# RATIONAL AND EFFECTIVE TREATMENT OF HIP-DISEASE

BENNIE

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# HIP-DISEASE

BY

P. BRUCE BENNIE, M.A., M.D., B.S. (MELB.)

HONORARY MEDICAL OFFICER, MELBOURNE HOSPITAL FOR SICK CHILDREN
PRESIDENT, MELBOURNE MEDICAL ASSOCIATION, 1896
PRESIDENT, MELBOURNE PEDIATRIC SOCIETY, 1907

**Founded on Experience of Numerous Cases in Hospital Practice during 28 Years**

COMPILED BY

ALEX. B. BENNIE, M.A., M.B., B.S. (MELB.)

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# INTRODUCTION

As I have found that the principles laid down by the late H. O. Thomas, in his work on Hip, Knee and Ankle, have not been generally known to medical men throughout the world, and as I have proved by successful treatment for many years that the methods of Thomas are the only satisfactory methods for treatment of diseases of the hip-joint, I have decided to bring before the profession the conclusions I have come to from the treatment of numerous cases at the Children's Hospital, Melbourne, where I have been Honorary Surgeon for twenty-three years, and at the same time to show the improvements introduced by myself, and taught to many of my resident surgeons at this hospital. I will also endeavour to point out the simplest methods of measuring for the splint, making, fitting, and otherwise adapting the splint for the purposes intended, and at the same time I shall, I trust, demonstrate clearly to all concerned that this method is the most rational and most effective

method of any yet known to medical science, and that any other method fails utterly in the most important point, *complete rest to the joint.* My long experience, and the successes obtained by me and by others following my method, warrant me in making this strong claim for the urgent consideration of this treatise by my brother medical men throughout the world. I am writing this in the interests of humanity as well, for when I was appointed Honorary Medical Officer to In-patients to the Melbourne Hospital for Sick Children, I found that many of my beds were occupied by hip cases, and I immediately became interested in the little sufferers, apparently condemned to a life of increasing suffering and uselessness till merciful death supervened.

In searching for a remedy, the methods of Thomas appeared the most rational, and after a trial of his and other methods, the others were discarded and Thomas's methods were followed, improved and simplified with the happiest results for my little patients.

Nature endeavours to obtain rest for the joint. How can we aid Nature to obtain rest for the joint? Only by fixing it, making it immobile; and the only method of doing this is by Thomas's splint, consistent with the free movement of the remainder of the patient's body. By the means of Thomas's

splint we convert the unstable equilibrium of Nature into an artificial stable equilibrium. We fix the joint at absolute rest in the position of lowered tension within the joint, and so arrange the apparatus that we are able *to gradually correct the deformity concurrently with the improvement in the joint.* We cannot lengthen a shortened bone; we cannot supply a new head to the bone when the head is destroyed; we cannot supply a new rim to the cotyloid cavity; but we can arrest the progress of the disease, and generally at the stage at which we receive the case. We can cure a diseased joint, and give a useful limb and a happy life free from pain and disease to those cases which, by other methods, would go on to fatal termination after months and months of increasing misery, and this we do by the use of Thomas's methods, improved by us, which have only to be understood to be appreciated. After the experience of a quarter of a century and hundreds of cases, we speak with no uncertain voice; we bring forward no immature, untried methods.

And I am satisfied, and speak with the utmost confidence, that the same success in the treatment of these cases lies within the reach of any medical man who will take the trouble to read this treatise and employ the methods here described. So strong is my belief in this, that I have decided to publish

the results. My brother, Mr. Alexander B. Bennie, has relieved me of the literary part of the work, and has kindly compiled this volume, for which work, owing to a busy practice, I have been unable to find time.

I recognize and acknowledge the valuable teaching of my predecessors, especially the late H. O. Thomas, a giant on the subject; I am but a pigmy who has climbed on his back, and claimed to have seen a little further, and to have extended and improved upon his methods.

P. B. Bennie.

Melbourne,
1907.

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# RATIONAL AND EFFECTIVE TREATMENT OF HIP-DISEASE

## HIP-DISEASE

### Definition.

By hip-disease we mean inflammation of the hip-joint, due to invasion of the joint by the *Bacillus tuberculosis*, taking the usually accepted meaning of the term. For other non-tubercular cases we differentiate by the use of terms indicating the precise nature of the disease—as, for instance, we talk of sarcoma of the hip. Throughout this volume by hip-disease we mean tubercular affections of the structures entering into the formation of the hip-joint.

### Short Pathology.

Hip-disease is a local manifestation of a constitutional disease. Tubercle bacilli are, I believe, present elsewhere in the body, as they must have passed through some part of the body to get into the hip-joint; and there is evidence of their presence

elsewhere in many cases; moreover, many cases cured of hip-disease fall victims to tuberculous lesions in other parts of the body; for these reasons, in the diagnosis we must have regard to any constitutional or hereditary tendency to tuberculosis. Of the other constitutional tendencies, syphilis is the most potent. Many of my cases have shown evidence of congenital syphilis. The *B. tuberculosis* and the *Spirochætæ* are very friendly (microbic association or symbiosis).

It is well known that in the adult syphilis is a powerful predisposing cause to tubercular affections. Many of the deaths occurring in acquired syphilis are stated to have been due to tuberculosis. In children I have found that the congenital syphilitics are peculiarly prone to fall victims to tubercular disease in its different forms.

## REST FOR THE INFLAMED JOINT

In hip-disease the joint is inflamed, and rest is required for all inflamed joints; hence the hip-joint must have rest. The inflammation is due to tuberculous processes. The organism defends itself from tubercular invasion by setting up defensive fortifications (calcareous and chitinous layers—Metchnikoff). Movement destroys these barriers, knocks down the walls, and the invasion spreads; hence uninterrupted prolonged rest is the *sine qua non* of the treatment.

Movement in the joint causes increased blood-supply, feeds the bacilli; rest causes decreased blood-supply, starves the bacilli.

Thomas's treatment is rest; enforced, uninterrupted, prolonged rest for the joint; rest in the position of decreased tension for the joint; rest in the position naturally assumed by the joint in the inflamed *condition, with gradual reduction of the deformity* as the joint gets better.

Reduction of deformity coincides with improvement in the joint.

Reduction of deformity and cure are obtained without operation, without pain, and with comfort to the patient.

The patient enjoys freedom of movement of other limbs, and soon gets about in the open air, walking with crutches, and all the time cure is going on. The functions of the joint are temporarily extinguished by the abolition of capsular friction and the reduction of interarticular pressure, which without the splint are increased by the movements of bones and ligaments forming the joint.

To ensure absolute rest for a joint, all the muscles which produce or tend to produce movement must be rendered functionless.

To obtain this ideal rest for the hip-joint all the muscles which are attached to the pelvis and to the femur of the affected side must be controlled, and all the muscles attached to the pelvis on both sides, which tend to cause movement of the pelvis, must also be controlled.

### Muscles Acting on Hip-Joint.

These muscles are twenty-four in all, and some of them are always on guard in hip-disease.

Flexors: Psoas, iliacus, pectineus, sartorius,

rectus, vastus externus, obturator externus, adductor longus, adductor brevis.

In front: Pectineus, psoas, iliacus.

EXTENSORS: Biceps, semimembranosus, semitendinosus, gluteus maximus, gluteus medius, gluteus minimus, obturator internus.

Behind: Gluteus minimus, pyriformis, obturator internus, gemellus superior, gemellus inferior, quadratus femoris.

ADDUCTORS: Pectineus, obturator externus, gluteus maximus, adductor magnus, adductor longus, adductor brevis, gracilis, quadratus femoris.

ABDUCTORS: Sartorius, gluteus maximus, upper fibres; gluteus medius and minimus, tensor vaginæ femoris.

Outer side: Obturator externus.

INVERTERS: Gluteus medius (anterior part), gluteus minimus, tensor vaginæ femoris, gracilis.

EVERTERS: Psoas iliacus pectineus, obturator externus, biceps, gluteus maximus, gluteus minimus (posterior part), obturator internus, adductor magnus, adductor longus, adductor brevis, quadratus femoris, gemellus superior, gemellus inferior, pyriformis.

Besides these muscles, all the muscles attached to the pelvis coming from above, and the leg muscles attached to the femur, and going to the leg, tend to produce movement of the joint.

This ideal condition of rest can only be obtained *post mortem*. As we cannot realize our ideal, we make the nearest approach to it, and the problem is a mechanical one — how to construct an appliance which will control the greatest number of muscles in question, and which will be compatible with the life, comfort, and cure of our patient.

## How to Obtain Rest.

For the purpose of obtaining rest for the joint Thomas's splint is the best of all the countless splints and appliances. Bonnet's is good, but weighs 12 pounds, and patients wearing it are confined to bed, so this cannot be used.

All the other splints fail in controlling the muscles which produce movement in the joint, and so increase the irritation and impede recovery.

Thomas's splint is cheap, and can be worn at the proper time by patients moving about on crutches with a patten or stirrup on the sound foot, gives better control of joint, and is *facile princeps* of all the inventions of its kind.

By Thomas's splint I mean not the hybrid production sent out by some instrument-makers as Thomas's, but in which all the principles so strongly insisted upon by Thomas are broken, but the splint

as manufactured, fitted, applied, and used by Thomas and described in his work.

We must know the principles of the splint before we can tell the faults of its manufacture. We must learn the normal before we recognize the abnormal, and I write to bring the normal splint prominently before my brother medical men.

It may not be out of place here to digress and mention how I became acquainted with Thomas's splint. When I had the honour to be entrusted, as Indoor Hon. Surgeon to the Children's Hospital in Melbourne, with the care of in-patients after five years' out-patient work, I was moved with pity towards the little sufferers with hip-disease destined to dire deformity and death after months and months of suffering, for such had been the general experience in most cases of the disease. I considered, therefore, that it was my duty to give the little sufferers with the pathetic faces the best treatment I could. Accordingly, I consulted all the accessible works of the noteworthy surgeons on the subject, and among these Thomas's treatment impressed me as the embodiment of one idea—*rest*—the other authors being vague, indefinite, and inconsistent. At the same time I noticed that the splint described by Thomas was quite another thing mechanically from the splint I had seen worn and called Thomas's, and this difference explained the fact that I had

never seen the wonderful result recorded in Thomas's work and produced by his splint.

I resolved to make a trial of the genuine Thomas's splint, and I selected from my private patients a bad case in the third stage of the disease, with considerable adduction, flexion to nearly 90° from normal, and on the antero-lateral aspect of the trochanter a discharging sinus large enough to admit three fingers. This patient had been in the Children's Hospital under treatment by extensive drilling of the bone and Bryant's splint, which had so little effect that he had now apparently not long to live, as he was greatly emaciated and worn out with hectic and pain; and as the splint which I ordered from the instrument-makers under the name of Thomas's splint was useless, as it possessed the main defects about which Thomas complains as ornamenting the splint out of its usefulness, there being an excess of padding, no rotation curve, and the splint was fitted to accommodate the lordosis, maintaining the deformity instead of curing it, I took the matter in my own hands, measured my little patient, set down the measurement of the curves and the dimensions of the several parts of the splint on paper, which I took to a blacksmith, borrowed an intelligent workman, and in less than one hour had the iron frame of the splint made exactly as Thomas directed it should be, and under

my own personal supervision. I then sent it to a saddler's, and had it correctly covered, and this was the first real Thomas's splint I saw, and, judging from remarks made at the Intercolonial Medical Congress in Melbourne, I believe it was the first genuine Thomas's splint made in the colonies.

I fitted it on to my patient, and as it required a very slight alteration, I ordered a pair of wrenches to do so, but when supplied I found they were so small that they would hardly bend hoop-iron. I then drew a plan of the wrenches in Thomas's book, and my intelligent working blacksmith made me a pair to order. With them I made the slight alteration necessary in the splint, and the patient was fitted comfortably.

The little patient felt the benefit of the splint, for on one occasion, contrary to my directions, the father took the splint off to wash the boy, and he cried to have it put on again, as the pain was beginning again, even in this short time.

Result: Pains ceased after a day or two; sinus healed slowly.

Case ultimately cured, with a straight back and leg.

While treating this case, and in order to become expert in the use of the wrenches, I drew some curves on paper, and amused myself in bending pieces of iron to coincide with them; and in order

to test the statements of Thomas as to the alteration in the position of the splints consequent on alteration of curves in the wing, I had three splints of varying strengths made to fit my son, aged seven, expanded and contracted the wings, increased and decreased the rotation of the stem, and found I could place the splint in varied desired positions; and when I carried him on my shoulder, and rolled him on the couch with the splint on, the splint did not move when correctly fitted, and it absolutely controlled the movements of the hip-joint. This experience convinced me that Thomas spoke the truth in this regard, and during two or three months I tested the statements of the author of the splint. Then I did not hesitate to introduce Thomas's splint into the Children's Hospital, and, thanks to the intelligent assistance of my resident medical officers, the results far exceeded my anticipations in numerous cases.

## What is Thomas's Splint?

Thomas's splint consists of four pieces of soft malleable iron (transverse section of each piece being rectangular—that is, flat iron), of requisite tenacity and dimensions, joined so as to form an iron frame, and suitably covered to prevent excoriation, and capable of being adapted to the body so as to fix the hip-joint in an immovable position, and easily alter-

able by the wrenches to fit the decreasing deformity of the joint as cure results.

1. The longest piece is the upright stem.
2. The second longest is the chest wing.
3. The third longest the thigh wing.
4. The shortest the leg wing.

1. The longest or upright stem extends from the lower angle of scapula to a little below the centre of the extremity of calf of leg, *the spinal part being as straight as the normal natural spine;* the buttock, thigh, and leg part of the stem following the contour of the deformity of the diseased side. Dimensions for adult, 1 inch wide, $\frac{1}{4}$ inch thick.

2. Chest wing, fitted round the chest just clear of the lower angle of scapula, leaving a gap of about 4 inches in front. This hoop is firmly joined to the top of the upright by two small rivets obliquely set, and at a distance of one-third of its length from the end corresponding to the diseased side. Dimensions for adult, $1\frac{1}{2}$ inches by $\frac{1}{8}$ inch.

3. The third longest, the thigh wing, is two-thirds or three-quarters of the circumference of the thigh, at a position, for the adult, 2 inches below the fold of buttock, firmly joined at right angles to upright stem by two small rivets set obliquely; the junction must be just behind the centre of gravity of limb—that is, a little to the inner side of its centre. For the stem must, for mechanical reasons, occupy the position of

the line joining the centres of gravity of contiguous cross-sections of the limb. Dimensions for adult, $\frac{3}{4}$ inch by $\frac{1}{8}$ inch.

4. The shortest, or leg wing, is two-thirds or three-quarters of the circumference of leg at lower extremity of calf, firmly joined at right angles to upright by two rivets as before, the junction being a little to the inner side of centre of curve. Dimensions for adult, $\frac{3}{4}$ inch by $\frac{1}{8}$ inch.

The curves for the chest wing, thigh and leg wing are taken by means of a narrow strip of sheet-lead and marked on paper.

Thomas gives two-thirds, but we have found three-quarters better suited to hospital out-patients, for you can enclose more of the leg in the splint, and so give the parents greater trouble in removing the splint—a procedure which they are so apt to follow, and frequently deny having done so, one mother removing the splint on her arrival home, and only putting it on for her visit to the hospital. This is mentioned in order that the splint may not be unjustly condemned.

This is the crude iron frame. For completion it requires to be covered with basil leather, not padded, for padding destroys its usefulness entirely. It also requires the rotation curve or twist to be given to it, so that it fits flat on the surface of skin along its whole length. Of these more important points more anon.

