ART. XIX.—*Observations on Fractures ; being the Substance of Clinical Lectures delivered in the City of Dublin Hospital.* By JOHN HOUSTON, M. D., M. R. I. A., &c. &c,

THERE are, in this country, two very opposite courses followed in the treatment of fractures of the lower extremities ; one, which consists in laying the broken limb, during the first few days after the accident, in a flexed position, and, subsequently, either preserving the same posture all through the cure, or, after a given period, changing the bent condition of the limb for the straight posture : the other, that of placing the limb at once in the extended position, and applying, from the onset, an apparatus destined to keep it, all through the period of healing, immoveably in that state.

The respective advantages of these two plans have been frequently discussed, but, as it appears, without the establishment of any general bias in favour of either the one or the other. In the midst of this diversity of opinion, and absence of any specific rule of practice, I have attempted to put the several methods to the test of experiment, and shall endeavour, in the following pages, to make known the result. I propose, in the prosecution of this object, to state in the first instance, as briefly as possible, several cases in which these different plans of treatment were tried ; and, secondly, I shall attempt to draw from them such inferences as the facts, aided by physiological considerations, appear to justify.

I shall, in addition, describe, for the information of those who may be seeking after a convenient and efficacious apparatus for the treatment of fractures of the lower extremities, one which I have found to accomplish every desirable indication.

CASE I.—Joseph Woods, an old soldier, of sober and regular habits, admitted May 3rd, 1833, received a fracture of the bones of the left leg, by a kick on the shin from a horse drawing the car on which he was seated as driver ; he fell to

the ground, and in the fall the leg was much twisted and bent. He was brought to hospital immediately, with the limb in the following condition: there was an oval-shaped wound on the shin, between three and four inches long; the bones were both broken, and the tibia was extensively denuded of periosteum; the fracture was oblique, and the limb shortened for nearly two inches, but the over-lapping was not of the ordinary description: it was not the result of the slipping of one oblique surface over the other, for, by some application of violence, which cannot be explained, the lower fragment had got to the reverse side of the upper, from that at which the obliquity existed, and had passed a long way up its side, so that the two slanting surfaces of the fracture looked widely away from each other. The effect of this peculiar displacement was such as to render reduction impossible by the usual force of manipulation. The man suffered great agony from pain and spasms of the limb, and the hemorrhage was alarming. Amputation of the limb, or sawing off the projecting extremity of the bone, to allow of reduction, appeared at first sight the only alternatives; but before proceeding to either of these extremes, I determined to attempt by force the replacement of the fragments, and, accordingly, by means of a lac applied to the thigh of the injured side, and another to the leg, I exerted extension and counter-extension, as in a case of dislocation of the knee, regulating the force so as gradually to fatigue and overcome the spasmodic action of the muscles. A force equal to that employed in the reduction of the most obstinate dislocations, was for several minutes exerted, before the points of the fragments were got to pass each other, but finally the object was gained; the two flat surfaces of the fracture were brought once more into apposition, and on the instant of the reduction, the patient exclaimed that he was at ease. The nature of the resistance offered by the muscles in the reduction of this fracture, will be readily understood when it is considered, that in bringing the spiculated points of the bones across each other, so as to give them an op-

portunity of reaching the relative places which they had originally occupied, it became necessary to pull all the muscles of the limb, both flexors and extensors, to such a degree as to cause an elongation of them, at least one inch greater than they had ever before been subjected to ; and the sudden and almost complete subsidence of the pain, on the setting of the bones, is to be accounted for by the relief which the muscles experienced in being restored to their natural relative bearings, with respect not only to each other, but to the bones which gave them natural and due support. The agony which the man suffered had, almost solely, reference to the deranged condition of the muscles. The solution of continuity in the bone contributed, but in a minor degree, to its production.

The patient's limb was settled steadily in the extended position, the gaping wound was stuffed with lint, and kept wetted with cold lotion ; a large opiate was administered, and sleep encouraged. For a week, neither the limb nor the dressings were disturbed, and from the moment of the reduction he had not, during all that period, the least feeling of spasm ; the pulse never rose above 80 ; the tongue remained moist ; he had no thirst ; and by an opiate he slept the greater part of each night. On the seventh day it became necessary to change the dressings, and on the instant that the extension and lateral support, furnished by the pads and splints, were relaxed, the limb began to tremble, in spite of every effort to keep it steady ; all the muscles were seen to work in convulsions, and the man screamed aloud with agony.

The soiled dressings having been removed, and fresh ones substituted with as much expedition as possible, and re-applied as before, the spasms and pain again subsided, and the patient found himself once more at ease.

During the first three weeks, the condition of this man was much as has been described ; on every occasion in which the muscles were deprived of the artificial support given to them by the splints, in lieu of that which they had lost by the fracture of

the bone, they fell into painful spasmodic action, which was always, however, checked by the proper re-adjustment of the dressings. The wound threw out healthy granulations; the bone became gradually covered in, and, after casting off some trifling exfoliations, healed with the preservation of its original length and shape.

The great size of the external wound, which in the beginning made it appear so frightful, was no doubt of much advantage in the subsequent stages of the reparation, as it allowed a ready escape for the purulent matter which was formed in great abundance, and thereby prevented the formation of remote abscesses and fistulous passages.

The patient remained in the hospital for upwards of four months, and after a short visit to the country, returned into the service of his master. He is at present in excellent health, and competent to the discharge of constant and laborious duties.

CASE II.—C. D. M'Carthy, a shopkeeper, ætat. 31, admitted August 9th, 1835. About two hours before admission, when attempting to get out of a steam-carriage before the vehicle had completely stopped, he had fallen to the ground in such a manner that one of his legs got under the wheels, two of which passed in quick succession over the limb, breaking both bones in three places. The upper fracture, at the commencement of the middle third, was compound; the middle, about three inches lower down, was both compound and badly comminuted; and the lower, near the ankle, was complicated by extension into the joint. The leg was much shortened, and when laid on the bed appeared so deprived of support, from the lesion of the bone, that the foot lay completely on its inner side. It being the opinion of some present in consultation, that it was possible to save the limb, an attempt was determined on being made at the accomplishment of this desirable object. The limb was accordingly put into splints, in the manner represented in the annexed plate, leaving out only the tailed bandage; an anodyne was ad-

ministered, and the strictest quiet enjoined. For some days nervous tremors, which he could not control, often came over him; the pulse did not rise above 95, and he enjoyed a good deal of sleep. The limb was occasionally uneasy, but not actually painful; and he never suffered from spasmodic action of the muscles, although, in the general tremor, the injured limb took a leading part, and I have no doubt would have become convulsed but for the manner in which it was secured by the dressings. On the third day, a fungous mass suddenly sprung up from the opening leading to the middle fracture, insensible to the touch, about the size of an orange, and consisting, apparently, of lacerated and protruded muscle, mixed with grumous blood and a yellowish substance like coagulable lymph. On the fifth day the foot began for the first time to swell, and a red and tender line was formed along the tibia; the fungous mass became emphysematous, and discharged a sanious fluid; but it subsequently disappeared, having its place supplied by a surface of granulations. From the seat of the fungus the integuments sloughed all about the limb, for a breadth of about two inches. From this date, up to the 20th of the month, he had several exacerbations of fever; the swelling extended into and above the knee, and profuse discharges issued from the openings in the skin. At the seat of the middle fracture the limb at this period appeared to be nearly severed into two, the lower part being only held in connexion with the upper by the tendons, and probably also by the vessels and nerves, as the foot remained still warm, and as granulations were present in abundance on the surface of the lesion appertaining thereto. Long before this date the necessity for amputation became obvious, but from the amount of tumefaction present, it was considered that had the operation been attempted, it should have been performed above the knee, and as the man was most anxious to have the joint saved, the removal was put off from day to day, having due regard to the limit beyond which it might be unsafe to procrastinate. On the morning of the 22nd, a favourable

