxide given, the mouth being held open by a gag.

3 a.m. Patient appeared to be in a deep sleep, out of which he could not be roused. At 5 a.m., he appeared to be absolutely normal, but no response was elicited until an hour
an hour and a half later.

7. 30 a.m. He now feels quite comfortable, is not complaining, and remembers nothing of the attack.

17.ix.37. 

Mag Sulph dr iv given, some of which was vomited.

Slept till 3.30 p.m., when he was still drowsy. The right side of the face twitched during sleep, and there was some grinding of the teeth. The conjunctiva were injected.

10. 30 p.m. Veramon gr vi given, after which he slept peacefully.

Considerable improvement followed.

11.x.37. Alternate days lying free in bed with light foot splints. POOL TREATMENT STARTED.

20.x.37. Vomited at 10, 11, 12, and 2.

Food and yellowish fluid. Enema given, with constipated result, followed by Calomel gr i in divided doses.

There was much twitching of the face, especially of the right side, and some grinding of the teeth. Veramon gr vi given.

Rigidity present on the right side of the abdomen, but no pain.

Taken off plaster shell.


29.x.37. Sickness and rigidity on right side of abdomen.

9.xi.37. Ultra violet ray started.

30.xi.37. Both feet manipulated, and plasters/ applied.
applied.

3.1.38. Hand plasters left off two hours daily.

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<tr>
<th>Arms</th>
<th>Right</th>
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<tr>
<td>Intrinsics</td>
<td>Slight improvement</td>
<td>Slight movement</td>
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<tr>
<td>Flexor Longus Pollicis</td>
<td>Improved</td>
<td>I.S.Q.</td>
</tr>
<tr>
<td>Flexor Carpi Ulnaris</td>
<td>Good</td>
<td>Weak</td>
</tr>
<tr>
<td>Abductor Longus Pollicis</td>
<td>I.S.Q.</td>
<td>Fairly good</td>
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Arms are still splinted up at night.

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<tr>
<th>Legs</th>
<th>Right</th>
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<tr>
<td>Glutei</td>
<td>Max: good</td>
<td>Ditto</td>
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<tr>
<td>Knee flexion</td>
<td>Med: fair</td>
<td>30°</td>
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<tr>
<td>Quadriceps</td>
<td>Improved</td>
<td>Improved</td>
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<tr>
<td>Hamstrings</td>
<td>Fair</td>
<td>Fairly good</td>
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<tr>
<td>Gastrocnemius and Soleus</td>
<td>Fair</td>
<td>Poor</td>
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<tr>
<td>Tibialis Anterior and Intrinsics</td>
<td>Absent</td>
<td>Fairly good</td>
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<tr>
<td>Flexors</td>
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<td>Poor</td>
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<td>Extensors</td>
<td>Poor</td>
<td>Weak</td>
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Circumduction of the foot improved: active movement now equals passive.

There is considerable improvement of the muscles of the back and trunk, and the abdominals.

12.iii.38. Abdominal retraction good. Can now sit up without using arms, and with knees only slightly flexed. Large muscles of arm good. Fine muscles of the hands considerably improved, but for the interossei and lumbricales, which are still weak. The left hand is slightly weaker than the right.

Some improvement in the legs; a flicker can now be elicited from the peronei on each side, and also from Tibialis Anterior.
Knee flexion


Right 15°  Left 20°

To sit up one hour forenoon and afternoon.

7.v.38.

General improvement sustained.
Glutei show better tone.
Full flexion of the knees obtained.
Improvement of the interossei and lumbricales, especially of the right hand. Opponens muscles improved.

11.vii.38.

Elevation of arms at night discontinued

20.vii.38.

Boots and irons supplied.

25.vii.38.

Allowed to sit up in chair for a short time daily.

19.x.38.

Plaster night splints for feet discontinued.

29.x.38.

Discharged.

The boy was walking well, with double irons and drop foot stop on either side. His general posture was good. A list of exercises was given him, to be carried out daily.

SUMMARY: This boy had an attack of anterior poliomyelitis in June, 1937, all four limbs being completely paralysed. On admission in August of that year, he showed some return of power; the weakness, being chiefly in the extensors of the wrists, fingers, the supinators on both sides, and the intrinsics.

In the legs, the adductors, glutei and thigh muscles were partly affected, there being severe deflection of the muscles surrounding the ankle joint, and those of the toes. The abdominal muscles were severely involved.

The boy's condition on discharge was very satisfactory.
very satisfactory. He was walking well with a double iron and drop foot stop on each side.

8.xi.38. Extract from Doctor's letter to M. O. H:

This boy has made a very remarkable recovery. He is walking well, and his general posture is good.

His gait shows a swing to the side which suggests a slight weakness of the gluteus medius muscle. This is a very slight swing, but will need careful watching; the boy should be put back to bed if he shows any tendency to get worse.

Recovery has been unusually complete and rapid, and may be expected to continue for some months still.

He is to have exercises.

12.iv.38. Readmitted to Hospital.

The boy has grown and broadened, and now looks the picture of health. His gait is good, and he never gets unduly tired after a fairly active day. There is still a very slight swing when walking, on the left side, but it has disappeared entirely on the right.

The right foot is now almost entirely correctable, and the left considerably better, although there is some slight degree of eversion present.

A new pair of back splints is being made to hold the improved position. He is continuing with his exercises.

When examined, he was modelling in clay, and showed excellent coordination of all the fine muscles of the hands.

He states that his arms are quite restored to their former capabilities.
TABLE OF EXERCISES

Without irons:

Sitting, alternate heel and toe raising
and out heel raising
low metatarsal head pulling foot up and in, in

Wrist rolling and finger exercises.

With irons:

Lying, breathing

Sitting, bicycling
crossed legs and trunk turning
Standing, astride, arm circling

Standing, alternate side bending

Lying, knee bending and stretching
head on knees raising legs to touch floor behind,

General correct position.
DISCUSSION:

The first mention of ANTerior Poliomyelitis is popularly supposed to be the case of Jonathan's child, MePbobshef, 'who was lame in both his feet'. Other causes of this lameness may be supposed, but tradition dies hard. There is little record of its recurrence until many centuries later, when in 1840, von Heine demonstrated its presence. It appeared as an epidemic in Scandinavia in the middle of the nineteenth century, and has since spread all over the world, the younger continents, America and Australia having cyclical epidemics of cataclysmic proportions, leaving their merciless trail of cripples throughout the country.

Epidemics are connected with the summer months in this hemisphere, March and April in the south. Susceptibility is greatest at the age of two, but adults may be attacked, although disease after the third decade is very rare. It is supposed to be due to the great vascularity of the spinal areas in the young child that susceptibility is commonest in youth.

Infectivity is very flitting and uncertain; a child may go free where its bedfellow is attacked, or pass through a town where cases have been recorded, and succumb to infection. Infection is transmissible by carriers, dust, or animals. It invades the mucosa of the upper respiratory tract, and passes thence to the brain via the lymphatic channels.

Aetiology: Pasteur found a \textit{macrodiplococcus} with which he produced paralysis in rabbits. He suggested that myelitic changes arose on those of other diseases, giving examples where they superceded typhoid, measles and rheumatism. Others considered it to be another manifestation of the herpes virus. Rosenow found strains of streptococci resembling the globoid bodies which had been demonstrated by Flexner and No-
guchi in the young state, with which they successfully inoculated monkeys, producing all the signs of paralysis within two weeks.

The disease is now known to be due to a virus which passes through the finest Berkefeld filters. It withstands exposure to cold, heat and other climatic phenomena.

It is most infective in the first two weeks, after which it becomes attenuated. It lives in the central nervous system, never passing into the circulating blood, but using lymph channels as its mode of progress.

Pathology: There is general infection, with specific lesions in the nervous system. These consist of haemorrhage, oedema, and fibrosis in the order named.

An acute interstitial meningitis occurs, pronounced in the vascular areas; the floor of the IVth ventricle, the cervical and lumbar regions, and the anterior fissure. Haemorrhagic areas have been demonstrated in the IVth and Vth cervical segments a few hours after illness in one case.

Infiltration with small lymphocytes occurs in the vicinity of the blood vessels of the leptomeninges.

This exudate may press on the vessels, cutting them off.

The anterior horn is especially affected. and there may be involvement of Clarke's column, although the posterior root ganglia may be primarily involved. This effect is always transitory. The cells show cloudy swelling, with disintegration of Nissl's granules.

The lymphatic system also shows signs of infection; there may be enlargement of the tonsils and the mesenteric glands; congestion of Peyer's patches occurs, and a hypertrophy of round cells suggesting typhoid fever. There is also hyperplasia of the Malpighian bodies of the spleen.

The toxins of the virus weaken the walls of the small blood vessels, leading to haemorrhages, and oedema forms as a reaction of irritation. The resultant pressure destroys
destroys many of the nerve cells. These are replaced by neuroglial tissue, which at first proliferates, and later contracts. Occasionally cavitation occurs.

As a result of the cutting off of the trophic supply, the muscles atrophy, granular degeneration proportional to nerve degeneration occurring. Healthy fibres may be present among those affected, and these hypertrophy.

The shortened muscles lead to stunting of growth, and there is rarefaction of the bones. Joints surrounded by atonic muscles may dislocate, and lead to flail limbs. Developments due to hypotonicity.

