increased by the unremitting pressure exercised upon the diseased surfaces by reason of the contraction of the muscles surrounding the joints. This muscular contraction is reflex in character, and is excited by the presence of the disease within the joint. If this grinding of the injured surfaces together is not counteracted by extension and counter-extension, great destruction of the bony structures may take place, attended with unavoidable deformity.

The outer condyle of the femur is the part which, almost exclusively, suffers from the unintermitting pressure, caused by muscular contraction. The constant traction of the single muscle attached to the outer side of the limb keeps up pressure at one particular spot, therefore causes interstitial absorption more rapidly than the contraction of the four muscles on the inner side, because of their varying points of pressure; consequently the outer edge of the articulating surface becomes more rapidly disintegrated, and gives rise to abduction, eversion, and rotation, after the manner illustrated by Fig. 130, taken from a plaster cast. In addition to my own observations, I have found this statement amply confirmed by examination of many morbid specimens of this disease in the anatomical museums of Europe as well as those of this country.

Fig. 130.

The apparent scrofulous condition of these patients is simply in consequence of the exhaustion induced by the presence of a chronic joint-disease. If the disease is purely constitutional, it should be cured by internal remedies, but the use of internal remedies alone does not cure, and the case gradually grows worse, unless something is done to remedy the local difficulty, and the trouble will finally kill the patient by the irritation and exhaustive suppuration produced.

This is the usual termination of these cases when left to themselves, or when simply treated by the use of internal remedies. Cure may, however, and does sometimes take place with the limb distorted and the joint anchylosed, and in many instances the distortion is most surprising, as seen by these models. (*See* Figs. 129 and 130.)

Before leaving the study of the symptoms of this disease I wish to make special reference to *pain*.

In many cases disease of a joint may be recognized by the location of the pain which accompanies it, as, for example, the pain in hip-disease is frequently entirely referred to the knee. In a case of chronic disease of the knee-joint, you will always find the pain most acute and most easily developed by pressure at the outer portion of the head of the tibia, just over the insertions of the coronary ligaments. It is quite common to be able to make pressure over the whole surface of the joint without causing pain, if you will avoid this particular point; but, the moment pressure is made over either the internal or external coronary ligaments, more especially the external, intense pain will be produced.

This pain is distinct from that caused by suddenly striking the head of the tibia against the condyles of the femur, and also, distinct from that caused by the pressure upon the diseased articular surfaces produced by reflex muscular contraction.

Pain produced by pressure over the situation of the coronary ligaments has a special value as a symptom, for, by its presence or absence, we are able to safely judge with regard to the continuation or cessation of extension in the treatment, as pain can be developed at these points by a reasonable amount of pressure long after all other symptoms of joint-disease have passed away; consequently, treatment should be continued until a reasonable amount of pressure over the attachments of these ligaments can be borne without producing pain.

We will next turn our attention to the subject of treatment.

LECTURE XVI.

DISEASES OF THE JOINTS.—KNEE-JOINT (CONTINUED).

Treatment of Disease of.—Early Treatment.—Treatment in the Advanced Stages of the So-called "White-Swelling."—Apparatus for making Extension.—Mode of Application.

GENTLEMEN: At our last lecture we studied the anatomy of the knee-joint, the diseases which may affect this articulation, their causes and early symptoms, and also the symptoms which

are present when chronic knee-joint disease becomes fully developed. To-day we will commence the study of—

TREATMENT.—This part of our subject may be conveniently considered under two heads:

1. Treatment for the earlier stages of the disease.

2. Treatment when the disease has become so developed that the case requires extension and counter-extension, operative interference, etc.

We shall speak first, then, of the treatment to be adopted when a case is seen early.

The most important element in the treatment of injuries of the knee in the earlier stages is absolute rest; no matter whether the ligaments or the synovial membrane is the part chiefly involved, or whether there is extravasation of blood beneath the articular cartilages or synovial membrane. You may secure such rest for the joint in any manner you see fit. In many instances it is, doubtless, the safer plan to carefully adjust a posterior splint made of sole-leather, felt, or other material, according to the convenience of the surgeon, which shall extend along the upper portion of the leg and lower portion of the thigh, and hold the articulation and its surroundings perfectly fixed. Place the patient in bed at once and keep him there until recovery is well advanced.

