representing the pelvis and the trunk, and thus prevents motion in the vertebral joints, *v v*, while motion at the hip, at *H*, is free. The limb is then raised in flexion, as in Fig. 9, and the clip is moved from *A* to *B*, releasing the vertebral joints and fixing the hip-joint. When an attempt is then made to reduce flexion or lower the limb to the table the result is lordosis.

It is interesting to note, by observing the transverse dotted lines, that the patient's height is increased by either adduction or abduction, and decreased by flexion when either is combined with fixation. The height is diminished in lateral curvature of the spine by the sigmoid curve, in Pott's disease by kyphosis, and in hip disease by lordosis.

The deformity of hip disease may readily, and with sufficient accuracy, be measured by the use of the goniometer, two forms of which are shown in Figs. 6 and 9. This instrument is simple in construction, and may well be in frequent clinical use. The one shown in Fig. 9 is made by attaching arms to a protractor.

To Measure Adduction or Abduction.—The limb is slowly moved in the direction of adduction and abduction alternately until, after repeated trials, it is seen that when it is held at a certain point in the arc of lateral motion the iliac spines are at right angles with the axis of the trunk. One arm of the goniometer is then held parallel with a line connecting the iliac spines. If the table is against the wall of the room, it is convenient to see that the iliac spines are at right angles with the wall, and then the arm of the goniometer may be directed point blank at the wall. The other arm is then made to coincide with a line parallel, as near as may be, with the axis of the limb, which may, for this purpose, be considered to extend from the middle of Poupert's ligament to the middle of the heel. If the axis of the thigh only is considered, the incidental presence of genu valgum or varum would impair the value of the observation. The degrees may then be counted on the scale of the protractor.

To Measure Flexion.—With one hand the limb is slowly raised and lowered alternately until, after repeated trials, it is found that when the limb is held at a certain point the lumbar spines press gently on the fingers of the other hand placed under the back. One arm of the goniometer is then held horizontally by the hand released from under the back, while the other arm is made to coincide, as near as may be, with a line parallel with the axis of the mass of the limb. The degrees then read off on the inner scale of the protractor are the degrees of flexion. Although its determinations are, from the nature of the case, only approximate, the goniometer is an instrument of precision, and as such finds a place in the consulting room.

Writers on this subject have usually viewed deformity as the result of immobilisation of the hip-joint. The figures and models referred to in the preceding pages have been constructed with that view. As a matter of fact, however, few cases present absolutely immovable joints at any stage. There is almost always considerable motion. In the acute stage the joint, which at the first glance appears to be motionless, is found to yield through an arc of many degrees in response to gentle force rightly applied. Later in the course of the disease many cases show wide and free passive motion in different directions, and the point at which motion is arrested often varies from day to day; and even in after-life the position of the limb is subject to considerable variation. The use of the goniometer facilitates recognition of these phenomena. Further observation in this direction may add to our knowledge and to the efficiency of treatment.

THE TREATMENT OF LEUCOCYTHÆMIA WITH BONE MARROW.

By J. R. WHAIT, M.B., B.Sc., M.R.C.S.,
South Hampstead.

THE following case may present some features of sufficient interest to justify publication.

A lady, aged 56, came under observation on September 20th, 1894, complaining of pain in the left side, enlargement of abdomen, dyspnoea, cough, weakness, and loss of flesh. There was nothing important in her history except that during the

menopause and since (menstruation ceased in 1891 at age of 53) she had a good deal of mental worry, to which she attributed her illness.

In January, 1894, she found that she was getting thinner, and in June or July that her abdomen was getting large and uncomfortable.

The patient was thin, but not at all anæmic-looking. The tongue was coated, the pulse 100, and the temperature 99.4°. The spleen was enlarged and extended downwards to $\frac{1}{2}$ inch above the iliac crest, and inwards to a spot $\frac{3}{4}$ inches to the left of the middle line. It was firm but not tender. The liver reached 2 inches below the costal margin. The lymphatic glands were not enlarged. On the inner aspect of the left tibia the bone was thickened and very tender. There was no sign or history of hæmorrhage. The blood contained a large excess of leucocytes: red corpuscles numbered 4,150,000 per c.mm.; the leucocytes 329,360 per c.mm., a proportion of 1 to 12.6 red cells. The hæmoglobin was 60 per cent. of normal. There were numbers of poikilocytes and granule masses present. She was ordered liq. arsenicalis $\mathfrak{m}$ ij three times a day, and the dose increased by $\mathfrak{m}$ ij every third day.

