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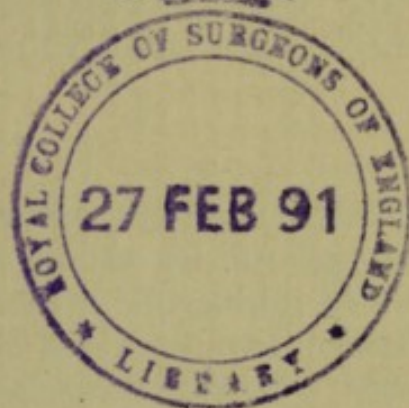
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The Non-operative Treatment
of Delayed Union in Fractures of the Leg 3.



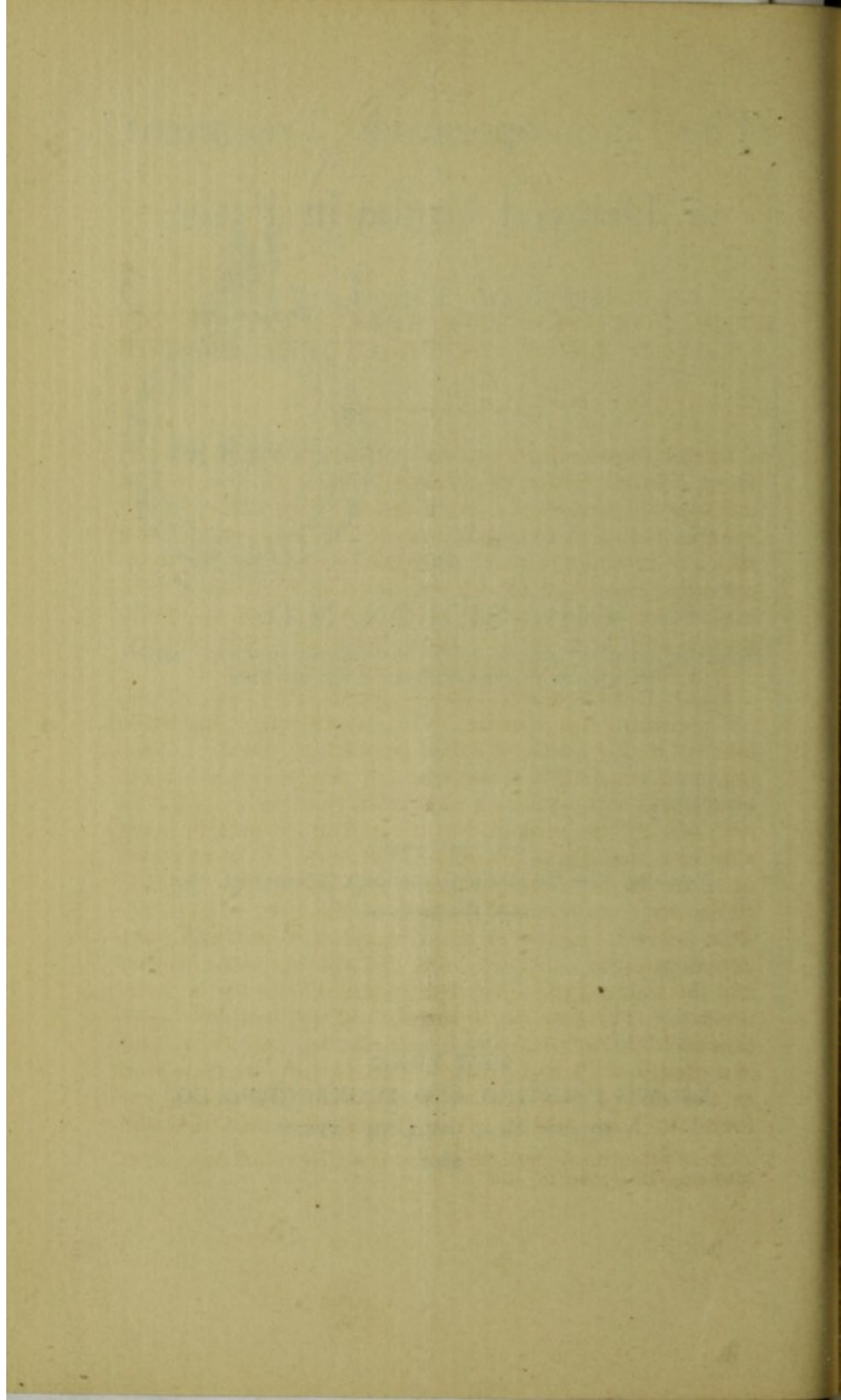
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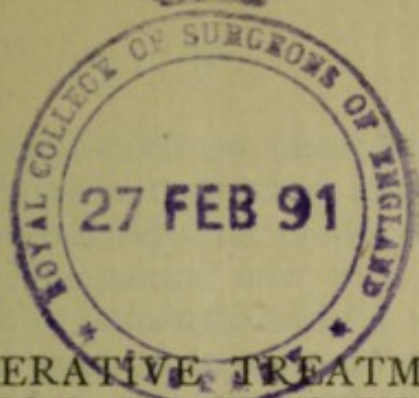
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THE NON-OPERATIVE TREATMENT OF DELAYED UNION IN FRACTURES OF THE LEG.¹