If the ligaments are the parts chiefly affected, you will not ordinarily have much difficulty with the case. Sometimes simply applying a bandage around the knee will give sufficient support and secure sufficient immobility to meet all the indications. The posterior splint and bandage will certainly fulfill every indication. The joint may be kept wet with hot or cold water, according to which affords the greater relief to the patient. After a few days have elapsed, when probably most of the acute symptoms will have subsided, you may write for a liniment, if the patient cannot be induced in any other way to give the joint a liberal amount of hand-rubbing and passive motion. These cases are usually slow in recovering, and it may be well to communicate this fact to the patient at the beginning. Treatment should continue until pain and tenderness have entirely subsided. The principles of treatment are, perfect rest, hot or cold applications, according to the feelings of the patient, and firm compression. In a majority of cases, hot applications will be more agreeable. Compression can be secured by means of a roller-bandage, sponge

and bandage, or by means of the double India-rubber bag already referred to. The latter is the best mode, especially for the knee-joint. (*See* Fig. 131.) This bag can be partially filled with

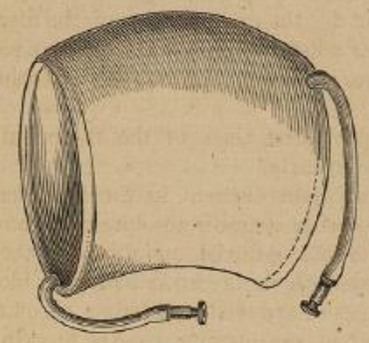

FIG. 131.

either hot or cold water, as may be indicated, and, then being distended with air, you have even compression, with the advantage of a hot or cold poultice as may be desired.

When, however, the synovial membrane becomes involved in the injury, either alone or associated with injury to the ligaments, a much more serious condition of affairs is present, and will in a majority of cases require a more active plan of treatment.

When the injury has been followed by effusion into the joint, next to absolute rest, *elastic compression* is the most essential element in the treatment. Place the patient in bed at once. It may be, and quite probably will be, necessary, in a majority of cases, to make some local depletion by means of leeches or wet cups before resorting to any measures for the purpose of promoting absorption of the fluid. The necessity of local depletion, and its amount, will be decided by the vigor, general health of the patient, and the degree of inflammatory action present, as manifested by increased heat about the joint, increased frequency of pulse, pain, and general constitutional disturbance. After local depletion, hot fomentations and elastic compression, secured either by means of a fine India-rubber bandage, or, still better, by the double India-rubber bag before referred to (*see* Fig. 131), will be of the greatest possible service.

If absorption of the fluid does not take place rapidly under

this treatment, counter-irritation may be resorted to by applying blisters above and below the joint. Never apply your blisters directly *over* the knee-joint, but apply them above the capsular ligament, and below the ligamentum patellæ. In addition, iodine-ointment may be applied over the joint, and covered with oiled-silk. Never use iodine locally in the form of tincture, for the reason that it is painful, the alcohol is soon evaporated, thereby leaving the iodine as a coating upon the skin which permits only a very small quantity to be absorbed. After the first application, succeeding applications are of no service as far as absorption goes; for they simply facilitate the destruction of the cuticle, and until this layer is removed further absorption of the iodine cannot take place. The objection to iodine, therefore, in the form of tincture, is that it renders but little service except when its effect as an escharotic is desired; but, used in the form of an ointment, scarcely any pain is produced, no exfoliation of the cuticle follows, and therefore absorption can go on, and in this manner the remedy renders continuous service.

When the acute symptoms have subsided, great benefit may be derived by freely shampooing the parts, slightly lubricated with cosmoline, vasoline, or any substance which will permit the hand to glide over the surface freely without producing too much irritation to the skin. Friction should be applied in this manner with very great freedom for from twenty minutes to half an hour at each sitting; and, while one hand is made to do rubbing *around* the joint, the other hand should rub up and down upon the limb above the joint, thereby greatly facilitating the absorption of the effused fluid. If the case does not yield to this treatment, and the effusion increases so as to make tension sufficient to paralyze the absorbent vessels, it may be necessary to aspirate the joint and remove all the fluid possible. In many instances, if only a small quantity of the fluid is removed, the tension upon the absorbent vessels will be relieved to such an extent that the remainder may be absorbed by the means already mentioned. This is an application of the same principle that governs us in the management of certain cases of ascites; namely, first, removing a portion of the fluid from the abdominal cavity in cases where great distention is present, and then resorting to diuretics, hydragogue cathartics, etc., for the removal of the remainder.

Before the aspirator came into use, it was the custom to make

a valvular incision through the integument and structures beneath it, letting the blade glide along until the joint was reached, and then plunging it in, and giving vent to the imprisoned fluid.