Incubation period: This is variable, two to thirty-three days being given; the usual period is fourteen days.

Tubby states that the children of Anglo-Indians are especially susceptible while in the Tropics. He also connects susceptibility with overexertion and chilling at the start of the paddling season. He finds that children of lively disposition and general alertness are more commonly affected.

The types of the disease described are:

1. Non-paralytic, or abortive,
2. Ataxic, the cerebellum, Clarke's column, and the basal ganglia being affected,
3. Cortical, with subsequent spasticity,
4. Spinal, with subsequent flaccid paralysis. This is by far the commonest manifestation.

The onset resembles that of cold or influenza, being mild or severe. There may be some neck rigidity, spastic in type, which is considered of diagnostic importance in the acute stage. On withdrawal of the cerebro-spinal fluid, it is found to be clear and under pressure, showing increased protein and cells, (polymorphs) and a little sugar.

These signs may be continuous or remit, paralysis following after an interval.

A more severe onset shows a short sharp
fever, hyperaesthesia and pain, (posterior root ganglion infection), which may be localised or diffuse. Occipital headaches may be present, and gastro-intestinal symptoms resembling alimentary irritation, (inflammation of the lymphatics of the abdomen), and there is sweating and congestion of the pharynx.

Meningitic symptoms may occur, and convulsions, especially in the debilitated.

Paralysis occurs usually after the subsidence of acute symptoms, about the second day. It reaches its maximum in from two hours to two days, extension after the eighth day being very rare. It may be diffuse, and clear up entirely, or settle in local areas. It may affect any muscle, any group of muscles, any number of groups. It is accompanied by extreme coldness of the extremities. Pain of a rheumatic type in the back and limbs may be concurrent.

Muscular atrophy begins within two weeks.

The paralysis remains stationary for about six weeks, and then recovery sets in. This may be rapid at first, and then slow up until finally a standstill is reached. Further recovery after one year is rare, although the tone of the muscles may be improved by exercises.

Incontinence may be present at first, but is rarely permanent.

Generally speaking, the legs are more commonly attacked than the arms; common muscles to be affected are:

Glutei,
Quadriiceps,
Tibials,
Peronei. Ilio-psoas and Sartorius are rarely damaged.

Muscles affected in the arm are:
Deltoid,
Biceps,
Supinators,
Extensors.
Lumbar puncture may prove a valuable aid to diagnosis in the acute stage. A slight increase in tension is noticeable; the fluid is clear, but of ground glass appearance. There is an increase in polymorphonuclear cells and the globulin fraction, and a decrease in chlorides.

If diagnosis is arrived at early, before the onset of the paralytic stage, the injection of serum from a convalescent patient is of definite value; it rarely aborts an attack, but it may be modified considerably. Its efficacy declines however with the passage of time, as once paralysis has set in, the principal damage to the nervous system has been done.
Results of infection are:
1. Loss of muscular power
2. Lowering of the temperature of the limbs which are frequently blue from venous stasis. Chilblains are therefore common.
3. Atrophy of limbs, and arrest of growth
4. Dislocation and subluxation of the joints
5. Alteration in the reflexes in the neighbourhood of the affected muscles.
6. Modified sensation
7. Reaction of degeneration shown in the damaged muscles. Muscles failing to respond to the faradic current by the second week are generally considered to be permanently paralysed.

Differential diagnosis from:
- Cerebral paralysis
- Myelitis
- Meningitis
- Progressive muscular atrophy
- Pseudohypertrophic muscular dystrophy
- Diphtheritic paralysis
- Traumatic birth lesions.

Prognosis: This is fatal only in cases of high fever, convulsions, or where there is no means of keeping the patient alive when intercostal paralysis is present. Excessive crippling may be avoided by careful watching and graded exercises.

Treatment: This consists in absolute rest, both to body and mind, as a preliminary. The child's limbs should be be splinted in the position of rest, a happy mean being struck between the muscular synergists of his limbs. It should always be remembered that those muscles which work against gravity are frequently those most affected.

Warmth is essential, as the child feels/f the cold
the cold intensely. The limbs should therefore be lightly bandaged with wool.

Massage is often not commenced until the i.e., only when the convalescent stage has been reached. paralysis has become stationary, but many surgeons believe in starting it as soon as the hyperaesthesia will permit. It should be very gentle as a preliminary, overactivity of the damaged muscles being worse than none at all.

Fru Christensen, the Swedish expert, believes in starting fine movements early, such as touching each finger with the thumb of the same hand, once daily to begin with. As improvement occurs, she expands these movements until the patient is performing large scale exercises.

Sister Kenny advised hot and cold contrast baths for toning up the skin and improving the circulation, which is undoubtedly effective. From Dr. Macnamara of Melbourne comes the pool treatment, which is now in general use. The patient performs his exercises in water slightly above body heat; she claims that salt water is more bracing than fresh, and also more buoyant for atonic limbs.

Movement must be limited at first to avoid overstretching of the muscles, damage which cannot be undone, and all exercises should be carefully graded under the eye of an expert. Charts of the muscle reactions should be taken at frequent intervals, and any possibility of overstrain, or sudden cessation of improvement treated by rest, and careful watching. Splinting should be carried out regularly, until no longer required.

If exercises bring about no further improvement, and deformity occurs, or there is a useless flail limb, operation should be considered.

Operative measures include:
1. Tenotomy, or shortening of taut or slack tendons
2. Tendon transplants; especially applicable in the foot.
able in the foot

3. Arthrodesis in flail limbs

4. Stabilisation operations generally, e.g.

the Steindler operation in the foot

5. Osteotomy

6. Nerve grafting

7. Amputation of useless limb

Where there is excessive venous stasis in one limb, lumbar sympathectomy has been performed to relieve the condition. This xit does temporarily, but within about six months the condition tends to revert.

Where joints are incapable of weight-bearing in cases such as an knee with weak quadriceps, weight-bearing calipers should be made and fitted by an expert, either the rim variety, or those with a leather thigh piece. A bolt at the knee may be released to allow of bending when sitting.

The results of operation depend on the damage done previously; they are difficult to prophesy, some being phenomenally successful, others hardly justifying the operation.

The nursing and gymnastic side of Poliomyelitis may well be approached from the psychological. The sensitivity of a cripple is extreme, and he will remain deformed rather than continue with efforts that are laughed at.

Therefore every help and encouragement should be extended to him. He should be interested in his case, taught anatomy, and shown how he can improve his own. He should never be left to himself in this. Occupational therapy will go a long way to the restoration of his own self-esteem.

After-care is an essential, and he must not be allowed to relapse his exercises, or slump into an easy posture, but interest in his progress should always be maintained.

In the case of Robert Fraser, there is a typical history of the almost unnoticeable preliminary infection.

An unusual fact
An unusual fact was the supposedly direct infection of the girl who came to nurse him, and whose disease took a more virulent form than his own.

The convulsions with which he was attacked twice within three months of the onset of the disease, are difficult to assess. They occurred rather late to be exacerbations of the original infection, and were probably epileptic in nature, although no account of previous attacks, or family history to that end could be obtained.

Injection in his case was fairly symmetrical, and recovery straightforward, and unusually complete.

The slight weakness of the fine muscles of the hands present when he left Hospital for the first time, had disappeared within the six months of his discharge. The weakness in the feet had much improved, although complete recovery is unlikely, and a drop foot stop may be necessary as a permanent fixture. A noteworthy fact is the excellence of his general posture, and the fact that his improvement has been steady and unremitting, due to watching and careful gradation of exercise.

Prognosis as far as he is concerned, is excellent, although he will probably have to take up an occupation which does not involve much standing about; however, there is complete recovery of the hands, and therefore handicrafts may be pursued with no difficulty.
CASE II.

Disease of Adult Life: OSTEOARTHRITIS OF HIP

In 1935 the patient underwent operation in the left hip for spondylolisthesis of the left side. He is since then that he has noticed that his leg was getting weaker, progressive myopathy of the ventral side and increase of the pain in his leg, led to his throwing up his job seven years ago. Since then he has not been walking much. The pain became constant, and he felt it in the small of his back.

In 1957, the left hip was manipulated, and there was some subsequent improvement, but although this improved his range of movement, it did not end the pain for long. This finally arrested his nights, and he says that he has had a good night's sleep for a year. Lately he has been slipping over his left being to his accident; his foot has also turned in, and he wants to keep it against the furniture. At night, he puts on his boots, his left foot now occasioned hyperesthesia, and he feels "tugging" along the hall of the feet.
MR. COCHRANE'S CASE.

WILLIAM RAEBURN, aet 58. Plumber.


COMPLAINT: Pain in left leg and small of the back.

DURATION: Nearly twenty years.

HISTORY: In 1915 when the patient was in a War Hospital for removal of his left eye, it was noticed that he was limping slightly on the left leg. He felt no pain, and being in a hurry to get back to a job, he did not have it investigated. Later he felt pain, coming on gradually, always worse in the mornings, and working off as he moved about. He felt it especially on walking downhill, and it was always aggravated by cold and wet. At times he felt 'rheumatic pains' in the whole leg while at work; he had a lot of roof work and kneeling to do, which brought it on.

In 1928 the patient underwent operation in the R. I. E. for septic bursitis of the left knee. It is since then that he has noticed that the leg was getting shorter.