I DESIRE to present to you two patients who have suffered from delayed union of fractured bones of the leg, to ask your inspection of a modification of the caliper splint for the treatment of conditions of this kind, and to call to your attention certain additional means for the non-operative treatment of delayed union in fractures in general, which, though by no means new, are not generally known, and, in so far as I know, not used in this country.

The histories of my two cases are as follows :

CASE I.—Thomas C. B——, aged thirty, unmarried, no constitutional disease. On March 22, 1888, while leading a dog across a street, jumped to escape a passing team, was pulled around by the dog and landed obliquely and with a twisting motion on right foot ; felt pain and fell to the ground, but sprang up to escape being run over, and made his way to the curb. Was removed in a cab to his home, where it was found that he had sustained a compound fracture of the right tibia somewhat below its middle part. A surgeon of skill and great experience was called at once, the wounds were dressed and the fracture put up in light board splints and a fracture-box. The next day a surgeon of world-wide reputation took charge of the case, and the leg was enveloped in a plaster-of-Paris dressing. This dressing was removed at the end of two or three weeks, when the wound was found to have healed. The plaster splint was renewed

¹ Read before the Orthopedic Section of the New York Academy of Medicine, December 16, 1890.

from time to time; and on September 17th, he entered Roosevelt Hospital and was operated upon by Dr. Frank Hartley, to whom I am indebted for access to the hospital records, and who subsequently transferred the case to my care. On his admission to the hospital it was recorded that the "motion at fracture is slight." When the seat of fracture had been exposed at the operation, "an oblique fracture of the tibia is found, passing from below upward, with plane looking forward and upward. The interspace between the fractured surfaces of the upper and lower fragments is filled with a thin wedge-shaped piece of fibrous tissue, which was perhaps externally muscular. The divergence, greatest below, did not exceed one-half inch. At the inner edge of the fractured surfaces is a thin line of bony union." The opposing oblique bony surfaces were chiselled, drilled, and wired, and the leg put up in a plaster-of-Paris dressing. He remained in bed thirty-one days, but the union was not solid when he returned home four days later, on October 22d. The plaster splint was continued, and the patient went about the house with crutches.

On December 27th I saw the case in consultation with Dr. Hartley, who then transferred him to my care. On January 10, 1889, the plaster was removed and a supporting steel splint applied. At this time there was distinct antero-posterior motion at the point of fracture, and though there was evidently soft union between the fragments, there was no appreciable callus to be felt about the fracture. There was some tenderness on pressure and on motion at the point of fracture. Only moderate constriction was made, as the dependent position after the removal of the plaster sufficed to give abundant œdema. The patient began to go about out of doors at once and visited my office two days later. When I next saw him, at the end of nine weeks, union was perfectly solid and abundant callus could be felt. He informed me that he had continued the use of the crutches for some time; and that he had removed the upper supporting part of the

splint at the end of the third week as it was somewhat uncomfortable. The lower portion of the splint, which acted only as a lateral support, he continued to wear for about five months.

The patient recently volunteered the statement that he believes that the delay in union was due to constantly moving the bones at the point of fracture within the plaster splint during the first weeks of the treatment.