When the fluid is serous, or of such character that it can flow through the canula, aspiration can be employed with much greater advantage than incision with the knife. Sometimes, however, it happens that the fluid contains so much flocculent material that it cannot be removed by the aspirator. Under such circumstances no hesitation need be made with regard to opening the joint, and giving free discharge to the fluid. As a matter of course, puncturing this joint, as puncturing any other joint, is a very serious and, if not properly managed, a very dangerous thing to do.

If you puncture this joint for the purpose of withdrawing the excessive amount of synovial fluid, and puncture it in such a way as to admit air, the consequence will be very serious indeed, because decomposition of the contents of the synovial sac will take place and you will have excessive fever, and suppuration will be set up. I am not afraid of air; but I fear *imprisoned* air. Therefore, if compelled to make an opening which will permit the entrance of air, at once make it large enough and in such a position that the air can get out again. I wish to be distinctly understood about this matter, and I want to impress it clearly on your minds, that the success of the operation depends almost entirely on keeping out the air when you puncture a joint. With this precaution there is no danger whatever connected with it. When you have punctured the joint and are about to withdraw the canula, no movement whatever of the joint must be allowed to occur until it is, so to speak, hermetically sealed and locked. You must have for this purpose some plaster-of-Paris, leather, or starched bandage—anything on earth, in fact, which will, when applied on the posterior aspect of the limb, promptly solidify and prevent the least movement. Let me, also, impress upon you not to allow the joint to move until the external opening is perfectly united. If you do, the air will be sucked into the synovial sac in spite of your valvular subcutaneous opening. This precaution is very simple, but is most important for the safety of the patient.

If, on puncturing the joint, you find the fluid which it contains has already begun to change, has become converted into pus, then, instead of leaving it with a simple puncture, make a free incision, always cutting at the most dependent part of the sac, so that there

shall be no possibility of secretions being pocketed or otherwise retained.

As soon as it is discovered that reflex contractions are taking place, which if not overcome will terminate in the production of serious deformity, mechanical appliances which afford extension and counter-extension must be resorted to, and are always required.

Such reflex contractions will not only produce deformity, but will greatly aggravate the pain by bringing the diseased articulating surfaces into contact. Extension and counter-extension may therefore be necessary for the relief of pain incident to such muscular contractions. When extravasation of the blood has taken place at any point beneath the articular cartilages, which can be discovered only by firm compression of the articulating surfaces of the tibia and femur in all possible directions, and also upon the patella, and especially making pressure immediately over the insertion of the coronary ligaments, you should immediately resort to the treatment already indicated, perfect rest, and firm compression with the sponge and roller-bandage or double India-rubber bag, *after extension* and *counter-extension* have been applied.

By the use of this bag which I now show you (*see* Fig. 131), the pressure on the joint is maintained evenly, and there is no danger of pressing the ecchymosed surfaces of bone against each other. Pressure by this means is to be continued until absorption of the effused blood takes place, and until the patient can bear concussion of the bones, the tibia and femur, against each other.

When the disease of the joint, no matter in what particular tissue it originated, has advanced to a condition of suppurative disorganization of the structures, it is often attended with grave constitutional symptoms, such as sleeplessness, loss of appetite, great pain, and irritative fever. This condition is then generally spoken of as "white-swelling of the knee-joint."

Such a condition will require a much more systematic and prolonged course of mechanical and surgical treatment than has been indicated for the *prevention* of this advanced stage of the disease. One great indication in the case now is, to place the patient in a condition such as will permit him to have all the advantages of fresh air and sunlight, and at the same time be relieved of all irritation attending the constant attrition of the diseased articular surfaces. It is in this particular form of the

disease, therefore—inflammation of the articular tissues—that extension is of the utmost importance. I regard this principle as one of such moment that, were its practical application interfered with by participation of the tissues in the inflammatory action, I should have no hesitation in cutting them, for the tendons will heal by the time the articular surfaces have resumed a healthy condition.

Extension is especially important here, for the reason that, even when the tendons are not inflamed, the irritation produced by the inflammation within the joint invariably excites reflex action. The muscles contract, and thereby increase the compression upon the already suffering tissues within the joint, and if continued produce serious deformities, according to the direction in which the predominating set of muscles are drawing.

In looking over Sir Benjamin Brodie's works, I find he recommends positive rest, and that is all. But you may do this—you may rest the joint in splints—but you do not do all that is required. You may keep the limb perfectly still, and locked up in every conceivable way, and yet you do not overcome the tendency of the muscles to contract—you do not prevent the reflex action.

