Sprains : their consequences and treatment / by C.W. Mansell Moullin.

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PREFACE TO THE SECOND EDITION.

The favourable reception given this little work upon its first appearance has encouraged me to bring out another edition, revised and partly rewritten. Pressure of work alone has prevented my doing so before. The arrangement has been altered; the methods of treatment that are applicable to all sprains alike have been separated from those that are better suited to individual cases; and certain matters that belong rather to the general principles of Surgery have been omitted, with what my critics will doubtless consider the merit of having made the book a little smaller than it was before.

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PREFACE TO THE FIRST EDITION.

It has been my endeavour in the following pages to confine myself as closely as possible to the commoner forms of sprains, and to those after consequences which may be regarded as directly and immediately dependent on them. Of those which follow more remotely there is no end, and the briefest description would lead me far beyond the limits at my disposal. It has been said, and not untruly, that in all probability half the crippled limbs and stiffened joints that are met with every day, date their starting point from the occurrence of some apparently trivial accident of this description.

The question of treatment has been dealt with at some length; and if I have seemed to advocate the adoption of more active measures than those generally employed, especially in the case of long standing inability, it is only that I am firmly convinced of their efficacy and safety when properly carried out.

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SPRAINS AND THEIR CONSEQUENCES.

INTRODUCTION.

Few injuries are treated with so little consideration as sprains. It is impossible to overlook wounds, owing to the bleeding and pain that accompany them. Fractures, it is understood, require rest and care; but sprains, in which the tissues are torn to such a degree that the damage is far more serious than in many fractures, merely because they are so common, are considered of little or no consequence.

It counts for nothing that the part injured is one of the most complicated structures in the body, and particularly liable to inflammation from the constant use to which it is subjected. The construction of a bone is comparatively simple, and its function is merely the passive duty of support. A joint, on the other hand, is exceedingly complex, and must not only be as strong for support as the bones between which it lies, but must, in addition, be capable of allowing rapid and often extensive movements. Two, three, or even more bones may enter into its construction; each of them where it forms part of the joint is faced with cartilage; around them is a protecting capsule of fibrous tissue, lined with a delicate secreting membrane; ligaments of different kinds hold the bones together; muscles of various size and strength move them one on the other; there is a very large supply of

blood vessels and nerves; and around, spreading in between the muscles and bones, are cushions and layers of the softest and most delicate tissues. Yet a fracture is regarded as very serious; a sprained joint as quite a trivial matter.

In the one the injury is simple and definite in its character; one broken bone does not differ very materially in this respect from another; in the other there is no limit to the variety of hurt sustained, or to the complications that follow. The ligaments may be torn across, or wrenched off the bone; the muscles may be lacerated; the tendons displaced from their grooves; the discs of cartilage, which are present in some joints between the bones, forced out from their position; the joint cavity filled with blood, and so much more extravasated into the tissues around that the discoloration may reach from the ankle to the knee; in short, the tissues may be torn and bruised as extensively as in a dislocation. Except that in the one the bones which were wrenched asunder at the moment of the accident resume their normal position as soon as the stress is past, while in the other they either remain fixed or slip a little farther aside, there is in many cases little to choose between them. Videl de Cassis appreciated this when he spoke of sprains as temporary dislocations.

There is no end to the variety of the injuries that are classed together under this name. It is almost an impossibility for two sprains to be exactly alike. Joints differ from each other as widely as they can, both in structure and action; different kinds of tissue enter into their formation, and serve as many separate purposes; the violence that causes the accident is different in every case, both in its force and direction; and the position of the limb at the moment can rarely be the same. Some joints are much more liable to injury than others, those especially in the lower limb;

and the ankle more than the hip or knee. In some the stress falls on the ligaments; in others, as in the shoulder, on the muscles; very often both suffer together, though in varying proportions; or the joint itself may escape without hurt, and the muscles and tendons around it be so strained that freedom of action is not regained for years.

Individual peculiarities of constitution make these differences greater still. Age, habits, occupation, temperament, and mode of life all have their effect. Repair is not carried on with the same energy; complications occur more readily in some; there is a greater tendency to inflammation, or it pursues a different course; or other troubles make their appearance, so that even if by some strange chance the injury at the first were the same in any two cases, it is impossible for it to continue so for any length of time. In the majority of instances, the ultimate result, whether the joint recovers within a reasonable period or remains cold, stiff, and untrustworthy for years, depends much more upon constitutional peculiarities and on the method of treatment than on the mere fact of a ligament having been torn or only stretched.

There is, however, a much more important reason why sprains do not merit the neglect with which they are so often treated. Imperfect recovery in the case of a broken bone is quite exceptional. Failure of union is very rare. It is more common for the position of the broken ends to be faulty, so that there is some deformity, or loss of power; but even when this does happen the after-trouble is only of a temporary character, and at the end of a few weeks or months, at the most, the limb is as strong and firm as ever. Such a thing as yielding, weakness, or continued pain at the seat of fracture is almost unknown, unless there is some exceptional condition present. It is not so with sprains. An amount of thickening round the seat of injury, so slight as altogether to

escape notice in the case of a fracture, is enough to disable a joint.

It is true that a large number of sprained joints get well of themselves, or under ordinary domestic treatment, a few, it must be admitted, in spite of it; but even in the young and healthy, it is not unusual to find the action of the joint seriously impaired. There may be merely a general sense of weakness and insecurity, a feeling that it is not to be trusted as it was before; or the least attempt at movement may be attended with intolerable suffering. There may be no very visible or definite alteration, or every tissue of which the joint is composed may be more or less disorganized. The skin may be exquisitely tender; the subcutaneous tissues swollen and distended, so that the natural outline cannot even be recognized; the muscles may waste away; the tendons become glued to their sheaths, and the interior of the joint be damaged to such an extent that, even if everything else were restored, free and painless movement would be impossible.

Results of this kind, happily, can nearly always be prevented. It is true that in some people the power of repair is more feeble than it is in others; and, no doubt, under some conditions, such as advancing age, joints are especially prone to stiffness and other troubles; but taking them as a whole, few kinds of accidents are more amenable to treatment than sprains, if only two conditions are observed: one, that it is commenced sufficiently early; the other, that it is carried out thoroughly and efficiently, not in a perfunctory manner.

Afterwards, if the time immediately after the accident has been allowed to pass by, and the joint is stiff, and recovery imperfect, a great deal can still be done; but as a rule, the longer the delay the more remote the prospect of perfect restoration. The sudden and startling cures that are so often

heard of are really few and far between. It must always be remembered that in surgery, as in most other things, successes are trumpeted abroad, and always quoted as an encouragement, while failures are either never heard of, or unconsciously are forgotten. Much more often recovery is slow and tedious, requiring care and much patience, with days in which improvement is well-marked, interspersed among a much larger number in which either no change at all is apparent, or possibly even the pain and stiffness seem actually worse.

PART I. (GENERAL).

CHAPTER I.

THE STRUCTURE OF JOINTS—THE COMMON ORIGIN OF THEIR SEVERAL PARTS AND THE SYMPATHY THAT EXISTS BETWEEN THEM—THE INFLUENCE OF AGE, EXERCISE, AND PROLONGED REST UPON THEM.

It would be out of place in a work of this kind to enter into any detailed account of the structure of joints, or to describe minutely the different varieties. I shall only mention a few particulars to which it seems advisable to call attention. Clinical symptoms following injury do not always correspond with structural details as given in anatomical treatises.

Roughly speaking, joints may be divided into two classes—those with a well-defined cavity in the centre, and those without. The former are highly complicated, occur chiefly in the limbs, and are frequently the seat of injury; the latter are simpler in structure, are met with chiefly in the trunk, and are of such strength that they are seldom sprained; if the force is so great that something must give way, they are either torn across or separated from the bone. The essential point with regard to both is that, however varied in outward appearance and physical properties their different parts become, because of the different services they have to perform, they never lose their mutual sympathy or connection. It is impossible for one part of a joint to be injured without all the rest suffering with it. Joints are not built up like machinery, of different and separate structures, any one

of which, if it is injured, can be replaced without interfering with the rest; they are living organs, and all their component parts suffer if the least of them is hurt.