opportunity having presented itself, as indicated by a good night's sleep, together with a diminution of the swelling, and subsidence of febrile symptoms, the operation was performed below the knee, and within half an inch of the wound connected with the superior fracture. The circular amputation was that practised. The skin was brought together in a transverse line, and three sutures were inserted. In sawing away a portion of the anterior projecting margin of the tibia, to avert after-protrusion through the skin, the periosteum was found thickened and vascular, and in such a high condition of sensibility, that extreme pain was produced in the attempt at scraping it from the bone. The flaps, as was to be expected, did not unite by the first intention, but, nevertheless, by being held in contact for three days by the sutures, they acquired a fixed degree of approximation, which left only a narrow line to be healed by granulations, and after the cure was completed the cicatrix was scarcely larger than would have remained had the healing been accomplished by the first intention. This is an advantage which I have frequently found from sutures in operations giving rise to large flap-wounds, and which leads me, in almost all such cases, to their adoption. I have had occasion particularly to notice such effect in a case of amputation of the thigh, which I performed for a large incurable ulcer of the leg, but after which the patient died within a fortnight of inflammation of the veins of the limb. In this case, which had been treated by sutures, I remarked that, although no primary union had taken place, the flaps had acquired such a firm degree of approximation over the face of the stump, as to hold their ground after death, and even to spring towards each other, when let loose, after being held forcibly asunder.

My object, however, in noticing this case, has not so much reference to these latter circumstances, as to make it serve in illustration of the value of extension and steadiness of posture in warding off extreme sufferings, even in the most aggravated forms of fractures of the extremities. For, the remarkable ab-

sence of painful or other distressing symptoms in this individual was, to every one who saw him, a matter of astonishment. I should remark, in this place, that the third fracture, or that near the ankle, was only discovered in the examination of the limb after its removal from the body.

CASE III.—Bartholomew North, ætat. 36, admitted on the 13th March, 1834, with fracture of the fibula, about three quarters of an inch above the ankle. The injury was caused by the bending outwards of the joint in wrestling, and was remarkable in exhibiting an extremely sharp projection of the lower fragment, which gave the appearance as if a pointed nail were pressing from within against the integuments, and which rubbed along the surface at every movement of the joint. No degree of pressure had any effect in replacing the fragment; indeed so much pain was produced by the least touch against the projection, that no attempts at replacing or keeping it right by any manipulation of this kind could be made. Steadiness of position, and guarding, at the same time, against any hurtful pressure, by which sloughing of the skin, and conversion of the injury from the state of a simple to that of a compound fracture, were, therefore, the chief indications aimed at in the treatment. There was great swelling and pain, and blackness from extravasation of blood, amounting even to the formation of vesications; but no spasms, as may be observed generally in fractures of the fibula, and as deserves particularly to be noticed in this case on account of its peculiarly complicated character, in illustration of the views taken in a subsequent part of this paper respecting the cause of spasmodic action of the muscles in fractures of the extremities. Day after day we dreaded to find an opening in the skin, which was so thinned as nearly to permit the bone to be seen through it; but we were pleased in observing, that after about a fortnight's apprehensions the prominence became less threatening, and finally sank down, without being attended with farther inconvenience. The joint, however, for six or eight months remained weak, tender, and swollen. In

case No. VI., to be hereafter noticed, wherein there was a like projection of a spiculated bone, a similar escape from the conversion of a simple to a compound fracture, was effected by attention to a particular line of treatment.

CASE IV.—John Probart, ætat. 53, admitted with fracture of the right tibia and fibula, between the lower and middle thirds of the leg, produced by the fall of a heavy piece of timber against the limb. Brought in within an hour. The leg was slightly shortened, and in the ascent of the lower fragment beyond the upper, a piece of skin was tucked in between the bones, so as to give the appearance of a wound in the integuments. By extension the bones admitted of being restored to their natural place, and by the same effort the puckering of the skin was made to disappear; but both these conditions recurred the moment the extension was discontinued. The pressure of the end of the upper fragment against the inner surface of the integuments, in the shortened state of the limb, threatened the production of an opening in that texture, and a consequent conversion of the simple into a compound fracture; and it became necessary, on this account, in the treatment of the case, to exert, from the very onset, permanent extension. This plan of treatment was accordingly at once put in force, and from first to last, the limb never winced from a spasm, the fracture gave no pain, and the inflammation which followed scarcely deserved the name. Moreover, the patient made no complaint of uneasiness from the position which he was obliged so long to maintain, nor of inconvenience from the apparatus of extension applied on his limb. About the end of the third week he was obliged, on account of some family matters, to be removed to his home; and although he accidentally sustained a fall during his absence from hospital, union was accomplished on his return in the ordinary time.

CASE V.—Richard Gaffney, ætat. 18, was admitted into hospital September 5, 1835. On the preceding evening, while wrestling for amusement with a comrade, his leg was twisted in

such a manner that the left tibia and fibula were both broken about two inches above the ankle joint; he suffered greatly during the night from pain, tension, and startings, and when brought into hospital the lower part of the injured limb was much swollen, and the ankle joint appeared filled with blood. Several large purplish vesications had formed over the tumefied part. The pieces of broken bone were in proper juxta-position, and the limb had undergone no shortening. The splints and bran-pads were applied on the limb, with a foot-piece to steady the fragments; but the apparatus for extension was omitted, there being no occasion for it as the limb was not shortened; and, fortunately, as the swollen and vesicated state of the ankle offered a complete barrier to its application. Ordered,

Cold lotion, without intermission.

The same position of the limb was maintained throughout the treatment, and with the exception of the primary fever, and pain consequent upon effusion into the ankle joint, not a solitary unpleasant symptom arose. From the secure manner in which the limb was supported in the straight position, the man was enabled to sit up in bed, and even to turn on one or other side, varying his posture at pleasure, so as to obviate fatigue, without any risk of deranging the broken bones. He was discharged on the 23rd of October, complaining only of some stiffness and weakness of the ankle.

CASE VI.—James Cullen, a healthy labouring man, about 50 years of age, admitted March 11th, 1835. A few hours before admission, a cart wheel had passed over his left leg, producing a comminuted fracture of the tibia, and a simple one of the fibula, nearly midway between the knee and the ankle. A portion of bone, about one inch long, was loosened by both its extremities from the centre of the tibia, and so displaced, that the ends were turned in a direction transversely to the long axis of the limb. The sharp point of this displaced fragment projected on the inside, so as to be felt and seen pres-

sing against the skin, which at this spot looked thin and blue, as if certain of being converted by slough or ulceration into a hole, and thereby of transforming the accident from a simple to a compound fracture. The limb was much shortened, and when lifted up in the hands felt like a bag of loose bones. When allowed to lie without the application of any extending force, it was bowed forward by the action of the gastrocnemii, and other flexor muscles. The least disturbance of the limb, or even the motion given by a stop in walking on the floor, caused pain and spasm of the muscles. The case threatened badly. The limb was at once secured immoveably in the extended position, in the manner represented in the plate, and as soon as the dressing was completed, the patient began to express his gratitude for the ease which had been given him. For a few nights an opiate was administered, and cloths dipped in cold water were applied to the limb. This patient never, from the application of the first dressing to the completion of the cure, experienced a single spasm, he every morning expressed himself as having had a good night's rest, and when questioned closely on the point, he said that "sometimes on going to sleep, but not always, he was reminded of his broken leg by some trifling sting in the part," which leaves no doubt, that had the limb been left in the flexed position, or unsupported in any position, it would have been harassed by spasms of a much more aggravated nature. The pulse in this man did not at any time undergo the least acceleration, he had no thirst, no furring of the tongue, in short, no fever. Neither did the broken limb become at all swollen, or exhibit any marks of inflammation. So much was this the case, that the man one morning asked me, what perhaps may have been suggested to him by some conversation which he overheard among the pupils about his bed, namely, "was I afraid that there was too little inflammation about his leg to knit the bone?"