Progressive myopia of the remaining eye and increase of the pain in his leg, led to his throwing up his job seven years ago. Since then he has not been walking much. The pain became constant, and he felt it in the small of his back.

In 1937, the left hip was manipulated, and there was some subsequent improvement, but although this increased his range of movement, it did not ease the pain for long. This finally affected his nights, and he says that he has not had a good night's sleep for a year. Lately he has been tripping over his leg owing to its adduction; his foot has also turned in, and he used to knock it against the furniture. At night, on taking off his boots, his left foot has seemed hypersensitive, and he felt 'burning' across the ball of the foot.
the foot. His shoe wore out consistently along the outer edge and over on the outside of the heel. Apart from the burning sensation, he complains of no other nervous phenomena in the limb.

1937 **ON EXAMINATION**: A considerable degree of arthritis of the left hip was found, producing adduction and flexion deformity. This has resulted in shortening, which is present to a large extent in the leg; the **left** being 1½" shorter.

**DIAGNOSIS**: Osteoarthritis of left hip, with adduction and flexion.

<table>
<thead>
<tr>
<th>29.xii.37.</th>
<th>Pre-operative treatment, Omnopon and Hyoscine.</th>
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<tbody>
<tr>
<td><strong>MANIPULATION</strong></td>
<td><strong>MR. ANDERSON</strong></td>
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<tr>
<td>Gas and oxygen anaesthesia.</td>
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<tr>
<td>The left hip moved through a fair range, flexion of 90° being obtained. Abduction of about 10° was procured by firm adduction, and kneading of the adductor tendons.</td>
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<tr>
<td><strong>Extension was improved to a slight extent.</strong></td>
<td></td>
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<tr>
<td>Following manipulation, apparent shortening was entirely corrected, and there remained only half an inch of actual shortening.</td>
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<tr>
<td>30.xii.37.</td>
<td>Discharged.</td>
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<tr>
<td>Within the next month the patient reported, and was seen by Mr. Cochrane. Movement was still limited, and the pain in the hip was still present.</td>
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<tr>
<td>The following letter was written by Mr. Cochrane to his doctor:</td>
<td></td>
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<tr>
<td>. . . As a result of manipulation, his backache is better, and he is improved. The limb is still considerably adducted, and abduction is impossible. It is this which causes the persistent strain on muscles and ligaments of the hip, maintaining his disability.</td>
<td></td>
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<tr>
<td>Most of his work consists in stooping down, and I do not think, in view of the fact that the X-ray shows/</td>
<td></td>
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<tr>
<td>almost complete</td>
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X-RAY OF RIGHT AND LEFT HIP, SHOWING COXA VARA

DEFORMITY OF THE LATTER
ROUTINE EXAMINATION:

Tongue: Moist, but rather coated.

Teeth: Four remain in the upper jaw. 'The others fell out one by one' They are in a very unhealthy state.

Sinuses: Apparently healthy; there are no headaches, or nasal discharge.

Abdomen: There are no regions of tenderness on deep palpation over the gall bladder and appendix areas.

Bowels: Fairly regular when active.

Micturition: Normal; therefore prostate unlikely to be inflamed.

Examination of other systems revealed no abnormality.
almost complete ankylosis of the hip-joint, that he will ever get enough movement to allow him to do work of a stooping nature.

A sub-trochanteric osteotomy would much improve function and comfort for the rest of his life....

It is a most successful operation, as it succeeds in abducting the lower fragments, and underpinning the pelvis in the right angle for weight-bearing, and relieves the hip itself from strain.


T 97  P 88  R 20

The patient proved a very intelligent man.

He says that this present condition, and septic bursitis eleven years ago, are the only complaints he has ever had.

He has always taken a lot of exercise, being formerly a keen swimmer, and he has always walked about a lot.

His house is dry, and comfortable.

There is no family history of an arthritic nature.

X-RAY shows gross arthritic changes in the left hip joint. There is obliteration of the joint space, with sclerosis of the joint margins.

Coxa vara deformity is present, with erosion of the head of the femur.

Coxa vara deformity of the limb, plus its adduction account for about one and a half inches shortening of the leg.

13.iii.39. 11 a.m.  Soneryl gr iii given

2.45 p.m.  H.I. Omnopon gr 1/3 c Hyoscine gr 1/150

3.30 p.m.  OPERATION  MR. COCHRANE

Gas oxygen and Ether anaesthesia.

The patient was placed on the orthopaedic table on his back, the table being tilted to allow of better access.
better access.

The upper end of the left femur was approached through a vertical incision on the outer aspect of the leg. The bony landmarks were defined, and the femur divided between the trochanters in a transverse line.

The lower fragment was then abducted, flexed, and medially rotated, and then levered inwards with a periosteal elevator, so that its upper end came to lie against the side wall of the pelvis, against and below the neck of the bone.

The position having been considered satisfactory, the skin wound was closed with interrupted silk worm gut sutures, and a well-padded plaster spica applied over the trunk and leg, from the costal margin to the toes of the left foot.

SUMMARY: Subtrochanteric osteotomy (Lorenz bifurcation operation)

9.30 p.m. H.I. Omnopon gr 1/3
14.iii.39. T 98.4° P 108 R 20

The site of operation was very painful, but the patient was more distressed by flatulence, and the high plaster.

11 a.m. H.I. Pituitrin, ½ cc. given
3 p.m. H.I. Omnopon gr 1/3
11 p.m. H.I. Morphine gr 1/6
15.iii.39. X-ray. Good alignment of osteotomy seen

Flatulence still troublesome, and discomfort in hip. There has been a little bleeding through the plaster.

6.30 & 7 p.m. H.I. Pituitrin, ½ cc.
9 p.m. H.I. Morphine gr 1/6

5. iv. 39. Patient fairly comfortable. He is sleeping well, and his back feels well supported by the plaster.

The feeling of constriction has gone; there is no pain
over the site of operation, and light percussion on the plaster elicits no tenderness.

20.v.39. Patient complains of slight 'rheumatic' pains shooting down the left leg from the hip, but lays no stress on these.

Within a few days the plaster is to be divided, and he will then rest in the posterior shell for a short time, preparatory to massage, and walking.
DISCUSSION:

OSTEOARTHITIS is a degenerative disease of middle life and old age, as opposed to other types of arthritis, which attack the young subject. The victims are frequently healthy and strong in every other way; the joint affected is usually the one they use most in their work or sport.

The affection is usually monoarticular, but may spread to other sites. The large joints are first affected, such as the hip or knee, or the sacro-iliac articulation; due to the nature of the predisposing injury, the disease is seen principally in men, and usually in those of the working classes.

Causation. The predisposing cause is trauma, either manifested by a chronic overuse of the joint, or a severe wrenching of it. Former fracture, altered alignment, or chronic irritation by loose bodies or some other cause may also predispose towards it. The damaged joint proves a ready site for organisms, which come either from a chronic septic focus, such as dental abscess, or grumbling appendix, or from toxic absorption from a condition such as chronic constipation.

Whitman's description sums up the ultimate condition:

'Bone destruction is combined here with bone formation, resulting in an irregular solid enlargement of the joint, and sometimes with distortion of the limb.'

Pathology: The joint itself is sterile, but first the synovia and then the cartilage show injection. The two clinical entities may exist, but they are frequently mixed.

The synovia shows thickening and hypertrophy of the papillae, and a serous effusion. Fat may be deposited as a degenerative change, the pedunculated fatty tags lying in the joint being known as lipoma arborescens. These may be nipped off to lie loose in the joint, where they form 'joint mice'. Calcification of the fat may occur as a further degenerative
ther degenerative process, leading to creaking on movement, and locking from the impaction of the loose bodies within the joint. The synovia grows over the cartilage, leading to vascularisation, and either detachment or fibrosis.

As the cartilage becomes affected, the matrix softens and splits, being later replaced by scar tissue. Friction wears it away; the cells then proliferate, and erupt into the joint, and they may also form loose bodies. 'Lipping' occurs at the edges, the cartilage overflowing the joint margins; later ossification occurs due to malnutrition. Bony spurs also form to project into the joint, causing mechanical obstruction.

In the bone itself, granulation tissue forms, leading to caries and canalisation. The softened bone gets worn away at friction points, becoming shiny and eburnated.

Later, cyst-like cavities may appear within the bone.

The tendons and ligaments are finally affected, undergoing atrophy, and losing their tense. There is free fusion of sterile fluid into the joint, and bursitis may result as the synovial inflammation spreads. Tense swellings may surround the joint; these are known as Morant-Baker cysts, being formed by the bursae connected with the cavity being nipped, where they emerge from the joint. They are tense from their fluid content.

X-ray shows the presence of joint mice and lipping, only if the cartilage has become calcified. There is rarefaction of the bone below the cartilage, leading to a characteristic 'light area' behind the articular surface.

In the hip joint, the X-ray of the patient shows a typical picture. The neck of the femur is short and broadened, the head being set lower on it and at more of a right angle than usual, in the coxa vara position. There is diminution of the joint space, both articular surfaces being roughened and irregular; frequently there are alternating/areas of
areas of density and osteoporosis. Extra-articular osteophytes may be prominent.

The onset is usually insidious, and the disease runs a very chronic course, spreading over years.