The bones.—Joints with a wide range of movement, those, in other words, that are most liable to sprains and similar injuries, naturally present great differences in the shape of the bony surfaces that enter into them. In the simplest they are flat, and face each other directly, so that only a slight gliding movement can take place between them. In others —the shoulder and hip, for example—the extremity of one bone is hollowed out into a cup into which the other fits more or less accurately, according to the degree of support required. In the lower limb, where strength is especially needed, the rounded extremity of the bone forms more than half a sphere, and is so tightly embraced by the sides of the cup, that, even when everything that holds the bones together has been divided, it requires very considerable force to pull the two apart. In the shoulder, on the other hand, the cavity is shallow, the head of the bone large in comparison, and the range of movement increased at the expense of the security. In a third class, the ends are so modified that movement can only take place in one plane as on a hinge. In the elbow, for example, the bone is rounded from before backwards, and fits into a corresponding depression in the other, rotating in it on an axis that runs from side to side. In the ankle there are stout projecting processes, one on either side, so that movement is limited to one direction, and lateral bending is impossible.

When more complicated movements are required, the modifications become greater still. In one instance a ligamentous ring attached to one side of a bone is thrown around the neck of another, so that it can turn securely in it on its own axis. In others, discs of fibro-cartilage are interposed between the bony surfaces to deepen the sockets and lessen

the impact of shocks; or, as in the case of the wrist and foot, a number of small bones are so adjusted to each other that pressure falling on one is distributed over all the rest.

The ligaments and capsule.—These bony surfaces, where they come into contact with each other, are faced with a layer of cartilage, so that there shall be the minimum of friction, and are held together by a capsule of fibrous tissue, the strength of which varies widely in its different parts. In those joints in which the range is slight and equal in all directions, the thickness is the same all round. When on the other hand the shape of the bones allows bending in one plane only, as in true hinge joints, the side portions springing from the ends of the axis of motion are highly developed, those at the back and front are thin and weak.

By steps such as this the capsule of a joint gradually becomes split up into divisions, which appear to be so isolated and distinct that they are often called anterior, posterior, and lateral ligaments. They are not, however, separate structures in any sense of the term. They are only subordinate parts that have become differentiated from each other by the difference in the character of the work they are called on to perform.

In a ball and socket joint, which, so far as this is concerned, may be regarded as a kind of universal hinge, the capsule is modified in an especial manner. In the hip, where unyielding support in front is required, that part is so strong that, even in dislocation, it very rarely gives way; behind, where there is but little strain, it is comparatively thin and weak. In the shoulder, everything is subordinated to accurate and rapid action in all directions. The capsule, with the exception of one part, is so loose and long that it only becomes tense when the angle of movement is extreme, and the muscles take the place of ligaments, and not only execute, but control and restrain the movements of the arm with a

precision that would be impossible with passive and unyielding fibrous tissue.

The synovial membrane.—The cavity of a joint always contains a certain amount of a viscid fluid, known as synovia. The quantity is very variable even in the same joint, but in general there is merely sufficient to moisten the surfaces that are in contact with each other, and prevent friction. It is secreted by a delicate structure known as the synovial membrane. This lines the interior of the capsule, and is prolonged into all the pouches in connection with it, but does not extend, at least in the adult, over the cartilage that covers the ends of the bones. Before birth an exceedingly delicate film of cells may be found in this situation; but they are soon worn off, and do not reappear. Where this membrane is reflected, at the attachment of the capsule to the bone, it is often thrown into folds, which, under some circumstances, are capable of assuming a very considerable size. The inner surface is smooth and polished; the outer is continuous with the fibrous tissue of the ligaments. In the intervals between them it has a delicate wall of its own, formed of connective tissue and attached to the structures around by a few loose and scattered fibres.

This membrane is often regarded as a separate structure found in those joints only in which there is a considerable range of action. This view is not correct: neither the method of development, nor the changes that take place in disease lend it any support. In reality, it is merely the lining of the cavity, developed by movement, and under similar conditions structures indistinguishable from synovial membranes may be formed in other parts of the body.

The common origin of all these parts and the sympathy that exists between them.

Joints are usually regarded as composed of many different structures, all of them separate and distinct, with different

and independent functions. There are ligaments to hold the bones together; a synovial membrane to render the movements smooth; cartilages over the ends of the bones to lessen the impact of any shock; and around them, filling up all the interspaces, a quantity of loose and delicate connective tissue, containing the blood-vessels and nerves.

This view may serve for the purposes of descriptive anatomy; but it gives an altogether wrong impression of the nature of the injury when a joint is sprained, and of the causes of the complications and after-troubles that follow with such frequency. The fibrous tissue that holds the bones together, no matter how many there may be, or how varied their shape, is structurally continuous with them. The cartilage that covers the ends of the bones is a remnant of the original matrix from which they were developed. The synovial cavity is formed by the breaking down of the soft tissue that in early life united all these together, and the synovial membrane is nothing more than the layer of cells that lines the cavity. Different parts in course of growth lose all external resemblance to each other. What they do not lose is their relationship from common descent. Throughout life the closest sympathy persists between them. It is impossible for one to suffer by itself or for a sprain to be confined to the stretching or tearing of an isolated ligament. The immediate effect of an accident may fall upon the ligaments, or it may not; it can never be limited to them.

Even if by any chance they were the only structures hurt at the moment, it is impossible for the other tissues to remain unaffected during the changes attendant on their repair. A wheel or a band in a piece of machinery may be damaged and restored without interfering with the other parts. When a ligament is sprained the blood pours into the synovial cavity and the open spaces around; all the vessels dilate; the synovial folds become swollen; the joint is tender to the

touch ; the temperature of the part is raised ; its movements are interfered with ; even the external shape of the limb is altered. Nothing escapes ; every structure around participates more or less.

The same is true of the later troubles that so frequently impair the freedom of movement in joints long after they have been sprained. The stiffness, for example, that is often laid to the credit of a contracted tendon, or shortened band, is never due to this alone ; nor is the sense of insecurity dependent entirely, or even to any extent, on the weakness of an injured ligament. It is only by taking a wider and more comprehensive view of the structure of joints, and by regarding them as highly complex organs, that a true conception can be obtained of the nature of the damage they suffer in sprains, and of the method in which they should be treated, so as to avoid, as far as may be, the occurrence of permanent injury.

The influence of age upon joints.

As age advances joints undergo modifications in structure, which are of some importance in connection with sprains. In childhood accidents of this kind are rare, except in the elbow, where a peculiar form of injury is not unfrequently caused by the way in which infants are hauled about by one arm, dragged, for example, across a road. The momentum of a fall is less in them ; the muscles are not so strong, and do not hold the limbs so stiffly, and the bones are so flexible that the effect of a fall is distributed over the whole limb, and not concentrated upon one joint. This more than counterbalances the liability that might otherwise arise from the rounded shape of the ends of the bones at that time of life, and the absence of the angular projections which in adults in so many cases serve as the main protection. But, on the other hand, when sprains do occur in children they

are liable to be followed by results, some of which are altogether confined to childhood, while others are much more common then than in later years.

Injury to the growing end of the bone, for example, is by no means rare. If the epiphysis is completely detached the condition is usually recognized without difficulty; but more frequently the separation is incomplete, and often there is nothing more than a little bruising along the line of union, without any reason to suspect a graver hurt, until it is noticed in the course of a year or two that the bone has ceased to grow. I have seen this on more than one occasion in the ankle, the most serious deformity resulting in later life from what has been casually dismissed in childhood as merely a sprain.