The first apparatus and dressings were not, with the exception of a little occasional tightening of the straps, as the leg

shrunk, changed for three weeks, when I deemed it necessary to make an examination of the state of the limb ; I then found it exactly as I had placed it in the first instance, and was much pleased to discover that the fracture was still a simple one. The sharp spiculum, from the projection of which I apprehended the production of an opening in the skin, had considerably receded, but not without having so far injured the integuments against which it pressed, as to have caused the death of that part, which, however, for about the size of half a sixpence, stuck as a dry scab in the opening which it filled up, and was not detached till the cure was completed. The bones had now altogether lost the crepitus, and there was a considerable degree of firmness about the fracture. The limb was again settled up as before, leaving out the bandages for extension, now no longer necessary, and allowed to remain so without being again disturbed for three weeks more, at the end of which time the union was found so complete, as no longer to require any further artificial support.

Certainly no mode of treatment founded on any other principle than that of setting the fracture at once in the straight position, and keeping it steadily and immoveably so, could possibly, in such an unpromising case, have effected a *more* rapid or perfect cure ; and there is reason to doubt whether any other plan would have been *equally* successful. Any disposition of the limb failing to check the spasmodic action of the muscles, would unquestionably have laid the foundation for a higher degree of fever and inflammatory action, and the almost certain perforation of the skin by the sharp bone which pressed against it, thereby opening up the fracture, and ending, perhaps, in the total exfoliation of that short detached piece, with all the evil consequences attendant thereon.

CASE VII.—James Carleton, ætat. 12, admitted on the 8th of October, immediately after the receipt of a fracture of both bones of the left leg, two and a half inches from the ankle. The limb was at once dressed, according to my custom, with

two long splints and corresponding bran pads; inflammation or spasm had not yet set in, and though there were neither internal medicines, nor outward lotions of any kind administered, during the whole period of his stay in the hospital, the union was completed in three weeks, without deformity, and without the occurrence of fever or local pain, or spasm. The only attention here paid was to the proper and steady adjustment of the broken bones.

CASE VIII.—Baines Deane, a workman in a calico factory, 30 years of age, on the evening of the 24th of October, in leaping over a wall, fell and broke both bones of his left leg, a little above the ankle. At a distance from the public road, and unable to make his melancholy condition known to the passengers, he endeavoured to crawl along, dragging his broken limb after, until at length, wearied and in pain, he was obliged to lie down in the open field, and, without hat or other outward covering, to bear the inclemency of a cold and rainy night. When discovered in the morning, and brought to hospital, he was shivering and feverish, and the leg and thigh were greatly swollen and livid; there was also considerable effusion into the cavities of the knee and ankle joints; and the spasms, which were frequent and severe, gave him much annoyance. About fifteen hours elapsed before the limb could be dressed. The leg was then placed in the straight posture, supported by splints and pads. In the course of the evening, the fever and the tension of the limb became so urgent as to require the abstraction of blood from the arm, and the administration of an active purge. On the following day, large vesications had formed all about the fracture, and in the course of twenty-four hours more, nearly all the cuticle from the knee to the ankle was detached, in some places with a subjacent effusion of yellow, in others of blackish serum. The vesications were punctured with a lancet, and the fluid squeezed out, but care was taken that no part of the cuticle should be detached: the limb was well supported, so as not to yield to any spasmodic action of the muscles; and

antimonials and cooling lotions were assiduously administered. After a few days, when the fever and local inflammation had abated, the cold was discontinued, and the vesicated part of the limb enveloped in lint smeared with ointment, to prevent the drying of the cuticle, and the contraction of any adhesion between it, and the surrounding bandages. The advantage of this treatment soon became manifest, for the patient made no complaint of any suffering except that arising from the pre-existing fever and inflammation. The cuticle served as the most appropriate application to the denuded cutis, which dried up, and formed new scarf-skin, as in the case of a blister, without the formation of a drop of purulent matter, a result which I scarcely anticipated, as in the generality of such cases which I have witnessed, abrasions of the cuticle have been followed by tedious superficial excoriations and ulcers, which embarrass the case, by giving rise to the necessity for a more frequent removal of the splints than is convenient or salutary. The union (November 25th) is already nearly completed, and the man promises to be cured in the ordinary time required for the reparation of a broken leg.

CASE IX.—James Toole, ætat. 38, was admitted July 11th, 1833, for a fracture of the right femur, about two and a half inches above the knee, caused by a heavy beam of timber falling against the thigh. The accident had occurred about six hours before admission, and the man had been carried for a distance of seven miles. The knee-joint became greatly swollen before the expiration of twelve hours, evidently from synovial effusion, as the patella was much elevated from the joint, and when pressed on with the fingers, sank back, so as to strike with an audible noise against the condyles of the femur. There was, however, no feeling of pain produced by this experiment, neither was the joint red, nor impressed with any of the other symptoms of acute inflammation. The symptomatic fever was also of such a character as to contra-indicate the presence of inflammatory action in the part. The limb was placed on the

double-inclined plane, and wetted with cold lotions. In the course of forty-eight hours a swelling formed along the outside of the thigh, extending from the knee to the trochanter. The patient could not bear the limb to be touched, and he was deprived of rest by distressing spasms which tormented him on every occasion of going to sleep. The tumour of the thigh increased rapidly, and threatened suppuration, which was, however, arrested by leeches, stupes, and antimonials. At the end of a fortnight, when the inflammation of the thigh had been subdued, and when the swelling of the knee had subsided, the limb was placed in the straight posture, and Desault's splints applied, gradually, from day to day, increasing the extending force, until the limb was brought to the same length as its fellow. Considerable complaint was made by the patient, of the inconvenience experienced from the lacs employed in making extension; but, as no excoriation followed their application, they were persevered in, until at length the relaxation of the extension ceased to be followed by shortening. Between the seventh and eighth week the union was complete, and in ten weeks the man was discharged, well in every respect, except as concerned the knee joint, the ligaments and other connecting textures of which were so unusually relaxed, as to allow of the tibia being bent on the femur in every direction. The joint was so weak and flexible as not to be able, without the aid of a knee cap or bandage, to support the weight of the body; and it was not before the expiration of twelve months that it regained its wonted strength. By this time, however, the man was completely well, and his limbs were of equal length.

This case is instructive in many respects. It teaches us that the treatment by the double-inclined plane will not prevent spasms, and that this apparatus does not act as an extending power; also, that there may be great effusion into a joint, independent of injury or inflammation of its cavity; and further, that at so late a period as a fortnight, it is possible to elongate a limb shortened by overlapping of the fragments. The

elongated and relaxed state of the ligaments of the knee was, no doubt, the result of the long-continued forcible extension.

CASE X. — M'Auley, ætat. 45, addicted to frequent excesses in drinking, was admitted into hospital on the 22nd of April, 1834, with a fracture of the middle of the left thigh, the consequence of a fall. The limb was placed on a double-inclined plane of the most approved construction, and the utmost pains taken to preserve it in a proper and steady position. There was considerable swelling and painful starting of the limb for several days. These symptoms, however, all subsided, but the patient remained restless and uneasy, and was much dissatisfied with his position. At the expiration of a month there was no sign of union, and even six weeks elapsed without any apparent advance being made towards a consolidation of the fragments, although the man did not exhibit any indications of derangement in his general health.

The limb was now placed in the extended position ; strong adhesive plaster was applied round the broken part, and some blue pill administered. A fortnight more elapsed, and still the broken pieces admitted of motion on each other. At this period a new and unexpected affection showed itself, namely, delirium tremens, in a paroxysm of which the man pulled off the splints, and leaped out of bed. In the effort at standing the limb yielded to the weight of the body, and was a second time completely bent at the fractured part. Having recovered from the delirium, the patient was removed to his own residence for change of air, and there, when he began to hobble about on stilts, having the thigh well braced with plaster and bandage, the union of the fracture was after a few months accomplished.

The failure in the process of union was not, here, for want of a proper apposition in the fragments of the bones, for the natural length and shape of the limb was not deranged ; I conceive it to have been the result of the preference given in this case to the plan of treatment by the double-inclined plane, over that wherein the extended posture and straight splints are had re-

course to. The grounds on which this opinion is founded are stated at a subsequent page.