The joint aches, and stiffens if left in one position, symptoms therefore being most obvious on getting up in the morning. Movement loosens the limb, and no discomfort may be experienced later in the day. A limp may develop without the patient's realising it, as demonstrated by the case in point, followed by a gradual deformity of the joint as the disease progresses. Locking in certain positions may occur, due either to the jamming of loose bodies within the joint, or of osteophytes outside it.

The pain increases in severity through the course of time, and shortening may occur. This is frequently more apparent than real, being due to a protective muscle spasm displacing the limb. Finally the joint may be either unduly mobile, due to the atony of the surrounding structures through disease, when it may resemble a Charcot joint from which it must be differentiated, or it may stiffen up through a false ankylosis. This is never due to true intra-capsular bony union which may occur in other cases such as tuberculosis, but is due to fibrous adhesions, interlocking of the extra-articular osteophytes, and muscle spasm.

Exacerbations of the condition occur in cold and wet weather.

Diagnosis: This is arrived at through a careful examination of the history, and the general appearance of the patient. Other causes of joint disease must be eliminated, such as tuberculosis, toxic arthritis, and those found in venereal disease. Chronic forms of typhoid, dysentery, and pneumonia may also give rise to swelling of the joints, and the rheumatic picture is well-known.
Treatment: This depends on how early the disease is discovered.

In the early stages of the hip lesion, a raised shoe, and support for the hip either by means of a spica bandage or a moulded leather splint may help. A ring caliper, the weight being taken by the tuberischium resting on a well-fitting padded ring, supported on side irons which are inserted into the heel of the shoe, the knee being held in position by a strap, will successfully relieve the joint of weight bearing, and remove the cause of pain.

Hot air baths, ionisation, and Scott's dressing applied over the joint if the effusion is very painful all help to palliate the condition. For the man of means, removal to an equable climate will prevent exacerbations.

Septic foci should be searched for and removed. Careful manipulation will also help matters, but any further trauma to the structures entering into play will only increase the damage.

Nothing is known that will arrest the course of the disease, but it may rest in statu quo for a long time without further progress. As it is essentially a degenerative condition, damage already done cannot be repaired spontaneously.

If pain becomes constant and unmanageable, operation is the only means of affording relief.

Operative possibilities are:

1. Removal of loose bodies from the joint,
2. Removal of osteophytes surrounding the joint,
3. Synovectomy,
4. Arthroplasty; recrudescence in the reconstructed joint has been reported following this operation,
5. Excision and immobilisation,
6. Arthrodesis, fixing the joint in the maximum position of convenience.
Of these operations, arthrodesis and osteotomy are generally favoured. They have the advantage of eliminating the condition for good and all. A stiff hip is left, but this may prove remarkably little disability compared to the painful and insecure joint of the preceding condition.

Prognosis under these conditions is good, but it must always be born in mind that another joint may be affected later, especially if infective foci in the body have not been efficiently dealt with.

This patient, William Raeburn, exhibits the classical signs of an osteoarthritis of the hip. The history, extending over a period of nearly twenty years, points to the chronicity of the condition, and the fact that he was able to pursue his trade through thirteen of them, shows how exceptionally slow the degenerative process may be.

In the course of his work, he had a lot to do on roofs, usually in awkward positions, in all and every weather. This may account for the original traumatising factor. His teeth were a probable source of infection. He has never been to a dentist, and the four remaining are far from healthy. Their removal will be beneficial therefore, as they are a potential source of infection for other joints.

Progress is difficult to assess, as activity has not yet been attempted, but X-ray photographs show that bony union is occurring, and it is fairly safe to assume that walking will be resumed, with cessation of pain. A certain amount of shortening is to be expected on the left side and this may be corrected by raising the boot on that side.

In all other respects, the operation performed will mean all the difference between a fairly active life, and a bed-ridden existence. Prognosis may therefore be pronounced good.
CASE III.

Congenital Deformity: CONGENITAL ABSENCE OF THE RADIUS
INA THOMAS, aet 12.

ADMITTED: 17.1.38.

COMPLAINT: Lateral flexion of both hands, with loss of pronation.

DURATION: Since birth.

HISTORY: Since birth the child has had deformed arms, and these are a limitation, although she manages well. There is no history of similar deformity or other congenital abnormalities in the family, as far as she knows.

PREVIOUS HISTORY: Measles, att 7

Otherwise general health is excellent.

She complains of 'crackings in the knees on getting up in the morning, but there is no accompanying pain.

SOCIAL & FAMILY HISTORY: Two-roomed house for five people.

Warm and dry.

Father, Mother, two sisters and one brother.

All alive and healthy.

ON EXAMINATION: The child is small for her age, her stature being that of an eight-year-old. Her proportions are good, except for extreme stunting of both forearm, the pendent hands reaching the tip of the iliac crests. The upper arm is ten inches in length, the forearm being four inches.

The shoulders. The musculature is very limited.

Movements are limited chiefly to abduction, but the child can reach the back of her head by flexion and scapular rotation. The deltoids are very weak, and also trapezius, while all the muscles of the shoulder girdle are under-developed, the left having a greater range than the right.

The elbows
RIGHT HAND, SHOWING RADIAL DEVIATION AND TRUNCATION OF LITTLE FINGER
RIGHT HAND, SHOWING DEGREE OF EXTENSION OBTAINABLE.
The elbows. These are held flexed at approximately a right angle. Full flexion may be obtained, but complete extension is impossible.

The forearms. These are considerably shortened. The styloid process of the ulna projects in a knob under stretched and reddened skin, and there is extreme deviation of the hand to the radial side. The ulna is thickened and bowed posteriorly. Pronation is very slight, about 30° being reached with passive movement; the child attempts to pronate by external rotation of the whole arm. Supination is complete.

The wrists. Ulnar deviation and dorsiflexion are impossible. Passive movement can bring the hand within 30° of the straight, and the hand may be straightened so that it is on a level with the arm. Active movement cannot achieve this however.

The hands. These are fully formed, the thumbs being normal in size and shape. The hypothenar muscles are well-developed, but she cannot extend the thumb, although this can be done passively. The fingers will not extend fully, and there are apparently no extensors present in the terminal joints. Flexion is also limited, and all the movements are weak. There is a very short middle phalanx in the little finger on each side, but the fingers are active in spite of the deficiency, although they have no power of abduction.

The child cannot make a fist; she can grip, but moves the whole arm to do so. She has a fairly strong grip.

Abnormal musculature therefore shows an absence of both Flexor and Extensor pollicis longus; Pronator quadratus, if present, is very rudimentary, and the extensors of the wrist are very weak. Extensor digitorum communis is absent, Flexor is present but weak. The biceps is present, but weak.

X-ray shows that the radius is completely absent on both sides, the ulna being short and bowed.

There is no true articulation at the/
X-RAY OF HAND OF NORMAL CHILD OF TWELVE YEARS
(reduced in size)

For comparison with the following X-rays of the patient
wrist, and the carpus is deformed in that the multangularum majus and navicular are fused, as are the capitate and hammate.

The humerus is very small in diameter.

**SUMMARY:** Congenital bilateral absence of the radius with stumping of the ulna, and marked adduction of both hands.

**PROGRESS NOTES:**

17.i.39. Admitted. T 97.8° P 92 R 20

25.i.39. H.I. Omnopon gr 1/6 given at 1.30 p.m.

H.I. Atropine gr 1/100 . . . .

2.30 p.m. **OPERATION**

Gas, oxygen and Ether anaesthesia

The patient was placed on the table with the left forearm across the chest.

An incision was made over the medial border of the ulna, at its lower end, the skin, fascia, and periosteum being incised in the same line. The incision was then carried deeply to expose the proximal aspect of the carpus on the radial side of the forearm, and a wedge was cut in the proximal aspect of the navicular with an osteotome.

The ulna was then divided one inch above the styloid process obliquely, from the ulnar to the radial side proximo-distally. The shaft of the bone was then bared above the osteotomy, and the distal end of the proximal fragment wedged into the cut on the navicular, the small 3rd-distal fragment lying against the subcutaneous surface of the shaft about an inch higher up. The wound was then closed with interrupted catgut and silk worm gut sutures, and the arm put in plaster from the knuckles to the middle of the upper arm the hand being held in ulnar deviation during this process.

**SUMMARY:** Osteotomy of the lower end of ulna.

9.15 p.m. H.I. Omnopon gr 1/6

26.i.39. 7.15 a.m. H.I. Omnopon gr 1/6
An X-ray taken the day after operation showed that the proximal fragment had become displaced in front of the carpus.

27.i.39. The plaster was split. On its removal, a small pressure sore was found over the bend of the elbow. This was dressed with vaseline.

8.iii.39. 1.30 p.m.  H.I. Ommopon gr 1/6
            H.I. Atropine gr 1/100 given

2 p.m.  OPERATION  MR. MERCER
Gas oxygen and Ether anaesthesia
The patient was placed on the table in the same position as before.

Through the old incision the bone ends were again exposed, the proximal fragment freed from its fibrous attachments, and brought out on to the dorsum of the wrist. A bed was then prepared for it in the proximal aspect of the carpus, and the end of the bone inserted and wedged into the gap. (See diagrams, page 8)

The wound was then closed, and the limb put up in a padded plaster.