### Apparatus Required for Measuring in an Ordinary Typical Case of Hip-Disease.

A flexible steel measure tape.

Strips of sheet-lead of requisite size for the particular cases, the broadest ones being used for the longest tracing.

I have in use five strips of sheet-lead of dimensions as under :

| Thickness (Inches). | Breadth (Inches). | Length (Inches). |
|---|---|---|
| $\frac{1}{10}$ | $\frac{3}{16}$ | 6 |
| $\frac{1}{10}$ | $\frac{1}{2}$ | 16 |
| $\frac{1}{10}$ | $\frac{13}{16}$ | 26 |
| $\frac{1}{10}$ | $1\frac{1}{8}$ | 36 |
| $\frac{1}{10}$ | $1\frac{7}{16}$ | 46 |

These strips are sufficient for all cases.

A piece of chalk.

A piece of cartridge-paper about 21 inches by 33 inches.

A lead pencil.

### How to Measure for It.

My method is an improvement on Thomas's, and gives a certainty of fitting the splint to the patient with far greater accuracy and celerity. The patient, when able, stands on the sound limb, and places foot of diseased limb on a low pedestal, which can be screwed up, but at first the two feet are on the same

level; then screw up the pedestal till the angle of repose be ascertained—that is, until the spine becomes straight, the patient upright, with the diseased limb flexed at the hip. (*N.B.—This minimum flexion with a straight spine is the angle of deformity.*)

The outline and curves of the desired position of the splint on the body are taken by means of strips of lead, and then traced on a large sheet of paper, which is supplied to the blacksmith. We get an accurate fit at once with my methods, and with the use of the lead strips as introduced by me—for Thomas does not use them, and states that you may require to alter the buttock curves for some weeks. All these alterations we save by the use of the lead strips, and the consequent accuracy with which the curves are taken. The blacksmith does the hardest work—moulding the iron to its proper shape without any liability to error, except in cases of great deformity, when the moulding must sometimes be done by the surgeon himself to ensure a satisfactory result. This moulding by the blacksmith is a great gain to the surgeon with little mechanical skill. At first we measured the patient in the vertical position recommended by Thomas, and we invented a pedestal for the purpose of resting the foot to reduce the lordosis. This pedestal consisted of an iron plate about 1 foot square with an iron screw rod

PLATE I

RIGHT HIP-DISEASE.

Note lordosis.

*To follow page 14.*

RIGHT HIP-DISEASE.

Lordosis disappears on flexing the thigh. The angle the straight back makes with the flexed thigh is the angle of deformity; the splint is fitted to this. The deformity is gradually reduced by straightening the splint.

*To face Plate I.*

18 inches long firmly fixed in it, and of another iron plate of the same size with a screw passing through its centre, so that it could be elevated or depressed to the required height by simply rotating it like a music-stool. We used this pedestal for some time in the Children's Hospital, but afterwards discarded it, as we found we could get a better fit for the splint by taking the mould for the stem of the splint in the lateral recumbent position, so that the edges of the strip of lead are vertical. (Strips of lead easily capable of being moulded to the shape of patient's body are required for this work, sizes corresponding to the lengths of the curves traced. In taking a mould of the surface, especially in the longer curves, care is taken to maintain the lead always with its edges vertical.) For the upright stem mould, place the patient on the sound side, and flex the leg, if lordosis or flexion exists, until the back is perfectly straight and there is no flexion of the knee-joint.

2. Then press the lead strip firmly against the patient's body, with the arms by the sides, beginning at the lower angle of the scapula about $\frac{1}{4}$ of an inch below ; then press the lead over the loins external to, but within $\frac{1}{2}$ an inch of, the posterior superior spinous process of the ilium and the prominence of the buttock, then along the course of the sciatic nerve, behind the knee, down the leg, and stopping

on a level with the top of the lower third of the tibia, a little to the inner side of the centre of the leg, the correct position for a comparatively straight splint—that is, if there is little or no flexion; but if there is marked flexion you must stop higher up, or you will find that, when your splint is straight, its lower end will project too low towards the heel. With the lead now moulded to the curve of the body, then mark off on the lead by means of chalk the positions required for the thigh and leg wing, then carry the lead to the paper *with its edges vertical*, with both hands in a horizontal position, and causing no tension or longitudinal compression of the lead strips, the hands in such a position that each hand carries half the weight. If you carry the lead with its weight acting at right angles to the plane of the breadth, it will sag. A piece of lead $\frac{1}{10}$ inch thick and 2 feet long held in a horizontal position by the ends, broad surface up, will sag 2 or 3 inches in the middle in three or four seconds, which is the time usually taken to remove the lead from the patient to the paper for tracing the curves, and this is why we discarded Thomas's upright position for measuring. Having now the lead on the paper, trace out the contour close to the side of the strip that was *not* next the patient's body, for the thickness of that strip of lead makes the necessary room for the splint covering. If you trace the curve on the other side,

your pencil should be held so that the tracing is 3 millimetres (slightly over $\frac{1}{10}$ of an inch) away from the lead, and this allows room for the lining.

3. When the splint is applied to the flexed position, and the flexion subsequently reduced, the end of the splint approaches the heel, a distance of about 1 per cent. of its length for every reduction of flexion of about 15°. This would give over $\frac{1}{2}$ inch in a tall adult, and over 4 inches in reduction of extreme flexion near the right angle. In children of two years it is about $\frac{1}{4}$ inch, seven years old about $\frac{5}{16}$ inch, and twelve about $\frac{6}{16}$ inch, for every 15° of flexion reduced. This fact will warn you not to make your splint come too far down the leg in cases of extreme flexion, and so save you from the mortification of finding the splint on the heel after reduction. Again, coming to the measurement, mark off on your paper the position of the chest wing as indicated by the chalk marks; then, with your patient sitting up, or with his shoulders raised, pass your lead strip right round your patient's chest just below the lower scapular angle on a level with the point from which you started your previous mould of the stem, and be very careful to take the exact mould of the posterior half of the chest, which is the pressure area when the patient is recumbent; if the patient is small, and not too heavy, letting him lie on the lead strip in the proper position for a few

seconds supported by your hands, as this gives a more exact impression of the spinal curve. The exact mould of the anterior half is not needed, as there is no pressure on it, and the patient has to breathe; then mark off with your chalk the points on the lead where the circumference is completed in front in the mid-line. Then open up the chest curves in front, taking care not to disturb the posterior half of the chest curve, and carry your lead to the paper, and trace the curves on the paper, just as you did with the upright stem, and mark on your paper the position of the spine and the ends of the circumferential length as given by your chalk lines, deducting from the circumference of the chest the length of the chest gap, 4 inches in the adult. This gives you the length of the chest wing. About three-quarters of this chest gap will come on the bad side; then measure a distance equal to one-third the length of the chest wing from the end corresponding to the diseased side, and mark this off on your chest curve, and this gives the position of the attachment of the upright stem and chest wing. Then draw tangents to the chest curve at the spine and at the upright stem attachment, and the angle of intersection of these two tangents on the diseased side of the upright stem attachment is the angle of rotation for the upright stem. Mark this angle thus: 'Angle of rotation,' of which more anon (see Fig. 1).

This rotation of the upright stem should be produced in its own longitudinal axis from the top of the buttock curve uniformly to its superior end, so that the splint lies flat on the surface of the body in this region. The rotation is from left to right across the front of the patient when the left side is diseased

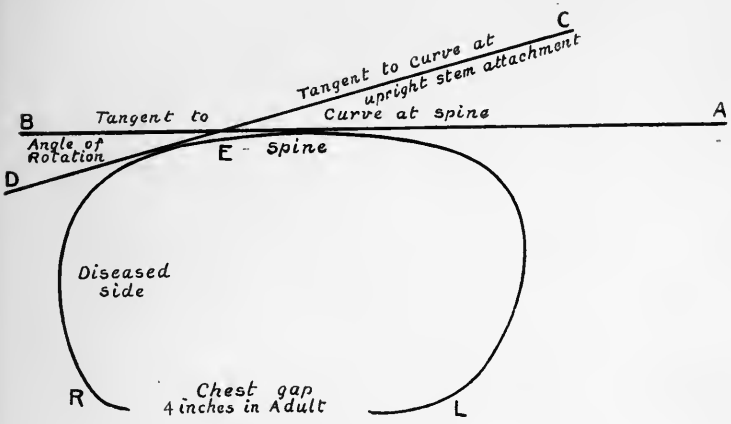



FIG. 1.—TANGENT DIAGRAM.

AB, Tangent to chest-wing curve at spine; CD, tangent to chest-wing curve at stem attachment; E, meeting of the two tangents; BED is angle of rotation towards diseased side.

—that is, negative when looked at from below—and *vice versa* for a diseased right side—that is, positive from below. The rotation is a necessity for mechanical reasons, to prevent movement, and to prevent excoriation by the edge of the splint. Instrument-makers generally leave out the rotation and pad the edges, destroying the efficiency of the splint. In a

hybrid splint in my possession there was a $\frac{1}{4}$-inch or 6-millimetre padding on the flat surface of the stem, and double that amount on the edges. Having obtained the splint with the ironwork completed, you should temporarily wrap a narrow bandage or small strips of brown paper round the iron to keep off the cold iron frame from touching the skin; then try it on the patient before sending it to the saddler's to be covered, in order to see that neither you nor the blacksmith has made any mistake. If you find a mistake in the splint, compare it with your diagram, which you should always get back from the blacksmith. It is as well to know who has been at fault. You may have to alter the splint a little with the wrenches to make it fit. This is more easily done before the covering is on.

All lateral displacement adjustments of the splints should be done before covering; for it is well to do as little adjustment as possible after covering the splint, as rotation damages the covering more than flexion.

I found in my early trials of the splint that the skin over the spine was liable to excoriation, but this trouble was easily avoided by dilating the curve about $\frac{1}{8}$ inch just over the spine, this dilatation meeting the curve of the chest mould about an inch from the spine, as shown in the figure.

So it would be advisable to make this slight altera-

tion before completing the chest-curve drawing. If the fit is accurate over the rest of the curve, this slight alteration adds greatly to the comfort of the patient, and does not interfere with the efficiency of the splint.

Next take a smaller strip of lead, and take the mould of the posterior half of the thigh, and mark with chalk the position of the upright stem a little to the inner side, where the weight of the thigh presses most; then transfer the strip to paper, and

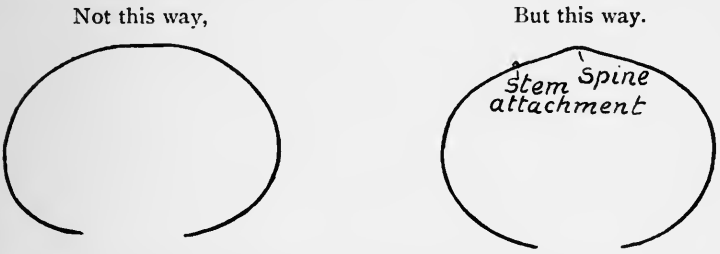



FIG. 2.—SHOWING SLIGHT DILATATION OF CHEST-WING TO PREVENT EXCORIATION.

trace out the curve, and mark the position for the stem attachment; then complete the curve, making it in length equal to two-thirds, or, better, three-quarters, of the circumference of the thigh. Take the curve for the leg wing in the same way, marking the stem attachment as before, a little to the inner side. In both these wings the curve must be drawn so that the longer arm, which should be always the inner one, comes nearly to the centre of

the anterior surface of the leg, this latter point not being important.

As a check on your work, tape measurements should be taken of the various lengths of the curves and written down on the paper. Write down also the other dimensions of the splint given in the table on p. 24. Fill in the name of the patient and the date, and mark right and left side on the wings of the splint, and the paper is now ready for the instrument-maker or working blacksmith. Fig. 3, being a copy of one of my cases, will serve as a model.

You should give directions to the workman to make the rotation of the stem uniform from the top of the buttock curve to the top of the splint. To do this properly it must be done in sections, for, say you want a rotation of 30°, it should be done in about six sections, 5° at a time. If attempted at one operation, it often produces, through heterogeneity in the tenacity of the iron, a torsion over a small area, leaving the other part of the splint with a flat surface. I have seen these localized torsions of faulty construction produce excoriations.

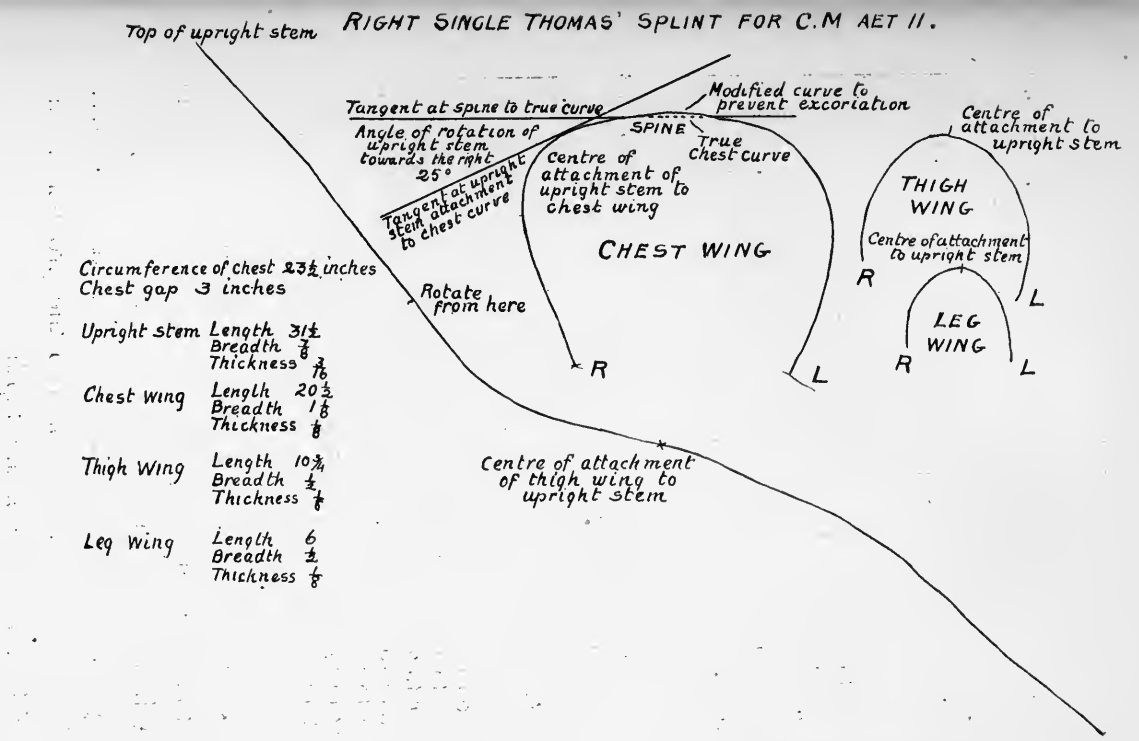



FIG. 3.—COPY OF CURVES TRACED ON PAPER, WITH LENGTH, BREADTH, THICKNESS OF SEPARATE PARTS; ALSO ANGLE OF ROTATION OF UPRIGHT STEM, AND POINTS OF ATTACHMENT OF THE WINGS TO THE STEM.