Inflammation of the articular ends of the bones again follows injuries of this kind much more frequently in childhood than in later years. This may be accounted for in some measure by the greater vascularity of the parts at that time of life. In the adult the vessels are restricted chiefly to two circles which surround the attachment of the capsule, and send loops into the folds and fringes. In the child not only are the vessels larger and more numerous in proportion to the size, but they extend much more freely into the bone, and over the inner surface of the capsule. As a consequence sprains in children are always attended by an excessive amount of swelling, and if inflammation does break out it attacks the growing ends of the bones much more often than it does in adults. Most of the cases of hip and knee disease date their outbreak from some apparently trivial hurt of this kind. Later in life, when growth has ceased, and there is no longer a soft and vascular portion of bone inside or in close proximity to the joint, the liability to this complication diminishes; inflammation may still follow, but it takes another form.

In adult life the joints attain their perfect shape and struc-

ture; and then, very gradually, as age advances, other modifications set in. The cartilage wastes away, or is replaced by other tissues; the bones become weaker and more brittle, so that fractures become more common, sprains more rare; the soft tissues grow harder and more rigid, restricting the range of movement, and the synovial cavity becomes more irregular. Fringes grow into it from the ridges and inequalities of the surface, and especially from the spot where the capsule is attached to the bone. Pouches are thrown out from it, until in outline it bears scarcely any resemblance to what it was at birth. Accessory spaces, known as bursæ, are developed around it wherever there is friction—under tendons, for example, or between bones and muscles—and as age advances these grow larger and larger until at length they encroach to such an extent on the lining membrane of the joint cavity that the intervening partition gives way, and a communication between them is established by an opening which grows wider and wider each year. Changes of this kind are natural, and are more or less well marked, even when the joints are healthy; exaggerated examples are met with in cases of chronic rheumatism, or rheumatic gout, and in those in whom work has been exceptionally severe.

The influence of exercise upon the structure of joints.

The principle that the more a part is used, within, of course, rational limits, the more perfect it becomes, has long been recognized in the case of bones. The skeleton of the male is very different from that of the female; the work is harder, and the bones are stronger. In the one they are solid, heavy, and exceedingly irregular, from the development of muscular ridges; in the other they are lighter and much more smooth and even. So with animals that have long been kept in confinement, the bones, contrasted with those of wild

ones of the same species, scarcely admit of comparison, the difference is so great.

What is true of the shafts and muscular eminences of bones is equally true of their articular ends, and of the rough surfaces to which ligaments are attached. Joints are well formed and secure from injury, so far as shape can make them, in proportion to the amount of their use and the perfection of the muscular system.

Where the muscles are poor and feeble the joints are poor and feeble too, and are easily sprained. The ends of the bones, instead of being angular, with sharply-cut and well-defined edges, are smooth and rounded. The articular surfaces are faintly marked, so that they can glide on each other in irregular and unusual directions; the capsule is loose and yielding, and the ligaments are unable to withstand a strain or even to maintain during exertion the normal relation of the two bones. The action of the joint is uncertain and often painful; there is no security; in case of any extra work the bony surfaces glide irregularly upon each other, or move beyond their ordinary limit; and the more often this takes place the more easy is it for it to happen again. The degree of perfection to which joints attain—and naturally they differ immensely in this respect in different individuals—is dependent entirely on the extent to which the muscular system is developed.

This, however, is not the only way in which the influence of the muscular system is shown. Without going so far as to say that sprains can be entirely prevented, there is no doubt that it is possible to avoid and guard against them to a very considerable degree. In some people they are particularly common; and so they are at certain times, and under certain conditions. Others escape in a manner that seems almost marvellous, and possess the power of using their joints in a fashion that would be impossible in the

majority. The difference in the degree of perfection attained by the bones and ligaments accounts for this in some measure; but a much more important factor is the condition of the muscles themselves. Sprains never occur unless the muscles are either weakened and tired out by prolonged exertion, or are caught unawares by some sudden slip, before they can recover themselves. Astley Cooper said of dislocations that it was only possible for them to take place when the muscles were unprepared for resistance; otherwise the greatest force would hardly produce them. Without saying so much of sprains, there can be no question that such accidents rarely happen, unless the muscles that safeguard the joints are taken by surprise or are tired out. Ordinarily speaking, they are the result of a sudden twist, so rapid that recovery cannot take place in time, and naturally this is most likely to happen to those who have never accustomed their muscles to much exertion, or who, from fatigue, have lost that instinctive vigilance and power of recovery essential to the safety of a joint.

This, among others, is one reason why sprains, especially of the knee and ankle, are so common among women, and those men who, in their youth, were distinguished for athletic feats. In the former, the muscles are insufficiently exercised, so that they never attain the vigilance and instantaneous power of response necessary to prevent the consequences of a careless step; in the latter, with advancing years and altered modes of life, the muscles fall out of training, without its being perceived, or perhaps sometimes without its being acknowledged. Then some unusual effort, especially a prolonged one, that in days gone by would have been accomplished easily, proves too much for their endurance under the altered conditions, something gives way and the joint is sprained.

An accident such as this, even if the joint is healthy, is

always serious, but when it occurs, not from overpowering force, but because the bones and ligaments are not developed as they should be, and the muscles are not equal to the work, it acquires a further significance. A very slight strain may make it occur again; and each time this takes place the amount of force required is less than it was before, until at last the joint, which never has time or opportunity to recover its strength, is permanently damaged. Such a condition may be almost called a chronic sprain. So long as it is slight it does not attract much attention. There are complaints of loss of power, and of twisting or giving way, but the deformity is not conspicuous, and especially as it is most common in children, it is put down to what is called "growing pain," a name which has probably done as much harm as any other by the way in which it makes light of what often is the commencement of a serious disease. When it is more severe, or when during some unaccustomed effort the limb fails completely, the joint is generally said to be out. The pain then is very severe; swelling soon makes its appearance, owing partly to the unnatural position of the bones, partly to the effusion round; and, owing to the insecurity of the joint, the loss of power is so great that the patient often believes himself paralyzed. It is serious, not on account of the tearing of the capsule or the injury to the parts around, but because the cause is such a persistent one, because the condition of things which has given rise to it is one that requires a long and systematic course of treatment before it can be rectified.

One of the most characteristic examples I have seen was in a young girl who was brought to me complaining of partial paralysis of the right arm, attended at times with attacks of severe pain. She was a tall, over-grown girl, fourteen years of age, employed as a nursemaid, having to carry about a heavy child, and owing to this condition of her arm, which had been coming on gradually for the last three or four

months, had lost her situation. She was not aware of having sustained any single severe injury to her shoulder ; but stated, of her own accord, that long before it reached its present state it was continually giving way, or, as she expressed it, coming out of joint. On comparing the two sides together, it was evident that the muscles around the shoulder joint on the affected side were smaller than those on the other, though the difference was not equally marked in all. The movements were limited to a great extent by the pain they occasioned, and the general muscular strength was decidedly below normal. The cause was apparent at once ; there was a large amount of thickening over the point of the shoulder, and the bones were so loosely connected together that one could easily be made to slip backwards and forwards over the other. When the shoulder-blade was held in position by firm pressure from behind, the movements of the arm could be executed nearly as well as those of the opposite limb, and with nearly as much vigour, while the wasting diminished so much that evidently it was in the main apparent only. As soon as the pressure was taken off the bone slipped round, a deep hollow made its appearance behind the collar bone, and this shifted its position in such a way that the two completely lost their normal relation to each other.

The fact that the wasting almost disappeared, and that the movements could be executed with ease as soon as the shoulder-blade was fixed, negatived the idea of paralysis. The slight amount of real wasting, affecting only a few of the muscles, was easily accounted for by the inflammation around the joints ; wasting much more extensive than this sometimes under these circumstances comes on within a week. There was no history of any accident sufficiently severe to suggest the idea of a dislocation : the onset had been slow and gradual, though every now and then the pain —which had, as usual, been called growing pain—and the

inconvenience had suddenly become worse. For the same reason it could hardly be termed a partial dislocation; the capsule was not torn, and it had come on so slowly and imperceptibly that the patient could assign no date for its first commencement. The characteristic features were the weak muscular development, the imperfection in the shape of the articular ends, and the loose yielding condition of the ligaments. So long as no extra strain fell on the joint, the muscles, weak and feeble as they were, were sufficient to maintain the surfaces in contact; a little extra work, slowly and gradually in this case, tiring out the muscles, allowed the strain to fall on the ligaments, until, as ligaments always will when subjected to long continued tension, they gradually stretched more and more, and became so loose that the end of one bone could slip backwards and forwards over that of the other.