SUMMARY: Fixation of the ulna to the carpus

9.iii.39. 12.30 a.m.  H.I. Ommopon gr 1/6 given
Some pain was present over the wound, but light percussion on the plaster did not cause pain.

7.30 p.m. Veramon gr vi

10.iii.39. The arm was X-rayed; the ulna was seen to be well fixed in the carpus.

15.iii.39. Massage and heat applied to fingers daily.

20.iii.39. The fingers were warm. They could be moved passively without eliciting pain except on extension of the proximal inter-phalangeal joints. There was no pain over the wrist, and the patient felt very comfortable.

23.iii.39. The plaster was split, and the stitches removed.
ches removed. The plaster was then renewed.

An X-ray showed the position to be satisfactory

25.iii.38. Discharged home in plaster for two weeks.

Reporting thrice weekly for massage and radiant heat; movements of the fingers are performed daily. After removal of the plaster, wrist movements will be given, and the radial deviation still further corrected by exercise. If the wished for results are obtained, a similar operation may be carried out on the right hand.

...
Congenital absence of the radius may occur as a familial diathesis, or may be the result of an embryonic anomaly. This is thought to arise either as the result of ill-health of the mother, or an accident befalling her early in her pregnancy; or as an inherent abnormality in the developing mesoderm of the foetus, here localised to the bones of the forearm.

There may be a deficiency of liquor amnii at the fifth week of pregnancy, when the arm buds are developing, and amniotic bands are thought to be present at times in the uterine cavity which may constrict the limbs of the growing embryo. In regard to the case in point, this latter would appear to be a far-fetched theory, the deformity being bilateral and each side resembling the other exactly.

The deformity is bilateral in 50% of cases and frequently coexistent with other deformities, one of the commonest being an absence of the thumbs and their metacarpals.

Again, thumbs may be present with no metacarpals, being adherent to the second metacarpal by means of skin and membrane, and being completely moveable.

Pathologically, the ulna is seen to be short, bowed, and thickened, the bowing usually being towards the radial side. The lower epiphysis is usually expanded to articulate with the carpal bones of the wrist. Carpal abnormalities associated with this condition are an absence or fusion of the navicular, and absence of the lunate. A small portion of the radius may be present, frequently fused to the ulna, giving a radio-ulnar synostosis.

The abnormal musculature is very complicated:

- The biceps may be absent altogether, or fused with lacertus fibrosus, brachialis anterior, or coraco-brachialis.

- The brachio-radialis may be absent. or/
may be a continuation of the short head of the biceps, or it may be continuous with extensor carpi radialis longus, and insert into the ulna.

Extensor carpi radialis may be absent, or fused with extensor digitorum communis.

Extensor pollicis longus may be lacking, or fused with the tissues.

Flexor pollicis longus and pronator quadratus are frequently absent.

Further abnormalities may include the termination of the radial nerve at the elbow, and the absence of the radial artery.

Consequent on this there is deformity of the hand, and extreme radial deviation, leading to the radio-palmar club hand.

X-ray appearances, apart from revealing the bony deformities already stated, show no abnormality in the calcium deposit, the bones being of average density and showing the normal bony lamellae. There are no areas of osteoporosis or additional calcification.

The joint spaces at the wrist may be reduced, but there is no arthritis present, altered activity of the joints being due to the abnormality or absence of the abnormal musculature.

Activities may be limited remarkably little. The patient develops an amazing adaptibility, many trick movements coming into play. Women can undertake the duties of the housewife with very little inconvenience; the chief drawbacks are the lack of arm reach, and the ugly appearance of the deviated hand. The shortening of the forearm also throws the body out of proportion.

The patient in question finds no difficulty at school in writing and sewing, and avers that she plays tennis, although the quality of this statement is open to doubt.
doubt. Various operations have been designed to straighten out the hand so that it may be held in alignment with the long bones of the arm, instead of in its extravagantly deviated position. These are as follows:

1. **Fryer's.** An osteotomy is performed on the ulna, the contracted tissues of the radial side being stretched, and the hand being held in as normal an alignment as possible by strapping.

   Some weeks later the lower end of the ulna is sharpened by removing the styloid process, and inserted into a gap in the carpus from which the lunate and capitate bones have been removed.

2. **Bardenheuer's.**

   The distal end of the ulna is split longitudinally to form a radial and ulnar portion. The carpal bones are slid between the two ends, and secured by pegging.

3. **Albee's.** A tibial graft is inserted into the middle of the ulna, and a bed made for the other end in the carpus.

4. **Hyerson's.** An ulnar graft is inserted into the position of the radius, the extensors of the hand being sutured over it.

   In the last two operations, absorption of the graft may occur.

5. **McCurdy** reports an operation which he performed satisfactorily on a five months old child, in which he severed the ulna, bringing the free end of the upper fragment to the lunate. An/
oblique incision across the forearm from the dorsum to the flexor aspect allowed the structures to slide upon each other.

They were then sutured in the correct position. Divisions of the tendons on the radial side was then carried out, the severed ulna being connected to the lunate.

6. Antonelli reported a case which he operated on at the same age, splitting the ulna from the wrist to the cubital fossa. The 'radius' thus formed was separated from the ulna by the interposition of muscles, and was attached to the ulna and the carpus with wire.

A Z-shaped lengthening of the tendons was performed on the radial side instead of a tenotomy.

The result appeared to be satisfactory.

In the case of the patient, Ina Thomas, operation was performed in order to improve the appearance of the hand, and to correct the extreme radial deviation, which proved a preventive to certain activities. The results of the operation have not yet been seen, but X-ray photograph shows good apposition of the ulno-carpal union, and straightening out of the deformity of deviation. The child is very cooperative, and therefore good results will probably be obtained, with distinct improvement in function.

Prognosis however must be guarded, as the contractures on the radial side of the wrist were of long standing, and together with the congenital absence of tissue, very good results are impossible. Some years will elapse before full results are seen, as by that time secondary contractures may or may not have developed. The child herself feels confident that there is improvement, the best proof of the results of any operative measure.
CASE IV.

Acquired Deformity:  HALLUX VALGUS

COMMENCING HALLUX RIGIDUS
Miss JANET CAMERON, aet 33.

ADMITTED: 3.x.38.

COMPLAINT: Pain in both great toes at first joint.

DURATION: Many years.

HISTORY: There has been pain in both great toes for many years, which has been getting worse recently. The pain is situated over the heads of the first metatarsals and metatarso-phalangeal joints; when bad, it radiates along the inner edge of the foot.

Pain is usually worse when the patient is sitting still, but is relieved when actually walking. Walking with bare feet is very painful, the left foot being especially affected.

PREVIOUS HISTORY: Pleurisy, gastric influenza. Jaundice 7 years ago. 'Blood-poisoning' from wasp sting 6 weeks ago. There is a history of attacks of 'laryngitis', but no joint pains apart from those complained of.

FAMILY: No history of bunions among other members.

ON EXAMINATION: The patient is an intelligent and cooperative woman from a comfortable home.

Nourishment good; all other joint functions excellent.

RIGHT FOOT: There is an inflamed bursa over the head of the 1st. metatarsal, covered with reddened skin. The subcutaneous structures are greatly thickened.

There is a certain degree of Metatarsus Primus
APPEARANCE OF RIGHT FOOT BEFORE OPERATION.
X-RAY APPEARANCE OF RIGHT FOOT SHOWING
OVERLAPPING OF 1ST AND 2ND TOES.
Primus Varus, with consequent valgus deformity of toe. There is limited movement of the metatarso-phalangeal joint and attempted movement causes pain. Limitation is due partly to spasm of muscles of the foot, partly to contraction of structures round the joint.

There is a corn on the little toe, but this is not complained of.

There is an exostosis on the postero-lateral aspect of the calcaneus.

LEFT FOOT: There is less obvious deformity of this foot on inspection, but the first metatarso-phalangeal joint is very stiff, and movements cause pain. There is slight flattening of the longitudinal arch.

A similar calcanean exostosis is present.

ROUTINE EXAMINATION: Heart and lungs normal.
Reflexes normal.
Other systems; N. A. D.

On Admission: T 97.6  P 92  R 20.

PROGRESS NOTES:

10.x.38. 11a.m. Soneryl, gr. iii given.

2.30 p.m. OPERATION. MR. ANDERSON.
Gas, oxygen & Ether anaesthesia.

The patient was placed on her back, with a sandbag under each heel and knee.

The left foot had been prepared for operation.

The 1st. metatarso-phalangeal joint was approached through a medial incision commencing over the middle of the proximal phalanx, and ending halfway up the medial side of the metatarsal, the convexity being upwards at the level of
level of the joint.

The joint was opened, and the capsule and periostium over the neck of the metatarsal reflected laterally.

The head of the bone was seen to be irregularly ossified, with a well-marked erosion over the dorsal part of the articular surface.

The head of the bone was reduced in size, and remodelled with an osteotome. The base of the proximal phalanx was then removed, and the remains of the capsule resutured with catgut.

The wound was then closed in layers with interrupted catgut and silkworm sutures, and a pin passed through the pulp of the toe, by which to apply traction.

The foot and leg were then put in plaster in which a piece of copper wire was incorporated along the sole.

The pin was attached to this with silkworm gut, and tension applied to toe.