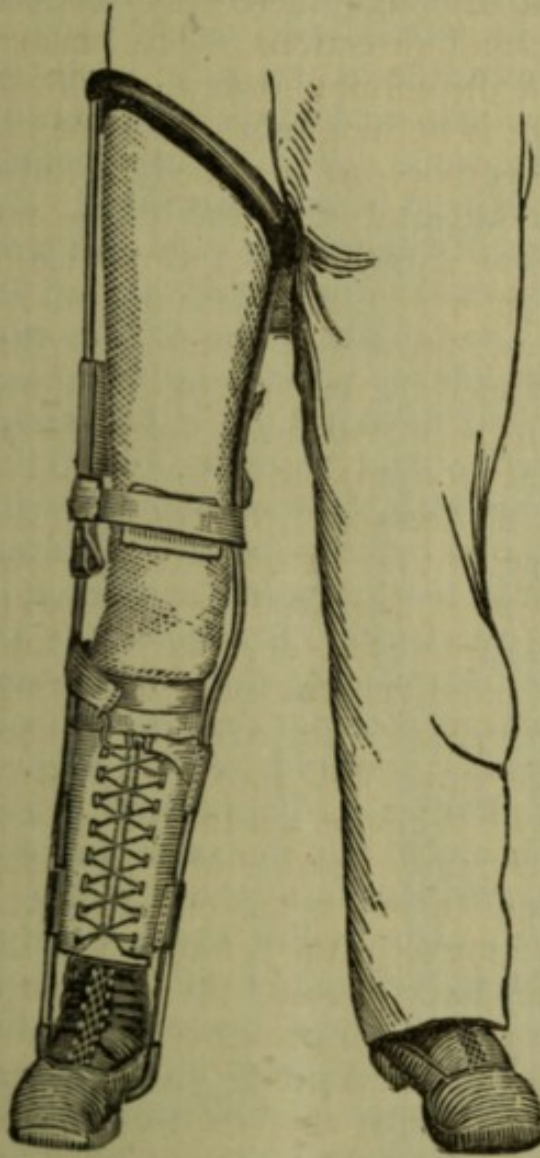
CASE II.—William D——, aged twenty-two, unmarried, no constitutional disease, presented for treatment at the Vanderbilt Clinic on September 8, 1890, and on the 22d of the same month was transferred to my care. In reply to inquiries as to his early history Dr. William T. Bull writes, under date of November 26th: "The history of William D—— is now in the hands of the binders, but I give you the following from my own remembrance, and that of my house surgeon at the New York Hospital. William D——, aged twenty-two, admitted to New York Hospital May 26, 1890, history of having been run over by a wagon. Examination reveals a compound comminuted fracture of the right leg at the middle and lower thirds. A large lacerated wound anteriorly, through which the bones project. Great displacement. Much contusion and laceration of soft parts. Under ether, loose fragments removed, bones replaced, hemorrhage stopped, thorough drainage at all dependent points. Plaster splint over antiseptic dressing. Rise of temperature necessitated change of dressing at end of forty-eight hours. Volkmann's splint applied for three weeks, then plaster splint with fenestrum and frequent dressings. Wounds gradually closed. Delayed union. Necrosis. Discharged by superintendent of hospital for insubordination August 5, 1890. Had walked on crutches, partly on leg, for three or four weeks before discharge. Some deformity and delayed union on discharge. I am not certain whether all sinuses were closed. Plaster splint on leg on discharge."

When the patient came under my care on September

22d all wounds were healed; no callus could be felt about the point of fracture; there was tenderness on firm pressure, and on motion at the point of fracture; soft union was believed to exist because the fragments could not be displaced, although there was very considerable motion possible in all directions. The plaster splint was discontinued, and the splint shown in the illustrations applied. The splint is nothing more than the caliper splint of Thomas, of Liverpool, so modified as to permit of no motion at the ankle, and with the laced leather sleeve added. The splint is made from three-eighth inch iron wire; the ring in which the patient sits is irregularly ovoid in shape, and follows approximately the outline of the thigh; it is joined by welding to the upright bars at an angle from within outward, and from behind forward, so that the lowest point of the ring comes underneath the tuberosity of the ischium; the angle of the ring with the inner bar from within outward is about one hundred and thirty-five degrees, and from before backward about one hundred and twenty five degrees; the lower ends of the side bars plug into vertical tubes that are joined by a shank which is riveted to the sole of the shoe; a band buckled across the front just above the patella prevents forward bending of the knee; a band below the knee at the garter line surrounds the leg and the outer bar, and furnishes the means by which the circulation is dammed, and is under the control of the patient. The laced leather sleeve may or may not be used. It is a matter of some comfort to the patient, as it prevents the leg from chafing against the side bars, and it possibly acts in some measure to immobilize; but if it is used care should be exercised that it is not sufficiently tight to check the desired œdema. Of course it should be unnecessary to say that the splint remains on continuously, and that the shoe is a part of the splint. In this patient, solidification has slowly but steadily increased, and abundant callus has been thrown out.

