NOTES RESPECTING
NON-UNITING FRACTURES.

BY

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WHAT Mr. Bransby Cooper says respecting certain injuries, "how rarely, even in remote districts, are now to be noticed dislocations remaining unreduced through ignorance of the nature of the injury, or of the means to be employed for their reduction," ought to be applicable to these fractures, for their occurrence is not creditable to surgery. They are most unfortunate cases, especially when the lower extremity is involved.

There is a woman, now *æt.* 43, on our Coburn fund, whom I see from year to year, who broke her leg in the summer of 1852. The fracture of the tibia was very oblique, extending from its upper third to just above the malleolus. Neither bone united, and she now limps with a fixed ankle. If she tried to flex or extend the foot, the attempted movement displaced the fracture, and caused her excessive pain. The source of this pain was not very clear; however, she learned

to avoid the movement, and her ankle-joint has become stiff from disuse.

The non-union of fractures has been attributed to a great variety of causes, constitutional and local. Mr. Amesbury, however, remarks, "by far the most frequent cause of non-union that I have noticed is want of rest, in consequence of the inadequacy of the plans of treatment which have been employed. I consider this to have been the primary cause in almost all the cases I have examined."

And Dr. Hamilton, in his treatise, writes, "I have myself seen a considerable number of examples of non-union, but in not one of my own patients, except in cases involving joints, has the bone refused finally to unite."

I have myself never seen the union of an ordinary fracture prevented by age.

There was recently in Lawrence ward a female, *æt.* 75, who repaired, very rapidly, a compound and comminuted fracture of both bones of the leg; and fractures at the neck of the thigh bone in old people are usually mended in the ordinary time, not indeed by bone, for the separation of the bone fragments and of the periosteum, or absence of the latter as in intracapsular fracture of the head of the femur, commonly prevents this, but very serviceably by fibrous tissue; indeed Mr. Charles Miles has given us the particulars of the case of a man, *æt.* 85, who died seven months after sustaining fracture of the neck of the right thigh bone, and of the radius and ulna of the corresponding side. The latter united perfectly in six weeks, and in the posterior part of the fracture of the femur firm bony union had also taken place.¹ Mr. Holden has recently had under his care, in Colston ward, a man in his eighty-ninth year, who repaired a fracture of the shaft of his left femur.

Even paralytic old people repair a fracture rapidly, as in the following cases:

¹ St. Bartholomew's Hospital Museum, C. 181.

James P—, æt. 65, suffered a paralytic attack of the right side, from which he had not recovered when he fell and broke his right thigh just below the trochanter major. He was extremely restless, and constantly displaced the apparatus, but the fracture was firmly united at the end of the fourth week.

James P—, æt. 68, was admitted into Kenton Ward, in October, 1853, with a fracture of the right femur, having for some years been hemiplegic on the same side. This patient recovered rapidly, and was discharged, with shortening to the extent of half an inch, on the forty-sixth day after the accident.

At the opposite time of life, children who are paralysed will be found to unite a fracture readily. During January, 1855, William W—, æt. 9, was under treatment at St. Bartholomew's, having slipped and fallen heavily on his left side. This side was paralysed, and wasted from his early youth, and, owing probably to the helplessness of the muscles, there was no shortening, and scarcely any displacement of the left thigh, where the femur was broken across about its middle. Union was perfect on the thirty-sixth day. It is needless to repeat examples of similar results.

Apart from personal experience, I should mention that certain cases have come to my knowledge in which skilful surgeons have found it impossible to obtain union of a broken bone in children of tender years. My friend and colleague, Mr. Thomas Smith, kindly informs me, however, that no such case has occurred in the practice of the Hospital for Sick Children in Ormond Street, and the only instance I can at all refer to from St. Bartholomew's is that of a child whose femur was bent, or broken, after the patient had been discharged from the hospital as cured.

But Mr. Coote has been so good as to give me the following note of a case of broken leg in a boy, æt. 5. The child was under treatment for rachitis, and whilst the mother was re-adjusting some simple orthopædic apparatus, she felt the bones snap asunder. The limb was wasted, and the bones were light and atrophied.

Despite treatment the fracture refused finally to unite, and after a last attempt to procure union by introducing ivory pegs, the limb was amputated, rather more than two years after the occurrence of the accident. Mr. Coote has also informed me of the case of a boy, æt. 8, who had a fracture of the middle of the clavicle which failed ultimately to unite.