A similar case, differing, however, in the joint affected, and in the fact that it was distinctly made worse by one rather severe strain, came under my notice almost the same day. The patient, who was also a girl, aged about 18 years, had suddenly felt a severe pain in the joint between the collar-bone and the sternum two days before as she was trying to lift a heavy weight, and, of course, had been told the joint "was out." At the first glance this did not seem unlikely, for the inner extremity of the collar-bone was much too prominent; but there was very little swelling or tenderness, and no bruising. On further inquiry, too, it was elicited from the patient that for some months past the arm had felt very weak and unsteady in its movements. Examination of the opposite joint showed that it was nearly in the same condition, and, in fact, the bones on both sides were so loose that they could be pushed almost as far backwards and forwards as they could upwards. Clearly, the ligaments were unusually lax, and two days before, when an unaccustomed

strain fell on the right joint, it gave way, causing so much pain that the patient was compelled to seek advice.

These two cases are, perhaps, somewhat exaggerated examples, because in both the already loose condition of the ligaments had been intensified by strains; the same state, however, exists independently of these, and no joint in the body is exempt. The shoulder, as might be imagined, is peculiarly prone to suffer. If the joint is poorly developed, or the muscles on which it depends for its security are lax and feeble, it can readily be made to assume abnormal positions. Sometimes this occurs with any movement, more often only with certain definite actions; in one case, a girl of 16, whom I watched for a long time, whenever in dressing of a morning she placed her hand on the back of her head in trying to arrange her hair, the upper end of the humerus slipped over the edge of its socket, and was caught there. At length she learned by a clever twisting action to bring it into its place again, and gradually to avoid displacing it altogether.

In the elbow joint, from the shape of the bones, displacement can scarcely happen; but the same condition of things occurs. Examples may often be met with in which the forearm can, without any violence or pain, be bent back to an abnormal extent on the arm; the ligaments in front are so loose that they do not check the movement, and the bones so feebly developed that their projecting extremities do not come into contact with each other until the normal range is greatly exceeded.

In the case of the lower jaw it has long been known. Hamilton described it as occurring in his own person, and, naturally, with the greatest possible accuracy. He has noticed, also, the curious circumstance that this displacement, when it does occur, is much more common in the morning than at any other time of day. Particularly at

breakfast the lower jaw, owing to the looseness of the ligaments that should restrict its action, is apt to become locked when the mouth is opened widely, and some manipulation is required to bring it back again.

Whether the same thing can occur in connection with the hip is, I think, very doubtful. I have seen one patient who could at will dislocate her thigh-bone by a peculiar twisting of the limb; but in the absence of any history that could be relied on, and as her other joints gave no sign, which they certainly would have done in such an extreme case, I imagine that this condition had existed from birth, by virtue of some congenital defect. In the knee minor degrees of it are quite common, not only allowing abnormal movements of the leg upon the thigh, but also giving too wide a range of action to the semi-lunar cartilages, so that not unfrequently they become displaced and lock the joint.

Want of proper training is mainly responsible for this. The joints are weak because they have never been exercised; the bones are smooth and rounded, the ligaments long and loose, and the muscles unable to stand the work. When a little extra strain falls upon them (and in such cases very little is needed) they soon become fatigued; and then, the feeble ligaments either yield little by little, with a very considerable amount of pain (as ligaments always do, when subjected to a protracted strain), or else give way. The security of a joint depends upon the shape of the articular ends of the bones, the strength of the ligaments, and, most of all, upon the vigilance and activity of the muscles around it, and these, in their turn, depend upon the extent to which the part has been educated and trained by previous exercise.

The influence of prolonged rest upon joints.

Healthy joints in young people can be kept at rest for an indefinite time without any serious change taking place in

them. They become slightly stiff, it is true, and the bones and other structures waste from want of use, but, unless other conditions are present, a few days' exercise with massage or passive motion effects an almost complete cure. This is not the case, however, with older people, or when a joint has been sprained. As age advances the tendency to stiffness becomes more and more marked, until at length confinement, even for a week, is sufficient to render a joint unfit for active employment for many months to come. The wrist and fingers, perhaps because the movements they execute are so numerous and complicated, are peculiarly susceptible. The power of bending them if the hand and forearm are confined between splints may be completely lost, even in a few days; they remain rigidly extended, and the least attempt at forcing them, no matter how gently it is done, gives rise to severe pain, and meets with a resistance which is not due to muscular contraction.

It is often said when this occurs that the patients are gouty or rheumatic, and that the stiffness is due to their diathesis; but there is no evidence of it. It comes on without aching or pain—that is not felt until after manipulation; the skin is not hot; there is no swelling or sign of inflammation; the onset is imperceptible; and the patient is unaware of anything being wrong until the hand is released from confinement and some attempt made to move it.

After a sprain, especially one in which a large amount of effusion has been allowed to collect, prolonged rest is always followed by this result. The injury, it is true, usually gets the credit, but in the vast majority of cases the sole reason is the rigid confinement to which sprained joints are subjected for days and even for weeks together. The tissue changes may be of the slightest possible description; there may be merely a little thickening of the capsule, or condensation of the delicate tissue that packs into the inequalities around and

between the ends of the bones; as soon as movement begins and the pressure shifts from one point to another the uneven tension causes such suffering that it is stopped at once. Properly directed movements in cases such as these very soon effect a cure; the longer the part is kept at rest the more rigid and crippled it becomes.

CHAPTER II.

OF SPRAINS IN GENERAL—THE NATURE OF THE INJURIES INFLICTED—THE CONSEQUENCES THAT FOLLOW, AND THE METHOD OF REPAIR.

SPRAINS differ a great deal in the nature and extent of the injury sustained. Sometimes it appears to be quite trivial; there is merely the slipping of a disc of cartilage from between two bones, or the displacement of a tendon from its groove; sometimes everything that holds the joint together, with the exception of the skin, is torn as in a dislocation. In many cases the injury is really as great: the bones are wrenched apart from each other at the moment of the accident, only instead of being caught and held, as they are in a dislocation, they fall back again of themselves into their natural position. Such accidents are always called sprains; but the tissues suffer as much as if the joint had really been put out.

Generally speaking, the tissues on one side of a joint are overstretched and torn; those on the other compressed and crushed; but there is always so much twisting, and such a difference in the strength and resistance of the various structures, that unless the part is examined with the greatest care it is almost impossible to say what actually has given way. In every case no pains should be spared to find out the whole of the mischief with as little delay as possible. Crippled joints are often due solely to the fact that a displaced tendon or other structure has not been recognized sufficiently early. The difficulty increases with every minute. Immediately after a sprain, before the position of the parts has been altered

by movement, or concealed by swelling, the nature of the displacement can often be recognized without much trouble. But if the chance is lost, the part begins to throb with pain, swelling sets in and obscures everything, and it is often necessary either to place the patient under an anæsthetic or to wait until the extravasation and œdema have been dispersed.

The ligaments.—The extent to which the tissues suffer differs very greatly. In sprains of ordinary severity the ligaments are scarcely hurt. A few fibres are torn here and there where they spread out to be attached to the bone, but there is seldom more. In others the strongest in the body, such as the internal lateral ligaments of the knee and ankle, may be torn across or wrenched away from the bone.

Internal ligaments, especially the discs of fibro-cartilage, which are interposed in places between the bones for the purpose of deeping the sockets and modifying the effect of shocks, are very liable to injury. Sometimes they are bruised or crushed; more often they are torn from their attachments and displaced, so that they interfere with the working of the joint. Or, without being actually separated, they may be so stretched that the result is much the same. This is best known in the knee; in other joints in which discs of this kind are found they are so much smaller and so firmly fixed that they rarely give rise to inconvenience. In the knee they are large; their normal range of movement is considerable, and they are so loosely held that displacement is not only easy, but, when it has once been produced (owing to the feebleness with which repair takes place), is always liable to occur again.