The supervention of that affection, marked by all the symptoms which characterize the delirium of drunkards, and relieved by the treatment appropriate thereto, at so late a period as eight weeks from the time at which the man had totally given up the use of ardent liquors, and during all which he had never manifested any longing for indulgence in his favourite beverage, is, I believe, an unusual occurrence; and, that the affection under which this man laboured was none other than that just stated, may be gathered from the fact that he had previously had more than one attack of a similar nature, brought on by excesses in the use of ardent spirits. It is certain, however, that while in the hospital he had no opportunity of being supplied with such potations.

CASE XI.—Patrick O'Hara, ætat. 5, an extremely handsome, chubby boy, and born of healthy parents of large stature, was brought into hospital on the 14th of January, 1834, with fracture of the left tibia, produced by a fall, in running to escape from a dog which frightened him. His mother stated that the opposite leg had been broken in the same place, and from an equally trifling cause, about nine months before, and examination proved the truth of her statement, for, not only had it been broken, but bore evidence of a bad job in the reparation. The recent fracture became united, and the patient was dismissed from hospital by the end of the third week.

On the 26th of November, in the same year, he was brought back by his mother, in equally apparent good health, with a fracture of the middle of the right thigh bone, caused by a fall of the same simple description as in the former instance. From this accident he recovered as expeditiously and as completely as from that of the tibia, and went home well. But we were not a little surprised to see him again conveyed to the hospital on the 13th of August in the following year, labouring under a fracture of the only remaining unbroken long bone of his lower

extremities, the right femur. From this he, in like manner, had a complete convalescence, and is at this moment, only in his sixth year, in as good apparent health, and of as full and perfect growth, as any boy of his age. There is certainly nothing of *mollities ossium* in his frame, his bones being all straight and his joints fine; and that *fragilitas*, if it be such, should be present at so juvenile an age, is, I believe, a condition of bones which may fairly be placed among the "cases rares." It would appear, that in the reparation of the fractures, the bones acquired increase of strength; for whilst the lesions have taken the round of all the long bones of the inferior extremities, in none of them has it as yet occurred a second time. I give this case as a rare one, rather than that I consider it bearing on the conclusions to which it is the object of this paper to arrive.

CASE XII.—Ellen Kenny, ætat. 13, was admitted on the 17th June, 1835, with fracture of the right thigh, close beneath the lesser trochanter. Two days had elapsed before she was brought to hospital, and during this time she had been allowed to lie on the side, with the limb in the flexed position: No other mechanical means had been used to bring the bones into apposition, or to preserve them against being moved by the action of the muscles: the girl had in consequence suffered much from spasm; the limb was swollen to more than double its natural size; vesications had also formed on several parts of the skin, and there was severe symptomatic fever. The upper fragment, as is usual in fracture of this part, projected much forward, and gave to the thigh a curved appearance. The same position as that in which she had lain before admission was persevered in, and under the use of refrigerating applications, a considerable reduction of the inflammation was effected by the end of the fifth day from the occurrence of the accident; but, nevertheless, during all this period, a night-nurse was obliged to sit by the bed-side, with her hand on the

broken limb, which, otherwise, on every attempt to sleep, awoke the patient with a spasm. On the morning of the sixth day she was turned on the back; the broken limb was pulled to the same length as the sound one; permanent extension was kept up by Desault's splint, applied on the outside; a corresponding long splint was placed along the inside, and a short one was laid on the front, so as to make pressure on the projecting end of the broken bone: long pads of bran were interposed between these and the limb, and the whole secured together by broad straps and buckles, in such a manner that the limb was subjected, on every part, to moderate and uniform pressure. The business of altering the position of the patient, and of setting the fracture, was productive of much pain, and no doubt had the operation been practised in the first instance, not only would the amount of suffering caused by it have been comparatively trifling, but most probably the distressing spasms, and inflammatory swelling, borne during the first five days, might have been averted; for, from the moment in which the limb was settled, as has been just described, all tendency to deranged action of the muscles ceased, the girl slept soundly, and the tumefaction rapidly subsided; she expressed herself as much more comfortable in her new than in her old position, and got well rapidly, without any farther untoward symptom. She walked out of the hospital on the 20th of August, without any appreciable difference, as to shape or length, between the unbroken and mended limb.

The treatment, by permanent extension, of fractures of the femur, close to the trochanter, is not, it will be observed, that which is usually practised in such cases; but it was here most completely successful, and I might state other instances in which I have adopted it with equal effect. I might also mention cases of a similar kind, in which the plan of keeping the limb in a state of complete flexure, all through the period of healing, was followed by an opposite result.

CASES XIII—XIV. Two sailors, Frederick Whitney, and

William Rochford, about the same age, nineteen or twenty, were brought into hospital within a day of each other, in the month of August, 1834. They had both fallen from a height, in different ships, and had injured, one the right, the other the left elbow. On examination, it was clearly ascertained that the injury in one consisted simply of a fracture of the humerus, about an inch and a half above the joint; and that in the other, in addition to the same injury of the bone, a perpendicular fracture extended from the transverse one into the elbow joint. In the former case there was not much of local inflammation, nor constitutional disturbance; in the latter, the patient had shivering, paleness, coldness of the feet, and vomiting, immediately after the accident. The arm, and forearm also, became much swelled, and there was great effusion into the joint; but in neither instance were there any spasms.

In the former case, cold applications were found most appropriate, whilst in the latter, warm stupes gave most ease to the patient; but after the local inflammation had subsided, they were both treated alike, with the arm in the semi-flexed position. The result was, that they both got well about the same time, and with an equally perfect use of the elbow joints.

These cases have been all selected from among patients under my own immediate care in the hospital. Many others, of equal interest, have passed through the hands of my colleagues.

Amongst the symptoms arising out of fractures of the extremities, disturbing, in a marked degree, the patient, and demanding the attention of the surgeon, are *spasms* of the muscles of the injured limb. The time of accession of this distressing symptom is liable to some variety, but generally it appears in a few hours. It is most severely felt when the patient is falling asleep, causing him to start in a fright, deranging the broken fragments, and producing great pain. The least movement of the bed, or even the step of a by-stander on the floor, will often be productive of the same effect. The period of the

duration of spasms is not in all cases the same ; they usually cease about the sixth or seventh day, but sometimes go on for a greater length of time. A case has been communicated to me by Mr. Cusack, in which they were extremely severe, and terminated on the sixth day, in the production of general tetanus, of which the patient lost his life. Spasms are usually most severe when the inflammatory action runs high ; and this latter is no doubt aggravated by their presence.

The occurrence of spasms in a fractured limb would appear to be independent of any injury which the soft parts may have sustained from the accident. The largest flesh wounds are exempt from spasms ; whilst the simplest forms of complete fractures, those freest from lesion of the surrounding soft textures, are as liable as any others to be attended by this symptom. A spasmodic condition of all the muscles of a limb sometimes, it is true, follows a trifling wound of the flesh uncomplicated with fracture of the bone, but this is a peculiar disease, not admitting of a comparison with that irregular spasmodic action usually attendant on fractures of the long bones of the extremities, nor relievably by the same means.

The spasmodic contractions of the muscles surrounding a broken bone, appear to be wholly the result of the unusual condition into which these organs are thrown by the withdrawal of the customary support which they had received from the bone, in its unimpaired state, aggravated perhaps, in some instances, by the irritation of the spiculated fragments. But, that the former circumstance is more concerned in their production than the latter may be considered proved by the fact, that there are abundant instances of fractures, wherein the limb has been harassed by spasms, without the presence of any spiculated points to irritate the muscles ; whilst there are others, equally numerous, in which, the main bone for the support of the limb remaining entire, the presence of numerous sharp fragments, whether of bone or of substances equally irritating, has excited no such diseased action. Pointed spicula may, in a case where the long bones are broken, aggravate the spasms

attendant thereon, but except with such complication, they appear to have no power of originating spasmodic contractions.