**SUMMARY:** Plastic arthrotonomy of Hallux Valgus.

<table>
<thead>
<tr>
<th>Time</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.45 p.m.</td>
<td>H.I. Omnopon, gr 1/3</td>
</tr>
<tr>
<td></td>
<td>H.I. Hyoscine, gr 1/100</td>
</tr>
<tr>
<td>11.30 p.m.</td>
<td>H.I. Omnopon, gr 1/3</td>
</tr>
<tr>
<td>11.x.38</td>
<td>T 99.4 P 80.</td>
</tr>
<tr>
<td>4.30 p.m.</td>
<td>Veramon, gr xii.</td>
</tr>
<tr>
<td>12 p.m.</td>
<td>Dover's Powder, gr x</td>
</tr>
<tr>
<td></td>
<td>Aspirin, gr x.</td>
</tr>
<tr>
<td>12.x.38</td>
<td>11 a.m. Veramon, gr xii.</td>
</tr>
<tr>
<td>17.x.38</td>
<td>11 a.m. Soneryl, gr iii given</td>
</tr>
<tr>
<td>1.30 p.m.</td>
<td>H.I. Omnopon, gr 1/2</td>
</tr>
<tr>
<td></td>
<td>H.I. Atropine, gr 1/100</td>
</tr>
</tbody>
</table>

There was a good deal of post-operative pain, therefore sedatives were freely given.

There was a good deal of post-operative pain, therefore sedatives were freely given.
A similar operation was performed on the right foot, the bursa being dissected out and removed. An erosion of the base of the first phalanx was found. The base was therefore drilled, and removed with a hammer and chisel, the sharp edges being removed with nibblers.

The sesamoid bones were also removed. A pin was put through the pulp of the big toe as before, the wound closed in layers, and the foot and leg set in plaster, again incorporating a Gallie wire.

**SUMMARY:** Plastic arthrotomy; Sesamoidectomy.

- **6.30 p.m.** H.I.Omnopon, gr 1/3
- **12 p.m.** P 108 H.I.Omnopon, gr 1/3
- **18.x.38.** 11 p.m. T 99.2 P 96. Veramon, gr xii.
- **20.x.38.** 10 p.m. Dover's Powder, gr x
- **24.x.38.** Aspirin, gr x
- **25.x.38.** Pin removed from left toe.
- **25.x.38.** Plasters removed, left foot. Stitches out.

The toe is still rather tender; some movement is possible.

The tenderness is situated chiefly over the base of the 1st phalanx.

- **13.xi.38.** Toes manipulated under gas and oxygen, the plasters having been previously removed from the right foot.
- **19.x.38.** Patient discharged, walking quite well. Metatarsal bars fitted to shoes.
- **14.xii.38.** Reported: walking well and in comfort. Advised to continue with metatarsal bars for one month.
- **18.1.39.** Reported: Satisfactory.

Patient is very pleased with her condition.
DISCUSSION.

The right foot of the patient, Janet Cameron shows a characteristic deformity, namely Hallux Valgus. This is seen to a lesser extent, also in the left foot, but here there are additional signs of an early Hallux Rigidus.

HALLUX VALGUS is a common deformity, especially in females. It is usually bilateral, frequently associated with pes planus, and may be familial.

Causes of the condition are:
1. Metatarsus Primus Varus.
2. Ill-fitting shoes.
3. Chronic osteoarthritis.

1. Deformity from this cause is commonly considered to be due to an atavistic tendency, a reversion to the prehensile toe of the apes. This resembles a thumb rather than a toe, and consequently there is a metatarsal bone shorter in length, and the intertarsal space between great and second toe may be relatively increased.

The adductor muscle of the great toe, Adductor Hallucis, pulls on the base of the 1st phalanx, drawing it inwards, and tending to displace the metatarsal head outwards in its favour. This pull may be assisted by that of Flexor Hallucis Brevis. (See diagram.)
2. Shoes which slope forwards to an exaggeratedly pointed toe and do not follow the natural straight inner line of the foot, may, if consistently worn, play their part in Hallux Valgus formation. Bursitis as a result of this, is relatively common, pressure being applied directly against the lateral side of the joint, which is not well-protected at this point, the bursa forming the only cushion between bone and outside pressure.

3. Chronic arthritis of the metatarso-phalangeal joint may be part of a generalised rheumatoid arthritis, or may be monoarticular. It is frequently met with in men who are constantly on their feet and who wear large heavy boots, such as postmen and farm labourers. The adductor group of muscles draw the inert toe inwards.

Pathology. The inner side of the joint becomes shortened, while the outer side is stretched. The metatarsal head becomes displaced laterally. The cartilage covering the exposed head of the bone becomes irritated and fibrillated, with subsequent degeneration; new bone is laid down as osteophytes over this rarefied area.

If not the causative factor, osteoarthritis now develops in the joint. The bursa over the metatarsal head becomes inflamed through pressure, and bursitis occurs, which, in conjunction with the exostosis, leads to bunion formation. In addition there is a broadening of the anterior part of the foot, due to splaying out of the joint.
HALLUX RIGIDUS may occur insidiously, or as an advanced form of Hallux Flexus. It usually develops through a change in weight bearing; in flat feet the weight is thrown along the inner side of the foot. The metatarsal joint sinks to the horizontal, the joint is strained in an endeavour to support a weak arch, and spasm will be later replaced by organic changes. Pain on walking results, and any flexion of the joint will be acutely painful, and later impossible.

Other causes of the condition are:
1. Trauma, as in a kick from a horse.
2. An overlong great toe.

Pathology shows an osteophytic growth all over the articular area followed by osteoarthritic changes. Marginal exostoses on the dorsal edge of the anterior surface of the head are present.

Accompanying changes are usually present in the rest of the foot, there being a dropping of the arch and stretching of the spring ligament, with subsequent dropping of the talus.

Treatment of the conditions may be palliative if seen in the early stages, but in chronic cases operation is much more satisfactory, and gives a better functional result.

A mild case of valgoid deformity may be treated by manual manipulation, a general toning up of the muscles of the foot by means of exercises and contrast baths, and well-shaped shoes worn, a metatarsal bar being applied. Fads between the great and second toe are anathema to most orthopaedic surgeons. Their chief disadvantage is that they readily become displaced, and are apt to irritate the tender skin between the toes.

If there is an arthritic joint with a painful overlying bursa, and adductor spasm is so extreme that the toe can no longer be straightened manually, operation is usually indicated.
ly indicated. However an active bursitis should be allowed to settle down first, felt pads being fitted to take the pressure off the bursa, and the foot rested as much as possible.

The aim of operation is Whitman's maxim:

'To relieve pain, to correct deformity, to restore movement, and to preserve, while so doing, the weight-bearing portion of the foot.'

The following operations have been devised:

1. Removal of exostosis by chiselling off the metatarsal head on the medial side, and dissecting out the bursa.

2. Excision of the proximal third of the lst. phalanx in lieu of the metatarsal head.

3. Mayo's arthroplasty. The bursa and subcutaneous tissue are dissected out, leaving them as a pedicle. The metatarsal head is now resected, leaving bone on the plantar surface for weight-bearing purposes. The sesamoids are removed, and the adductor insertion stripped off to avoid possibility of post-operative recurrence of spasm. The bursal flap is then turned into the joint space, and retained with catgut sutures.

It is obvious that this operation cannot be performed where there is any degree of inflammation of the bursa, therefore its use is limited.

4. Removal of bursa and exostosis, the deformity being corrected by means of a wedge osteotomy from the metatarsal neck.

Tubby recommends the removal of the intersesamoid pad when inflamed; otherwise the remodelled head impinges on it on walking with painful consequences.

All these operations are followed with plaster, and traction on the big toe in a straight line.

This may be achieved by extension strapping, but a pin/
gives a more adequate pull.

The plasters may be removed in about a fortnight, and exercises commenced almost immediately. Weight-bearing is allowed within two to three weeks of operation.

Subsequently good shoes are of the utmost importance, both to preserve the line of the foot, and to prevent pressure recurring on the joint.

**Treatment of the rigid joint, both in its early and late manifestations,** may be conservative or operative.

The first consists in either thickening the sole of the shoe, or inserting a steel plate along the inner edge between the inner and outer soles. **Measures**

Operative measures are more satisfactory however, as a rigid great toe constitutes a deformity, and an ugly and awkward movement results on lifting the foot from the ground in walking.

These include:

1. In an early case where the painful spasm is muscular only, division of the plantar ligaments, and manipulation of the toe, or the foot may be wrenched under anaesthesia.

2. If arthritis is present in the joint, the base of the proximal phalanx may be excised, to allow mobility.

In all cases, operation should be followed up by exercises, especially where there is an accompanying flat foot.

The operation performed on the feet of the patient was a combination of the two first described, the metatarsal head and the base of the first phalanx being trimmed to enlarge the joint space. Any post-operative adhesions which caused pain on movement of the joint were overcome by manipulation under anaesthesia, this being followed up immediately by movements of the great toe, to/ avoid
avoid functional spasm of the muscles.

It was interesting in view of the slight varus deformity, that no other members of the family suffered from bunions, as it usually shows a familial diathesis. The deformity has been observed in the feet of the African pigmies, and therefore cannot be simply the result of so-called civilising footwear which rarely shows in its design, any knowledge of the anatomy and functions of the foot.