The capsule usually suffers with the ligaments. On rare occasions it is torn open, so that the synovial cavity communicates freely with the cellular spaces around. Much more often there is no perceptible rent, but merely staining and discoloration along the line of attachment to the bone,

where the fibres are fewest and weakest and the blood vessels most numerous.

The muscles.—In the slighter forms of sprains the muscles escape for the most part; at the moment of the accident they are relaxed, either from fatigue or because they are taken by surprise, and the only hurt they sustain is that occasioned by their sudden and spasmodic effort at recovery. If, however, they are firmly contracted and are overcome in spite of their resistance they may be very seriously injured, torn across, or wrenched away from the bone.

The weakest part of a muscle depends on its shape. When they are short and broad, with wide attachments to the bones and firmly bound down by sheets of fibrous tissue, there does not seem to be any definite rule. Probably the part that gives way first is determined mainly by individual peculiarities of structure; but when they are of considerable length, and attached to distant bones by tendon, the weakest part is the line of junction between this and the muscular fibres. It is at this point that they tear, causing a great extravasation of blood, and giving rise to a swelling which at first is soft and fluctuating, but which soon becomes hard and solid, and may persist in that condition unchanged for an almost indefinite period.

Tendons are so strong that they seldom give way. The sheaths, however, in which they lie, lined with a delicate membrane similar to that found in joints, are often bruised and filled with blood, and sometimes torn open, so that the tendons escape and lie displaced among the adjacent tissues. This is not uncommon at the ankle and on the back of the wrist.

A similar injury sometimes occurs where a number of long, slender muscles are placed side by side, as in the back of the neck. The sheath is torn open, and one or more slip out from their bed between the rest. When the sheath of a larger

muscle gives way in this fashion the muscular substance is generally squeezed out through the rent and forced into a kind of mushroom shape, which at first feels like a tumour, and then generally wastes away, leaving behind a deep depression in the substance of the muscle.

The structure, however, that suffers most in ordinary sprains is the soft and vascular tissue that fills the interstices between the bones and the ligaments and tendons. Even in a simple twist it is pinched and often torn, sometimes sufficiently for the extravasated blood to stain the overlying skin. When the injury is severe it is crushed and bruised, and the blood pours out from the vessels, and either collects in the cellular tissue around, or fills the synovial cavity and tendon sheaths. The pain is intense, and in the first few minutes the part may swell to an enormous size. Then the blood coagulates and absorption begins. If this is complete, convalescence, though it may be slow, ends in recovery; if it fails, troubles of various kinds are left, and the joint is more or less disabled.

Sometimes the capsule remains distended with fluid; or coagula adhere to the lining membrane, and becoming organized, leave it hard and rough. Loose bodies may make their appearance; fringes may grow out from the margins of the folds, and hardened masses may be left in the capsule itself. These are most painful when they take the place of the soft pads that fill the spaces around the ends of the bones. The blood that escapes into them becomes organized; they grow hard and dense, and if the joint is kept at rest in one position they assume a definite shape and refuse to give way before variations in pressure, or to accommodate themselves to the movements of the parts. So long as the limb is kept perfectly quiet in the same position, it is fairly comfortable; as soon as it is moved and the points upon which the pressure falls are shifted there is a stab of intense pain.

The same thing occurs with the bursæ around joints. Many of these are merely spaces in the connective tissue lined by a single layer of cells, and in ordinary circumstances contain only sufficient fluid to enable one surface to glide freely and smoothly upon another. After sprains the blood that is extravasated collects in them so that they may be immensely distended. If the fluid is absorbed at once, there is no ill result; the walls contract and the cavity resumes its former size and shape; but if there is any delay, organization begins, and the softened walls are thrown into folds so that the sides grow together and become incorporated with each other. Instead of there being a thin walled sac, assisting every movement by diminishing friction, there is a rigid mass of tissue, stiffened, irregularly thickened, and adhering to everything around, the seat of constant pain and tenderness. The amount of bleeding when a joint is sprained and the rapidity with which the extravasated blood is absorbed are very important factors in determining the speed and the completeness with which recovery takes place.

Repair begins at once. The blood vessels throughout the injured area dilate; their walls become relaxed and softened; the volume of blood circulating through the part increases, and lymph pours out into the tissues around, mixing with the blood that has escaped already. The different structures are affected in various degrees. The natural spaces, such as the bursæ and tendon sheaths and the synovial cavity of the joint, are filled first, so that for a time the swelling follows distantly the shape of the joint. The loose tissue around the edge of the capsule, where the synovial membrane is folded on itself and covered more or less with fringes and processes, follows suit. Then the capsule and the structures around it become thicker and softer. The ligaments with their close, dense texture resist the longest. Meanwhile, as the swelling becomes more general, the shape of the part

grows round and uniform. The temperature is higher than natural; there is a certain amount of throbbing, especially when an attempt is made at movement; and the skin becomes tense and shining from being kept upon the stretch. If the joint is superficial the surface is redder than natural; but not unfrequently, in spite of the increased heat, it is paler; it is so stretched that the small blood vessels are emptied.

To some extent these changes are necessary, but they must be kept within bounds. If they pass a very moderate limit they delay instead of promoting recovery. Absorption ought to begin its work as soon as the effusion makes its appearance, slowly at first, but steadily advancing until it gains upon and at length overtakes it. What is wanted is not a passive collection of stagnating fluid in the tissues, leading to swelling and œdema, but a more rapid circulation through them, so that they may be better nourished and better able to repair the injury with the least delay.

The sooner absorption begins and the greater the activity with which it is carried on the better the prospect of speedy recovery. When it flags the consequences are always serious. Inflammation may set in from the tension kept up by the fluid. The synovial cavity may continue distended until the capsule loses its elasticity and cannot contract again; the ligaments may be softened and stretched; bands of organized lymph may bind the muscles together, or fibrous adhesions may form around the joint so that it becomes stiff and rigid and loses all freedom of movement. The problem in treating a joint that has been sprained, after the extravasation of blood has been checked, is to maintain the circulation through the vessels and through the tissues at a rapid but perfectly uniform rate. If this can be done the blood that has escaped already is absorbed; enough lymph is effused to repair what has been injured without causing inflammation; the tissues are better nourished, and those structures that have

been damaged beyond recovery are removed and replaced with the minimum sacrifice of time.

The length of time before repair is perfect naturally varies very greatly. The fringes at the margin of the synovial membrane and the tissues at their base retain their altered character the longest. When the injury has been severe and convalescence protracted, they may never quite regain their former size or texture. In many instances they become firm and hard, and more opaque from the organization of lymph in their substance. Sometimes the larger ones become vascular, a loop of blood-vessels growing down into them from the base; and then they are practically permanent. If a joint has been sprained more than once, their presence can nearly always be detected in certain favourite localities, as, for example, on either side of the knee-cap. Owing to the synovial membrane being so superficial here they can be felt distinctly, even when they are still small, rolling between the finger and the bone. So long as they remain small they scarcely give rise to a sensation of inconvenience, but when they reach any size they act to all intents and purposes as so many fixed foreign bodies. From their position, well out of the way of the bones, they do not often get caught between them, or they would prove a grave source of danger; but even though they escape this, they keep up a continuous, if slight, amount of irritation; the hyperæmia and effusion never quite disappear; the capsule and the ligaments become involved more and more, and the strength and security of the joint at length are seriously impaired.

Where ligaments have been torn, whether they are completely separated in two, or, what is more usual, have merely sustained a number of small lacerations, it is, of course, a matter of some considerable time before recovery is perfect. So it is when muscles or tendons are torn, or if the sheath in which they lie is widely rent; and above all, if, before the

parts are firmly united, they are strained again. If this happens, not only is the whole of the original mischief reproduced, but the degree is, generally speaking, more severe; for, owing to the vascularity and softness of the part at the time, the hæmorrhage and laceration are nearly always more extensive than they were at first.