An application of the laws which regulate the actions of the voluntary muscles, to the circumstances in which these organs are placed in the case of fracture of the bone on which they depend for support and fulcrumage, supplies an easy solution of the cause of their unnatural contractions under such circumstances, and points to the right method of prevention.

The actions of the voluntary muscles are principally regulated by the will ; the will, nevertheless, can only exert its influence upon them as long as the fulcra and levers, by which the natural movements of the limbs are accomplished, remain in perfect order. Let any of these levers be broken, as occurs in fracture of the tibia, or let the fulcrum at the upper end of this bone be altered, as by its dislocation from the femur, and the whole power of the will over the motions of the limb is destroyed. But this is not all : the muscles which retain unimpaired, their contractile powers, are, by the fracture or dislocation, thrown into a completely new predicament ; a predicament by which the usual fixtures of their extremities are loosened or changed, and by which, in many instances, their extremities are brought nearer to each other. The effect of such a change on these excitable organs, is to induce in them a perpetual tendency to contraction, and which will only cease when they have been restored to their original position, and furnished with their natural points of resistance, or after having been for some time accustomed to their new state. Then, only, it is, that the will will regain its natural ascendancy over them, and the tendency to morbid action subside. That involuntary spasmodic action will be excited in muscles, by cutting off or loosening one or other of their fixed attachments, is shown by a variety of facts ; and, among others, as the most applicable in illustration of the present case, may be mentioned the instances of spasms so commonly witnessed in the muscles of stumps recently after amputation. Here the contractions are of the same character,

and generated by the same temporary exciting causes, such as motion of the limb, or dozing asleep, as those attendant on fractures of the bones of the same member; and yet, in this case, there are no irritating spicula to account for their production.

I have mentioned the case of dislocation as a parallel instance to that of fracture, in producing an alteration in the relative position of the bones and muscles to each other, and thereby depriving the will of its power over the actions of the latter. But in this case it is not usual for the muscles to fall into a spasmodic state; and why? certainly, not because the tendency to such action does not exist, but, simply, because it is prevented coming into operation by the fixed and immoveable condition of the bones, resisting any further shortening of their fibres. Even in fractures of the extremities, circumstanced in this respect like dislocations, viz. where the broken bone is mechanically prevented from bending under the action of the muscles, as, for instance, in fractures of broad surfaces near joints, such as the condyles of the tibia or femur, or of the lower end of the humerus, (*see Cases XIII. XIV*); fractures near the trunk of the body, where the weight and length of the limb prevents its being turned to one side or other by such agency, as—in the case of the neck of the thigh bone or humerus; or in fractures of the extreme parts of the limbs, where one of the bones remains unbroken, to act as a resisting splint in support of the other, as in fractures of one of the bones of leg or forearm, (*Case III*), we scarcely ever hear patients complain of startings in the injured limb. Neither do we find that in similar injuries of the skull, pelvis, (*see the case of John Fortune in the last number of this Journal*), ribs, or sternum, any such symptoms ever follow in their train, no matter how comminuted or spiculated. The reason of the absence of this symptom in all such cases is, without doubt, independent of any peculiarity in the lesion of the bone, and solely attributable to the intervention of some mechanical support enjoyed by

the muscles, which has escaped unimpaired, notwithstanding the lesion of the bone, and which, by maintaining the tendons at fixed distances, thereby prevents the muscles from falling into spasmodic action. Partial support, or that which allows of a degree of motion in the broken bone under the action of the muscles, but which brings back the limb, after the contraction has ceased, to the same point at which the spasmodic action was generated, and thereby places it in a predicament to induce a repetition of the diseased motion, and to be again bent in the same direction, would appear to be worse as regards spasms, than no support at all. Thus, in fracture of the bones of the leg, where the weight of the foot, or the action of the extensors, restores, to a certain degree, the bones after having been bent during the spasm by the flexor muscles, a repetition of this spasmodic action will be sure to occur on the least revival of the excitement; whereas, in fractures of the patella or olecranon, and, perhaps, also of the os calcis, the loosened tendon of the appertaining muscle being drawn by a permanent state of contraction nearer its fixed extremity, the occurrence of such spasmodic exacerbations is seldom to be witnessed.

With these facts so fully established, namely, that no degree of injury unless accompanied by a fracture of a bone, is followed by spasms of the muscles, of the kind here alluded to—that no fractures of the bones in the body, except those of the extremities, give rise to those spasms—and that, even in the case of the extremities, if the broken fragments be naturally so circumstanced as not to admit of derangement from the action of muscles, there will be a complete exemption from unnatural spasmodic action, an obvious practical conclusion suggests itself, namely, that by imitating artificially the condition adverse to the development of spasms in either of these cases; viz. by restoring the broken fragments to their original places, and retaining them immoveably in that predicament, avoiding at the same time all hurtful pressure, a similar exemption from this harassing symptom may be obtained. Such anticipations are very plausible in

theory, and will, I believe, if the experiment is properly made, be generally realized in practice. The cases above cited afford several illustrations, not only of the possibility of preventing, by such means, the occurrence of spasms in fractures which otherwise would be liable to them, but also of putting a sudden check to their continuance after having fully set in. In Case VII., admitted half an hour after the accident, and placed into proper position on the instant, no spasms whatever occurred, although not so much as a cooling wash was brought to the assistance of the mechanical means employed; in Cases V. and VIII. the spasms which had commenced were instantly checked, even during the presence of high inflammation, by the security given to the limbs against motion; and in Cases I. and II.—bad compound fractures—the spasms were suppressed as long as the dressings were kept steadily on the limb, but showed themselves on the instant of their removal. There are cases, I admit, for I have seen such, in which it may be found impossible to bring the broken ends of the bone into apposition, and in which the means efficacious in obviating spasms under circumstances where no such complication exists, would fail in producing the same result; but such occurrences tend rather to establish my position than to subvert it, for if the fragments do not admit of being brought together, natural support cannot be provided for the muscles, and a continuation of the spasms may be expected. The case already alluded to, in which the spasms ran into general tetanus, was of this description. The protrusion of the bone into or through the muscles in its vicinity, is one of those conditions which, more than any other, militates against the replacement of the fracture. Mr. Cusack informs me that he has seen several such cases in which reduction could not, by any force or manœuvre, be accomplished, and in which the spasms were of the most aggravated description.

Intimately connected with the phenomena of spasms is the *pain* experienced by patients disabled by fractures of the extremities. Accidents of this nature often occur, in which, from

the receipt of the injury to the period of its reparation, little or no sensation of pain is felt in the injured part ; but, in such cases, it may be taken as a pretty general rule that there have been no spasms of the muscles. The treatment which had averted the one has contributed to the relief of the other. Pain is an essential concomitant of spasm in fractures, and the pain from this cause is the most distressing of any which such patients have occasion to complain of. The mere solution of continuity in a bone is not, in itself, necessarily attended with pain, for a limb is often broken without the individual being apprized of it at the moment, by the occurrence of any painful feeling, and the first intelligence which he receives of the precise nature of the injury may be learned from his inability to stand. The pain, then, attendant on the first stages of fractures may, like the spasms, be looked upon as a non-essential symptom of lesion in the bone, and, like that phenomenon, more or less relievable by treatment directed properly to the particular circumstances on which its presence depends. I have a notion that any pain experienced in simple fractures, except that attendant on excessive inflammation, is relievable by the same means as those which succeed in averting or removing spasms, and I always suspect, when a patient complains of much uneasiness after the fracture has been set, that the dressings misfit him in some way. In Case VII., which was settled up in straight pads and splints immediately after the accident, no pain was felt at any period during the treatment, and in all the cases managed in the same way, but in which the treatment was not undertaken until after pain had seized on the limb, the patients got almost instant relief by the dressings.