On September 27th the spleen was considerably larger. The blood remained unaltered.

On October 6th her condition was about the same as on September 27th, and she was then taking liq. arsenicalis $\mathfrak{m}$ xij thrice daily.

Remembering the success with which Professor Fraser had treated a case of pernicious anæmia with bone marrow, as reported in the BRITISH MEDICAL JOURNAL of the previous June, I resolved to try it in this case. Dr. Robert Maguire, who kindly saw the patient with me at this time, concurred, and she was put under the treatment at once. It consisted in the administration of a dessertspoonful of ox bone marrow spread on toast three times a day with meals. The arsenic was continued as before. She began to improve almost immediately.

On October 9th the spleen was slightly smaller. Red corpuscles, 4,050,000 per c.mm.; leucocytes, 190,000 per c.mm., or 1 to 21.3 red cells. The arsenic was producing gastric irritation, and the dose had to be diminished $\mathfrak{m}$ x.

On October 26th the spleen was still smaller. Red corpuscles, 3,510,000 per c.mm.; leucocytes, 46,000 per c.mm., or 1 to 76.3 red cells. Very few tailed red cells were left.

On November 10th both spleen and liver were greatly reduced; the red corpuscles had risen to 4,170,000 per c.mm., the leucocytes fallen to 25,000 per c.mm., or 1 to 167 red. Ferri carb. sacchar. gr. xx, t.i.d., was added to the treatment.

On December 8th the red corpuscles were 4,200,000 per c.mm.; leucocytes, 20,000 per c.mm., or 1 to 210 red cells. The hæmoglobin had risen to 70 per cent. By this time, however, marked symptoms of peripheral neuritis had appeared. The tongue was very white; the skin was dry and taking on a brownish hue. The hands and feet were suffused, tender, and numb. She was unable to perform the finer co-ordinative movements, and there was considerable jerking of the limbs. The prick of a pin anywhere on the soles of the feet or on the toes was imperfectly felt and localised. There was also tinnitus and deafness. The arsenic was again reduced, but the symptoms got steadily worse. The bronzing of the skin getting so marked as to suggest Addison's disease. It was universal, except for a small white patch the size of a threepenny piece over the upper end of each sacro-iliac joint. The pigmentation was exaggerated at the nipples, axilla, umbilicus, etc. Speech became blurred, tongue dry and brown, and the urine scanty and loaded with urates. There was great desire for sleep; for several days the patient slept twenty-two hours out of the twenty-four.

On December 24th the arsenic was stopped. The spleen still filled the whole left hypochondrium. The red corpuscles were 4,300,000 per c.mm.; leucocytes, 19,500 per c.mm., or 1 to 220 red cells. The fresh marrow had become very distasteful to the patient, and I substituted for it tabloids of compressed marrow. Of these 6 were given daily, and later increased to 9.

The neuritis getting worse, on December 28th hypodermic injections of strychnine were commenced ($\frac{1}{10}$ gr. t.i.d.), and by January 4th she could control the jerkings and her grasp

was much stronger. The dose of strychnine was increased to $\frac{1}{10}$ gr.

On January 12th all the symptoms had given way. Sleep was natural. The extremities were only painful to hard pressure, jerkings had ceased, and the bronzing and deafness were noticeably less. The spleen was not felt below the costal margin. Red corpuscles, 4,370,000 per c.mm.; leucocytes, 14,500 per c.mm., or 1 to 300 red cells. Haemoglobin was 80 per cent.

On January 31st the colour of the skin was normal. She had gained flesh and strength, and grasped as firmly as ever. There was only pain upon attempting to stand. Hearing was normal and so was the blood. Large sheets of epidermis peeled off the lower limbs.

On February 19th the spleen and liver were of normal size. She could fasten her clothes or pick up any small object, and cutaneous sensibility was restored. There was, however, some degree of footdrop, and the fingers were rather tapered. The tabloids of marrow, with tonics and massage, were continued until the end of May. She was very well in general health and could walk a little with help, although not without some pain. The spleen and blood had then been normal for several months, and one seemed encouraged to hope that the leucocythæmia was cured. She then went away, and I saw nothing of her until early in August she came under treatment again. She told me she gave up taking marrow when she went away in May, and for a while felt well, but for the last five weeks had felt herself rapidly losing ground.