## Dimensions.

LATERAL DIMENSIONS IN INCHES OF MATERIAL AND SIZE OF CHEST GAP FOR THE DIFFERENT AGES.

| Age. | Chest Gap. | Stem. | Chest Wing. | Leg Wings. |
|---|---|---|---|---|
| 0 to 1 | $1\frac{1}{2}$ | $\frac{1}{2} \times \frac{3}{32}$ | $\frac{7}{16} \times \frac{1}{16}$ | $\frac{3}{8} \times \frac{1}{16}$ |
| 1 to 4 | 2 | $\frac{1}{2} \times \frac{1}{8}$ | $\frac{9}{16} \times \frac{3}{32}$ | $\frac{3}{8} \times \frac{3}{32}$ |
| 5 to 7 | $2\frac{1}{2}$ | $\frac{5}{8} \times \frac{1}{8}$ | $\frac{5}{8} \times \frac{3}{32}$ | $\frac{1}{2} \times \frac{3}{32}$ |
| 8 to 10 | 3 | $\frac{3}{4} \times \frac{3}{16}$ | $1 \times \frac{1}{8}$ | $\frac{1}{2} \times \frac{1}{8}$ |
| 11 to 13 | $3\frac{1}{2}$ | $\frac{7}{8} \times \frac{3}{16}$ | $1\frac{1}{8} \times \frac{1}{8}$ | $\frac{1}{2} \times \frac{1}{8}$ |
| 14 to 17 | $3\frac{3}{4}$ | $\frac{7}{8} \times \frac{1}{4}$ | $1\frac{3}{8} \times \frac{1}{8}$ | $\frac{5}{8} \times \frac{1}{8}$ |
| 18 to 21 | 4 | $1 \times \frac{1}{4}$ | $1\frac{1}{2} \times \frac{1}{8}$ | $\frac{3}{4} \times \frac{1}{8}$ |

LATERAL DIMENSIONS IN CENTIMETRES OF MATERIAL AND SIZE OF CHEST GAP FOR THE DIFFERENT AGES.

| Age. | Chest Gap. | Stem. | Chest Wing. | Leg Wings. |
|---|---|---|---|---|
| 0 to 1 | 3·75 | 1·25 × ·23 | 1·09 × ·15 | ·93 × ·15 |
| 1 to 4 | 5·00 | 1·25 × ·31 | 1·40 × ·23 | ·93 × ·23 |
| 5 to 7 | 6·25 | 1·56 × ·31 | 1·56 × ·23 | 1·25 × ·23 |
| 8 to 10 | 7·5 | 1·87 × ·46 | 2·50 × ·31 | 1·25 × ·31 |
| 11 to 13 | 8·75 | 2·18 × ·46 | 2·81 × ·31 | 1.25 × ·31 |
| 14 to 17 | 4·375 | 2·18 × ·62 | 3·43 × ·31 | 1·56 × ·31 |
| 18 to 21 | 10·00 | 2·5 × ·62 | 3·75 × ·31 | 1·87 × ·31 |

These dimensions were thus obtained :

I took the figures given by Thomas for the adult as a basis, and made use of 'Roberts's Anthropometry,' and of the fact that the resistance to cross-strain in iron is proportional to the product of the breadth and square of the depth.

From these data I calculated the figures in the table so as to ensure a minimum of weight combined with a sufficient strength and a maximum of facility for working the wrenches, and made allowance for a factor of safety and the dimensions of the iron bars in the market—*i.e.*, stock sizes.

A writer in the *Lancet* gave a similar table a short time ago, in which the figures gave much weaker splints than those made by my figures, which have proved not strong enough in some cases for the children in this part of the world. I would presume from this that the children in Australia were more developed for their age than the children for whom the *Lancet* writer just mentioned wrote, and the children from whom Roberts got his data.

As this table of mine has been in use at the Children's Hospital, Melbourne, for eighteen years, it may be relied on as completely efficient for its purpose, taking care, if a child is above the average weight, or more muscular for his age, to apply a splint made of materials suitable for an older child, and *vice versa*.

## How to Make It.

*Directions to Maker.*—Direct him to put two small rivets into each attachment of the cross pieces with the stem, and to place them obliquely, and not one large rivet, as blacksmiths are liable to do to

save themselves the extra trouble of drilling two holes. The splint with only one rivet often becomes very shaky and inefficient through lateral rotation of the wing after a little use, and defeats its object of rest to the joint. The diameter of each of the rivets when two are used should not exceed one-fifth, or be less than one-sixth of the breadth of the smaller bar riveted, or the bar will be liable to break in using a splint in the former case, and the rivets to give way in the latter.

### How to Line It.

We have now an iron frame moulded to fit the child comfortably all along its course, the upright fitting the straight back, the plane of the iron stem parallel with the plane of the surface throughout the length of the splint; also the centres of the curves of wings coinciding with the centres of the chest, thigh, and leg respectively, so that there is no undue pressure anywhere. As the stem passes over the buttock and down the back of the thigh and leg the patient can lie on it in comfort; we then cover it or line it, but do not pad it, as padding destroys its usefulness. If you pad, you may as well apply the splint under the bed, and take in mattress, palliasse, and all, for all the use it would be. Use only a single layer of flannel along the inner surface of the stem and wings, and a single layer of basil

leather sewn tightly over stem and wings with the seam outside (basil leather is a portion of the split sheepskin); at the same time we use a strap on the sound side, and buckle on the diseased side outside the chest wing to close the chest gap.

Two pieces of leather strap about as broad as the chest wing, and about 2 inches long, are sewn on to the outer side of the leather covering, or two narrower pieces of the same length on to the inner side, leaving a space of about 1 inch unstitched in the centre of each piece. One piece is fixed with its centre on the sound side, about the same distance from the position of the spine as the upright stem attachment, and the other in front in a corresponding position. These pieces of leather are divided transversely in the centre, and an eyelet-hole punched in each side through which a piece of tape can be tied when required. The object of these pieces is to fix the attachments of the three straps, which are sufficient to prevent downward displacement of the splint for patients in bed or to fix the attachment of the straps required for supporting and steadying the splint in walking on crutches. Some use iron rings on the upper surface for this purpose. These are effective if placed in the proper position, and if not large enough to cause pressure on the skin.

A leather strap or a piece of webbing is obtained with a loop at the end large enough to let the chest

wing pass through it. This strap is long enough to pass from the posterior attachment vertically over the sound shoulder to near the chest wing in front. If made of leather, the front of it has holes punched into it in order to fix on to a buckle. On to this brace, behind and about one-third the distance of the splint from the shoulder, are stitched two pieces of strong webbing—one horizontally and long enough to pass round the diseased side to near the vertical strap in front, and the other intermediate in direction set obliquely to pass over the shoulder of the diseased side to the point in front where the horizontal one terminates.

Another short strap of the same material as the vertical strap previously mentioned, about as long as half the distance of the shoulder from the splint, with a loop of the same size as the posterior one at its lower end, and a buckle at its superior end, has two other buckles sewn into it at a point about one-third of the distance of the splint from the shoulder, and so arranged as to meet the two pieces of webbing which come from behind on the diseased side (Fig. 4).

The splint must be swung on the sound side to avoid rotation displacement, and the three braces are necessary to avoid other displacements. To repeat, one over the shoulder of the sound side, another over the shoulder of the diseased side, and

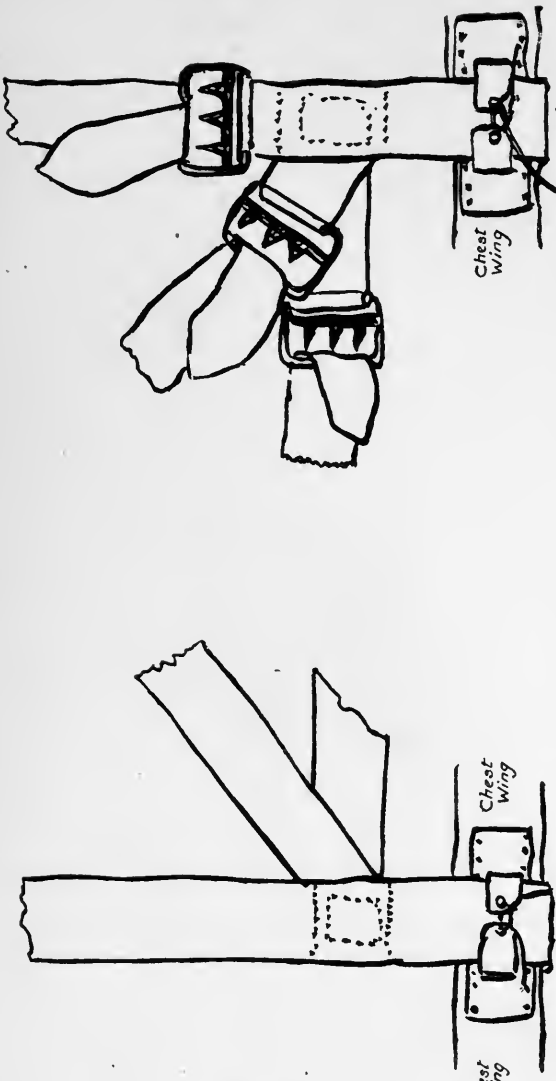



FIG. 4.—DIAGRAM OF STRAPS: BRACES FOR RIGHT SIDE HIP-DISEASE.

the third round the chest of the diseased side, uniting in front and behind.

The position of the centre of gravity of the splint being situated at about the level of the top of the buttock, an inch or so in front of the stem, and an inch or so to the inner side of the same, and near the centre of gravity of the patient's body, tends to keep the machine in equilibrium when slung in this way, and makes it well fitted for comfortable locomotion.

## The Apparatus required for Fitting the Splint and for Further Treatment.

Three pairs of iron wrenches. The ones I use have a crook at each end—one at right angles to the stem, used for flexion, and the other parallel to the stem, used for rotating the stem of the splint. The dimensions of these are: Largest size—stem cylindrical, 24 inches long, $\frac{9}{16}$ inch diameter, the crooks of which are 2 inches long, with a bite of $\frac{1}{2}$ inch across.

Middle size—18 inches long, $\frac{9}{16}$ inch diameter of stem and bite, $\frac{3}{8}$ inch across. The crooks are $1\frac{5}{8}$ inches.

Smaller size—12 inches long, $\frac{9}{16}$ inch diameter of stem, bite $\frac{1}{4}$ inch, and crook $1\frac{1}{4}$ inches long.

A goniometer. I use one of brass nickel-plated,

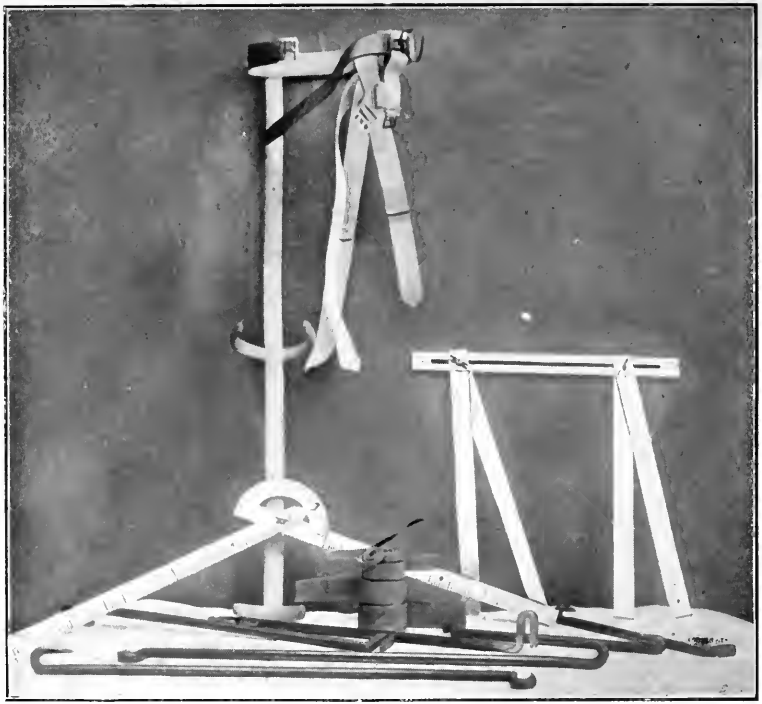


PLATE III

APPARATUS REQUIRED FOR FITTING THE SPLINT: THREE PAIRS OF IRON WRENCHES, LEAD STRIPS ROLLED UP, GONIOMETER, INSTRUMENT FOR MEASURING LATERAL AND ROTATORY DISPLACEMENT.—THOMAS'S SPLINT READY TO BE APPLIED.

*To face page* 30.

with arms 18 inches long and 1 inch broad, and a graduated semicircle of 5 inches diameter, with the zero point of the arc on the inner side of the butterfly screw, as this position is more convenient for measuring the flexion from zero.

Callipers for measurements about the diseased area.

An instrument for measuring lateral and rotatory displacement of the limb.

## Instrument for Measuring the Lateral and Rotatory Displacements.

The instrument I use consists of five pieces of brass, each 15 inches long, 1 inch broad, and about 19 to 20 gauge in thickness. The five placed one on top of the other make about $\frac{1}{4}$ inch deep. One of these pieces is slightly thicker than the others, and has a slot running down the centre $\frac{1}{4}$ inch broad to within 1 inch of each end. Each of the others has a slot about 1 inch long and $\frac{1}{4}$ inch broad, coming to within $\frac{1}{4}$ inch of one end. These four pieces are fixed in pairs to the piece with the long slot in it by means of butterfly screws passing through the slots, so that they can represent the radii of the circle with its centre at the butterfly screw, and can be clamped by means of it, and so any angle can then be read off by means of the goniometer.

Each pair of arms, with the short slot in it, is

placed on opposite sides of the piece with the long slot in it, so that it can be shut up by clamping one of the screws into the perforations of the opposite arms, something like a pocket-knife with four blades, for convenience in carrying (Fig. 5).

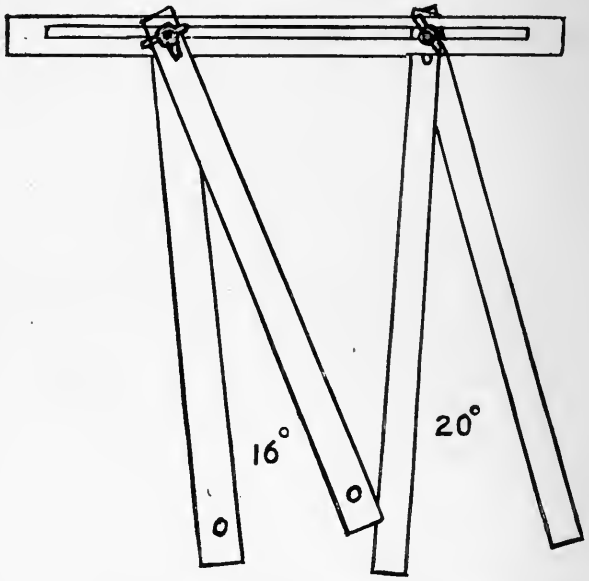



FIG. 5.—INSTRUMENT FOR MEASURING LATERAL AND ROTATORY DISPLACEMENTS.

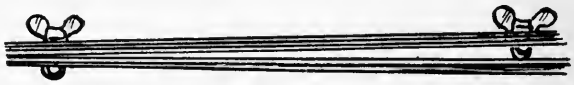


FIG. 6.—FOLDED FOR CONVENIENCE OF CARRIAGE.

To measure adduction or abduction with this instrument, the centre bar is placed parallel to the

SIDE VIEW OF SPLINT SHOWN BEFORE BANDAGING THE LEG.

Splint moulded to fit the deformity. Back straight.

*To face page* 33.