The result is the diseased surfaces are brought in contact; the pain is continuous, and the parts pressed upon undergo interstitial absorption. But when you give *extension* to these limbs, thus locked up by disease, you will give the patient instant relief.

I have been very successful in the treatment of this class of cases, and I attribute my success, in a great measure, to the fact that extension has been made a leading feature of my treatment.

Some people imagine that this extension means hitching on a pair of horses, and subjecting the patient to a sample of what some of the old-time martyrs endured. But you have seen in our clinical practice that all we want is simply enough extension to overcome the reflex contraction of the muscles, and to separate the diseased surfaces of the joint so far as to remove the pressure occasioned by their contraction. By doing this you relieve the pain. Of course, if you extend too much you injure instead of benefiting the patient; for, anything that has power to do good, has power to do harm, if indiscreetly used.

Remember, then, in the first place, that *rest*—permanent rest

of the tissues involved—is an essential part of the treatment. In addition to rest, *extension*, constantly and persistently employed until the patient is cured. Besides rest and extension, you want *compression;* but this must be employed after the two former, for compression of the joint, without first obtaining rest and extension, would aggravate the difficulty.

These indications are met by an instrument that I devised several years ago, which you here see. (*See* Fig. 132.)

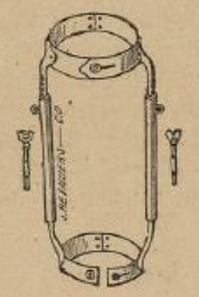

Fig. 132.

This instrument should be applied the moment there is any evidence that the disease has affected the articular structures, or reflex muscular contractions have been excited, which, if permitted to continue, will produce deformity.

When the joint is filled with liquid acting like a foreign body, as in the ankle-joint, it is advisable to give the patient the benefit of the doubt as regards being able to secure absorption, trusting that fixation of the joint in such a manner as will relieve the patient of all pain, and remove all pressure from the diseased surfaces, will diminish the amount of irritative fever, and give us the opportunity to build up and invigorate the general system, so as to render the absorption of the fluid practicable.

As long as there is any hope of preserving the joint intact, this instrument should be applied. The instrument consists essentially, as you see, of two sheet-iron bands or collars, connected by two bars so constructed that they can be made longer or shorter as required. The bands are about an inch in width, have a joint behind, and slots and a pin for fastening in front.

The hinge-joint at the posterior portion of the band that is to

surround the *leg* is made by cutting straight across the band, and then fastening the pieces in the proper manner for forming a joint. The hinge-joint at the posterior portion of the band that is to surround the *thigh* is made by cutting out a V-shaped piece, and then fastening the pieces in the proper manner for forming a joint. This V-shaped piece is removed for the purpose of securing a smaller circle at the lower edge of the band than at the upper, which will better adapt it to the natural tapering shape of the thigh. The band which surrounds the leg should be immovably attached to the side-bars. The band which surrounds the thigh should be attached to the side-bars in such a manner (by a single rivet or hinge) that it can be tilted about at pleasure, which permits the use of the instrument when the leg is flexed upon the thigh at a slight angle. The bars which connect these bands or collars are divided into two pieces, one of which carries the cog and the other the ratchet, by means of which extension

Fig. 133.

Fig. 134.

is to be made. The ratchet is moved by means of a key, and in this manner any amount of extension desired can be readily obtained. (*See* Fig. 133.)

So much for the description of the instrument, and now we

come to the method of its application. In the first place, if the limb is much distorted, the leg flexed upon the thigh, and perhaps the tibia partially luxated backward, as illustrated in Fig. 134, extension must be made, while the patient is in bed, until the limb is brought to nearly a straight position, before the instrument is applied. Such extension previous to the application of the instrument (as already indicated in cases of long standing when sublux-ation is present) must be made in two directions: 1. From the foot and lower portion of the tibia by means of weight and pulley, with the limb placed in such a position that the patient can endure the extension *without* suffering pain; and, 2. From behind the tibia upward and *forward*. (*See* Fig. 135.) It is all-important that such *double* extension be applied, for more than likely the direct extension from the foot will give pain until the *second* line of extension is brought to bear. This *double* extension can be applied to a limb, and *continued* when the limb is placed in the proper position, so that the extending force is brought to bear at a proper angle without giving pain. This proper angle must be found, which can be easily done by moving the limb about; and the extension should not be made until such position has been obtained. When this has been done, and the extension is