On August 7th all the original symptoms were present, the spleen larger than ever, reaching the iliac crest and laterally to a point $1\frac{1}{2}$ inch to the right of the middle line, and it was very tender. The liver reached $2\frac{1}{2}$ inches below the costal margin, and was also tender. Red corpuscles, 3,070,000

c.mm.; leucocytes, 225,000 per c.mm., or 1 to 13.6, red. She was put on marrow tabloids and ferri carb. sacch., and began to improve again at once.

On August 23rd the spleen was to the left of the middle line and 1 inch above the iliac crest. Red corpuscles, 3,300,000 per c.mm.; leucocytes, 41,250 per c.mm., or 1 to 80.

On September 5th she was up and about her bedroom, and felt much better. The spleen and liver were considerably smaller. Red corpuscles, 3,700,000 per c.cm.; leucocytes, 21,760 per c.cm., or 1 to 170 red.

She progressed satisfactorily until September 30th, when she became very sick and breathless. The pulse was rapid, and temperature 102° F., and there were signs of pulmonary congestion and pleurisy. The face and upper and lower limbs were cedematous and tender. She did not respond to treatment, and gradually lapsed into a semicomatose condition, and died during the night of October 7th.

The fatal chest complication was attributed to undue exposure at her morning ablutions. I was unable to examine the blood after September 5th, but judging by her condition just previous to September 30th, I believe the blood had greatly improved in the interval.

Necropsy.—The spleen was found freely movable, smooth, and firm. It measured $7\frac{1}{2}$ in. by $4\frac{1}{2}$ in., and showed the typical leucocythæmic characters. The suprarenal bodies were greatly atrophied, being represented, in fact, by a little mass of firmly-adherent connective tissue. The pericardium was distended with fluid, and the right heart much dilated. The left lung was adherent, as a result of old and recent pleurisy. The marrow of the rib bones was red. I did not examine that of the long bones.

Throughout both attacks the temperature exhibited an evening rise and morning fall. Generally speaking, there

were short periods of mild pyrexia, with much longer intervals of apyrexia.

The chart on p. 841 shows the progress of the blood condition during the different stages of treatment, from which it will be seen that during seventeen days under arsenic no improvement occurred; that directly bone marrow was adopted a remarkable diminution in the leucocytes followed, and was maintained after the arsenic was discontinued, and that in the second attack a similar diminution occurred under bone marrow without the aid of arsenic. It seems, therefore, that in this case, at any rate, bone marrow proved itself a valuable therapeutic agent, and probably, had the patient continued its use, the second attack would have been averted, much in the same way as myxoedema is controlled by continued thyroid feeding.

Most textbooks state that there is no means of checking developed leucocythæmia, that arsenic is the most valuable drug in its treatment, and that iron is useless. The impression I received from watching this and one other case was that iron did help the patient, while in this case arsenic was undoubtedly responsible for the peripheral neuritis. The marked bronzing of the skin is interesting in view of the condition of the suprarenals as found *post mortem*.

A NEW METHOD OF DIVIDING BONE IN SURGICAL OPERATIONS.

By THOS. H. MORTON, M.D., C.M.ABERD.,

District Surgeon, Manchester, Sheffield, and Lincolnshire Railway.