It is impossible to lay down any precise rule as to the length of time required for the repair of these more serious hurts. Each case must be judged on its own merits. The amount of injury, not merely that sustained at the moment, but the subsequent damage often inflicted in ill-advised attempts at treatment; the kind of tissue that has suffered most; the extent of the extravasation; the particular kind of joint, whether in the upper or the lower limb; the age, and above all, the constitution of the patient; the care he will take of himself; all these things have to be considered with many others before an estimate can be given. All that can be said is that a severe sprain, tearing a strong ligament, or wrenching it from the bone, takes quite as long before union is perfect as a fracture through the bone near it. The patient may be able, probably will be able, to make limited use of the limb much earlier, especially if he is careful to avoid any movement calculated to throw a strain on the injured part (which, of course, in the case of a fracture is rarely possible); but recovery takes at least as long, and perfect convalescence, with perfect movement, often much longer.

CHAPTER III.

THE TREATMENT OF SPRAINS IN GENERAL—MASSAGE—COLD —HEAT — COMPRESSION — PASSIVE MOVEMENT — FIXED BANDAGES.

The results obtained by the ordinary modes of treatment cannot be regarded as satisfactory. Even when the greatest care is taken, when every precaution is used, tedious convalescence is frequent, rapid and perfect recovery rare, and often the joint never recovers at all. It is left weak or tender, not trustworthy, prone to swelling with the least exertion, and sensible to every change of weather, so that there is an end once and for all to the healthy unconsciousness that such a thing as a joint exists.

The reason is not far to seek. In a large proportion of cases the measures adopted are altogether insufficient; in some they are absolutely wrong, when, for example, a joint is kept perfectly quiet until it becomes hopelessly stiff; while in nearly all the time that is of the greatest value, that which immediately follows the accident, is allowed to pass by without anything being done, and wasted.

Whatever plan is adopted it is essential to begin at once. Every moment lost makes a serious difference. The injury is not confined to the instant of the accident. The blood keeps pouring out from the wounded vessels and accumulates in the synovial sac and the interstices of the tissues, until it causes such an amount of pain and tension that inflammation is almost certain to follow. If recovery is to be speedy or sound this must be stopped at once, or, at any rate, confined within the narrowest limits. When once it has left the

vessels, and become extravasated, blood serves no useful purpose, whether it collects in the cavity of a joint or spreads itself through the loose tissues of the limb. It separates the ends of the torn ligaments; it distends the synovial sac until it becomes stretched out of all proportion; when it is absorbed it leaves the capsule loose and flaccid, so that the joint feels weak and powerless; and when it is not it often becomes converted into a hard unyielding mass, which interferes with the action of the muscles and compresses the nerves so that free use of the limb is rendered impossible.

The sharp sickening pain at the moment of the accident cannot be prevented; but the dull, persistent aching afterwards is due to the way in which all the sensory nerves of the part are stretched by the swelling that follows, and the more this is kept under control the less pain there is.

The first thing is to check the bleeding and to spread out over as large an area as possible the fluid that has escaped already. Then, as reaction sets in, as the part becomes warm and red, and as the quantity of blood circulating through the uninjured vessels begins to increase, steps must be taken to keep this within bounds. There must be a certain increase; it is essential for repair; the injury entails more work; there is a large quantity of worn-out material to be removed and replaced, and more blood is required for it. Only it must be kept strictly within limits, and not allowed to run on until the synovial sac and tendon sheaths become distended or inflammation sets in.

If this can be done little further is required. All that remains is to assist the circulation through the tissues in every way, to maintain the nutrition at its highest level, and by gentle passive motion prevent the limb becoming stiff. Repair takes place with very different rapidity in different people and at different ages, but ligaments that have given way, or that have sustained many small injuries in their sub-

stance, naturally cannot in any circumstance be repaired at once.

The particular method adopted must be guided by the condition of the injured part. Sprains may roughly be divided into three classes; those in which the injury is extra-articular—the tissues that are torn or crushed lie outside the synovial cavity, and the bruising, though it may be extensive, is confined to one side of the limb; next, those of medium severity, in which, sooner or later after the accident, the central cavity becomes filled with blood and lymph; and those in which ligaments are torn or tendons displaced. There is no hard and fast line between these, but, taking typical examples, there is a well-marked difference between them, both as regards the length of time the symptoms last and the liability to complications.

Slight sprains.

Slight injuries should be treated by massage at once. Other measures, such as cold or heat, may be used as temporary expedients; when properly applied they are of service in numbing the pain and checking the tendency to effusion; but they are not nearly so effectual in restoring freedom of movement.

The history of massage is a very curious one. It has never been altogether forgotten; some people have always practised it, more or less carefully, and with a varying degree of knowledge and skill; but at certain times, and in certain countries, it seems to have acquired an extraordinary reputation, and then, again, almost capriciously to have been as strongly condemned. Possibly fashion may account for it in certain measure, for this exerts an influence over the use of remedies just as it does over everything else; but something, at least, must be attributed to the indiscriminate and unscientific manner of its application by unskilled persons in

all cases alike, whether they could or could not be benefited by it. Like many other things it has been destroyed by its own popularity.

It is certainly not a novelty; in most countries there has been handed down by tradition from unknown ages a custom of treating injuries of joints and muscles by friction or manipulation, and in some places this has been considered a special prerogative of certain families or individuals, who, by dint of long practice and a certain delicacy of touch (perhaps inherited), have attained no inconsiderable degree of skill. The modern plan is simply the scientific outcome of this; the working has been studied more accurately; its action on the tissues better considered; and rules laid down for guidance in the selection of cases.

At one time, for example, Beveridge's rubbers were well known in Edinburgh, and the success that attended their treatment (which was carried out very thoroughly and methodically) had a marked influence on the practice of the Continent. Then the process was almost forgotten, or, at any rate, was rarely employed, except in country districts, where rubbing is often used, in a rough sort of way, without skill of any kind other than that derived from custom. Lately, again, owing in great measure to the exertions of Dacre Fox, in England, and Graham, Norström, Metzger, and others abroad, it has been placed on a scientific basis, and received once more into favour. Even at the present day, however, there is too great a tendency to consider it a quack remedy, and to hand it over to persons whose chief recommendation is that they act as untiring rubbing machines, without following rules or guidance.

It is often said against it that those who take it up abandon it again as soon as they have had sufficient experience of its results; they find, so it is alleged, that not only does it require a large amount of patience on the part of the sufferer,

as well as the operator, but that it is only beneficial to those who would recover as soon without it, and that in some cases it is actually injurious. So far as sprains at any rate are concerned, this arises from the inability to distinguish massage from mere unskilled rubbing. It may or may not be true that it requires two years, as Dr. Murrell states, to learn the process ; that depends on the person and on the previous training ; certainly many do not acquire the art even in that time.

Like many other words that have crept into science from popular usage, massage has scarcely yet acquired a precise or definite meaning. It has been used for every kind of manipulation, whether applied to joints alone or to the whole surface of the body, with the hands only, or with the assistance of instruments. All varieties of friction, pressure, kneading, percussion, and even passive motion have been included in it at one time or another ; and the description of the manner in which it is carried out, and the rules by which suitable cases are selected, are proportionately vague and uncertain.

For all practical purposes, so far, at least, as concerns the treatment of injured joints and muscles, the various processes that have been enumerated may be grouped under the three heads of friction, percussion, and kneading. Passive motion differs to such an extent in its object and method of application that it seems unwise to include it.

Friction.—Of these friction is by far the most simple, but its power is very limited, and it has scarcely any direct influence, except on superficial structures. It consists merely in a succession of strokings with the hand (using as much of the surface as possible, and fitting it into all the inequalities) from the extremities towards the trunk, commencing lightly at first, and gradually increasing in strength as the part becomes accustomed to it. The skin soon becomes red and

warm; more blood flows through it, the temperature rises, and, after a few days' treatment, a distinct change may be noticed in the nutrition of the part.