I have heard of somewhat similar cases, and they seem to have this in common; when a broken bone fails to unite in a child, within the usual time, the efforts on the part of the surgeon to procure subsequent repair are usually unavailing; a fact which should make us careful in the treatment of these cases in their early stages, and should render us cautious of transferring them to the care of inexperienced attendants before union is firmly completed.

Pregnancy and the period of lactation have been supposed by some surgeons to interfere with recovery from a fracture. I have never noticed any such consequence of these conditions. The following case is to the point:

Anne Thorne, æt. 22, pregnant eight months, was taken into Harley ward with a fracture of the left femur just above the knee, which had been caused by a fall on the pavement. The knee-joint was fixed, and the thigh disfigured by sinuses, the results of disease in early childhood.

On January 13th, 1853, twenty-two days after the accident, she was delivered of a boy. On February 9th the limb was put up in gum and chalk, the femur having firmly united, and she was discharged well, fifty-six days after her admission.

The repair, after fracture, of a bed-ridden bone, shows the ability of nature to deal with these hurts under apparently unfavorable circumstances. A man, æt. 56, had been bed-ridden for some years before he sustained, at intervals of time, a fracture of either femur whilst he was being turned in bed. Both fractures are in our museum.¹ One was through the shaft, about two inches below the lesser tro-

¹ St. Bartholomew's Hospital Museum; series iii, 92, and C. 116.

chanter; the posterior portions united firmly and smoothly, but so that they form an acute angle. The left femur, broken at the same part of the shaft, united at an angle of 75° . A second fracture occurred through the same shaft a few days before death. The texture of the bones is soft, light, and spongy, and infiltrated with fatty matter.

It has been said that patients tainted with syphilis occasionally fail to unite a broken bone. A great number so afflicted are under treatment in our wards, but I never heard of any such showing delay in mending a fracture. There is, however, a case reported by Mr. William Taylor¹ of fracture of a humerus in a female, æt. 23, caused by external violence six years before death, while she was affected with syphilis. On examining the humerus, which is in the museum of the hospital, it is clear, although the fractured ends are united only by soft cellular substance, that abundance of new bone is formed upon the outer surface of the shaft immediately above and below the fracture, but the extremity of the lower portion of the bone has perished, and is in progress of exfoliation. Thus, whilst the death of this part of the bone, in no way attributable to the syphilis, was in itself enough to have marred the union of the shaft, this specimen shows that the constitutional taint had no influence over the production of bone, which was abundantly deposited about the broken mass.

Mr. Paget has been so good as to give me the notes of the following case, in which a fracture was rapidly repaired in a patient suffering from syphilitic disease.

"A gentleman, about thirty-five years old, had lived a rough life, and had syphilis in Australia. On his return to England he was thin and feeble, but had no evidence of syphilis, or any other disease, except pains in his limbs, and especially pain about the middle of his left arm. The pain was not sufficient to prevent his using the arm, and he led a fairly active life. In trying to pull down a cab-window with his raised left arm the humerus broke across its middle.

¹ St. Bartholomew's Hospital Museum, series iii, 58.

The fracture was treated in some ordinary way : three grains of iodide of potassium were given three times a day, and in six or seven weeks the fracture was well united. The union remained firm many months afterwards, when I last saw the patient."¹

Perhaps as good proof as any that constitutional causes are wrongly held to account for non-union of a fracture is found in the results of the treatment of the poor patients in St. Bartholomew's Hospital, who are drawn from the classes in which such influences exist to a large and varied extent.² During the last seven years there have been 2376 fractures under observation in the wards, exclusive, that is to say, of fractures of the upper extremities. With the exception of certain fractures of the patella, and of the neck of the thigh bone, which commonly unite, if at all, by fibrous tissue, there has been but one case of non-union.