FROM time immemorial the saw has been the surgeon's sheet anchor in all operations requiring severance of bone, and it might be deemed an act of temerity to impugn the capabilities of this time-honoured instrument; but for many years I have doubted if the surface of living bone divided by a saw was in the most favourable state for the subsequent healing process, whether stumps or resections. With an ordinary amputation, major or minor, under satisfactory conditions—say, healthy patient, sound tissues, good apposition of flaps, safe occlusions of vessels, and antiseptic dressing—the surgeon does not feel much anxiety as to the result except in regard to those tissues, bone cartilage, and tendon which have a lower vitality. Necrosis of the sawn end of a stump, formerly common, is still not infrequent, and the dead parts extruded after some weeks of tedious suppuration. This terminal section invariably includes the whole circumference of the bone, showing the clean, groove-like sawn surface on the distal side, and irregular spicula, with semi-rounded points, on the other, indicating the softening and absorbent nature of natural separation. The question arises, Would an irregular-grained surface, as in simple fractured bone or a bone cleanly crushed through, provided there were no loose fragments, be a better medium for attachment to surrounding live soft parts and less liable to necrosis? Before answering affirmatively, it might be well to inquire what evidence there is for this assumption. Primarily the saw action is destructive in its course, the vital material in contact with teeth effecting separation of the bone is utterly killed; that is, the *débris* or bone dust, and which needs free irrigation, or it will act as a foreign body. The surface of bone on either side track of saw is minutely lacerated or corrugated; the lacunæ and canals are impacted with sawdust, even when well sponged.

The periosteum generally divided by the operator's knife perhaps escapes the saw, but the medulla is naturally torn freely. Possibly also heat generated by rapid saw movement may have a prejudicial effect. That the vitality is not always lost near the surface subject to attrition or only slightly impaired must be admitted, as stumps do heal satisfactorily and superficial suppuration may and does occur without necrosis. Recently surgeons have employed the chisel and gouge for resections with very good results. It is a modification of this principle—the wedge as a cutter to all bones when practicable—that the instrument I am about to describe is constructed. Before doing so, we might consider the shortcomings of the ordinary chisel, also bone forceps or pliers; the latter is simply an approximation of two chisel edges with or without a little shear movement. When attempting

to divide a long bone, the chisel fails first, owing to imperfect support of the side opposite cutting edge; secondly, the hard resisting nature of bone is in excess of ordinary muscular hand power; if a mallet is used there is danger of irregular fracture and splintering up of edge, although cancellous structure of some bones can be readily and evenly divided, and when using a narrow chisel or gouge the separation of fragments is effected with more precision.

Bone pliers in general use are fairly well adapted for nipping off projecting spicula or digital phalanges, the bone being equally supported on both sides, yet a longitudinal or lateral fracture is sometimes noticed with brittle bones, metacarpal for example. From these remarks, it may be conceded that an instrument dividing bone without undue laceration or disintegration of structure, absence of fracture, or uneven splitting the terminal surface, is what we require and is at present a desideratum.

Description of Instrument.—The cutting surface consists essentially of two opposing blades, slightly wedge-shaped from edge to back, the edge being moderately deeply serrated, indentations one-eighth of an inch or less uniformly alternating, the projections fitting digitations opposite, the whole looking like a set of shark teeth; each are spear-pointed, having a cutting edge on both sides extending to the base of each tooth. The cutting blades are continuous with two lever handles similar to common bone forceps, but with the important addition of a closing screw turned by hand; this approximates forcibly the serrated blade edges. Division of bone is effected first by penetration of the spear-tooth points. Pressure continued brings the edge of each tooth in contact with the bone structure, which is thus divided in segments successively, obviating the tendency to fracture. The instrument has a slight shear or curvilinear movement, which rather assists the process of separation. Modifications of this instrument are contemplated, such as variation in size of the teeth suited to different bones, also wedge-shaped, forked, indented cutting edge, with another to meet it worked by screw, winch handle, or lever. The material of all cutters must be of specially hard, tough steel and unbreakable. For cylindrical large bones it might be desirable to have the posterior cutting part made semi-lunar or concave, and the anterior convex fitting when in apposition, thus reducing the chance of fracturing the outer edge by lateral thrust during division, a mechanical obstacle apparent in cutting any tubes of brittle material. The living bone, often extremely hard, has cohesion and a certain amount of tenacity with elasticity, and would stand the strain while the dividing points were cutting their way as before described. The chisel shown is on this dentated principle, and can be made of any size. It will supplement if not supersede the ordinary bone chisel or osteotome with plane edge. It might be possible to divide a femur effectually by a well-directed blow on the handle end if a suitable unresisting support was close up on the other side.

The serrated bone forceps has been tried on various animal bone, and cuts evenly. Being made entirely of steel nickel plated, it can be easily kept aseptic when using the chisel. The mallet might also be metal, as less power is needed, and in striking a quicker impact is gained than by wood.

I am indebted to Messrs. Parramore and Sons, of Sheffield,