PLATE IV.

line joining the anterior superior spines of the ilium. One of the arms is placed parallel to the normal position of the axis of the thigh-bone, and the contiguous arm is placed parallel to the assumed position of the axis of the thigh-bone of the affected side. The two are then fixed with the butterfly screw, and the angle between them is read off with the goniometer. To measure the rotatory displacement, one of the arms is placed perpendicular to the patella in the normal position of the limb, and this position can be obtained from the patella of the sound side when only one hip-joint is affected; and the contiguous arm is placed parallel to the perpendicular to the patella in the inverted or everted position of the leg. The two arms are then clamped as before, and the angle read off.

With these instruments you can watch and record the progress of the deformity to complete reduction.

## How to Fit the Splint.

Having obtained the splint from the makers, you now require to fit it. Place your patient in bed on a soft mattress if acute inflammation exists, but use a hard one for reduction of deformities when the acute inflammation has subsided. If the chest wings are not wide enough apart, you may require to expand the chest wing so that the distance between the ends is slightly greater than the antero-

posterior diameter of the patient's abdomen. The expanding forces must be applied only to one end at a time, and act only on the anterior part of the chest wing, so as to preserve the curve of the posterior part of the chest. This can be done in most cases with the two hands, holding the middle of one side of the wing with one hand and pulling the end of the same side apart with the other. It is, however, much better done with the wrenches described on page 30. On no account pull the two ends of the chest wing apart with a hand on each end, for the effect of this action is to straighten out the spine curve. An expansion of 1 inch of chest gap made in this way causes the wing to come $\frac{1}{8}$ inch nearer the spine, and you will want $\frac{1}{8}$ inch more padding on the rest of the splint—not over the spine, or excoriation will result. I have several times seen sores on the spine which have been produced in this way; and in these cases, on again comparing the chest curve with the splint curve, the results showed that the sores had been produced in this manner.

The chest gap being open to the right extent, present it to the abdomen on the diseased side, with the stem of the splint on the outer side parallel to and above the leg of the diseased side. Have the patient's hip raised, encircle the abdomen with the chest wing, then rotate the splint so that the stem

PLATE V

BACK VIEW.

This splint requires a slight flexing at buttock with the wrenches, the back not being quite straight.

*To face page* 34.

is behind the bad leg, then move the splint up to its proper position, the top of it being just below the lower angle of the scapula, and the stem lying along the course of the sciatic nerve; then contract the ends of the chest wing on the sound side, so that the lateral curve fits the body, and expand the part of the chest curve on the diseased side, so that the expansion of the chest walls in front of that side is not interfered with. This is absolutely necessary, for your patient must breathe with comfort. Next contract the thigh and leg wings on the inner side, and open the outer ends of the same so as to fit the splint in its proper position, and if your measurements and curves are correct, you will find that you have little or nothing to do with the wrenches.

By contracting or expanding the ends of the three wings, and by increasing or decreasing the rotation of the stem, you can make the splint assume any desired position: contracting the inner ends of the thigh and leg wings makes the splint move towards the mid-line of the body; contracting the outer ends makes the splint move the opposite way.

Contracting the right side of the chest wing makes the splint move to the right; contracting the left side makes the splint move to the left. If we increase the rotation of the upright stem, the splint moves towards the mid-line of the body; decrease

the rotation, and it tends to pass outwards over the buttock.

Should the splint tend to move to the outer side of the limb, close the inner ends of the wings and open the outer. If the splint tends to move to the inner side, close the outer ends of the wings and open the inner. If the splint fits the chest wall well, there is no moving of the splint round; but if the stem is too much towards the mid-line, then the rotation of the stem is too great, and must be decreased. If the opposite displacement, the stem needs more twisting or rotation.

N.B.—Increased rotation of stem brings splint nearer mid-line, and *vice versa.*

If you get rotation towards the diseased side, then contract the longer wing of the upper crescent.

If the body wing is circular instead of oval, you get inversion of the limb.

If the upright stem does not pass to the inner side of the popliteal space, you get rotation inwards. If too much to the inner side, you get rotation outwards, the leg behaving like a cylinder rolling down an inclined plane; so you must have the line joining the centres of gravity of contiguous cross-sections of the leg as near as possible to the middle of the plane of the splint.

To correct inversion or eversion, alter slightly the position of the stem, so as to let the leg roll in the

PLATE VI

FRONT VIEW.

Splint applied and bandaged.

*To face page* 37.

desired direction; or apply a bandage rolled out in the reverse direction to the displacement, and fix to the wings.

Thomas says: 'The deformities of inversion and eversion usually become corrected after resolution, consequently they may be ignored during treatment.'

I cannot agree with this statement, as I have found that these deformities can always be improved or corrected in the way I have indicated.

If the mechanics of your splint is right, and if shortening from destruction of the joint is not present when you receive the case, the patient should be cured without any deformity whatever. Shortening from destruction of the joint is the only deformity that cannot be cured with this treatment.

Having now got your splint in its proper position, bandage the leg with the splint evenly from the foot to the thigh wing, leaving out the ends of the leg wings if prominent. If your patient is in bed, fasten the buckle of the chest wing straps, and pass a bandage round the chest wing in front at the position mentioned above; then pass it over the sound shoulder and round the splint on the sound side in the position previously described, then over the shoulder to the front again, and fasten it to the other end with a strong safety-pin. Next pass a bandage over the shoulder of the diseased side, and have it stitched to the right shoulder bandage in the

position before described; then pass the bandage round the chest on the diseased side to meet the end coming over the shoulder, and this end must be fixed by safety-pins or stitched to the other in the proper position. This will prevent downward displacement of the splint.

### Treatment when Fitted.

The patient, being now apparently comfortably fitted, must be visited every day for a few days, and closely watched for any undue redness of the skin under the splint, the harbinger of excoriation, and if redness be found the wrenches must be judiciously used to remove the pressure.

When properly fitted, the patient can wear these splints for years without any damage to the skin, and even with comfort.

Rapidly-growing children may require occasional refitting.

On several occasions I have been told by fond parents who said it was cruel to keep their children in irons, and have been foolish enough to take the splint off, that the little ones have cried till they got their 'irons' on again.

Great gentleness is required in handling or examining a diseased hip-joint. Rough manipulations or many examinations may add months to the treatment by breaking down Nature's fortifications within the joint.

Sometimes during the interval which elapses between taking the measurements and fitting the splint flexion increases, and is often aggravated by the irritation to the joint caused by examination, especially in hospitals with many students about, so you must see that the back is resting firmly on the splint. Test the splint pressure on the back with your fingers, and if not satisfied that the back is resting firmly on the splint, give the splint more flexion by bending the stem at the point opposite the hip-joint (see Plate V.).

You will find on attending the case, if you pass your fingers between the back and the splint in the lumbar region, that from visit to visit you have more and more difficulty in doing so, for the pressure on your fingers is increased. This is the test of the satisfactory progress of the case, and indicates that you may gradually reduce the flexion angle up to 5° or more at a time till the flexion disappears—that is, becomes zero. (I may state here once for all that I calculate all the deformity angles from zero as normal, though in the books you find the flexion calculated from 180° as normal. Why 180° should be taken as the normal flexion angle I cannot understand, for taking it from zero facilitates comparison in the treatment of the case.)

The flexion generally disappears in a few days if the case has been of only a few weeks' duration, and

it disappears in a few weeks if the case has been of a few months' duration. Cases of a year or more may take three months or more to reduce the flexion.

No definite rule can, however, be made on this subject. In some cases marked flexion will disappear in a surprisingly short period, while in others a slight flexion will take a long time to reduce.

In early cases the pain often disappears immediately after the patient is comfortably fitted with the splint. Should the pain, however, continue, it is an indication either of a badly-fitting splint or of abscess in the process of formation. *In most cases the time of application of the splint marks the crisis of the disease.*

There is thereafter usually a gradual improvement to soundness in the limb, and invariably no increase of deformity.

Unfortunately, it is impossible to state definitely in any particular case how long the patient will be kept in bed or how long the treatment will last; its average duration is between two and three years. To ascertain these points each case must be a special study. It may, however, be said that *festina lente* is the golden rule for hip-splint treatment.

Too much attempted at one time prolongs the duration of treatment. You must continuously and gradually reduce the flexion. When all signs of acute inflammation in the joint have disappeared, the

joint being cold and painless, and the limb straight, you may allow the patient out of bed on crutches, with a bandage round the waist to steady the splint, and a patten 4 inches long on the boot of the sound side. He may take a step or two on crutches the first day, three or four the second, and so on, provided there is no sign of fatigue, *but on no account must he allow the bad foot to touch the ground*, the case meanwhile being carefully watched for any sign of relapse. If there is the slightest sign of irritation in the joint, the patient must go back to bed again. If the patient is permitted to get straight out of bed and walk about without the splint, he almost invariably has a return of the disease. This has happened with many of our cases at the Children's Hospital, when foolish parents, neglecting our instructions, fondly imagining that their children were quite well again, being free from pain and deformity, have rashly removed the splints and allowed their children to run about, with the result that they have been compelled to bring back their children—in a few days in some cases, and weeks in others—in a much worse condition than when first treated, with the usual apologies for their mischievous interference.

After the patient has been walking about on the splint for weeks or months, as the case may be, an attempt may be made to remove the splint. When the splint is off, the practice of massage of the locomotive

muscles of both legs greatly assists their development, but no massage over the affected joint can be permitted, or you may get a relapse. The removal of the splint is not done suddenly. The splint is taken off for one hour for the first night, two hours the next, and so on till it is left off all night, and all the time careful watch for any relapse of symptoms must be kept. Then the splint is left off for one hour the first day, the patient going about on crutches, and in the splint altogether the rest of the day. When we have found that the patient can do without the splint day and night, he is allowed to go about for a time with crutches and patten on the sound foot. Then comes a most anxious time for the surgeon—the time of training the patient to bear the pressure on the joint in ordinary locomotion.

Again I repeat, *festina lente.*

You begin by letting the patient stand on the foot of the sound side with the leg straight, and with a patten or cork sole on the foot of the bad side, of such a size as to make the distance of the pelvic spines to the ground equal on both sides, and then slowly and gradually transfer some of the weight of his body for a few seconds only on to the diseased side.

A young patient will require an attendant to keep him upright and help him to do this, and an older one may require some crutch assistance in keeping

his balance. The next day he may bear more of the weight of his body on the bad side, and in a few days more he may bear all the weight of his body on the bad leg *for a few seconds only*. When he has reached this stage he is now able to take his first step with the leg of the bad side. The next day he can take two steps, and the next three steps, and aftewards he may rapidly increase the number of steps taken at a time; but all the time you must watch carefully for any signs of fatigue or return of symptoms, and if you get any you must immediately put your patient back. During this stage, when not actually engaged in the training for walking, the patient goes about during the rest of the day with crutches, and patten on the sound leg.

The reason for all this graduated exercise is that from long disuse there is atrophy of the locomotive apparatus with abeyance of function, and development takes time, and takes place gradually; so we train the limbs gradually to resume their duty, structure growing to adapt itself to the mode of exercise.

I divide the mechanical treatment into six periods:

1. Splint on in bed.

2. Splint on day and night, patient going about on crutches during the day with a patten on foot of sound side.

3. Splint on during the day only; crutches, and patten on sound side.

4. Splint off day and night, patient going about on crutches during the day, with patten on sound side.

5. Splint off day and night; patten on foot of bad side if leg is short. Locomotion assisted with crutches.

6. Crutches discarded, patten or cork sole on bad leg if short; ordinary locomotion.

There must be no sudden transition from one stage to the other, but a gradual development of the cure.

By using this method several cases of undoubted hip-disease, which I was fortunate enough to get before any joint destruction occurred, have recovered completely without leaving any perceptible evidence of the disease behind, and though many years have elapsed since treatment, there has been no return of the disease, and they can now walk and run as well as if they had never had hip-disease (*vide* case F. C.).

### The Patten.

The patten is simply an oval ring of iron—for children the iron is $\frac{1}{4}$ inch by $\frac{3}{8}$ inch—and there are two iron rods, at least 4 inches long and $\frac{3}{8}$ inches in diameter, welded on to the narrow extremities of the oval. The rods are flattened at the top end, and bent at right angles with three or four screw-holes countersunk on the inferior aspect, so that the patten can be easily put on or removed from the

strong leather sole of the boot. The patten must be so placed that the rods of support are immediately under the centres of the anterior and posterior pillars of the arch of the foot, and accordingly the length of the oval can be taken from the patient's foot. The breadth must be near that of the patient's boot.

The height of the patten must be at least 4 inches.

## RESULTS OF THE USE OF THE SPLINT

### Treatment of Some Complications and Sequelæ.

So far we have been speaking of ordinary and recent cases with flexion and little or no lateral or rotatory displacement.

As the limb is not immovably fixed in its abnormal position in these cases, such displacements are easily corrected by the ordinary use of the splint; for they are generally due to muscular spasm, which quickly disappears with the rest obtained.

But we now come on to speak of cases of old-standing disease with great deformity.

When I first read Thomas's book I was rather sceptical about the statement that he could reduce a right angle flexion deformity of the hip of twenty years' standing. I have since learned by experience, and now believe, that there is no deformity except shortening from destruction of the joint left by hip-disease which cannot be corrected by perseverence in a proper use of his methods, extended, if necessary, to suit the case.

Old cases with the limb fixed in extreme flexion

can be reduced by treating them with a double Thomas's splint, which is made in the same way as a single one with two upright stems, and, as Thomas directs, set parallel and at a distance of 1 inch more than the distance between the tip of the right and the left posterior superior spinous processes. If the stems are closer together than this, you would get excoriation. The double Thomas's splint does not require such accurate fitting for comfort as the single, and is very easily put on, and so may be used in all cases where the single one is used, and when expense is no consideration ; for a new single splint will be required when the patient walks about, unless you have the stem on the bad side accurately fitted to the patient, as in a single one for that side.

The double Thomas is joined at the bottom by a cross-piece when there is no deformity. This steadies the splint, and is handy for moving the patient. The crosspiece cannot be used in cases of deformity.

Old-standing flexion we reduce with a double Thomas accurately fitted with the back straight and no flexion at the knee, the bad thigh flexed to the deformity angle, and we have found it add to the comfort of the patient to have the sound leg flexed a little in beginning the reduction. After a few days you can straighten the sound leg and gradually reduce the deformity of flexion till you come to zero.

This will take, it may be, three months or more, and is done in the manner described above.

Rotation inwards or outwards of the limb can be corrected by bandaging the limb in the reverse direction and fixing the end of the bandage on to the thigh wing, and seeing every day that there is slight tension on this part of the bandage, and also by shifting the position of the stem outwards or inwards accordingly.

Thomas reduced a case which had been treated by other methods for four years, and which had 90° flexion, in seven weeks, visiting the case once a week, using the wrenches six times in seven weeks. He must therefore have reduced the flexion 15°, on an average, at each visit. I have found it better to make smaller reductions at shorter intervals, some cases requiring longer intervals than others.

Thomas says nothing about the reduction of adduction and abduction; perhaps he meant lateral and not rotatory displacement when he made the statement previously mentioned regarding inversion and eversion.

The following case which I treated I quote to show what may be accomplished by one who was at that time just learning Thomas's methods. The information is obtained from the Children's Hospital Register, Melbourne.

Sixteen years ago a boy aged seven years was admitted into the Children's Hospital suffering from

double hip-disease. He had been treated for two years by other methods. On admission he was unable to lie down in bed, but slept in a sitting posture with his head bent over his chest and knees, which were acutely flexed. Both legs were flexed over the abdomen more than a right angle from normal. The angle of flexion of the left leg was 110° from normal, and that of the right leg was 115°. In three weeks the flexion was reduced by the method here indicated in both legs down to 70° from normal.