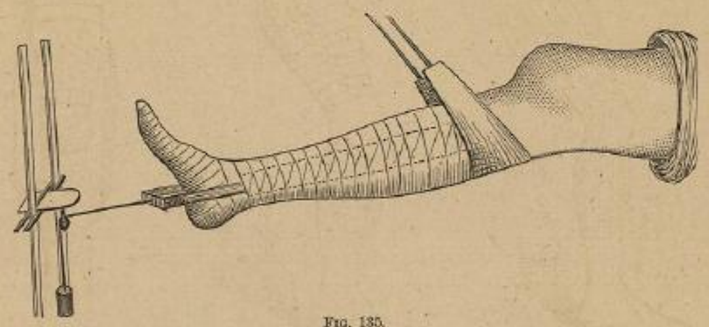

Fig. 135.

properly applied, the pain is immediately relieved. The apparatus for making the direct extension is the ordinary extending apparatus, consisting of adhesive plaster, roller-bandage, cord, and pulley and weight. (*See* Fig. 135.)

The second line of extension can be made by means of a cord fastened to the ceiling, or other apparatus such as the ingenuity

of the surgeon may devise. When the double extension, the two lines being made to gradually approach each other, has brought the limb into nearly the straight position, it is ready for the instrument, which is to be applied in the following manner:

Surround the leg with strips of adhesive plaster about one inch in width placed lengthwise, and reaching from the top of the tibia down to the ankle-joint, and secure them with a roller-bandage from the top of the tibia down to the point at which the lower band of the instrument is to be applied, leaving four or five inches of the lower extremities of the plaster loose, fastening the bandage with stitches. Next, surround the thigh with strips of adhesive plaster of about the same width applied in the same manner and extending lengthwise upon the thigh from the lower extremity of the femur nearly its entire length. Secure these plasters with a nicely-adjusted roller bandage from the knee upward to the point where the upper band of the instrument is to be applied, leaving the remaining portion of the plaster loose. (*See* Figs. 136 and 137.)

The limb is now ready for the application of the instrument.

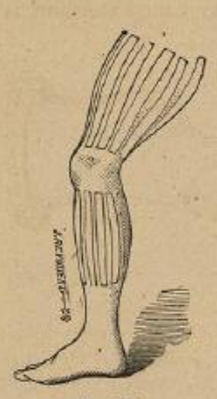

Fig. 136.

Fig. 137.

Fig. 138.

Place the instrument on the limb in such a manner as to bring the side-bars upon the same plane with the condyles of the femur, and place it in the hands of an assistant, to be held steadily in that position. The collar embracing the leg should be closed so as to closely engage the leg, but not sufficiently tight to

interfere in the least with a free return-circulation. Now reverse the loose extremities of the pieces of adhesive plaster, bring them snugly over the collar and upon the leg, where they are to be secured by a few turns of the roller-bandage which has just covered the foot and secured the upper portion of the plaster. Next press the lower collar down into the plasters which now engage it, and then secure the upper band about the thigh. This band you must recollect is attached to the side-bars in such a manner, like a swivel, that it can be tilted sufficiently to come in contact with the thigh and produce serious results, by pressure, unless it is properly secured. This can be done by taking one piece of plaster *behind* and another in *front*, at points exactly opposite upon the circumference of the limb, and reversing them in such a manner as to bring equal traction upon the collar posteriorly and anteriorly, which will balance it so that its edges will not come in contact with the thigh at any point. The band is first closed around the thigh only sufficiently tight to be comfortable. When this is done the remaining strips of plaster can be reversed without causing the edges of the collar to make pressure at any point, and all are then secured with a roller-bandage. (*See* Fig. 138.) Now we have the instrument fastened at its lower and upper extremity in a manner which will enable us to make extension and counter-extension to any degree required.

This is done by means of the key and ratchet on the bars of the instrument. The amount of extension and counter-extension required is that which is sufficient to produce perfect relief from all pain, or the possibility of producing pain by making concussion or pressure. This can be obtained by extending the bars first on one side and then on the other, until the desired amount of extension is reached, when the instrument is locked by the slide and retained there.

An important point to be remembered is, that you can do a good deal of harm by making too much tension upon the lateral ligaments. The point to be aimed at is, to make just sufficient extension and counter-extension to give perfect relief from all pain by pressure upon the articular surfaces of the joint, and no more.