The results were extremely good, from the cosmetic effect, as far as function was concerned, and in the satisfaction of the patient. This latter is the best criterion of the results of operation on the feet. It has been reported in dancing masters, who were able to resume their work within three months, without any difficulty.

There is always preliminary tenderness, pain as a result of operation on the extremities frequently being much more severe than the amount of interference warrants, the swelling often being extreme, and the subcutaneous space limited.

The patient therefore, when sensible of improvement in the original condition, proves the efficacy of the operation much better than any visual or X-ray results can.

The prognosis in this operation is very good, provided due care is taken in trimming the bone.

All tenderness from scar tissue should have disappeared within two to three months.
CASE V.

Trauma: IMPACTED FRACTURE OF HEAD OF HUMERUS
MR. MERCER'S CASE.

EDWARD TACKET, aet 43. Vandriver.

ADMITTED: 3.ii.39.

COMPLAINT: Pain and loss of function in right shoulder.

DURATION: Two months.

HISTORY: On the 24th of December, the patient fell off his horse van on to his right shoulder. This received his whole weight. He was taken to S. O. P. D. and X-rayed, being admitted to the Waiting Ward.

The arm was rested between sandbags, being very swollen and painful. He was sent home a week later with his arm in a sling, and returned in another three weeks to the Massage Department, where he was given radiant heat.

His arm was still stiff, and abduction proved impossible, and when movement was attempted, he felt 'grating in the joint'. There was still some pain.

He was seen by Mr. Mercer, who advised open operation.

PREVIOUS HISTORY: There is no history of previous accident.

The only previous illness was that, when aged 8, he suffered from osteomyelitis of the right radius, which necessitated removal of some of the bone. This had left him with some degree of club hand, but he has been doing heavy manual work with it all his life, and had noticed no degree of disability.

ON EXAMINATION: The patient is a large heavily-built man, extremely well-developed. He is plethoric in appearance, and intelligent in his answers.
X-RAY OF FRACTURE OF NECK OF HUMERUS
On examining the right arm, marked wasting of the deltoid was found to be present; abduction beyond 80° was impossible, and most of this movement was taking place at the scapula.

The actual range of shoulder movement in any direction was very limited.

The upper end of the humerus was felt through the wasted muscle to be displaced into the axilla, the head being felt in the glenoid cavity.

Crepitation was felt on rotation of the arm.

The right forearm was found to be shorter than the left; the head of the ulna was prominent, and there was some radial deviation of the hand.

The movements of the wrist and the elbow are full however, and the patient has never been conscious of any disability through deformity.

X-ray of the shoulder shows a fracture of the surgical neck of the humerus, with displacement of the lower fragment inward by one diameter. The head is in the glenoid cavity, and there is some degree of impaction.

An examination of the systems revealed no abnormality.

Teeth: good
Tongue: clean

PROGRESS NOTES:

23.11.39. On admission: T 97° F 72 R 18
1.11.39. H.I. Omnopon gr 1/3 c Hyoscine gr 1/100 given at 2 p.m.

3 p.m. OPERATION MR. MERCER

Gas, oxygen and Ether anaesthesia.

The patient was placed on his back on the orthopaedic table, the arms being attached to the exterior arms, and abducted to 90°.

The anterior half of a sabre blade incision/ was drawn
was drawn from the top over the front of the right shoulder. The skin and fascia were divided, and the anterior fibres of the deltoid were separated by blunt dissection, exposing the bone underneath. Some branches of the superior deltoid artery were divided between forceps, and ligated.

The periosteum was elevated from the shaft of the humerus, and the fracture defined.

The lower fragment was found jammed into the axilla, and firmly fixed to the upper portion. An osteotome was introduced into the fracture line to separate the partly united fragments, and a wedge of bone removed from the upper part of the shaft. The lower fragment was then levered into place with Lane's T-saw, the rawed surfaces thus coming into apposition. It was also seen at this time that the greater tuberosity was fractured at the same time as the neck.

The alignment being found satisfactory, the wound was closed with interrupted catgut and silkworm gut sutures, and the arm was bandaged firmly to the side, with a pad of wool between the middle of the shaft of the humerus and the chest wall, so as to maintain lateral displacement of the lower fragment relative to the head.

**SUMMARY:**

Open reduction of fracture of the neck of right humerus.

10 p.m. H.I. Morphine gr 1/4

2.iii.39.

2.30 a.m. H.I. Morphine gr 1/6

Some pain was complained of.

An X-ray taken showed that fragments to be in good position.
5.25 p.m. Veramon gr xii given

6.iii.39. Patient allowed up. There was no further pain in the arm.

13.iii.39. Patient discharged. The arm was kept tied in the post-operative position.


31.iii.39. Reported. To have shoulder movements.

15.iv.39. Reported. Movements fairly good, although there is still some slight limitation of abduction.
DISCUSSION:

The patient, Edward Taket, was suffering from an old impacted fracture of the humerus.

Fractures are generally classified as Simple and Compound; those in which damage is strictly internal, and those in which the skin is involved. Compound fractures are the more dangerous, and their secondary results are seen early. Simple fractures may prove dangerous only through damage to the overlying vessels, or through excessive shock. Damage to nerves may however occur, and trophic changes are found, with disturbance of sensation, and wasting of the muscles. Finally loss of function may occur, and deformity, due to malunion of the fragments.

Fracture of the humerus may be classified under four headings; 1. Fracture without dislocation 2. Fracture with accidental dislocation, and adduction of the distal fragment 3. Fracture with dislocation and abduction of the distal fragment 4. Fracture of the greater tuberosity.

A fall on the shoulder is the commonest cause of fracture of the neck of the humerus. Other causes may be a direct blow, a fall on the outstretched hand, the lines of force passing up through the long bones to the shoulder joint. The fracture in this injury however usually occurs lower down.

Any weakening of the bone may predispose to fracture, due to former injury or disease, and this should always be borne in mind. Osteoporosis may occur in the region of the shoulder joint in diseases such as Sprue; it is also a common situation for tumours or cysts of the bone, such as Ewing's tumour, secondary carcinomata, or giant-celled/
giant-celled tumours.

The direction of the force of the fracture is clearly evident in the case in point, there being no question of localised weakening of the bone.

The force of the fall was received by the upper arm, the greater tuberosity being fractured, the lower fragment being driven inwards by the force of impact.

Fracture of the neck of the humerus is potentially dangerous owing to the important structures that run anterior to and below it, namely the axillary artery and the brachial plexus. If there is adduction of the distal end in relation to the proximal, this danger is emphasised, especially if there are sharp and serrated ends of the bone.

Damage to the vessel is self-evident, the rapid collapse, pallor and air-hunger of the patient being more obvious signs than those seen locally.

Damage to the nerves may not be so obvious at first, the shock of the fracture militating against the usual nervous reactions. Later, tingling, numbness and loss of sensation may direct the attention to it. Loss of muscular power will also result. Plotting the areas of anaesthesia and which muscle groups are affected, will enable the surgeon to isolate the lesion.

Muscular wasting is the last noticeable change to occur; where there is nervous damage, this tends to be much more rapid than that due to disuse of the limb.

There are various factors to be considered before operative interference is undertaken, the first being...
to operate only if other methods of reduction have failed, and perfect anatomical position is essential. In fractures of the humerus, this is one of the reasons most easily shelved; the upper arm has not the cosmetic importance of many other parts of the body, especially in men, and it is not concerned with bearing the weight of the body. If there is interference with abduction, the most important shoulder movement, much may be taken on by the scapula.

The second factor is injury, or threatened injury to associated structures; this has already been dealt with.

The third is in cases of malunion, important from the point of view of function, and from weight-bearing where this is necessary, the lines of force being distributed in a plane incapable of sustaining them.

The operative technique is just as important as the other considerations, the trump card being rigorous asepsis, always the rule when dealing with bone, the threat of osteomyelitis hanging over the patient, unless every precaution is taken.

**Operative Factors:**

1. **Time.** The optimum time of operation is between the third and fifth days, when the patient is over the initial collapse, and before union has started to occur.

2. **Presence of septic foci.**

   If possible, ensure that there are none present in the body, thus avoiding the possibility of any released organisms settling in the bone where it has been damaged by operation. The history of previous osteomyelitis in the patient's case is too distant to record it as a potential focus, but its presence must not be forgotten.

3. **Skin.** Wait until surrounding skin is as healthy as possible, so that sepsis from this source may be avoided, the sutures
the sutures will hold, and the apposing edges unite by first intention. Unhealthy skin may be excised, and treated later by grafting.

4. **Anaesthesia.** This should be as complete as possible, to ensure adequate muscle relaxation, any division and suturing of muscles thereby being carried out under optimum conditions.

5. **Periosteum.** This should be disturbed as little as possible, and extensive stripping avoided, as healing is thus delayed.

Operation on the patient, Edward Taket, was performed after two months because he still complained of pain, and there was considerable loss of function in the shoulder. As he was a van driver and found it necessary to use his arms in heavy work, a painless functioning joint was essential to his livelihood.

There had fortunately been no vascular or nervous damage, the head of the humerus in the glenoid cavity having been impacted by the lower fragment, thereby keeping it at rest, and avoiding pressure on vulnerable structures. Whether this occurred primarily, or was a secondary development subsequent to his preliminary treatment, it would be difficult to say; the patient having been sent home in the first place with his arm in a sling, points to the fact that fair apposition was thought to have been obtained.