In four weeks flexion was: right, 50°; left, 55°
In five ,, ,, ,, 40°; ,, 45°
In twelve ,, ,, ,, 15°; ,, 25°

At this stage an abscess formation over the left hip-joint interfered with the reduction.

In nineteen weeks flexion was: right, 15°; left, 10°
In twenty-one ,, ,, ,, 0°; ,, 10°
In twenty-seven ,, ,, ,, 0°; ,, 0°

That is to say, both legs and back were quite straight.

In eighteen months this boy was walking in the wards, but with a shuffling gait caused by fibrous adhesions in the right hip-joint; the left, which was apparently attacked later than the right, had good movement, probably due to having been treated during a part of the acute stage with the splint.

This upholds what Thomas states—that the earlier the splint is applied, the greater the probability of obtaining movement in the joint.

## TREATMENT OF OLD-STANDING CASES WITH MARKED DEFORMITY

And now we come to the most difficult part of the splint treatment, the reduction of old-standing extreme deformity of marked adduction or abduction with flexion.

Thomas gives no direction as to the treatment of these cases, and I have heard several surgeons say that it is impossible to treat them with Thomas's splint. One surgeon said that he had had splints made for him by an expert who worked with Thomas, and the expert could not do it.

I have even seen attempts made to fit the splint by getting a blacksmith to bend the stem in its own plane in the direction of its breadth, and to flex the stem at right angles to its own plane in the direction of its thickness. This is all very well for the first fitting, but you need to take the coverings off the splint and to get the blacksmith to make the slight reductions necessary in the deformity from time to

time. This would be very tedious, very troublesome, and would delay recovery from the absence of the splint while the alterations were being made. If it is not done, the splint becomes simply a machine for maintaining the deformity.

For many years I had considerable difficulty in fitting these cases. By guess-work I rotated the stem on its own axis a little above the joint, combined this rotation with a subsequent flexion over the joint, and then gave the stem a reverse rotation to counteract the necessarily assumed oblique position of the plane of the stem. I succeeded fairly well with practice in getting the splint to fit the deformity.

But when I reflected on the cause of the assumption of any position of the limb by muscular forces compounded of flexion, abduction or adduction, and rotation, I recognised that the problem could be treated mathematically, and I worked out two formulæ for the relation between the angles concerned.

The one I give first is practically applicable to all positions of deformity met with, and was found after the discovery of the second, which, though much simpler, was found to be practically impossible in most cases, and very difficult to work with if the iron was thick or tough. It is mathematically possible by either formulæ to get any position

required. By using the formula now given it is practically possible to put the splint in any position that may be required in treating hip-disease by the requisite manipulation which is acquired by a little practice with the wrenches.

# MATHEMATICAL FORMULÆ FOR ACCURATE FITTING OF SPLINT AND CORRECTION OF DEFORMITIES

FORMULA.

$$\text{Sin } \theta = \frac{\cos\alpha.\sin\beta}{\sqrt{(1-\cos^2\alpha.\cos^2\beta)}}.$$

WHERE $\theta$ = angle through which the plane of the splint is rotated in the direction of the lateral displacement, $\alpha$ is the angle of flexion required calculated from 0° as normal, and $\beta$ the angle of adduction or abduction, the rotation being made just above the joint and the flexion opposite the joint.

By the use of this formula, which is applicable to all positions of the limb, the rough approximation to the required position obtained by tedious experiment was replaced by an easily attained greater accuracy. Scientific perfection in these matters, like moral perfection in ethics, is practically unattainable, but without an ideal we flounder hopelessly. The formula gives us the ideal perfection, and by means of it we come nearer to the real.

Now take a few examples in elucidation of the formula.

If there is no adduction or abduction—that is, where $\beta$ equals 0°—then sin $\beta$ equals 0°; therefore sin $\theta$ equals 0° and $\theta$ equals 0°; therefore no rotation of the stem is necessary.

It follows that, if there is no adduction or abduction, but 45° of flexion, you simply flex the splint to that angle, as in an ordinary case.

If there is no flexion and no adduction or abduction, then $\theta$ equals nothing, so that the leg is in the normal position: no alteration of the axis of the stem is required.

The formula also shows that if there is no flexion $\theta$ must be a right angle if there is any adduction or abduction.

Suppose there is 60° flexion and 20° adduction. By the formula $\theta$ equals 11° approximately. This value of $\theta$ is obtained by substituting in the formula the value of the trigonometrical ratio of 60° and 20° found in the trigonometrical tables. The rest is simple arithmetic.

To adapt the splint to a case of these amounts of flexion and adduction you simply rotate the plane of the splint, a little above the joint, in the direction of the lateral displacement—that is, towards the sound leg through an angle of 11° measured by means of the goniometer. This is best done by

first measuring the angle between the wrenches when placed in the position ready for twisting and pulled apart as far as possible without any twisting; then rotate with the wrenches until the angle between them is the sum of the angle just measured and the angle of 11°. Say the angle just measured is 25°, you must rotate till the angle between the wrenches is 25 plus 11, or 36°.

Or you may get a rough approximation by using the goniometer set at the angle of 11°, with the edge of one of its arms in the plane of the stem and lying transversely across it, then rotating until the edge of the other arm of the goniometer is in the plane of the rotated part.

You now flex to the required angle of 60°, and when this angle is reached you have attained the adduction of 20°.

Next take a case with 40° flexion and 30° abduction. Here by the formula you get $\theta$ equals approximately 30°. You have, therefore, to rotate the stem at a point a little above the joint in a direction away from the sound limb through an angle of 30°, and then flex the stem immediately at the joint to 40°. When this amount of flexion is reached you must necessarily have 30° of abduction.

The inclination of the stem to the vertical brought about by this manipulation is easily corrected by rotating the stem round its own plane in the reverse

direction at a point just below the flexure, so that a reverse rotation is sometimes necessary below the joint to counteract a too oblique position of the plane of the leg part of the splint, and sometimes you require to place for comfort a small piece of lint or a little cotton-wool fixed by a narrow bandage on the splint at the point of rotation.

You can proceed in this way to adapt a splint to any deformity met with.

To correct the deformity in the subsequent treatment of the case it is only necessary to reduce the flexion 4° or 5° every few days, and a corresponding, though not necessarily equal, reduction is made in the adduction or abduction, as the case may be.

Then, as regards the other formula to which I have referred, I have found that if the splint, instead of being rotated round an axis transverse to the stem, as in ordinary flexion, were rotated round an oblique axis, then you could fix the splint in any desired position of flexion, adduction or abduction. Any position of the splint as attained by this manipulation is given by the formula.

FORMULA.

$$\tan \phi = \frac{1 - \cos\alpha.\cos\beta}{\cos\alpha.\sin\beta} = \frac{1}{\cos\alpha.\sin\beta} - \cot \beta.$$

The second expression is more convenient for calculation. Where $\phi$ is the angle which the edge of

the splint on the opposite side of the displacement makes with the axis of rotation of the lower part of the splint

$\alpha$ is the angle of flexion required measured from zero as normal, and

$\beta$ is the angle of the lateral displacement.

This formula, like the other, is mathematically applicable to all positions of the splint as regards flexion and lateral displacement.

Now take an instance or two to show how it applies.

1. Say there is flexion 30° from normal, and no adduction or abduction. By the formula, $\tan \phi = \infty$; hence $\phi$ is a right angle; the stem must therefore be flexed in the usual way—that is, at right angles to its edge.

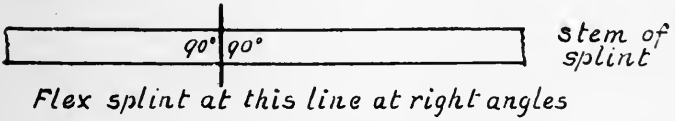



FIG. 7.—SHOWING ANGLE AT WHICH SPLINT MUST BE FLEXED TO FIT CASE 1.

2. Take the case of 60° flexion and 20° abduction. By substituting the values obtained in a similar way to that adopted for the other formula you get $\phi = 72°$. To adapt the splint to a case with this amount of flexion and adduction, you rotate the stem opposite the hip-joint round an axis inclined at an angle

of 72° to the outer edge of the stem, then flex to 60°, and the adduction is then 20°.

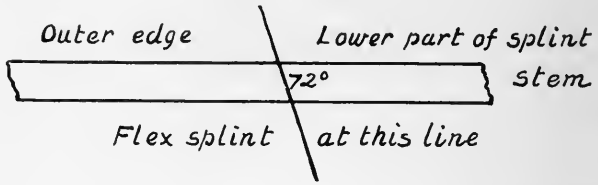



FIG. 8.—SHOWING ANGLE AT WHICH SPLINT MUST BE FLEXED TO FIT CASE 2.

Take the case of 40° flexion and 30° abduction. Here you get $\phi = 41°$, so you have to rotate the stem round an axis inclined to the inner edge of the stem at an angle of 41°, and when the flexion is 40° the abduction is 30°.

To correct the deformity you have only to reduce the flexion as before, when the adduction or abduction is correspondingly reduced.

This method, however, has a great practical difficulty, so that I would not advise its adoption; for when the angle $\phi$ is small, you can with the wrenches neither apply the force in the necessary direction, owing to the tendency of the jaws of the wrenches to slip, nor get sufficient force, owing to the toughness of the iron.

By proceeding in the manner here indicated I believe almost all the deformities of flexion, abduction, adduction, inversion, and eversion can be

reduced. Of course, we can do very little for shortening which has occurred from destruction of joint, though this deformity may be improved from the action of the weight of the leg while the patient is walking about in the crutch and patten stage.

Splint treatment is powerless to reduce deformity if bony ankylosis is present, about the existence of which, however, in childhood, due to tubercular disease of the hip, I am very sceptical, for I have never seen one case. In all the numerous cases I have treated, and in the stereoscopic skiagrams I have seen, the union has been invariably fibrous (see skiagram of fibrous union Plate IX.).

In old-standing cases after the reduction of a deformity, and in some cases even before this, a patient is allowed to go about on crutches for some time till the leg gets used to its new position. If this is not done, relapses are likely to occur by a sudden burden being imposed on the muscles wasted and awkward from disuse. The method of training a patient to the new exercise is carried out in the way which has been previously fully explained in the treatment of ordinary cases.

When both hip-joints are diseased a double splint must be used, and the patient must be confined to bed for a much longer time than when only one is affected, and extreme care must be taken in train-

ing his muscles for locomotion when the crutch stage is reached.

Sometimes you meet with cases with sinuses or extensive sores over the buttock or just on the place where the splint should lie.

What are you to do?

Thomas gets over the difficulty by advising the application of the splint to the sound leg with a pad between the legs, and bandaging the bad one firmly to the other. He does not say what he would do if both hips were so affected. I have found that the difficulty may be easily overcome by making a curve on the splint with the wrenches, the concavity of the curve being towards the sore. This interferes very little with the efficiency of the splint, and is not uncomfortable to the patient if care is taken not to make sharp re-entering angles at the extremities of the curves.

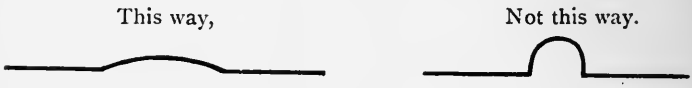



FIG. 9.—SHOWS NATURE OF CURVE ON SPLINT WHEN LARG SORES ARE ON THE SPLINT LINE.

# TREATMENT

## Prophylactic Treatment.

Before discussing the treatment of the actual disease, let us inquire if we can do anything in the way of prevention.

To answer this question we must consider what are the predisposing and exciting causes of the disease. The main predisposing causes are the presence in the patient's body of tubercle bacilli, and some lesion—it may be a very slight one—in the structures entering into the composition of the joint, and the only exciting cause, is the lodgment and development of the bacilli in these structures, which, owing to their peculiar nutritional characteristics, become a point of least resistance to the ravages of the microbes.

To prevent the disease, then, the child must have plenty of pure air, sunlight, good food, proper clothing, healthy surroundings, so that his opsonic index may be kept up. He should be protected from the sputa and infected secretions of consump-

tive patients, and should not sleep in the same room as consumptives. He should not be allowed to hug or kiss invalids or domestic animals, for tuberculosis is stated to be the most common cause of the death of the domestic animals.

Children who are known to have tubercle in the glands or elsewhere, or children who are born of parents with a tubercular or syphilitic history, and accordingly may be suspected of breeding the bacilli in their bodies, should have their hip-joints guarded as much as possible against injury; high jumping from tables, chairs, and fences, etc., should be prohibited.

Some of these cases where the disease begins in the epiphyseal plane are probably thus caused.

The point of intersection of the line of transmission of the weight of the body and this plane is, in my opinion, the part most frequently primarily attacked.

Such children should not be punished on the buttocks. Consumptive parents, who are generally of an irritable temperament, are much given to punish their children, and frequently beat them posteriorily over the hip-joint.

(In the out-patient room at the Children's Hospital I once saw a woman beat her child on the one hip while the child was wearing a Thomas's splint for the other, which was diseased.)

A blow on the outer side of the joint while the thigh is partly flexed subjects the ligamentum teres to a considerable strain. Some of those cases where the disease begins at the point of attachment of this ligament probably owe their origin to such blows.

To prevent the disease, then, we must keep the non-tubercular child from becoming tubercular, and protect the hip-joints of those possessing a *damnosa hereditas* from even slight injuries.

## Local Treatment.

All irritation, counter-irritation, pressure, and counter-pressure in connexion with the structures of the joint should be avoided as much as possible, and also tension, extension, and counter-extension, as I have said before.

Any irritation, whether intra-articular—as by movement—or extra-articular—as by liniments, poultices, leeches, blistering, or massage about the joint—only tends to aggravate the disease.

Blistering causes increased blood-supply, increased inflammation, and danger of infection.

Rubbing liniments, and massage cause increased movement.

Poultices cause increased temperature and blood-supply, and favour incubation and development of bacilli.

As so much is now known of wound infection and microbic invasion it is surprising that leeches are still used, for leeches increase the chance of infection by means of their bites. Their mouths are not aseptic, and there is no known method of obtaining hirudinal oral asepsis, nor can we boil them.

The patients do not stand the loss of blood.

Erysipelas after leech-bites is common.

All pressure of any kind about the joint, as by the splint or padding, must be carefully avoided. Patients should not sleep inclined on the diseased side. Splint pressure over the joint is easily rectified by the wrenches.

### General Treatment.

You should examine all your cases carefully for evidence of any pathological basis or constitutional taint, such as syphilis, rheumatism, anæmia, etc.

If you examine your hip cases carefully for signs of congenital syphilis, you will be astonished to find how frequently you will meet with the disease (a large number of my cases showed strong evidence of it)—most marked in abscess cases—and you will be surprised to find how often you will require to put your patients on antisyphilitic drugs to get the best results from your treatment.

If there is much hyperplasia in the bone, even without any other signs of syphilis, there is probably

a microbic association of the bacillus and the spirochæta—so-called tuberculo-syphilis—and you will do well to treat the case for syphilis as well.

Another microbic association commonly met with in children is the streptococcus and the spirochæta. It has long been recognized how prone the heredo-syphilitics are to be attacked with the streptococcus, so in your hip cases with acute abscess look out for syphilis, and treat it also.

## Drugs.

As for drug treatment, great benefit has been obtained by the use of syrup. ferri iodidi and quinine and cod-liver oil, which was the routine treatment thirty years ago. The syphilitic factor probably accounted for its success.