Besides this, however, friction exerts considerable influence on the nerves distributed to the skin, and indirectly through them on internal organs, especially on other parts of the nervous system. The medium through which this takes place is not accurately known. It is possibly the result of the increased activity of the circulation, but more probably it is due to the sympathy existing between different parts of the nervous system, by virtue of which one cannot be stimulated or excited without influencing the rest.

Combined with baths, and applied generally over the surface of the body, it is of excellent service when the limbs are aching and stiff from over-exertion or exposure to cold. It allays the sensitiveness of the skin, leaves behind it a feeling of well-being and comfort, and does away with the sensation of fatigue. In sprains, however, and injuries of like character its application is more limited; its chief use is as a preliminary to allay the sensibility of the skin and accustom the patient to firmer kneading.

Percussion, whether carried out by means of an instrument or with the hand, is of very limited application in recent accidents. Massage, on the other hand, when thoroughly employed is of the greatest service, and when the injury is slight restores freedom of movement more speedily than anything else.

Massage.—The method of application is not easy to describe, and it can only be learnt through practice, even by those who already possess a knowledge of anatomy. This is indispensable; without it, massage must degenerate into mere rubbing. Each group of muscles must be known, where it ends and begins, how thick it is, and how the tendons lie, where the intermuscular septa of connective tissue come,

and where the vessels and nerves that supply the part are situated. All the natural movements and the different arrangement of the structures in various positions of the limb must be perfectly familiar. The synovial cavities of the joints and the tendon sheaths must, as it were, be mapped out underneath the skin. In short, there must be a thorough practical knowledge, not only of the anatomy of the part at rest, but of the direction and mutual relations assumed by the different structures when at work.

Supposing the case of a sprained ankle of moderate severity in a healthy person, a few hours after the accident: the ligaments are strained, perhaps even slightly torn; the synovial cavity contains an excess of fluid, the tissues around are swollen, the skin is hot and discoloured, the normal shape of the joint is lost, and all the hollows between the bones are filled up. The patient must be seated comfortably, so that the muscles are, as far as possible, relaxed; the knee must be bent, and the foot and ankle given over altogether to the manipulator. The foot is to be held gently, but firmly, so that the patient may make no incautious start, and the whole proceeding from first to last should be entirely devoid of pain. The operator should have plenty of room, so that he is not cramped; perhaps as convenient a position as any is kneeling on one leg, or sitting on a low seat in front of the patient, with the heel of the injured limb resting on the front of his knee. The movement at first must be exceedingly light, and so directed as to diminish as much as possible the sensitiveness of the skin, commencing with the part above (nearer the trunk) the injured joint, and working gradually downwards. The thumb, or the tips of the fingers, or the palm of the hand, should be used according to the shape of the surface, taking care always to employ as much as possible.

The direction of the movement must always be towards

the trunk, from the insertion to the origin of the muscles, in the direction of the returning current of the circulation, commencing over a part where the swelling has not yet shown itself, and gradually working on to the rest. The most tender spots must always be left to the last. If, for example, the foot has been twisted outwards, there is nearly always great sensitiveness over the tip of the internal malleolus, and a considerable amount of swelling along the course of the tendons behind, extending up the leg and filling the hollow in front of the tendo Achillis. This must be left until friction has been applied over the whole of the rest of the foot and leg; if this is carried out thoroughly not only does a great deal of the swelling disappear from the injured part, but owing to the condition of the circulation through that which has been already manipulated, the remainder is absorbed more readily than it otherwise would be.

Gradually, if the treatment is persevered in, the tendency to start on the part of the patient, and even the involuntary shrinking, disappear; the foot is given up to the operator with greater confidence, and the swelling begins to diminish. More attention may then be paid to the spaces in which the extravasated blood has collected. The tips of the fingers, or the thumb, may be made to trace out the irregular intervals between the bony prominences, moving round and round in small circles on the skin. The two hands should be used close together, so that the paths the fingers traverse intersect each other, and the manipulated surfaces overlap. Gradually, as the effusion subsides, the circles increase in size, the pressure becomes firmer, and the deeper lying structures are treated in their turn. The individual muscles and tendons are grasped and squeezed in the direction of their fibres, the fingers being always carried onwards towards the trunk in the interspaces between them; and the soft tissues are firmly pressed, and, as it were, rolled along by one hand after the

other, until all the excess of fluid has returned once more to the blood stream, and slight passive movements of such a nature as not to exert any traction on the injured ligaments are allowed without resistance.

This is to be taken as the sign of success in the treatment of recent cases. How long before it is reached differs naturally in each individual, and no rule can be laid down. Sometimes in slighter injuries a single short sitting suffices; at others the process must be repeated for several days. The time that has elapsed since the accident, the condition of the joint, the degree of swelling, and the severity of the pain, all possess some degree of influence. As a general rule, if the injury is recent, there is more tenderness about the part, but the swelling disappears sooner; in older cases firmer pressure may be used from the first, as the skin is less sensitive; but the time before the swelling is absorbed, and movement becomes free and painless, as a rule is much longer.

Where other joints are concerned, the treatment must be conducted on essentially the same principles, varying the details according to the circumstances of each case. The operator should always keep sufficiently far off so that his movements are not cramped or constrained, and he should always endeavour to make use of as much of the surface of his hand as possible. The fingers must be kept close together for the sake of mutual support; they should not be allowed to slip too much upon the skin, which should move with them as far as possible, or the operation may be uncomfortable to the patient. For this reason ointments and other similar applications are better not used unless it is wished either to diminish friction or to produce some specific effect.

The patient must be placed in an easy and comfortable position, with the limb well supported, and, where possible, well raised, so as to assist the return circulation. If, for

example, the wrist is the part in question, the point of the elbow should rest on the table ; if it is the elbow itself, or the shoulder, the patient should either rest his hand on the shoulder of the operator, or should lay hold of something higher still.

The hands must always lie in the direction of the muscular fibres, and the rolling and squeezing always tend upwards from the extremities towards the trunk. The rate of movement and the amount of force that is used must vary with each individual ; but there should never afterwards be any sign of bruising due to the manipulation. It is always present, of course, to a greater or less extent in recent sprains, and it is nearly certain to be there if adhesions are broken down or a joint is forcibly manipulated under an anæsthetic ; but it never occurs after massage unless the force used has been excessive, and its presence generally means that more harm than good has been done. Instead of assisting in the repair of the damage it has inflicted more.

It is most essential to commence as gradually and as gently as possible, only working on the deeper tissues after the superficial ones have become thoroughly accustomed, and have been unloaded of their surplus fluid. The skin, the soft subcutaneous tissue, the muscles, and the deeper layers must all be worked in turn. Nor should the manipulation be confined to the injured part. In a sprain of any standing the whole of the limb is affected more or less. It is usually better to devote attention first to the parts nearer the trunk, then to deal with those around the injured area, and only afterwards, when the circulation is thoroughly re-established, to manipulate the joint itself.

The tendency is to make the sittings last too long. Deep manipulation itself rarely requires more than five minutes but in dealing with a recent injury it may be advisable to

spend a longer time than this over the friction and other preparatory measures, so that a quarter of an hour soon passes by. When the tenderness is very great, and the amount of swelling excessive, much longer than this may be necessary, but short, frequently repeated sittings are of greater benefit than one long one. A skilled operator, too, will often effect more in a few minutes than an ordinary rubber will in as many sittings.

Sprains in which the injury does not involve to any serious extent the synovial cavity of the joint or the tendon sheaths require nothing more than this. The application should be renewed the next day, and continued until the swelling and œdema no longer return; but unless the work that has to be done is unusually severe, there is no need for prolonged rest or bandaging. The limb may be swollen; movement may be very painful; the skin may be tense and shining, much too hot to the touch, and exquisitely tender; under proper massage all this vanishes as if by magic. The tension disappears as the fluid is carried off; the pain is relieved, the temperature falls, the natural outline begins to be apparent once more, extravasated blood is broken up, the *débris* dispersed, and adhesions between the torn and bruised surfaces effectually prevented. Sometimes even tendons, which have been turned almost out of their grooves by the accumulation of fluid in their sheaths, can in this way be restored to their position without further assistance.