The patient has been seen only at intervals of from

one to two weeks; and motion was not carefully tested till the end of nine weeks, when no motion could be detected and the patient walked across the room without the splint or any support. He felt, however, some



[FIG. 1.]

sense of weakness and tenderness in the part. After the application of the splint he continued the use of one crutch for a short time only, and he was soon able to walk three or four miles without discomfort, and after

eight weeks resumed his laborious work of unloading vessels.

In speaking of delayed union, I do not use the term as synonymous with *non-union*, or *pseudarthrosis*. Neither do I use it in precisely the same limited sense that it is generally used by writers who would place a time limit, more or less movable to be sure, upon the term, and make subjective pain and tenderness play an important part in the diagnosis. A given case cannot rightly be denominated delayed union this week, and non union next; nor delayed union while pain and tenderness exist to-day, and non-union when they are no longer felt on the morrow. The normal union of a fractured bone occupies a pretty definite period, and if union fails to be perfect at the end of that time either delayed union or non-union may be said to exist; but if it be delayed union in the beginning, delayed union it will remain until it has become solid by non-operative treatment; while if it be non-union in the beginning, non union it will remain until cured by operation. Non-operative treatment has no place in the treatment of cases of true non-union, and we will not further consider that branch of the subject, however interesting it would be to discuss the query as to why union is more readily obtained in cut off than in broken off bone ends. In the same way we believe that operative measures have no place in the treatment of cases of delayed union. For time is not a subject for consideration when weighed in the balance with the risk to life of even an aseptic operation; and no cutting operation should be thought of until every other known means and an abundance of time have been expended.

As orthopedic surgeons more than our rightful share of these unpromising cases will come under our observation. During the past two years I have met with delayed union in two fractures of the leg, two of the shaft of the femur, one of the neck of the femur, and one of the humerus. The two cases of fracture of the leg I have presented to you. It therefore behooves us to take counsel one with

another as to what causes these delays in the perfect union of fractured bones, and as to how we can best contend against the evil results that have been wont to follow.

In the works on general surgery, and in those works

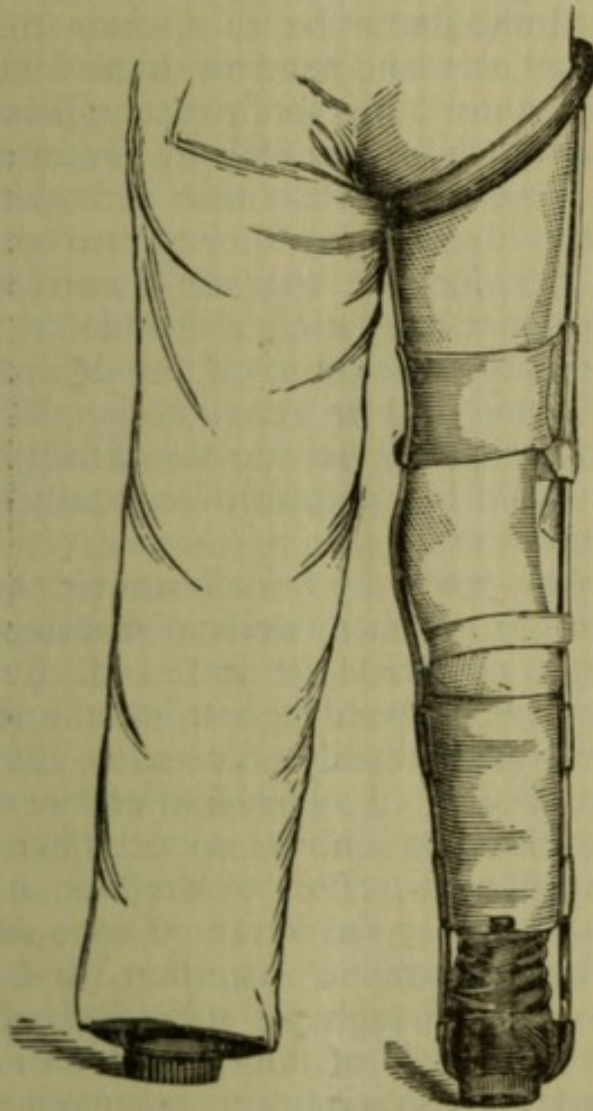


FIG. 2.