Any of the tonics of the metals iron, arsenic, and mercury are good, but the best of the three is mercury given in the form of a syrup of the red iodide in small doses well diluted after meals, and taken for a long time, as it meets the specific factor, and as its germicidal power is so much greater than quinine.

You may, however, require salicylates to treat the rheumatic factor, which is often uncovered and rendered evident by the exhibition of drugs of the metallic series.

If anæmia is marked, give red iodide of mercury in small doses, and ferri et ammon. cit.

I need not remind you that the primæ viæ may require attention, as in all other morbid states.

*Koch's Tuberculin.*—I have seen it tried in tuberculous joints, with the result of aggravating the symptoms, and in one case death from tubercular meningitis. It may be used in small doses as a diagnostic test; its dangers, however, are so great that I have never used it, having been able to make a satisfactory diagnosis in every case without it.

### Hygienic Treatment.

Open-air treatment is a necessity, for the disease is not local only, but constitutional.

During the time splint treatment is being carried on the patient should be as much as possible in the open air.

The diseased area should be exposed as much as possible to direct or diffused sunlight, with as little covering over the joint as possible, regulated according to the weather, for by doing this there is a systemic and local raising of the opsonic index.

I have found direct sunlight of great value in the treatment of tuberculosis of smaller joints, some of which have completely recovered by this treatment, combined with rest, even after surgeons have advised excision.

## Diet.

The patient should have a liberal diet of nitrogenous food, for, being a tuberculous subject, we must make him more carnivorous than herbivorous.

I have not much faith in forced feeding and the exhibition of urea, though I have found benefit from gentle exercise with the arms and the sound leg when there is no pyrexia or pain. The urea that results from exercise does more good than that taken by the mouth.

Again, we must be very careful not to overdo the animal food diet, especially if there is a family history of rheumatism, for with this history, combined with over-nitrogenous feeding and little exercise, we are very apt to produce what Thomas says is popularly termed rheumatic pain. He puts this down to altered atmospheric pressure. I consider it is due to increased arterial tension from excess of uric acid in the blood.

Hip tuberculosis and rheumatism may now and then occur in the same subject with a long interval between, but very rarely occur in the same subject at the same time.

## Massage.

When the acute symptoms are over, massage of the sound leg and arms is beneficial. The body

should be sponged over every day with a weak antiseptic. The splint will not interfere with this.

When the leg bandage is being renewed, great care is needed not to let the patient's leg get out of the splint, otherwise an aggravation of symptoms from the interruption of rest follows with certainty.

## OTHER SPLINTS AND APPLIANCES

### Hip Appliances.

1. Thomas's hip splint.
2. Bonnet's *grand appareil* } Posterior
3. Charrière's improved Bonnet } fixation.
4. H. P. Davis's, of New York, appliance.
5. Louis Sayre's splint.
6. C. F. Taylor's splint.
7. Washburn's hip splint.
8. J. C. Hutchinson's splint.
9. Dr. Andrews' ischiatic crutch.
10. Dr. Bauer's hip appliance.
11. Verral Institution treatment: anterior reclination on double inclined plane.
12. Barwell's hip appliance—does not allow painless nursing.
13. Bryant's hip splint.
14. Weight and pulley.
15. Long splint and permanent board.
16. Hamilton's splint.
17. Hilton's appliance.

18. Shellac bandage.
19. Starch bandage.
20. Pasteboard mould.
21. Silicate of potash bandage.
22. Gillingham's splint.
23. Campbell de Morgan's splint.
24. Cripps's splint.
25. Lannelongue's corset.
26. McFlaments' modification of Lannelongue's.
27. Leather mould.
28. Plaster of Paris bandage.
29. Poroplastic splint.
30. Wire breeches.
31. Professor J. S. Wight's inclined plane and extension.
32. Howard Marsh's extension on inclined plane.
33. Von Volkman's weights on both legs.
34. A. H. Tubby's inclined plane and weights on both legs.
35. V. P. Gibney's splint.
36. Dr. A. B. Judson's modification of Taylor's.
37. Dr. Lovett's Thomas's with extension.

### Other Appliances.

We come now to consider the value of other appliances for giving rest to the joint. We have not space to enter into the details of each of these. I have considered the mechanics of all I could find

in many treatises. They all fail in the purpose for which they were intended except Bonnet's, which is only applicable to a patient in bed, and is very expensive, and cannot be worn by a patient getting about, hence discarded.

All the other appliances — Sayre's, Chance's, Davis's, Taylor's, Hamilton's, and a host of others —fail more or less in controlling the muscles acting on the joint. Many of these appliances, as Chance's, are fixed only to the thigh, and the knee-joint has free movement, and so the muscles attached to the pelvis and to the leg below the knee have free play, and their action keeps the joint irritated.

Thomas recognized this fact, and those following his method apply the splint with the knee always straight.

*Plaster of Paris Splint over the Hip and down to the Ankle.*—This effectively fixes the joint, but it also effectively keeps out the sunlight, and has the drawback of frequent changes being necessary in the reduction of the deformity. If not frequently changed, the treatment would maintain the deformity instead of curing it, if on the contrary the plaster is frequently changed, movements which retard recovery are produced in the joint during each reapplication. These repeated movements and the prevention of access to the joint of the different rays in the sunlight, which are beneficial to recovery, are sufficient to condemn the plaster splint.

I may add that for many years I have totally discarded the application of plaster of Paris to tuberculous joints, as I found that they did not do so well when shut up in the dark, the reason apparently being due to the fact that darkness favours the development of tubercle bacilli.

### Bryant's Splint.

The double Bryant's splint, which is so universally used, fixes the joint laterally, but gives no posterior fixation, so that when the leg is straight the back arches, and every movement of the patient in the necessities of daily life interferes with this arching of the back, and so keeps up a constant irritation of the joint, prolonging the case, and if the case does recover, which is exceptional, the deformity is not cured, and the patient is often twisted like the letter S, as one of my confrères so aptly expresses the result. The double Bryant extension, with weight and pulley, is usually employed. As for extension in hip-disease, I am of the opinion that it should never be used. The mechanics of this treatment with extension is absolutely wrong.

Some say the object of extension is to reduce the interarticular pressure of the head of the bone on the acetabulum. If the point of application is below the knee, what is the action of the force? It tends to drag the leg down, stretches the ligaments of the

knee, and is then resolved into forces acting on the fascia lata, the muscles of the thigh, and the femur, so very little of it reaches the hip-joint. Some surgeons, recognizing the force of this argument, say they always apply it above the knee on the skin of the lower third of the thigh.

Well, what happens then?

The skin is attached to the fascia lata beneath, and both are attached to the pelvis, so this mode of applying extension does as much good as if the extension were applied to the trousers of the patient.

Again, when the leg is kept straight and the back arched, a pull on the leg causes increased tension of the psoas and iliacus muscles, which cause flexion; a powerful lever is put in action, and the head of the bone is jambed more forcibly against the acetabulum, rotation and translation of the head of the bone increasing the pressure between the head of the bone and some part of the cotyloid cavity.

Draw a diagram with the forces acting, and you see that this is so.

When there is increased tension in the joint from effusion, extension, if its effects reach the joint, would stretch the capsular ligament still further, and so tend to decrease the volume of the interarticular cavity, and in this way still further increase the interarticular tension, soon making the case ready for excision.

Counter-extension, as by a perineal band, would still further increase the mischief.

Extension, then, with weight and pulley is, in my opinion, a capital device for bringing on rapid destruction of the joint and early necessity for an excision. One surgeon, who reports 100 cases of excision, treated the majority of them with extension before the operation, and after it with Thomas's splint. If he had used Thomas's splint, properly applied, first, the probability is he would have had very few or no excisions.

The fact of his having so many excisions is quite enough to condemn his previous treatment.

At a very early time I was accustomed to excise in every case where there was any marked destruction in the joint; but, having learned Thomas's method, my excisions became fewer and fewer, and I have not excised a tuberculous hip for many years.

There are others, again, who say the correct method of applying extension in hip-disease is with the back straight and the leg flexed, and with the force in the direction of the limb.

Draw another diagram of the forces acting, and you will see that the pressure of the head of the bone against the acetabulum is increased by the lever action, the pressure being in this instance the same as before, when the back was arched and the leg straight.

## COMPLICATIONS

### Pain.

The characteristic pain in hip-disease usually subsides rapidly after the patient is comfortably fitted with the splint. Should it continue thereafter, it is generally an indication of a badly fitting splint in early cases, or acute abscess formation in later cases. During the fitting, however, which may occupy several days, it may be very acute, and may require an opiate or other sedative.

The less nerve poisons are used in this disease the better, for chemical restraint of the nerve cells retards recovery by interfering with the processes incidental to repair of tissues.

The night startings, which are so common a feature of untreated cases, are practically absent after rest has been secured for the joint. I have very seldom met with them in cases on the splint, and when I have, they have quickly disappeared on correcting some mistake in the fitting (*vide* case E. S., p. 91).

## Abscess.

There are two main types of abscess in hip-disease :

The chronic cold or tubercular abscess, due to the *Bacillus tuberculosis*, in which there is no true pus.

The acute abscess, which arises from the invasion of the seat of the disease by pus-producing organisms. There is no marked line of demarcation between these, the one frequently passing into the other, especially after incision.

*The cold or tubercular abscess* requires little treatment. The so-called pyogenic membrane lining these abscesses has been found to be swarming with tubercle bacilli. There is therefore a danger, in incising them (*vide* case), of the bacilli being taken up by the small veins and entering the general circulation, with disastrous results, as pointed out by Flüggé, ' Tuberculous Infection by Wound.'

Long ago I treated them by first aspirating them and then injecting them with a solution of iodoform 5 per cent. in ether with satisfactory results, but soon rejected this treatment on account of the severe pains it sometimes caused. Afterwards I had recourse to iodoform emulsion, which caused less pain, but now I generally leave them alone, when they usually become absorbed. Should they point

and be near to bursting through the skin, I apply antiseptic dressing, so that when they burst through the skin there is less danger of their becoming infected with pus organisms.

Should you decide to incise these abscesses, the longer, in my opinion, incision is delayed the better, for there is less tissue to cut through, and less danger of spreading the infection, and less danger of your introducing new organisms from without. Incision, if done, should always be performed under strict antisepsis.

Thomas favoured repeated aspiration of these abscesses. I aspirate in these cases only when the so-called abscess is very extensive, causing pressure symptoms.

*The acute abscess*, attended with pain, rapidly increased swelling, and constitutional symptoms indicating the formation of true pus, requires the opposite treatment. As soon as I believe pus has formed I make an incision into the abscess, and drain it, with antiseptic precautions.

The old maxim *Ubi pus ibi evacua* holds good to this day.

The effect of this treatment is to cut short the painful evolution of the abscess, and lessen the constitutional disturbance.

If fever is present with it, I treat the case with a few doses of red iodide of mercury, which is usually

effective in giving speedy relief by inhibiting the growth of the pus-producing organism in the blood.

As for the operation of opening up these abscesses and curetting the pyogenic membrane which was once the custom, I never do it now, as I found the result in so many cases was an aggravation of the symptoms; and the same remarks may be made about the procedure of opening up the tubercular focus and scraping the bones. This scraping scatters the bacilli, and is necessarily attended with a certain amount of hæmorrhage, which is an evil in tuberculosis elsewhere, and hæmorrhage into a tubercular joint is a sorry hastener of the tubercular process. If the hæmorrhage is excessive, it will increase intra-articular pressure, and lead to further mischief.

I have seen rapid destruction of the tissues of a tuberculous hip-joint after a spontaneous hæmorrhage into the joints. I saw the same thing occur once in a tubercular knee-joint when amputation was performed in the middle of the thigh, and the patient died fifteen months after, worn out with pulmonary tuberculosis.

There is a recognized tendency of tubercular processes to cause ulceration of bloodvessels—*e.g.*, pulmonary hæmorrhage, hæmorrhage in caseating bronchial glands in children, and occasional hæmorrhage from iliacs in spinal abscess. Residual

abscesses not connected with the joint require opening and drainage.

Sometimes after the bursting or opening of an abscess the tissues slough, and take on a sort of phagedænic ulceration.

Many such cases you will have little difficulty in recognizing as heredo-syphilitic. In one of my early cases there was a large, deep ulcer behind the trochanter, which was slowly spreading for months, until I recognized its specific character and healed it up in a few weeks with the internal exhibition of iodides and mercury.

Should septicæmia or hectic arise through invasion of the blood-stream by organisms, I have found nothing does so much good as red iodide of mercury and iron.

## OPERATIONS THAT MAY BE REQUIRED

Arthrotomy for removal of loose sequestra from the joint may be required.

Amputation at the hip, when the disease has destroyed the joint and the upper end of the femur, so that no repair is possible, may also sometimes be required; but I have never seen a case in which it was necessary.

### Excision of the Hip-Joint.

As a result of my twenty-eight years' experience, I now believe that if the joint is properly fixed by a Thomas's splint excision will never be required.

Dr. G. A. Wright, a warm advocate of excision, gives a table of 100 excisions in his book, 'Hip-Disease in Childhood.' He also gives a table of 15 cases treated by Dr. Alexander of Liverpool without excision. In the latter table the only cases marked 'Cured' were treated by Thomas's splint.

The treatment of these hundred cases of Dr. Wright's was in the majority of instances extension, excision, and afterwards Thomas's splint. I am not

surprised he had so many excisions. The good results afterwards I would attribute to Thomas's splint.

Once I excised in every well-pronounced case of the disease, but now I consider it is an operation that should hardly ever be done. This opinion is supported by the pathology of the disease. If there is any evidence of loose sequestra in the joint, an incision should be made over the trochanter in the middle line and a little concave forward, as for an excision, and the sequestra removed.

The excision of the joint will very seldom be required. From the nature of the tubercular process being usually an infiltration forming wedge-shaped, adherent, necrotic areas lined with healthy tissue, excision causes the unavoidable removal of a large amount of healthy tissue, and is frequently followed by a local spreading of the disease, and sometimes by infection spreading to other parts and causing death, as by tubercular meningitis, hectic fever.

If it is necessary to excise, the incision over the middle of the trochanter concavity forwards is, I think, the best, and I have used it in many cases. I now believe that it is the beginner and the general operating surgeon, who have not watched these cases from day to day and from year to year, who are the strongest advocates for operation.

It is my opinion that the warmth of the advocacy of the knife in hip-disease is inversely proportional

to the amount of experience of the surgeon in watching the evolution of the disease.

I believe it is very rare to find the head of the bone in this disease separated as a sequestrum. The only two cases in which I found the head loose on cutting into the joint proved to be errors in diagnosis, the separation having been the result of a previous acute suppurative arthritis of the hip.

### Amputation.

This is an operation which may be required, though the occasions will be extremely rare. Should there have been acute diffuse tubercular osteo-myelitis, leading to speedy destruction of the bone, amputation may become a necessity. I have, however, never had occasion to amputate.

The only case I know that refused amputation, after being advised to have the thigh amputated in the Children's Hospital, I saw five years after, when she was seventeen years old. She was never treated by Thomas's splint. The upper part of the thigh was riddled with sinuses all healed except one. She was 'twisted like the letter S.' She was quite well and happy; glad to have her leg, and can walk about with the characteristic gait of that condition.

If you are compelled to amputate, you will require to make your flaps according to the healthy

condition of the skin. Furneaux Jordan's operation is generally applicable, and if so, is perhaps the best.

The operations, then, which may be required in treatment are:

Aspiration of large, so-called tubercular abscess.