Delayed union, it is true, is occasionally met with, and re-fracture of a bone sometimes retards the recovery. In other words, some patients take a long time to mend a hurt, some are unlucky. That the process of repair should be tedious in some cases is no more than we might expect from observation of the manner in which other hurts, or even diseases, are recovered from ; for instance, in the varying time required to repair mere surface ulcers ; and there can be no objection to refer delayed union to varying constitutional conditions, but this is widely different from the assumption that a certain state of the constitution can absolutely prevent a broken bone from ever uniting.³

¹ Dr. Drage has favoured me with the notes of a case of compound fracture of the left leg complicated with fracture of the right thigh. These injuries were sustained by a male who at the time was under treatment for secondary syphilis. The broken bones were united in about eighteen weeks.

² I may add that erysipelas and, amongst children, scarlet fever and various infantile complaints have been noticed in our wards as complicating, but in no way retarding, the repair of fractures.

³ Amongst our hospital patients 157 days, 195 days, and even longer periods have occasionally elapsed before union of a broken thigh has been secured.

Amongst various instances of re-fracture in adults I never saw any bad consequences result. One of our hospital patients had, however, to remain with us from July until the following February, from his stamping on the floor to test the strength of the repaired fracture, when the femur at once snapped asunder.

On March 16, 1865, a labourer, æt. 52, was placed under treatment for a broken thigh, which united in 160 days. Shortly after his discharge he fell and broke the same bone at the same place as before, and the repair was again very tedious. He was kept at rest in bed, with immoveable apparatus, and recovered, with firm union, in 122 days.

The single case of non-union of a broken thigh was under my own care whilst I was on duty at the hospital during August, 1864.

Having broken his left femur at the junction of its upper and middle thirds, a hawker, aged fifty-four, was under treatment for 280 days, when he was discharged, but the bone was not united. We did a great deal too much for this man. From the first it was difficult to get the thigh into good position. The ends of the femur bulged outwards at the fracture, and the foot was constantly everted. To remedy this the apparatus was frequently shifted and modified, and I have always considered that our well-meant handling of the broken bone was the cause of its failing to unite—we did not give it sufficient rest. This fracture was at first treated by extension, with a weight drawing from the foot, and various attempts were subsequently made to obtain union of the bone, but they were ineffectual, and the patient eventually limped painfully, with his limb encased in a supporting apparatus.

Abscess in the shaft, or necrosis, or, as in Sir James Earle's case, the interposition of muscle, may now and then account for the non-union of a broken bone, but these cases must be of rare occurrence. Some of these fractures, too, belong to a class altogether distinct from ordinary cases. I refer to the fracture of a shaft from mollities or atrophy,

instances of which have been described by Mr. Stanley and others ; or from cancer ; or from necrosis with loss of that periosteum from which new bone is usually formed ; the loss of this tissue is also the cause of non-union in a shaft from which any considerable portion has been removed, so that an interval is left between the fragments, as in the fractures referred to by Sir Astley Cooper, where there was loss of substance of the tibia, whilst the fibula retained its length.

I am indebted to Mr. Chippendale for notes of the case of a man, aged fifty, of cachectic appearance, who was admitted into Rahere ward, under the late Sir William Lawrence, during October, 1856. About five weeks before, whilst exercising a pair of horses, the one he was leading started away from the other, on which he was mounted, giving his arm a severe wrench. An abscess formed the following week, and this, when opened, was found to lead down to bare bone. On the morning of his admission, whilst merely turning over in his bed, he distinctly heard and felt the bone snap asunder. When subsequently examined there was deformity, with shortening and preternatural mobility, and a considerable surface of the shaft was felt to be bare. Although his general health improved, yet, despite treatment, the humerus showed no tendency to unite, and at last, the patient having been previously weakened by bleeding from a wound made to let out some deep-seated pus, it was found necessary, forty-four days after the accident, to amputate the limb. The man's condition became rapidly worse, and he died ten days later.

On examining the amputated portion a large sequestrum of bone, about four inches long, was seen to be almost detached from the shaft above, and quite so below where the fracture had occurred ; no new bone had formed around the dead portion.

Mr. Charles L. Parker has presented to our museum¹ a tibia from which a portion of the shaft, nearly four inches in length, and including both the walls and the medullary tube,

¹ St. Bartholomew's Hospital Museum, series i, 262.

separated after necrosis. The remaining portions of the shaft are connected by a thick band of tough ligamentous tissue, attached to their gradually attenuated ends. They are also soft, light, and smooth on their surface, as if extremely atrophied. The fibula is healthy.

These parts were removed from a girl in whom the disease had long existed, and who had been quite unable to use the leg in walking.