The *local inflammation* and *general fever* attendant on such accidents vary extremely in different instances, and are less under the control of treatment than either of the two preceding symptoms. In a simple fracture, that kind of attention which is successful in obviating spasms and other painful feelings will, no doubt, contribute much towards averting any excess of in-

flammatory action which the irritation produced by them must, otherwise, necessarily create. And, even in a case of comminuted fracture, when not much complicated by injury of the soft parts, if the limb be duly supported and maintained in a sufficiently easy posture to avert spasm and pain, it is possible for the patient to escape without inflammation or fever sufficient to deserve the names—a fact which is well illustrated by the case of Cullen, No. VI. There are, however, numerous collateral causes which may bring on severe inflammatory and febrile symptoms; such as severe injury to the soft parts, motion of the broken limb after the accident, exposure to cold, &c., and, in the treatment of which, the surgeon must bring to his aid the usual means resorted to in ordinary inflammatory affections. He will find, however, that the methods most successful in relieving spasms and pain in the more simple cases will be equally available, for the same purposes, even in such complicated accidents as these. Witness the good effects of combining the mechanical with the medicinal parts of the treatment in Cases I. II. VIII. X., &c.

These cases and observations being premised, I proceed to apply them to the consideration of the treatment of fractures generally; and in particular to the question of the relative advantages of one kind of practice over another. They will, I hope, assist in leading us towards a conclusion as to what is the best mode of preventing early spasms, pain, and fever, and of securing for the patient, after the cure, the most seemly and useful condition of limb—whether that of leaving the broken bone, during the first days, in the predicament in which it has been thrown by the accident, or that of bringing about, and securing, by artificial means, the proper apposition of the fragments, is the more likely to accomplish these objects. They may also enable us to draw a comparison between the advantages of the flexed and straight postures in the treatment of such accidents.

It appears to me that no advantage whatever is gained by leaving the ends of a broken bone in any manner out of place, whilst it can be clearly shown that such derangement is, in many

respects, injurious. The excuse for this practice, founded on the doctrine of relaxing the muscles to prevent or relieve spasms, is conceived in error. For, independently of the just and oft-repeated argument, that in the act of relaxing one set of muscles for the purpose of obviating such an inconvenience, the antagonists of these muscles are thrown into that very condition, viz. a state of extension, which, it must be presumed, by holding to the same argument, promotes spasmodic action, it is a fact that relaxation of the muscles, having a tendency to spasmodic contraction, excites and promotes such contraction; whilst, on the other hand, extension or stretching of the same muscles will be found the most likely means of averting the spasm, or of subduing it when the action has taken place. It is, for instance, known to the experience of every one that in the spasmodic action of the gastrocnemius, which follows over-exertion of that muscle, relief is sought in an attempt at elongating the muscular fibres by stretching out the heel, and not, in encouraging their contraction, by pointing downwards the toes. A person, in bed, seized with such cramps, will, instinctively, press the heel of the affected limb against the foot-board, or get out of bed, in order more effectually to accomplish the same object, by standing with the heel on the ground. In this case it is obvious that relaxation of the muscle is favourable to the occurrence of spasm, and that extension constitutes a means of relieving it from that state.

The primary cause of spasms of the muscles in fractures appears to be the loosening of one or other of their fixed points of attachment, and it is not likely that by leaving them in the loosened state, or by giving one set of the muscles a greater degree of relaxation than another, such as is given to the flexors by bending the limb in their favour, a check will be given to irregularity in their movements. On the contrary, it would appear, both from an examination into the laws of muscular contraction, and from observations of the phenomena which occur in other cases of disease as well in fractures, that the more

completely the muscles are extended in length, and secured by their extremities to unyielding points, the less will be their disposition to spasmodic action. A striking illustration of this point lately occurred in our hospital under the care of Doctor Benson.

A young woman, labouring under white swelling, with ulceration of the cartilages of the knee, but in whom the joint was to a certain extent very moveable, on account of a relaxed state of the ligaments, and effusion into the cavity, became affected with the most excruciating spasms of the limb, accompanied with pain, which forced from her heart-rending screams. The flexor muscles appeared to be those most engaged in the spasms, as the knee, on every occasion of starting, was raised in a bent direction from the bed. She suffered in this way for nearly three weeks, during which sleep scarcely ever closed her eyes, even under the fullest doses of opium; for notwithstanding the soporiferous influence of this medicine, she was continually roused at the instant of slumbering by a violent spasm of the limb. Neither had local bleeding, counter-irritation, or the application of anodyne liniments, the least effect in appeasing her sufferings. Under these circumstances it was determined to try the experiment of treating the case as one of fracture attended with spasms. A tailed bandage was accordingly applied around the knee with uniform and moderate pressure, and long bran-pads and splints were so adjusted as to prevent the possibility of any motion in the joint or limb; abstaining at the same time from all other medicinal treatment. The practice was most successful; for, from the instant of its adoption, the spasms completely subsided, and all pain ceased. Under a continuance of this plan the patient lay contented and at ease, until anchylosis of the joint was accomplished.

That the relief obtained in this instance was solely the result of the mechanical resistance and support given to the muscles, is proved by the circumstance, that on every occasion of removing the splints, the trembling, spasms, and pain of the limb,

returned with equal violence as before, and continued until the re-adjustment of the artificial support, as was noticed to have occurred in Case I. of fracture of the bones of the leg.

Connected with the question of the relaxation or extension of muscles, as encouraging or preventing spasmodic action in their fibres, is a point which should not be lost sight of in the investigation—namely, the great increase of facility for contraction given to the flexor muscles by bending, or, as it is termed, relaxing the limb, and the proportionate abstraction from the power of the extensors which attends on such posture: for, it is a well known principle in the mechanism of the limbs, that the more the bones approach to the side of flexion, the greater becomes the power and facility of the muscles to move them in that direction, and that the power in the extensors of resisting such contractions are weakened in the same proportion. The power of the flexors, on the levers which they move, is at the minimum in the extreme of extension, and at the maximum in the extreme of flexion; whilst that of the extensors, on their levers, is at the minimum in the extreme of flexion, and at the maximum in the extreme of extension. The practice, then, of placing a broken limb in the bent posture is not that which—reasoning on the nature of the muscles, or their relation to the levers which they move—we should expect to be most successful in averting or checking spasms, for by such posture the most powerful set of muscles, the flexors, are brought into a predicament not only exciting to, but favouring the energy of their contraction; whilst the less powerful, their antagonists, are brought, thereby, to a state in which their influence, in counteracting the effects of such contractions, is nearly in the same degree weakened. And, of the correctness of this reasoning, we may find a corroboration in the fact, that the distortions from spasm which occur in such cases are almost always to the side of the flexor muscles.

Moderate, soft pressure on the surface of a fractured limb appears to assist in the prevention of cramps in the long muscles;

on the same principle that proper fixtures for the attachment of their distal extremities contributes to that effect. Such pressure may exert its beneficial influence, in controlling any irregularity of action in the muscles, by numbing their sensibility, and producing in them a certain amount of fatigue which weakens their powers of contraction, as well as by propping together and keeping steady the broken fragments of the bone. And, is it not much better, if the object can be gained by such means, to adopt them in preference to the practice in common use of employing a nurse-tender to sit by the patient, with authority to check the painful startings caused by the spasms of the muscles, by pressing with her hand on the injured limb? The uniformly good effect which attends on, and leads to the frequent adoption of this last-mentioned device, may, in itself, be regarded as an argument in favour of the value of mechanical interference in such cases, and should lead to the contrivance of some less expensive, and more trustworthy plan of accomplishing the object.

Such being my views respecting the physiology of muscular action, as applied to fractures of the extremities, and such my experience of a practice founded in accordance therewith, I need scarcely say that I concur fully in opinion with the advocates of the extended posture, accompanied, if necessary, with extension. Several of the cases which I have given, and others which I might add, show the efficacy of this practice in preventing the occurrence of spasms, inflammation, and fever; and others go to prove its utility even when circumstances have prevented its adoption until after the occurrence of these symptoms. In the former, no such consequences followed at all, even under the most threatening conditions; in the latter, they were either altogether checked, or very much mitigated in severity, from the moment of its application; and, in all, the final result was most satisfactory.