If too great tension is applied, the patient will complain of a sense of discomfort. In either case, therefore, the countenance and feelings of the patient are to be your guide with reference

to the amount of extension to be applied. When the dressing is first applied, the plasters and bandages may so yield that the patient, soon after their application, again suffers pain. When this happens, extension is to be immediately increased, until the patient gives no response in his face upon the application of concussion or pressure. Now we have an apparatus applied to the limb, as you will see, which is competent to remove all pressure from the articulating surfaces of the joint.

If there are present any evidences of inflammatory action about the joint, such as may demand active treatment by leeches, cold or hot applications, counter-irritation, etc., your command of the joint is perfect, and such applications can be made as may be deemed necessary. If you wish to apply hot or cold, it can be done by means of a sponge and roller-bandage. Just here there is an essential element in practice which must never be lost sight of; for, if we should leave the limb as you see it with the instrument applied, so as to make extension, and do no more for it, it would be ruined. The boggy, infiltrated connective tissue which everywhere surrounds the joint, if left without proper support, would become more and more engorged by the bandages which have been applied until strangulation would take place, gangrene ensue, and the knee-joint and patient go together.

Compression, then, is an essential element in the management of these cases and must never be neglected, but is never to be applied until after the extension is properly adjusted. Then you must firmly strap the joint, first filling the popliteal space with cotton, old rags, or sponge, and, commencing below with the adhesive strips, go upward, shingling the joint, as it were, in such way as to leave no point uncovered. These adhesive straps must also be applied in such a manner as will make uniform pressure over the joint. You will not, however, strap the joint after this fashion until your instrument has been applied, and extension and counter-extension have been made; for, if applied before this has been done, the skin will be folded into pleats, and strangulation and gangrene may result.

Again, we wish to continue the *double* extension which has been applied to bring the limb into the present position, and this can be accomplished by carrying the bandage (after covering the knee just strapped) between the bars of the instrument and the leg, then over the bars, and under or behind the tibia in such

a way as to crowd the head of the tibia *forward;* and in the same manner above the knee, applying the bandage in front of the femur so as to crowd its lower extremity *backward*. In this manner you will at once see that we are putting into practical application, upon the instrument, the same principle we were applying when the double extension was used while the patient was in bed.

Now, if the patient be an adult, he will probably require the aid of crutches in walking, otherwise too great a strain will be brought to bear upon the plasters which hold the instrument in place; but, if a child like the one before you, he may go about without their assistance. As you see, he walks without any limping, by keeping his well knee stiff to match the diseased one, and has no pain whatever when the instrument is properly adjusted. Compare his present condition with what it was an hour since (*see* Fig. 134), and no argument is necessary to prove the value of the treatment (*see* Fig. 139).

FIG. 139.

Artificial support for these diseased knee-joints (which, if properly applied, removes all pressure from the articulating surfaces, and gives the patient perfect comfort; which can be worn for months, and, if need be, without changing) permits the patient to be out-of-doors, where he can obtain fresh air, the influence of sunlight, and, in short, to avail himself of all the hygienic measures which are to contribute so largely to his final recovery.

LECTURE XVII.

DISEASES OF THE JOINTS.—KNEE-JOINT (CONTINUED).

Treatment of Chronic Disease (continued).—Removal and Reapplication of the Instrument.—Passive Motion.—Protection of the Joint after the Splint has been removed.—Shall the Joint be permitted to anchylose?—Cases.—Operative Interference in Extreme Cases.

GENTLEMEN: In our last lecture we studied the method of treatment in the earlier stages of the disease and the mode of applying the instrument used for making extension in chronic disease of the knee-joint, and to-day we will first answer the questions, How often is the instrument to be removed and reapplied, and how long must it be worn?

It may be necessary to reapply it very often, if it has been carelessly or unskillfully applied, or if poor plaster has been used. For it must be reapplied just as soon as it fails to meet the indications, no matter if it is every hour in the day.

But, when the instrument is carefully adjusted, good plaster is used (Maw's moleskin), the skin *clean* and *dry*, and the plaster not warmed too much before it is applied, it may remain perhaps for three months, or even longer.

As long as the instrument maintains the proper amount of extension it need not be changed. When it does become necessary to readjust it, you must remember never to attempt to apply new plaster over the layer of dead epidermis which will be found if the plaster has been worn for a long time, for you might as well fresco an old scaly wall.

The instrument must be worn until the joint is well; until concussion, produced by bringing the tibia and femur together, does not cause pain; and until pressure over the coronary ligaments is painless. When this can be done, you may remove the