The following case is described in the third volume of the catalogue of our museum.¹ The patient, a strong muscular man, suffered from a hard cancer of the breast, first noticed twelve months before his death. In the last two months of his life both humeri were fractured by slight forces. "Large portions of the medullary cavity of one of the broken bones are filled with a compact, very firm, greyish substance, like that of the common forms of scirrhus cancer," the bone tissue having completely disappeared before it. The walls are also thinned and in parts destroyed by the cancer, which even protruded through them. No union had taken place.

It is evident, I repeat, that these and similar cases are governed by conditions quite unlike those which surround ordinary fractures, and should not be mixed up with the latter in the consideration of the causes of non-union of bone.

From the preceding observations I conclude that some commonly assumed causes of non-union (as distinguished from delayed repair) of fractures may be fairly criticised. In writing of fractures which fail to unite, it is clear that three well-defined varieties must be enumerated.

(1.) Fractures, not inaptly termed spontaneous, which issue from diseases of bone, such as abscess, necrosis with absence of new bone formation, or cancer supplanting the osseous tissue, or such a condition as exists in mollities ossium. With such, it is evident that no union is likely to take place, for the bone is not merely broken, but its very nature is perverted or destroyed at the site of the fracture.

¹ St. Bartholomew's Hospital Museum, series i, 290.

(2.) Fractures (*a*) with separation of the bone and periosteum to such an extent that there cannot be thrown out bone material enough to fill up the gaps between the fragments; (*b*) occurring through bones not provided with periosteum (as in intracapsular fracture of the femur), and where it is difficult to keep the broken ends together.

(3.) All fractures other than the preceding; and these supply the large number of cases of so-called non-uniting fractures requiring treatment.¹

It is with reference to this third class of cases that constitutional causes of non-union are so systematically enumerated,² but such causes are illustrated by evidence of a contradictory character, and we have, I believe, reason for ignoring the unfavorable influence of age, of paralysis, of pregnancy, of fevers. Rather than attribute non-union of fracture to influences of at least so doubtful a nature, it seems to me desirable to admit the force of Mr. Amesbury's statement, respecting the bad management of a broken bone, such as is involved in tight bandaging, insufficient rest, and so forth; or to accept the proposition of Malgaigne, that "when union is deficient, it is generally the treatment that is in fault." Without denying the possible occurrence of non-union of bone from causes beyond the control of the surgeon (apart from the local obstacles I have referred to), we find nature so apt at mending a fracture under the least favorable circumstances, and she so very rarely fails that, when she does, it is, I consider, always right and necessary to criticise treatment before finding fault with the constitution.

I have elsewhere referred to the coagulation of blood in veins, in consequence of bruising of the soft parts about a fracture, and to the extension of the clots from the lesser to the greater vessels, until they may come to obstruct the

¹ Nine cases of ununited fracture have been admitted into St. Bartholomew's during the last three years.

² These cases may be read in the 'System of Surgery,' article "Fractures;" in Malgaigne's work; or in Hamilton's 'Treatise on Fractures and Dislocations.'

chief vein of a limb. I have also mentioned several cases in which this condition was met with at after death examinations. Some few weeks ago, an old man died in the hospital, after mending a fracture in the upper part of the thigh, but the circumflex veins and the profunda were still filled with firm but partially decolorised coagula, and the venous circulation of the limb had been imperfectly carried on. The œdema which is associated with this condition is very characteristic, and I have thus referred to it: "This œdema often embarrasses the repair of fractures, more especially when the breakage is near the medullary foramen, or involves the laceration of a large vein, or when the tissues around are greatly bruised from the direct violence of the injury, so that clots form in the principal vessels. As this complication is of such common occurrence, it is strange that attention has been so little directed to it in cases of tardy repair or non-union. It may be suspected when, about the fourth week after the injury, the parts continue or become œdematous, cold and often aching. . . . It is always a serious affection, as shown by the frequency with which opportunities offer for inspecting the bodies of old and feeble people, who die some weeks after a fracture with no trace of union, but with numerous ecchymoses and plugged veins around the seat of injury."¹ In cases such as these the whole of the venous blood is commonly thrown into the superficial veins, and it becomes important in every way to facilitate the circulation through them. Under such circumstances, it is needless to insist upon the damage occasioned by tight bandaging, or to show how materially it may hinder the return of blood from the limb. So far as my experience goes, fractures of the forearm are most liable to suffer from this cause, from the facility with which pressure can be applied to the superficial vessels between the wrist and the elbow.