The operation was complicated by the presence of commencing adhesions between the two ends of the bone, these were divided, and the fragments levered into place without difficulty, care being taken to preserve adduction of the lower fragment, abduction having been formerly present.

Recovery was uncomplicated.

**PROGNOSIS:** This is excellent. The deltoid is once more in use, and there are no signs of trophic disturbance.
CASE VI.

Trauma: OLD FRACTURE OF SPINE
SPONDYLOLISTHESIS
MR. COCHRANE'S CASE.

JAMES MUNRO, aet. 38. Mechanic.

ADMITTED: 25.iii.39.

COMPLAINT: Pain in back, especially on bending.

DURATION: Over two years.

HISTORY: On 12.xi.36., the patient was bending to pick up his tools, when a heavy beam fell across the lower part of his back, striking him to the ground. He sustained a fracture of the fifth lumbar vertebra, and a fracture of the lower part of the shaft of the left femur. He was treated in Perth Royal Infirmary with traction on the femur with a Kirschner wire, but had no definite fixation of the spine. He has since had electrical treatment and massage off and on, but has never returned to his work. He wears a brace to support his back.

He complains of severe pain in the bottom of his back, especially marked at night when he takes off his brace. This radiates round to the left side. Any effort or bending produces acute pain of a stabbing character; this has never radiated upwards or into his legs, although he often finds it difficult to get into a comfortable position in bed at night. During last summer, he had two weeks at the seaside with the result that his general health was considerably improved, and the pain in his back became less. The pain is always aggravated by wet weather.

Since the original accident, patient has never been able to bend his knee (left) more than 30°; this does not impede his walking to any extent; formerly he had severe cramps on the leg, but has no pain now.

PREVIOUS HISTORY: Influenza when in the Army.

No other illnesses.
ON EXAMINATION: There is a prominence of the spine of the Vth lumbar vertebra; firm pressure over the spine elicits tenderness, which is also present over the transverse processes. Any movement of the spine causes pain, especially flexion.

The mobility of the lumbar spine is therefore limited by muscle spasm, although the thoracic and cervical spines are comparatively mobile.

The patient is very deaf. Examination of the other systems revealed no abnormality. Heart and lungs N. A. D. Reflexes normal. Teeth: false Tongue: clean.

X-RAY: This revealed an old compression fracture of the Vth lumbar vertebra, with fracture of the transverse process on the left side of the IVth. The lateral view shows some degree of spondylolisthesis, the IVth and a wedge of the anterior margin of the Vth being sloped forward on the side of the Vth.

PROGRESSNOTES:

25,iii.39. Admitted. T 97.4° P 84 R 20
26,iii.39. 11 a.m. Soneryl gr iii given. The patient was laid on his face on the plaster table, and a posterior plaster shell made, extending from the lower cervical region to the middle of the calves.
27,iii.39. 2 p.m. H.I. Omnopon gr 1/3 c Hyoscine gr 1/150 3.30 p.m. OPERATION MR. COCHRANE Gas, oxygen and Ether anaesthesia.

The patient was placed on his face on the table, and a sandbag placed beneath the abdomen to straighten the lumbar spine.

A curved incision
X-RAY OF LUMBAR SPINE, SHOWING FRACTURE OF TRANSVERSE PROCESS
A curved incision was made from the level of the third lumbar vertebra well down on the sacrum, the curve being to the right, to avoid pressure on the spinous processes. The spines of the first sacral segment and fifth and fourth lumbar vertebrae were exposed, and split with an osteotome. A notch was made in the spine of the third lumbar vertebra and those below it, and by means of moving small pieces of the spines, a bed was prepared some four inches long by half an inch wide.

The patient's right leg was then flexed at the knee, and, the skin having been prepared, a vertical incision was made over the medial aspect of the tibia, six inches in length. The periosteum of the tibia was incised, and by means of a mechanical saw, a piece of this bone was removed, the length necessary having been measured by means of a probe bent to the length of the spinal bed. The piece of bone removed measured four inches by half an inch. This graft was then placed in the bed prepared in the spine, and sutured in place with strong catgut.

The lumbar dorsal fascia was then sutured together over the graft, and the skin was closed with interrupted silk worm gut sutures, dressings being applied to both wounds.

The plaster shell was then laid over the patient's back; he was turned in the shell on to a trolley, and taken back to bed.

8.15 p.m. H.I. Morphine gr 1/4 given
28.iii.39. 12.15 A.M. H.I. Morphine gr 1/4 given

Patient complained of little pain over the region of his wounds, but felt his 'stomach stiff' from stretching.

10 p.m. H.I. Morphine gr 1/4 given
29.iii.39. 12 P.M. H.I. Morphine gr 1/4 given
13.iv.39. Turned in plaster shell. The stitches were removed from the lumbar wound and that of the leg. Both were satisfactory, and showed healing by first intention.

25.iv.39. A few slight twinges are occasionally felt in the lumbar region, but otherwise the patient states that he has felt little pain since operation.

28.iv.39. The scar on the leg has healed perfectly, and there is no tenderness on palpation or percussion.

18.iv.39. Discharged home in plaster shell. He is to remain in this for six months, and is then to be readmitted for his removal from it. This will be followed for some weeks by his lying loose in bed, with massage to the legs, preparatory to attempting weight-bearing.
DISCUSSION:

Fracture of the spine is not of direct danger to life unless there has been excessive shock, and damage to the spinal cord occurs. The lower the fracture therefore, the greater are the chances of recovery.

Fracture frequently occurs without the victim's being aware of the fact, and he may walk home afterwards. After treatment for a 'strained back', he may rise from his bed and go back to work.

This phenomenon is due to the excessively strong spinal ligaments, anterior and posterior, which are so firmly attached to the vertebrae that considerable wrenching force is required to tear them. These tend to keep the vertebrae in apposition; later weight-bearing tends to preserve this line unless fracture has occurred at one of the flexures of the spine, when a certain degree of collapse will occur, and the patient develop a kyphos.

If the fracture has gone unrecognised, a commencing osteoarthritis, or symptoms in the legs relating to pressure on the cord draw the surgeon's attention to the old injury.

Spondylolisthesis may be a developmental condition, or directly related to trauma, superimposed on defect.

Various theories of causation are:

1. The result of improper bony contact at the articulations, or loss in the bony arch of the Vth lumbar vertebra,

2. Trauma on top of developmental defect, particularly affecting the ligamentous structures of the Vth lumbar vertebra,

3. Where there is an exaggerated lumbosacral angle, the articular facets become gradually worn, and/
Treatment of fracture should be carried out as soon as the patient has recovered from the initial shock.

This consists in application of a tight plaster, the patient sitting on a stool with the arms slung from a rack, taking some of his weight. By this means the spine is stretched, the weight of the body being distributed between two fixed points. The minimum of padding should be applied before the plaster is put on, as it is essential that it should fit tightly, and thus preserve extension. The patient should thereafter rest in bed for at least three weeks; later he may be allowed to walk about in the plaster. Progress is checked by results, both physical and by X-ray, and a spinal brace may later be necessary.
allowing the body to slide forward upon the sacrum.

Types of the deformity are:

i. Unilateral, accompanied by paralysis,

ii. Bilateral, where displacement is gradual, and there are mild symptoms only.

Pain may or may not be present, and nervous disturbance is not essential. The patient frequently walks with a waddling gait; flexion of the back is limited, and there is a reduction in the interval between the ribs and the crest of the ilium. Presence of the deformity may only be detected for the first time in a woman in labour, undue prolongation of the first stage leading to the search for obstruction.

Treatment should be initially conservative, the patient resting in bed with a pad under the sacrum, and letting the weight of the upper part of the body push the lumbar spine into position. Later they may be allowed up, wearing a spinal brace. It is obvious however, that this treatment may be employed only in the mildest form of case, as recovery of the stretched anterior spinal ligaments is unlikely.

Therefore operative measures must be resorted to, consisting of a spinal graft, with additional laminectomy if there is much nervous disturbance.

The patient, James Munro, had had little treatment for the essential condition, massage and heat allaying the original stiffness. He complained of extreme pain when bending forwards, and was unhappy without a spinal support for his lumbar region. Pain was felt principally on the right side, although the detached process seen in the X-ray was on the left. This showed that the loose fragment of bone was not in itself a discomfort, as referred pain would hardly be specifically one-sided. Osteo-arthritis changes present in the spine were probably responsible for the pain felt on movement.

There were no sympotms of spinal pressure, therefore/
the degree of spondylolisthesis was not extreme enough to cause pressure on the cord.

This therefore proved an ideal case for spinal grafting, as no pain was experienced when the lumbar spine was immobilised. An internal splint was therefore applied by means of a bone graft from the tibia.

The results of this operation have not yet been seen, but the absence of post-operative pain and shock was very striking. If the engrafted splint unites effectively with the bone of the vertebrae, perfect local immobilisation of the part should be obtained, with complete cessation of symptoms. The disability of an immobilised lumbar spine is comparatively slight, the patient unconsciously compensating for it by flexion of the hips and thoracic spine.

Prognosis in this case may therefore be said to be very good; whether the patient can return to his job again is doubtful, as a lot of stooping is involved, but there is no reason why he should not manage bench work.