specially devoted to the consideration of fractures, various causes are laid down for delayed and ununited fractures ; but two, however, need detain us, and these only because the present fashion of treating fractures by plaster-of-Paris bandages conduces to the one or the other,

namely, constriction of the seat of fracture, or to deficient immobilization. Bandages of plaster-of-Paris are so readily obtained, so easily applied, so wholly safe from interference on the part of the patient, and so comfortable withal that it is not surprising that they have come into general use in the treatment of fractures, especially outside of hospital practice. It appears to the writer, however, that no dressing has ever been devised for the treatment of fractures which so illy accomplishes the end in view, namely, immobilization without undue compression of the part. I would not deny that it is possible to use plaster of-Paris as a dressing for fractures without harm, but I do hold that for its proper use is required a greater skill and experience and a higher grade of intelligence on the part of the surgeon than for any of the other dressings. To swathe a broken limb in plaster-of-Paris and to then trust in God for the result may be evidence of a sublime faith, but it is also frequently evidence of very cowardly surgery.

Plaster-of-Paris when used for fractured bones is applied either before or after swelling has taken place. If applied before, it constricts the seat of fracture, prevents the normal amount of swelling, and literally strangles the life out of the young callus; in a certain number of cases delayed union results. If applied after the swelling has taken place, it becomes loose as soon as the swelling of the soft parts subsides, motion of the limb in the splint and of the fragments of the fractured bone one upon the other is possible, and again in a certain number of cases delayed union is found when the splint is removed.

The treatment of delayed union in fractured bones I take from that most original and ingenious of surgical thinkers, Hugh Owen Thomas, of Liverpool. It consists in "hammering, damming, depending, and fixing" the bones involved in the fracture. Thomas first hammered the seat of fracture in March, 1874, with a copper mallet faced with rubber; later he protected the skin with basil leather and used an ordinary carpenter's hammer; he

now uses an egg-shaped wooden mallet. The hammering may be done with or without an anæsthetic, but should not be repeated at too frequent intervals. Probably once in two weeks is sufficiently frequent, though more observations on this point are needed. He first used damming in 1876, by means of a tourniquet applied intermittently for a period of ten minutes once each day. Gradually the duration of each *séance* was extended and their frequency increased until, in 1881, we find him employing continuous damming. To what point shall the interference with the circulation be carried is a question that will occur to you. I do not think I err in saying that it should be sufficiently complete to cause abundant œdema, but not enough to cause pain or interfere with the nutrition of the limb. In going over the thirty-nine cases reported by Thomas in 1885 we find a gradual diminution in the frequency and severity of the hammerings and an increased reliance upon damming, until now we find him damming all and percussing some.

The advantage of making the limb dependent has long been recognized and need not be dwelt upon here.

To properly immobilize the fracture is probably the most important of all; certainly none, except damming, at all approach it in importance. Delayed union may often be made solid by hammering, damming, and depending without any fixation at all; but if fixation be employed improperly, that is, so as to circumferentially constrict the fractured point, all the percussing and damming in the world will not be of avail. To properly fix a limb the bones must be held by a grasp which does not circumferentially constrict the seat of fracture, and the muscles covering the part must be lulled to rest by continuous fixed traction, and not nagged by an elastic or an intermittent traction; further, the joints which it is the function of these muscles to move must be absolutely locked. When a fracture exists in the bones of the leg, as in the cases reported, the knee and ankle must both be locked. The splint of Dr. H. H. Smith, of Philadelphia, figured

in most of our works on fractures, is open to the objection that it immobilizes neither knee nor ankle, and the caliper splint of Thomas is open to half that objection, in that it allows motion at the ankle. This fault I have endeavored to obviate in the splint which I have presented to you.

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