It is impossible to exaggerate the hurt sustained by a joint, owing to the non-union of the long bone which serves

¹ 'System of Surgery,' vol. iii, p. 300.

as a fulcrum for the efficient performance of its chief movements.

During the year 1854, there was under the care of the late Mr. Stanley, in Darker ward, a man, æt. 27, who had an ununited fracture of the femur. The hurt had been treated elsewhere, thirteen months before he came to the hospital. Ivory pegs were inserted into holes drilled through the broken ends of the bone (which were also wired together). In the end no good resulted from the irritation set up by the pegs, and the limb being painful and useless the patient begged to have it removed. Amputation was eventually performed at the upper third of the thigh. Severe recurrent bleeding caused great exhaustion, but the man eventually recovered.¹

The effect of non-union upon the movements at the knee was well marked in a case for permission to use which I am indebted to Mr. Paget, and which is also of interest because of the nature of the disease which prevented the broken bone from uniting.

A man, æt. 27, was admitted into St. Bartholomew's in January, 1864. He had long roughed it in New Zealand, and had complained for two years of intense pain in the lower part of his right thigh; but thirteen months ago, as his knee began to swell, this pain by degrees disappeared. The limb, however, presently became useless, and the joint could, as it seemed, be twisted in almost any direction, as if from great laxity of its ligaments, flexion being limited by the great thickening about the end of the femur. Coarse rubbing and crackling were felt when the joint was moved, as though portions of thick fibrous tissue, or even bony materials, jostled one against another.

The limb was useless, the knee movements were lost; splints were quite inefficient to give support or relief, and his age justified, as the necessities of his life needed, the removal of the limb. After amputation, the lower end of the femur was found to be expanded into a thin-walled cavity, and filled with what looked like dried-up pus. Just

¹ Part of the bone showing the non-union is in St. Bartholomew's Hospital Museum, C. 121.

below the situation of the line of the epiphysis, that is, through the condyles, the bone was broken across, and the broken surfaces had become smooth and hard. This fracture had allowed the free movements which had been so deceptive, for the joint itself with its ligaments was free from disease. The patient made a slow recovery, in the course of which it was necessary to tie the right common femoral artery for severe secondary bleeding from the stump.

In none of the cases of long standing non-union of the femur which I have seen has any practical good been derived from the use of the apparatus, which has been devised to supply the stability lost by the lack of continuity in the bone, with the object of enabling patients to get about. I join with those who are of opinion that for this condition amputation may be ultimately necessary, if the patient is not advanced in years, as the limb is useless for working purposes, a constant trouble and a source of pain; always premising, however, that amputation should never be thought of until every effort has been made to get the bone to unite, for indeed it is surprising how very long a time after the occurrence of the injury union may take place.

To this end the treatment most likely to be successful, when the femur is the bone concerned, is that which ensures rest in bed with the limb secured in good position, but without any circular compression, for two or three months, or longer if necessary; and I believe that the good results which are said to follow certain remedies, and various operations for the cure of these cases, have issued from the quiet and immobility which at the same time have been rendered necessary. It is easy to believe that remedies which improve the general health are advantageous, but it is less easy to understand the recommendation that a person suffering from non-union of a broken thigh should be up and about and using the limb, which it is said should be secured in some fixed apparatus. It is true the health may be bettered by the exercise and the change, but it is very questionable whether the process of repair is expedited. So far as I have

had opportunities for noticing these and other cases of only slightly delayed union, they should certainly be kept in the horizontal position until the bone is fixed, and should not be exposed to the risks, and at best the uncertain good, of the patient's moving about, for no arrangement of apparatus can then be relied on to ensure immobility of the femur, and without security for this no repair can be confidently looked for.¹

With reference to the great length of time after the lapse of which a fracture, if properly treated, may be repaired, and as indicating the treatment which may be followed, I add to those previously referred to the following histories.