The apprehensions entertained regarding the prejudicial effects attendant on forcible extension, such as pain, excoriation,

sloughing, &c. of the integuments, I have never seen realized in practice. The apparatus of Desault, modified, as described hereafter, and represented in the plate, I have employed, over and over again, without its being productive of inconvenience in any of the cases, except in that of Toole, No. IX., in whom the extension, although applied so forcibly as to give rise to relaxation of the ligaments of the knee, was kept up for weeks without the least abrasion of the skin.

But, in addition to these advantages, connected with the extended position in the treatment of fractures of the lower extremities, the adoption of this plan is beneficial in other important respects. The patient becomes sooner reconciled to the bed in this posture than in the flexed one; he can be shifted more readily, so as to vary the points of contact between his body and the bed, and thereby save himself from excoriations or sloughing of any part; he can assume the sitting posture, and maintain it, with less of fatigue, for a considerable time. A better judgment may be formed of the length and shape of the broken limb, by its admitting of a comparison with the sound one; the limb can be kept more steady; and extension, if necessary, can be more readily and effectually practised.

Many advantages attend on an early and perfect coaptation of the broken fragments. The patient will experience much less pain from the operation of setting, in the first moments after the accident, than at any subsequent period; and, if we are privileged to form a conclusion from a single case, it is obvious, from the success attending the practice in that of Woods, No. I., that we need not be apprehensive of damage from the exercise of a very considerable force, should it be found necessary towards the accomplishment of this object. By leaving the fragments out of their proper place for any number of days, the morbid sensibility, generated in the periosteum by the super-vention of inflammation, aggravates the sufferings attendant on the operation of re-setting, and the tendency to spasmodic action in the muscles; which had, perhaps, somewhat subsided by

the habitude which these organs had acquired in their new position, is, by the second change, kindled anew into action. The extremely sensitive state of the periosteum, under such circumstances, was well shown in the case of M^cCarthy, No. II., in whom amputation was performed for a compound fracture fourteen days after the accident. This man, though he went through the whole operation without uttering a complaint, could not refrain from screaming when the periosteum came to be scraped off the tibia, which was done with a view of sawing away the anterior projecting angle of that bone, to prevent after-protrusion of it through the skin on the stump. And that severe spasmodic action will also be the result of every attempt at extending a fractured limb, after having lain for any time in the flexed position, is a fact so generally known as to require no particular case for its illustration. But nevertheless, even with the certainty of giving rise to temporary suffering of this kind, I would not be deterred from the operation, having often found, even after spasms, pain, and high inflammation had set in, by bringing the broken fragments properly together, and placing them so that no motion could take place between them, that a check has been given to the cramps of the muscles, and relief from pain procured. The momentary suffering caused by such a procedure will be amply repaid by the subsequent ease, and good final result.—See Cases I. II. VIII. XII., &c.

The *double-inclined plane*, the apparatus in most common use for the treatment of fractures of the lower extremities, does not appear to me exempted, in any considerable degree, from the ordinary inconveniences attendant on any other plan of treatment which has for its object the principle of relaxation or flexure of the limb, whilst it is almost totally useless as a means either of effecting elongation of a shortened bone, or of giving, in many cases, steady support to the member. Besides, it throws the weight of the body so completely on one part of the buttock, and by its bulk and shape so deprives the patient of the means of relieving himself from such injurious pressure,

that excoriation and sloughing of the hips are frequent consequences of its use.

In fractures of the tibia and fibula, I can scarcely conceive a case in which all the indications of treatment would not be more completely fulfilled by the straight posture, with soft, lateral pads and splints, by which the bones can be retained steadily in apposition—extension, if necessary, applied—spasms of the muscles prevented—the limb and body shifted about, or even turned for a time on the side—and a proper measurement of the limb be made, than by the inclined plane, under the use of which fixed extension cannot, to any amount, be exerted, nor that position of the muscles established by which their tendency to spasmodic action is subdued, which confines the body in a fixed, uneasy posture, and takes out of the hands of the surgeon the means of judging of the accuracy of adjustment in the fractured bones. For, respecting the powers of extension and counter-extension attributed to the inclined plane in fractures of the leg, there can be no doubt that they have been over-stated, both as regards the influence of the weight of the foot acting upon the knee when bent over the middle elevation of the plane, and as regards the resistance which that elevation gives, in case the foot be pulled downwards to any resisting object; for, it is the fact, that in the former case the suspension of the foot is not such as to make it act by its weight in producing extension; and that, in the latter, the least effort of the patient—no matter how well the apparatus be adjusted—will advance the knee in front of the elevated angle, and thereby nullify the resistance which it is supposed to offer against the extending force applied at the foot. Any attempts, therefore, at extension by means of the inclined plane are not, in such cases, to be fully relied upon.

In the treatment of fractures of the thigh, the objections to the inclined plane are even more numerous; for, in addition to those urged against its applicability to injuries of the bones below the knee, there is one, which only requires to be mentioned to

have its force recognized, namely, the absence of any provision in its construction by which the upper fragment may be steadied against the lower, especially in cases where the lesion in the bone has taken place near the trochanters. The lower piece, together with the knee and leg, are immoveably fixed, whilst the upper is left in such a predicament that the least movement of the buttocks bends it from side to side, and rubs and twists its broken surface against that from which it has been detached, and with which it is the chief object of the treatment to keep it in steady apposition. There is no provision in the inclined plane by which the upper part of the thigh, when bent upon the pelvis, can be secured against the motions communicated to it by that part, such as may be effected in the extended posture by long splints and pads, passing up on the inside close to the perineum, and on the outside as far along the body as may be thought necessary, securing, thereby, all the parts, so that in any movement which is made, all must go together, as if they were one solid piece. The failure in the process of union, which occurred in the case of M'Auley, No. X., I attribute solely to this ground of imperfection in the inclined plane—the apparatus used in his case. The usual objections to the adoption of the straight posture in fractures below the trochanters, on account of the tendency in the upper fragment to be pulled forwards by the psoas and iliacus muscles, are not of universal application; as I have given a case, that of Kenny, No. XII., in which, under this plan, no more difficulty attended the treatment, and no more deformity remained after the cure, than in fractures of any other part of the bone. The projection forwards of the upper piece, so remarkable in the first days after the accident, gradually subsided, under gentle pressure on the forepart of the thigh, and the bones finally assumed their natural points of connexion with each other. By the adoption of the extended posture, with the aid of extension, that deformity, so common in fractures of the thigh—permanent eversion of the toes,—and, I believe, also, that of shortening of the limb,—will

be more probably averted, than can be done under the best directed efforts of the double-inclined plane. By the same plan, likewise, an inconvenience, of which patients often complain bitterly, viz. pain and excoriation of the heel, may, with the aid of a narrow pad between the limb and the bed, a little above the heel, be easily obviated.

These observations are not, in any degree, meant to apply to fractures of the neck of the thigh bone, in which, the possibility of osseous union being very remote, if not altogether questionable, the less of constraint put upon the patient or his limb, so much the better.