Incision and drainage of acute abscesses.

Osteotomy, or division of bone, to correct deformity, if there be bony union, but bony union is extremely doubtful.

Excision.

Amputation.

## THE OPERATIONS THAT SHOULD NOT BE PERFORMED

Tenotomy, or division of muscles to improve the position.

Drilling the bone is worse than useless.

Scraping or curetting of the tubercular areas.

Circumcision. For the influence of a long prepuce is fantastical as an etiological factor in the disease.

### Bloodless Surgery.

The operation of forcible reduction of deformity —*redressement forcé*—as practised for congenital hip dislocation, is bad surgery and is a most dangerous operation. Although this operation has been called bloodless surgery, it is usually a most bloody one, but you do not see the blood; it is effused from the torn structures covered by the skin. It is more likely to aggravate than ameliorate the condition.

## CASES

I HAVE some notes of all the cases (404) treated in the Children's Hospital up to the year 1894 and many hundreds since, and I give an epitome of the first four cases I measured for Thomas's splint:

No. 304.—R. P., æt. 3, f. Admitted 7/2/88. Fell out of a perambulator six months before admission. Has been lame for five months. Was treated with extension weight and pulley and double Bryant's splint. Result: Flexion 85° from normal, with increased swelling and tenderness about the joint.

8/4/88. Thomas's splint applied. After the splint was fitted child never seemed to have the slightest pain.

26/8/88. Leg was quite straight, and the child was discharged with splint on.

The next we hear of this case was in 28/3/91, when the child was brought to the hospital with a deformity of flexion 88°, and several sinuses discharging freely, *without any splint on*, the parents having taken the treatment of the case into their own hands. A new Thomas's splint was applied, with the result:

25/8/91. Child discharged; deformity cured; leg straight; slight discharge from sinus; is able to go about on crutches and patten.

No. 306.—R. P., æt. 4, m. 23/3/88. Nine months ago

child fell from boxes 4 feet high. Five weeks after the fall he was taken to a doctor, who treated him by Thomas's splint, with extension. The splint was removed by his parents, and he was allowed to crawl about, with the result that, on admission to the hospital, he had a flexion of about a right angle. He was treated with Thomas's splint, and discharged in the splint, with the deformity cured, in three weeks. He was never brought back to the hospital again. Being anxious to know the result of the treatment, I managed to trace the case, and interviewed the father about two years after. The father had removed the splint a few weeks after leaving the hospital, with the result of flexion deformity 90°, with the hip-joint apparently sound. The father said he would not let us do any more for his boy, as he believed we did not understand the case—that he had no consumption in his family.

These two cases both illustrate, firstly, the pernicious effect of leaving off the splint, thereby interrupting the prolonged rest needed for cure and, secondly, the speedy reduction of the deformity by Thomas's splint.

No. 307.—W. S., æt. 8, m. Admitted 17/4/88. Hip-disease, three years' standing. Flexion deformity 75°. Thomas's splint applied. Result: discharged, 24/6/88, deformity cured, flexion 0°, leg straight; patten and crutches. Illustrates rapid cure of deformity of three years' standing.

No. 305.—M. S., æt. 5. Early case. Symptoms only three weeks, flexion 20°. Splint made, but when father saw it he took the child away from the hospital before it was fitted, saying he would not have his child put in irons. This illustrates one of the troubles you have to contend with.

No. 326.—E. W., æt, 4, f. Admitted 17/8/89. Symptoms

over three months' standing. Flexion 22°. Discharged in splint a month after admission, but brought back to the hospital two years afterwards, on the 28/9/91, with right-angle deformity, mother stating that she had taken the splint off two years ago, as she had thought the child was quite well. Splint was reapplied, with reduction of deformity. Three months after this, on 19/1/92, the child was brought back again, without the splint, the mother had taken it off; the deformity recurred. Splint was re-applied, with reduction of deformity, and about three months after (28/6/92) the child was brought back again in a worse condition, the mother having removed the splint again. The splint was reapplied, and on this, the fourth time, a Thomas's splint was fitted to the case. The condition was flexion 50°, inversion 25°, adduction 32°. The mother gave as the reason for removing the splint that she thought it was cruel to keep the child in a splint when she was quite *well* in health. On the serious nature of the disease being reiterated to her, and that her child might die of it, and if she did there would be an inquiry into the cause of death, it seemed to alarm her, for she never brought the child to us again.

No. 318.—M. M., æt. 5, f. Admitted 14/1/89. Suffered from hip disease for one year. 22/2/89, discharged on Thomas's splint; deformity reduced.

14/7/90. Readmitted. Shortly after her discharge from hospital in February, 1889, her father took the splint off, as she appeared quite well, and she has not been to hospital since. Her condition now is abscess formed in thigh, pointing 2 inches below Poupart's ligament, in front; in great pain; flexion nearly right angle.

21/12/90. Discharged on splint; flexion and deformity cured; sinuses still discharging.

22/9/92. Father had taken the splint off; flexion now 113°, adduction 13°, version 0°; abscess forming on inner side of thigh.

3/10/92. Flexion 107°, adduction 10°.

1/4/93. Discharged; still on splint, and leg straight; deformity cured.

It is not only the laity who remove the splints prematurely. I have committed the same error in my early practice several times, as in the following case:

No. 324.—S. O., æt. 2½, m. Admitted 5/8/89. Six weeks' duration. Lameness; night screams; flexion, 30°; sensation of grating in right hip-joint on rotation of femur.

15/8/89. Thomas's splint applied.

20/12/89. Joint seemed perfectly sound when splint was removed.

1/4/90. Has perfect freedom of movement of right hip in all directions. No flexion, no pain. Sent to convalescent cottage without splint.

14/4/90. Return of symptoms—night screams, pain in right hip, abscess forming over right hip-joint — so Thomas's splint was reapplied.

23/6/91. Apparently quite well. Splint removed, and sent to convalescent cottage.

24/10/91. Returned from the cottage with return of symptoms after six weeks' walking on leg. Thomas's splint reapplied.

10/2/92. Deformity cured. Sent to convalescent cottage again.

26/7/92. Returned from convalescent cottage. Aggravation of symptoms; three discharging sinuses.

N.B.—Here the child showed some ulceration of the mouth, which betrayed the syphilitic character, and the child was treated accordingly. The child improved, sinuses closing up.

25/4/93. Child discharged from the hospital perfectly cured of hip-disease. No deformity; perfect freedom of movement in right hip-joint; only very slight shortening, and can walk well on his bad leg.

This case illustrates the folly of leaving the splint off too soon, and allowing the child to walk. I did not know so much about these cases at that time, otherwise I would not have taken the splint off so soon; nor did I know much about congenital syphilis in relation to these cases. The case lasted three and three-quarter years; but it is very probable that, had the patient had the benefit of prolonged uninterrupted rest on the splint, and constitutional treatment for syphilis, the treatment would have been much less prolonged, and more agreeable to all concerned.

Thomas states that, should the patient be taken out of the frame and happen to assume a sitting posture, thus moving the trunk from a straight line with his limb, he would retard the recovery, and may possibly in a few minutes undo the repair of months, and cause suppuration—a disaster he might otherwise have avoided.

These cases just referred to emphasize this statement. There was repeated abscess and aggravation of the symptoms on leaving off the splint and allowing the joint to move, and repeated improvement on reapplying the splint.

Here the inductive method of concomitant variations applied to the same case is a conclusive argument as to the efficiency of the splint.

In the out-patient department about sixteen years ago I diagnosed a case of hip-disease—flexion 15°—measured the case, and had it fitted with Thomas's splint. The mother brought the child back in three weeks and saw a resident medical officer, and told him there was nothing wrong with the child. He had the splint taken off, examined the child, and found no symptoms of the disease, so he said: 'Your child is all right. Leave the splint here; he doesn't want it.' And she took her child away minus the splint, but brought him back again in three weeks with flexion increased to 25°, in great pain and suffering. This case went on to abscess formation, with destruction of the joint. The medical officer was profuse in his apologies for removing the splint, saying he thought it was a junior who had made a mistake, as he could find nothing whatever wrong with the child.

J. T., æt. 10, f. Admitted 16/1/97. Ordinary symptoms of hip-disease of six weeks' standing: limping, pain in the right knee and hip, etc.; flexion, 30°.

1/3/97. Discharged; flexion reduced to normal.

This case was kept on the splint for about two years, treated outside the hospital in the manner

indicated by me, and has now a straight back, and no deformity whatever except a very little shortening, which is easily corrected by a thick sole to the boot.

W. N., æt. 10, m. Admitted 22/4/97. Hip case, three years; two discharging sinuses over right hip; right leg flexion, 85°; adduction, 30°. Put up in double Thomas's splint to fit; gradual reduction of deformity.

23/10/97. Both sinuses nearly closed.

2/2/98. Discharged, with deformity cured.

This case took over nine months to reduce.

My experience has been that abscess formation and discharging sinuses interfere with reduction of deformity.

R. N., æt. 5. Admitted 14/1/99. Right hip-disease, two months' standing. Lame; pain, wasting, etc.

25/1/99. Double Thomas's splint applied; flexion, 60°.

13/3/99. Flexion reduced to 0°; discharged in Thomas's splint.

This case illustrates resolution of a recent flexion of 60° in less than seven weeks.

L. S., æt. 4, f. Admitted 17/3/99. Lame nine months; left hip-disease; flexion, 71°, inversion, 25°, adduction, 40°; double Thomas's splint applied.

31/7/99. Discharged on splint with flexion and deformity cured.

E. S., æt 7, f. Admitted 16/7/99. Running about until a few days ago; swelling in left groin.

2/8/99. Flexion and rigidity of left hip-joint; loss of tone, and wasting of muscles of left thigh; measured for single Thomas's splint.

20/9/99. Has had night screams and pain for the last three nights.

21/9/99. Flexion of the splint increased, and there were no more complaints of pain and no more night screams. This case was progressing favourably, but she developed tubercular meningitis, of which she died 2/12/99. In this case the flexion had increased during the interval for measuring for the splint and fitting it, so that it fitted badly; hence the night screams and pain, which were stopped as soon as the proper degree of flexion was given to the splint.

I may add in this connexion that a contributor to the *Lancet*, reporting a case of hip-disease, stated that he had a case with night screams and pains for which he could get no relief, trying opiates and other things; when he flexed the leg fully, and rested it on a pillow and kept it at rest, there was almost immediate relief to the child's pain, and he advised others to try the same treatment in their cases under similar conditions. Apparently the writer had never heard of Thomas's method of treatment or of his splint.

This case also shows that Thomas's splint does not interfere with the developing of tuberculosis elsewhere, and that, no matter how well you treat your cases, some of them will die.

To make this number as few as possible, we must not neglect the hygienic treatment.

E. G., æt 7, m. 19/11/89. Admitted into hospital for treatment of large abscess over right hip. Has been wear-

ing double Thomas's splint for over five months when attending as an out-patient. Abscess aspirated; discharged relieved. Readmitted 1/5/90. Splint has been taken off; abscess reformed and burst; flexion now 54°. Splint reapplied and deformity reduced; discharged 28/8/90.

30/7/91. Readmitted for tubercular disease of shoulder-joint. As for the hip-disease, his leg is quite straight, and he has a movable joint.

This case shows the necessity of treating the disease as a constitutional one, and the evil of interrupting the rest.

M. M., æt. 10, f. Admitted 27/8/90. Right hip-disease, three months' duration. Treated by Thomas's splint for about one year. Was allowed to walk too much, when the parents got frightened, and brought her to hospital for a severe pain in the leg.

1/1/91. Movement in joint in every direction, but not quite so free as in the other leg. She was kept under observation till 19/9/91, when she was discharged perfectly cured.

S. F., æt. 8, f. Admitted 6/11/89. Hip case, two years' duration. Three discharging sinuses and great flexion deformity. Double Thomas's splint was applied.

16/5/90. Child sent home; leg straight; deformity cured.

J. B., æt. 3, f. Right hip, five months' duration.

3/10/90. Flexion 50°. Double Thomas applied.

20/1/91. Discharged; flexion, 0°.

E. R., æt. 9, m. Admitted 13/8/88. Limping; pain in right hip and right knee for five months. Flexion of thigh, and night screams.

23/8/88. Thomas's splint.

23/1/89. Crutches and patten. Flexion reduced.

8/1/91. Has walked on bad leg without crutches for six months. No shortening nor deformity.

This case shows the progress of an ordinary case when there is no interference to the rest treatment and very gradual resumption of the functions of the joint.

B. M., æt. 13, f. Admitted (15/9/91) for reduction of deformity. Hip-disease, over two years' duration; treated elsewhere with no fixation, in third stage, with four discharging sinuses; flexion, left thigh, 90°, rigidly fixed, 1½ inches real shortening. Treated with double Thomas's splint.

20/6/92. Discharged in good health, with flexion deformity cured.

This case is a type of a large class with cure of the deformity and improvement in health under splint treatment.

T. S., æt. 7, m. Admitted 31/12/91. Left hip-joint disease, eighteen months' standing; similar deformity from bad treatment. Double Thomas's splint applied. Has an abscess below and in front of the joint.

2/5/92. Discharged on splint; abscess nearly healed. There is still a slight resistance to full extension. Readmitted 5/12/92, having had his splint removed shortly after having left the Children's Hospital, when he was treated at another hospital. He had now six bad bedsores and several discharging sinuses. Flexion of hip over a right angle, with grating in the joint. Joint was again healed with fixation. The joint was incised to improve the drainage. The child died, 25/3/93, of general tuberculosis.

This is another case showing the evil of interrupt-

ing the rest to the joint, also the danger of incising these joints, the incision probably being responsible for the general infection.

L. M., æt. 6, f. Admitted 5/4/93. Right hip-disease, four months' standing. Put on Thomas's splint. Contracted measles, and died of general tuberculosis 12/8/93.

This case showed the effect of the toxin of measles in disseminating the tubercle. The poisons of both measles and scarlatina I have found generally cause aggravation of the local symptoms in hip-disease, and sometimes general infection, acting like tuberculin. They are toxic agencies of great potency for evil.

W. P., æt. $2\frac{3}{4}$, m. Admitted 16/1/93. Mother stated she noticed stiffness in one of his knees seven months before. Child examined, and found to have right hip-disease. Was put on single Thomas's splint a few days after admission. Discharged, 7/4/93, with leg in good position. Readmitted 24/4/93, as parents could not manage the splint.

23/6/93. Was found to have pain in the left knee and limitation of movement of the left hip-joint, the left hip-joint becoming diseased, so he was measured and fitted with a double Thomas's splint.

11/11/93. Discharged, with limbs in good position. This boy was taken to his home, 100 miles away, and brought to me at intervals of two or three months. Tubercular abscesses formed. They were not interfered with, but dressed antiseptically on spontaneous rupture. I saw him when he was about sixteen years of age. He could walk fairly well with only a little awkwardness of

gait, owing to slight stiffness in his hips; had no deformity.

This case of double hip-joint disease showed the efficiency of the splint treatment even at a distance. He was brought to me by train, on one occasion the family fearing an abscess formation, when all he required was a slight dilatation of one of the curves of one of the splints, which was hurting him owing to his growth.

A. H., æt. 7, f. Admitted 24/6/90. Right hip-disease, six months' duration.

25/7/90. Discharged on Thomas's splint, with leg in good position. Attended as an out-patient for some time, then splint was taken off about the middle of 1891, as the parents thought she was all right. Readmitted, 27/7/92, with a relapse; flexion 50° from normal; double Thomas's splint applied on 19/1/93. Discharged, flexion reduced; made an out-patient.