In the spring of 1865 a soldier, recently discharged from a cavalry regiment, æt. 23, and in good general health, came under my care with ununited fracture of the right humerus at the upper part of its lower third. The arm had been broken whilst he was in India, twenty-seven months previously, by a fall from his horse. It was now useless, for he was unable either to flex or to extend the forearm, because the attempt to do so doubled up the humerus at the seat of its fracture.

Some time after his admission into St. Bartholomew's I cut down upon the bone, following a line in front of the course of the musculo-spiral nerve, which was seen during the operation lying somewhat in the way, and exposed the broken bone ends. These tapered to a point and were loosely connected by tough fibrous tissue, indeed they tapered so gradually that a considerable portion had to be removed from either before any breadth of surface could be obtained. The raw bones were then wired together, and the parts were fixed in an angular tray and were kept at rest for two months. The wire was then removed, but no union having been established the arm was again fixed and kept at rest for two months longer. At the end of this time union was not

¹ These remarks do not apply to fractures of the leg, which can be easily and securely 'put up' in plaster of Paris, or in gum-and-chalk bandages, and the patient can be allowed to get about without incurring any risk.

absolutely firm, but, with slight external support, he was able to leave with a useful arm and elbow-joint.

I think it has escaped general notice that a broken humerus may be very serviceably united by fibrous tissue if time is allowed, before the arm is brought into use, for the thorough contraction and hardening, if the latter term may be permitted, of the material joining the two portions of the shaft.

To the description of a case of non-union by bone of the middle of the shaft of the humerus it is added by Mr. Brendon,¹ "the use of the arm was so little impaired by the fracture that the patient worked as a sailor to the time of his death." In September, 1855, a man, æt. 29, was in Darker ward with an ununited fracture of the humerus, just below the insertion of the deltoid, of nine months' standing. The arm was kept fixed in an immovable apparatus for four months, and the union, not osseous, was so far completed by the great thickening of the tissue about the fracture that the patient could use the limb nearly as well as its fellow.

I had recently an opportunity of examining the parts in a case in which fibrous tissue had united a fractured arm. In May, 1862, a sailor fell from the main topgallant yard, and in his fall struck his left thigh and arm across some spars stowed midships. The fractures which resulted were treated by the ship's carpenter. He was then eighteen. In July, 1864, he was admitted into St. Bartholomew's, under the care of Mr. Paget. The humerus was firmly united, but the two portions of the shaft were fixed at a right angle at the upper third of the bone. When this fracture was operated upon for the cure of the deformity it was found, contrary to expectation, that union was not osseous but by tough fibrous tissue.

With reference to the support given by parts around the fractured ends, there is a curious specimen in our museum²

¹ St. Bartholomew's Hospital Museum, series iii, 2.

² Ibid., series iii, 65.

in which the disjoined portions of a broken humerus are held together by a distinct ring of bone which completely surrounds them.

Such cases should encourage us to persevere with treatment for non-united fractures, more particularly of the humerus, even when but a small chance apparently remains of osseous repair, yet this may follow years even after the occurrence of the break.

I have before me the original notes of the case in which the late Mr. Stanley obtained bony union in an ununited fracture of the bones of the leg, after driving ivory pegs into the ends of the disjoined portions. The fracture, a compound one, had occurred two years previously. For twelve months the patient tried to get about with the help of an apparatus, and after this he came up to town. Blistering was then employed for two months, when he was discharged, but returned the following January, and two years and four months after the occurrence of the accident the ivory pegs were introduced, and four months later the bones had firmly united. In this case, as in one previously referred to, the pain caused by movements of the bones, as in the simple act of crossing one leg over the other, was remarkable, and was the constant complaint of the patient.

An equally good result was obtained by different means in a case under Mr. Paget's care, during the years 1866-7. The patient, a Deal boatman, æt. 35, a robust-looking man, had a broken humerus of twelve months' standing. The fracture was in the upper part of the lower third of the shaft. Soon after his admission, the bone was fixed by a metallic piercer after the plan recommended by Bickersteth and Gaillard,¹ but no good resulted from the operation. Rubbing the broken ends together, and confinement in a gum-and-chalk bandage, had no good effect, and eventually the limb was freed from all bandages and simply supported on an angular splint, which was swung during the daytime

¹ 'Med.-Chir. Trans.,' 1864, and 'New York Journal of Med.,' 1865.

from a 'davit.' The patient was thus enabled to take active exercise without the least risk of disturbing the ends of the bone. In three months the bone was united, and two years and two months after the occurrence of the fracture the union was firm.