Respecting the failure of union, which is observed to occur occasionally in fractures of the bones, I am inclined to believe that our knowledge of its cause is very unsatisfactory. The doctrine that want of inflammatory action will be attended with a corresponding imperfection in the secretion of callus, is far from being well established; for, if ever there was a case exhibiting complete absence of all the symptoms indicative of inflammation, it was that of Cullen, Case VI., in whom, from the receipt of the injury to its final cure, neither pain, nor swelling, nor cramps, nor fever, at any time showed themselves: and, nevertheless, in this man the bones, though badly comminuted, became united in the ordinary course. In a case, the preparation of which was presented, by Professor Kirby, to the Museum of the College of Surgeons, I have met with a singular illustration of this point. An old woman, from a fall, sustained a fracture of the thigh bone, and after lying in hospital for several months, without having had much occasion to complain of suffering, the leg was surrounded by adhesive plaster, and she became enabled to walk about by the aid of crutches. She did not, however, long survive her convalescence, and upon examination of the limb after death, it was discovered, that, in addition to a transverse fracture of the middle of the thigh, a perpendicular one, four inches in length, ran up to the trochanter. The transverse lesion exhibited a perfect false joint, with

fibrous capsule, and synovial membrane, whilst the portion detached by the perpendicular fracture had become firmly and universally united to the original bone, in a manner which showed that the union must have been accomplished in a very short period from the receipt of the injury. The explanation usually given of the cause of such a failure, want of sufficient action, will not hold good in this case, as the action was fully competent to the reparation of the lateral fracture, though it failed in the transverse one. Want of proper apposition, and the frequent occurrence of motion between the two main pieces of the bones, were, more probably, the causes of non-union at this part. In my own case, that of M'Auley, No. X., I have no doubt that such was the cause of the want of union. Professor Kirby has also stated to me an instance of a middle-aged man, in whom almost every long bone of the body had been broken, at one time or other, from trifling causes, but, notwithstanding what might be called, in this case, great weakness of the system, all these accidents were repaired with very little suffering, and in a moderately short space of time.

Neither does an excess of healthy inflammation appear to militate in many cases against the formation of healthy callus. In illustration of this circumstance, reference may be made to the case of Deane, No. VIII., in whom, although the inflammation and fever ran so high as to require active depletion, yet, nevertheless, the process of reparation was not retarded or rendered imperfect.

The apparatus which I am in the habit of using for the treatment of fractures of the lower extremities, in adaptation to the principles here laid down, is extremely simple and cheap. A representation of it is given in the plate annexed to this paper. It consists of a tailed bandage, two long lateral splints and splint-cloth, two calico bags containing bran, and broad straps with buckles, together with a foot-board, and, if necessary, lacs of calico for the purposes of extension.

The tails of bandage may be two inches and a half broad, and about two feet long. They should be applied neatly around the limb, with due regard to tightness, beginning from the foot. In a case of fracture of the thigh, the whole limb should be enveloped by them. The application of this bandage tends to steady and support the muscles, and if much inflammation be present, it may, when very lightly applied, be of use in conveying discutient washes. In a case of compound fracture, the bandage may be left out, to facilitate the discharge of matter, and to permit the application of poultices or dressings, without disturbing the other parts of the apparatus. The splints may be made of deal, of sufficient thickness to prevent their bending, and varying from two and a half, to three and a half inches in breadth, according to the thickness of the limb to which they are to be applied: they should be of equal breadth, as otherwise the limb will turn to the side of the narrow one. In case of a necessity for permanent extension, the external splint should be made as directed by Desault, with a hole and notch at either end, by which to fasten the lacs, and it will be advantageous, here, to have this splint of sufficient length to mount well up along the side of the abdomen, as the higher the point to which the lac is fastened, the more effectually will the extension be exerted in the axis of the limb. The superior extremity of the inner splint should approach as near the perinæum as circumstances will permit; in applying it to males, it may go somewhat higher than in females; its lower end should be made to project exactly to the same distance beyond the foot as that of the outer, as any inequality in this respect will be found to throw the limb to the side of the shorter one.

The splint-cloth should be about two yards long, and of sufficient breadth, when applied transversely under the leg, to reach from the heel to the top of the inner splint. The splints are to be rolled in this cloth, from the ends towards the centre, in such a manner as to leave sufficient space for them to be turned on their edges at the sides of the limb, and to hold be-

tween them and it, the pads of bran : it will be found advantageous to roll up the splints in the cloth, so as to bring them nearer each other at the lower than at the upper part of the limb, in accommodation to the difference of its thickness in these regions. The pads may consist of bags of linen or calico, half filled with bran, about one-third broader than the splints, and of sufficient length to extend from the sole of the foot to the top of the inner splint. The external may be somewhat longer than the internal. The leg being held up, the pads are to be arranged lengthwise on the splints, and the bran which they contain is to be apportioned in quantity, in different places, to the irregularities of the contour of the leg. The inner edge of each pad should be made to project towards its fellow, beyond the margin of the splint, by which means, when the leg comes to be laid on them, they will form a cushion underneath it, supported by the splint-cloth ; the outer edge should be brought on a level with the corresponding margin of the splint. The limb, well extended by two assistants, should be now laid down, and the splints and pads turned up along its sides. The act of turning up the splints should be accomplished quickly, as, otherwise, the bran will gravitate to the lower edge of the bags, and thereby fail in admitting of proper adjustment. The space between the edges of the splints, resting on the bed, and held together by the splint-cloth, should be exactly such as to allow the boards to lie parallel to each other, when turned up along the sides of the limb. The whole being thus properly arranged, they are all to be secured together by three or four broad straps and buckles.

When shortening of the limb requires the exertion of an elongating force for its removal, the application of extension, on the principle recommended by Desault, will best accomplish the object. But for the purpose of preventing excoriation of the groin, the upper lac or band for counter-extension should be filled, in a bag-like form, with bran, at the place where it is likely to exert most pressure. The ends of this lac should be

long enough to be carried round the abdomen, after being fastened to the top of the splint, as, by so doing, the splint will be effectually secured to the side. In order that the extension at the lower end may be made as much as possible in the line of the axis of the limb, it will be found advantageous to draw the lac through a hole or slit in the centre of the foot-board, which will thereby serve as a pulley to give the lac a perpendicular direction, before being turned towards the extremity of the outer splint, to which it is to be fastened. A piece of leather, introduced between the ankle and the lac, will save the skin from the injurious effects of pressure. The lac may consist of a long strip of calico, doubled up several times, into a breadth of about an inch and half, and smoothed so as to make it lie flatly. The mode of its application may be that usually practised for the reduction of dislocations, by which, extension is made equally from both sides of the member. A foot-piece, to support and steady the toes, is an essential part of the apparatus, as it not only affords great ease to the patient, but contributes to preserve the permanent immobility of the fragments. The application of it may be accomplished by a simple contrivance. A piece of board, the length of the foot, may be propped up against the sole by means of a couple of small bars of brass or other material passed, as represented in the plate, transversely through holes in the lateral splints. A number of such holes should be bored along the margins of the splints, previous to their application, into any of which the bars may be inserted, according to the elevation required for the foot-piece. Screws fixed in the ends of the bars will serve the double purpose of preventing the bars from slipping out, and of assisting in giving steadiness to the side splints. It is necessary to introduce a pad between the foot and board to obviate a disagreeable feeling of heat, of which the patient will be likely, otherwise, to make complaint. In fractures of the tibia, where extension is not called for, the lateral splints need not be of such length; but, in all cases, they

should extend above the knee, and sufficiently far below the foot to admit of the application of the foot-piece.

Such an apparatus, as this, can be procured at a moment's notice; it looks neatly when applied; is borne without inconvenience by the patient; and fulfils all the objects to be aimed at in the treatment of fractures of the lower extremities.

The annexed plate gives a representation of a limb dressed, in a case of fracture of the tibia, in accordance with the description above given. The drawing is so perfect and intelligible as to render any farther explanation of it unnecessary.

It may be said by the advocates of the flexed position, that I have not given this plan a fair trial, that I have adopted and advocated the treatment by the straight posture, rather than fulfilled the object which I set out to accomplish—that of drawing a parallel between them. But I contend that such objection is not founded in fact. I have not, certainly, selected a given number of cases, treated throughout by one method; and placed them side by side, with a corresponding number treated in the opposite way. But I have given cases, in which the plan by extension gave instant relief from suffering and deformity, after the flexed position had failed in accomplishing the same desirable object: I have adduced others wherein the plan by extension, from the first, produced beneficial effects, which could not have been obtained by any mode operating on the principle of relaxation: I have, finally, endeavoured, without any bias, other than that in favour of truth, to determine, from physiological considerations, the respective influences of these two opposite postures on the occurrence of spasm in the muscles, and derangement in the fragments of the broken bone: and, the conclusions which I have arrived at, appear to me not only consistent with the facts which I have advanced, but, also, with good and rational practice.