26/8/93. No flexion; back quite straight.

2/9/93. Put on single Thomas's splint.

16/9/93. Walking on crutches, with patten on sound leg. No return of the deformity. Shows prolongation of the case through discarding the splint too soon, but, notwithstanding this, there was ultimate recovery.

W. D., æt. $3\frac{1}{2}$, m. Admitted, 19/6/03, with left morbus coxæ. Acute abscess forming over left trochanter. Put up in double Thomas's splint; had marked flexion and eversion. Incision down to periosteum of trochanter, evacuating pus which contained pneumococci.

14/10/03. Flexion and eversion reduced to zero. Discharged on splint; wound quite healed.

This case showed a pneumococcal infection of a tubercular abscess of hip.

M. D., æt. 12, f. Old hip case, right side. Admitted 27/2/04; flexion 50° from normal. Double Thomas's splint applied; flexion rapidly reduced to 0°. Discharged on double Thomas's splint on 14/5/04.

This case showed rapid reduction of deformity flexion.

J. B., æt. 9, m. Admitted 29/6/05. Disease of left hip, one year's standing; flexion to a right angle.

11/12/05. Discharged, with no flexion, and going about with patten and crutches.

Case showed reduction of old-standing flexion deformity.

Cases with a history like the following are very numerous, showing the evil of patient's friends removing the splint and allowing the patient to move about at will:

L. G., æt. 5, f. Admitted, 26/9/92, with right hip-disease, three months' duration; lameness, pain on adducting or inverting limb, obliteration of gluteal fold, etc. Flexion 45°; double Thomas applied.

18/10/92. Flexion reduced; taken to Tasmania.

5/4/94. Readmitted without any splint; joint apparently sound; angle of flexion 50°.

12/4/94. Double splint put on again.

17/4/94. Flexion now 40°; no pain or trouble of any kind.

3/5/94. Flexion 30°.

20/5/94. Flexion 17°.

23/5/94. Flexion 10°.

26/5/94. Flexion 0°.

6/6/94. Back and leg quite straight.

6/9/94. Discharged on splint.

Case had lasted so far for two and a quarter years, and was not heard of again.

This case is a type of so many which come back with deformity from leaving off the splint, but apparently with a sound joint. Splint treatment cures the deformity, and they are not heard of again.

Many of them come from the neighbouring colonies to be treated at the Melbourne Children's Hospital, which has earned an Australian reputation for the successful treatment of these cases by the methods described in this book.

Even the working blacksmith and the saddler engaged by our hospital get orders from medical men in the other colonies to make Thomas's splints for children, the only direction as to the shape of the splint being a statement of the ages of the children. No wonder Thomas's splint gets a bad name when so little is known of his methods.

And what do medical men do with the splint obtained in this manner? Somehow or other they fit the child into the splint, and maintain the deformity, having no idea of the use of the wrenches.

What a different tale there usually is to tell in the cases in private practice, when they are under supervision during the whole period of cure! I have had uniform success in the treatment of these

cases by following the methods indicated in this book when fond parents have not interfered with the prolonged use of the splint.

The type of these cases is like the preceding up to 18/10/92, and afterwards crutches and pattens on the sound leg; then gradual discarding of splint, then crutches without splint, and gradual training to walk, and resumption of the functions of the joint, and cure without deformity, the period of treatment generally occupying about two years.

I have received several letters from the parents like the following, which was from the mother of a child who was under treatment only nine months on the splint, being seven years old at the time, and is now sixteen years old :

'DEAR DR. BENNIE,

'I have intended writing to you for some time to let you know how well F. has got on; she is running about as well as ever, and seems to have no trace of anything wrong. She grew very stout and tall as well while lying down, and now walks as well as ever she did. I thought you would like to hear of her progress.

'Again thanking you for all your kindness and trouble, with kind regards,

'Yours sincerely,

'K. P.'

This child, now sixteen years old, is at the present time under treatment for tubercular glands in the neck. The hip-joint is absolutely sound and normal.

A child was brought to me recently with flexion of 50°, adduction 20°, and inversion 15°, and 1½ inches shortening deformity of several years' standing. The joint was sound, but ankylosed in this position, with fibrous adhesions.

I told the parents I could reduce the deformity with Thomas's splint, but they refused to undergo the treatment, saying that the child was treated with Thomas's splint, that they had had enough of the splint which produced the deformity. I asked who fitted on the splint, and they told me it was an instrument-maker. On asking how often the doctor used the wrenches as the case progressed, they told me the doctor did nothing to the splint after it was put on. Such experiences have been common with me.

Some medical men convert Thomas's splint into a machine for maintaining the deformity, and others convert it into a machine for producing or increasing deformity through bad fitting, through leaving the whole conduct of the splint treatment in the hands of a lay workman; and the extent of that conduct comprises only the fitting of the splint to the condition of the child when the splint is put on.

Cases of undoubted hip-disease, when brought

under treatment with the splint in the early stage, may recover without leaving any trace of the disease behind, and the black sheep of the profession may tell the patient's friends that there was no hip-disease, and accuse you of obtaining money under false pretences, and the patient's relations are often too ready to give them credence, being unwilling to admit any tubercular taint in the family, perhaps making statements like this—that they knew it was not consumption the father died of, but only a neglected cold of the chest, and your next interview with the patient's entourage may be very unpleasant; so it would be well in these cases, after being sure of your own diagnosis, to have a consultation with some expert in the disease, or with as many experts as the patient's friends can afford to pay.

Even when supported by other evidence, you may not be thanked for your effective treatment, as happened in one of my early cases which recovered completely, and three months after the disappearance of all symptoms was skipping about as usual with her skipping-rope, when she was suddenly seized with vomiting, and three weeks after died of tubercular meningitis. The mother accused me of killing her child by driving the disease from the hip-joint into the brain, and said she would rather have had a lame child than none at all. One of the mother's friends said to me, a short time after

the child's death, 'I was so sorry for you, doctor, for making such a mistake with Mrs. H.'s child by driving the disease into the brain.'

It would be well also in every case to explain clearly and emphasize the serious nature of the disease, and the danger of abscess formation and shortening of the limb, and the danger of tuberculosis in other parts; and in cases in which there is joint disturbance when coming under your care, you should make it very clear to the patient's friends that the treatment will not make a new joint, and will not cure tubercle in other parts, and that the most they can hope for is an arrest of the disease in the stage in which you meet with it; that if there is already joint destruction the patient will always be lame more or less, and have more or less stiffness in the joint from replacement of the normal tissues of the joint by tissues of a lower order.

One of my patients whom I treated in the Children's Hospital, and who had advanced joint destruction, recovered with an inch of shortening and walked with a cork sole on the bad leg and a slight limp, but a straight back. This boy's father meeting me once in a public place, and, pointing to his boy, called out, 'You ruined my boy's hip—you have lamed him for life. That's the way you cured him of hip-disease in the hospital.' This was

annoying, for it was one of my most satisfactory cases, and I was extremely gratified with the result, considering the immense amount of joint destruction which was present when I first saw the case.

On another occasion I had another unpleasant meeting with the father of a boy I treated in the Children's Hospital. The boy had, when I first saw him, shortening, abscess formation and deformity. His deformity was reduced, and he was sent to the country on a splint. While there a country practitioner who saw the case ordered the splint off, saying to the father, 'You mark my words, that boy will be lame and have a short leg; that is what Thomas's splint does for these cases.' The parents did not take it off for some months, and, finding, the boy lame and leg short, came with the boy to Melbourne and blamed me for the result.

I give these incidents to let the practitioner know what to expect in some cases *if he does not clearly explain what he will do, what he may do, and what neither he nor anyone else can do in the treatment.*

The treatment of hip cases may not be a remunerative one generally. It is a labour of love, for you relieve a vast amount of pain and suffering.

If the patient does not die of tuberculosis elsewhere, or of other intercurrent disease, you must get one of two results: either perfect recovery without evidence of previous disease, or recovery with more

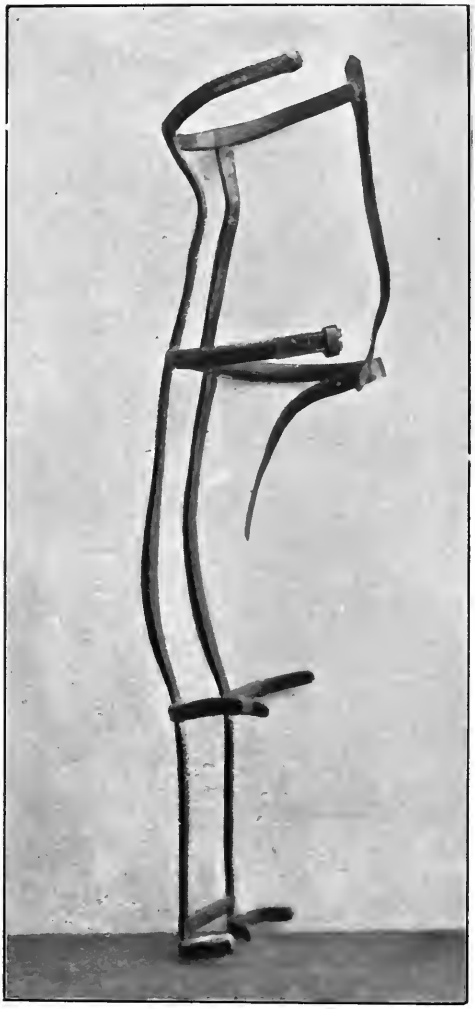
or less impairment of the functions of the joint. In the one instance you may have to fight the statements and insinuations of your confrères that you have treated a shadow, and in the other you may have to contend against the laity, especially the uneducated, who blame you for laming the patient for life. *Hinc illæ lachrymæ.*

Each case selected for comment in this work is chosen to illustrate some point in the treatment.

The numerous cases that have gone on uninterruptedly to recovery and perfect cure could be quoted *ad nauseam*, but more can be learned from the history and treatment of those cases which have not gone on to perfect cure without relapses, such relapses being due almost invariably to premature removal of the splint.

I have outlined my own evolution in treatment from the period of excision, use of Bryant's splint with extension, up to our present methods as laid down in this volume, and I trust that my brother medical men will credit me with the desire of promoting the welfare of the patients entrusted to our care rather than with any desire to belittle the practice of others who differ from me in the treatment of these cases, and I hope that my arguments may convince them of the scientific accuracy of these methods.

# PLATE VII



DOUBLE THOMAS'S SPLINT WITH BENNIE'S HEAD EXTENSION FOR SPINE DISEASE.

*To face page* 105.

# APPENDIX

## Head Extension.

Thomas's splint, especially the double one, may be used in a great variety of other complaints. It is the best hip-joint fixer, and may be used with great benefit in fractures of the femur high up, especially those involving the joint, and in all cases where hip-joint fixation is required. The double splint may be used in all cases where fixation for the lower part of the spine and hip is required. It may be used in all cases of psoas contraction, when you want to relieve the pain or give the muscles rest.

I have used it in many cases of tuberculous spine—cervical, dorsal, lumbar—in sacral and sacro-iliac disease. In appendicitis, in postperitoneal abscess, and in intra-pelvic inflammation, where there was psoas contraction, I have found a double Thomas's splint give great relief from pain.

Having used a double Thomas's splint for disease of the lower vertebræ, as recommended by Thomas in his book, and having obtained such magnificent results, the thought naturally suggested itself to me to try the same method in dorsal and cervical disease. Why Thomas did not do so I cannot say. Perhaps a difficulty lay in the fitting.

I found the upper dorsal and cervical spine could be very easily fixed by means of a double Thomas's splint with upright stems continued above the chest wing, running nearly parallel, and meeting a head wing which passes round the occiput, and is fixed by a strap on the

forehead. This head wing can be made to prevent any movement of the head that you may wish. The moulding is done by the instrument-maker or blacksmith, who is supplied on a diagram with the curves of the surface contacts of the splint from the head and neck to near the ankle; these curves being traced on paper with the strips of lead moulded to the proper shape exactly in the same way as is done with the splint for the hip.

I introduced this method of treating spine disease into the Children's Hospital, Melbourne, eighteen years ago, after a few months' experience with Thomas's splint.

I have used it ever since, and I have found it the best method of fixing the spine, and cases treated with it before deformity has occurred recover without any deformity if proper attention is paid to the treatment. Of course, like Thomas's splint, it is not gifted with intelligence, and cannot adapt itself to varying conditions; the workman can make the splint, but he cannot treat the case, so a judicious use of the wrenches may be required to alter the direction of certain forces tending to deformity.

Even cases with considerable deformity have had the deformity much reduced by treatment with the splint. It cannot cure a shortened spine; it may improve it —as Thomas's splint cannot cure, but may improve a shortened leg.

The photograph shown is a front view of a splint which was worn for more than a year in a case of dorsal disease of the spine. The child grew out of it, and had another made to fit. The case was cured without any deformity, the only evidence of the past disease now being very slight impairment of mobility of two or three dorsal vertebræ, evident only to an expert.

My apology for introducing this splint in this work is that the use of the splint has been followed by such brilliant results in spinal cases in my practice that I believe the

# PLATE VIII

PHOTOGRAPH OF SKIAGRAM OF ANKYLOSED HIP OF BOY AGED TEN OF EIGHT YEARS' STANDING.

This skiagram of the right hip, taken in the usual way, might lead one to believe that ankylosis was bony.

*To face page* 106.

*Taken by Mr. A. G. Fryett, of Melbourne*

# PLATE IX

PHOTOGRAPH OF SKIAGRAM OF ANKYLOSED HIP OF BOY AGED TEN, OF EIGHT YEARS' STANDING.

This stereoscopic view of the same hip shows distinctly the fibrous junction.

*To follow page 106.*

*Taken by Mr A. C. Fryell of Melbourne.*

same results will be obtained by others by following the methods here laid down.

In the interests of the little sufferers I have deemed it my duty to bring it forward.

## Normal Axis of Thigh.

As regards the normal position of the axis of the thigh, from measurements which I made I came to the conclusion that there is in babies a deviation of the axis of the thigh from the vertical of 10° or more when knees are touching. In young children I found little or no difference in boys or girls. In boys there is a gradual reduction to about 4° in adult age, while in girls there is a gradual reduction with age, though not to the same extent, and then a gradual increase as puberty is approached, coinciding with the differentiation of osseous structure required by the adult female. This increase, going on until the deviation, is nearly what it was in infancy. The adduction or abduction deformity should always be measured from the normal as zero.

## Skiagrams.

I show two photographs of skiagrams of an ankylosed hip-joint of eight years' standing from a boy aged ten. The one showing the right hip-joint, in which the fibrous junction is very indistinct, was taken in the usual way; a careless inspection of this skiagram might lead one to suppose there was bony ankylosis. The distinct one is a stereoscopic skiagram of the same hip, taken through a diaphragm. Here the fibrous line is distinctly marked. In the stereoscopic view with the naked eyes the fibrous junction was most clearly marked. I am indebted to Mr. A. G. Fryett, of Melbourne, for permission to publish these skiagrams. They are introduced as a

warning not to be too hasty in coming to the conclusion that ankylosis of the hip is bony, which the skiagram or the indistinct one might very easily lead one to believe.

### Treatment of Other Tuberculous Joints.

The treatment by these methods of other joints affected with tuberculosis is just as efficacious as the treatment of hip-disease, and I have followed it with success in many other tuberculous joint affections.

THE END

*Baillière, Tindall & Cox, 8, Henrietta Street, Covent Garden*

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Bennie, P
Rational and effective treatment of hip-disease.