There exists a very general fear for the ultimate condition of joints which become stiff from disease during the repair of a fracture. I do not refer to joints which are actually broken into, but to such as lie near to a broken shaft, as the elbow with fracture of the humerus, or the knee with fracture of the lower part of the femur. From this fear comes the recommendation, which may be read in most surgical works, but which is certainly a bad one, to make passive movements of the joint at an early date, to guard against the possibility of stiffness; "hence," Malgaigne writes, "the surgeon as soon as the apparatus is taken off should move the joints, forcing those which are stiff, and advise the patient to continually exercise them in this way. Next day and the day following he should keep it up, until the articulations have recovered their full freedom."¹

Dr. Hamilton has described the bad effect on a fractured humerus, produced, he believes not infrequently, by the weight of the forearm, or of apparatus continued beyond the elbow when used for a broken arm, dragging upon the lower portion of the shaft and displacing it from the upper; he considers that this, with the attendant and frequent shifting of the lower end of the bone, is a constant cause of delayed union, and even of non-union, of the humerus. At St. Bartholomew's Hospital, fracture of the arm above the condyles is never encumbered with heavy apparatus. The shaft is kept in position by three or four light and well-padded wooden splints, a short one reaching from the inner condyles to the armpit, and others from the elbow to above the shoulder; these are held together by straps, which can be readily tightened from time to time, and the forearm is slung with bearings from the wrist. The great advantage of this plan of

¹ Translated by Packard, p. 241.

treatment consists in the entire freedom of the elbow, which, far from becoming rigid, as in the cases observed by Dr. Hamilton, allows of chance movements of the forearm being made without risk, because they hinge entirely upon the joint, as is natural to them, so that the fracture is not disturbed.

When, however, from the necessity of the case, or from the treatment employed, the elbow has become stiff, there is every reason to believe, as Mr. Paget suggested to me some years ago, that non-union of the humerus is risked by the well-meant attempts which are made by the surgeon, or by the patient, to move the joint before the new bone is thoroughly firm; and how likely it is that the fracture will recur from such attempts is evident when the powerful leverage used in making passive movements at the elbow is borne in mind.

This risk alone, and the same holds good for other articulations, should make us careful not to be in any hurry to remedy the rigidity which follows from temporary disuse of a joint; it is certainly not worth incurring when it is known that this stiffness is all but invariably recovered from in time.

There was recently under my care a labourer, æt. 38, who fell and fractured the upper third of his left tibia. The bone united as usual, but the knee remained stiff, the movements of the joint were slowly recovered in four months. In a case of compound fracture in the lower third of the leg, nearly a year passed before the ankle-joint movements were regained. And perhaps it would be well if it were made more clear to a patient than it often is, that although a fracture will unite in a given number of weeks, yet that complete recovery from the injury is always an affair of months, and when joint stiffness is superadded of six months, or even more.

For all joint stiffness resulting from disuse during the repair of a fracture, passive or other movements should never be attempted until the broken bone is firmly consolidated, and then only with great caution.

In the preceding notes I have not thought it necessary,

for obvious reasons, to refer, in individual cases, to the meddling with recent fractures which still seems to be, unfortunately, of common enough occurrence. I have been obliged to hear from patients that the splints, or other supports, have been removed daily, or every few days, to see how the repair was going on. Nothing could be more reprehensible. As a rule, a fracture is badly "put up" which requires any subsequent moving or disturbing of the apparatus.

From what I have observed respecting non-uniting and slowly uniting fractures, I arrive at the following conclusions:

Non-union of an ordinary fracture should never occur.

Under careful treatment bones will unite two years or longer after the occurrence of the fracture.

It is reasonable to suppose that such fractures would have united at an earlier period if properly treated.

Treatment of delayed union (slowly uniting fractures) should consist—

First, in the improvement of the health.

Secondly, in placing the broken bone in the best position attainable, and in the avoidance of local obstruction to the circulation. *

Thirdly, in leaving it at rest until it unites; its doing so being simply a question of time.

Fourthly, in avoiding all attempts to overcome the stiffness of joints adjacent to the fracture, until the bone is firmly united; and this applies also to the management of fractures which unite in the usual time.