Such results as these cannot, of course, be obtained in every case, and even when the treatment is successful in relieving the pain and getting rid of the swelling, it must always be remembered that time is needed for the repair of structures that have been torn. I am convinced, however, that, especially when the stress of the injury has fallen on the muscles, this plan may be adopted, not only with the greatest safety, but with an infinitely better prospect of speedy re-

covery than under the old-established method of bandaging and rest.

Sprains of moderate severity.

Sprains of greater severity, those, for example, in which the capsule of the joint or the tendon sheaths are distended with fluid, and the pain is continuous and throbbing, require more than this. Massage alone is not sufficient ; it cannot check the stream that keeps oozing from the torn vessels or stop the effusion of lymph. Recourse must be had to other agents, such as cold, heat, and pressure, and then later massage and passive motion may be called in to disperse the swelling and restore the circulation. Of the three, cold and pressure are by far the best ; heat is only of use within the first few moments. Cold, applied immediately, and as soon as the part is thoroughly blanched, followed by compression, massage, and passive movement, is the ideal treatment ; but everything depends upon the method.

Cold.—When the matter is thought out there is something almost ludicrous, if such serious consequences did not follow, in the way in which, as a matter of routine, a wet bandage is applied to a sprained ankle. For the moment it is cool and pleasant, and with the folds and turns lying evenly and smoothly on each other, looks exceedingly neat. The uniform pressure does give relief at first, but in a very few minutes the coolness disappears and the temperature is as high as that of the joint beneath. In a few more it begins to dry, and as it dries it becomes loose, so that the pressure (which never at any time falls quite on the right part) disappears altogether. If the bandage is removed and the limb examined it is smooth and round, with the hollows quite filled up. The bandage, of course, passes over them without pressing upon them, reserving this for the bony prominences which do not require it. The soft tissues are swollen and œdematous, and the synovial sac and the tendon

sheaths distended with fluid. Applying it again in the same fashion does no good, nor is it of any use keeping the bandage wet. The principle is correct, but the method is altogether a failure. Neither the cold nor the pressure is applied effectually, and the result of this method of treatment may be seen in the fulness and swelling that persist round ankles for years after they have been sprained.

The fault is not that of the cold. If this is applied at once and thoroughly, so that the temperature of the limb is not allowed to rise, it is simply invaluable. It is always at hand, anyone can apply it, and for a time it fulfils every indication. The blood-vessels contract, the skin becomes white, the bleeding is checked, the sensitiveness to pain is diminished, and the tendency to swelling very much lessened.

The simpler the method the better. It may be dry or moist. In the former case it acts by conduction only; in the latter by evaporation as well, but this advantage is more apparent than real. It is more important that time should not be lost, and that the injured limb, especially if it is the ankle, should not be allowed to hang down. In some parts of the body, such as the hip, there is no doubt of the superior comfort of the dry method; in others the position in which the limb must be placed, and the facility with which the cold can be applied, form the best guide.

Cold spring water is nearly always at hand. It may be either poured freely over the injured part, or this may be immersed in it. The former plan is the more efficacious; independently of the fact that fresh quantities of water are continually being brought into contact with the skin and abstracting heat from it, and that a certain amount of evaporation can take place as well, it is probable that the actual impact of the falling water, perhaps by the shock and the influence it has on the nerves in making the vessels contract, perhaps by the force of its fall, is of great assistance.

The same effect can be produced by immersion, but unless the water is very cold it is much more slow, probably because the layer next to the skin is soon warmed to the temperature of the body. If ice can be obtained at once in sufficient quantity, the result is as rapid, but there is the disadvantage that it is nearly always necessary to allow the limb to hang down, a position which should always be avoided, as it tends to increase the amount of blood in the part, and makes it much more painful.

As soon as the joint ceases to swell and the skin is beginning to look dull and livid, the maximum amount of benefit has been produced, and the sooner compression is applied the better. If, however, the pain continues, especially if the joint begins to throb, cold may be advantageously continued for some time longer, in a somewhat different manner, over the bandages.

One very convenient plan is by a set of Leiter's coils. They may readily be improvised out of rubber tubing (the best is that which has an internal diameter of about one-third of an inch and moderately thin walls), or composition gas piping, which has the advantage of retaining the shape to which it is bent. They may be applied to any part of the body, coiled round a limb, for example, without the circles being in any way fastened together, or wound in a flat spiral and rested on the part, as in the groin, or pressed into the shape of a low cone and arranged to fit the shoulder. All that is necessary is that there should be two buckets, one containing water of the desired temperature placed on a stool a little higher than the limb, and connected with one end of the coil; the other, on a lower level, empty, and connected with the other end. As soon as the current is started from one end to the other the flow is continuous, and may be regulated with the greatest accuracy. It is not essential that the cold should be confined strictly to the part. If an icebag

is laid on a limb over the course of one of the main arteries it causes a very sensible diminution in the temperature below by the constriction it induces, and by the proportionate diminution in the amount of blood.

A still more simple way is to fill a rubber bag (or where this is not handy an ordinary bladder answers all the purpose) with small fragments of ice, or with ice and salt, and to allow it to hang over the joint so as just to be in contact with it. A double fold of lint, or a thin pocket-handkerchief, must be placed underneath, lying on the skin, and changed occasionally, as it soon becomes wet from the condensation of moist air on the outside of the bag. This plan is particularly useful when it is desirable to produce an effect on deep-lying structures, or to keep the cold up for a considerable length of time, as it is very effectual, may be graduated exactly, does not want watching, and makes no mess.

There are other methods as efficacious, but less convenient. One depends on the well-known fact that if a skein of wool is allowed to hang over the edge of a vessel, so that one end dips in the fluid inside and the other hangs over the edge, a continuous stream of drops will come from the dependent half until all the fluid is gone. A drip pot of this kind, or more than one, suspended over a limb and filled with evaporating lotion, reduces the temperature quite far enough. Iced water, or a lotion containing chloride of ammonium in solution, answers very well, but if the full effect is desired, there is nothing to equal lead lotion mixed with spirit, and containing a few fragments of ice. The effect is greater in proportion to the amount and strength of the spirit. It may be allowed to drip on to the skin directly, or this may be covered with a single thickness of lint, to avoid splashing, and to carry off the surplus fluid. If the lint is folded even once, so that there are two layers, evaporation is checked to a considerable extent, and a great deal of the effect lost.

Cold is most successful in sprains of large joints when the swelling comes on rapidly. If twelve or more hours pass by before this makes its appearance, pressure applied at once answers better, though even then, if a joint such as the knee or ankle has been bandaged carefully, an ice-bag laid on it makes its influence felt, and helps to relieve the feeling of tension and throbbing. When the brunt of the injury is borne by the muscles it is not so serviceable. In the aged, in the very young, in those subject to local congestions such as chilblains, and in the rheumatic, it must be used with great caution.

Heat.—Heat may be employed in cases in which the use of cold does not seem advisable. Its value as an immediate application depends on the fact, which is not so widely known as it might be, that hot water, if the temperature is sufficiently high, is as effectual in stopping bleeding as ice. The skin becomes cold, the vessels in it and in the layer immediately beneath contract, and the circulation in many instances almost stops. In the case of the fingers, where in proportion to their thickness the extent of surface is very great, I have seen complete blanching and numbness produced by dipping the hand into very hot water, and have known it to last even in the hot days of summer for many hours, longer than if it had been due to the application of ice.

To produce such an effect as this the temperature of the water must be as hot as can be borne. It cannot, therefore, be kept up for more than a few moments, for fear the skin should be injured; and for the same reason it cannot be employed, as cold is, to diminish the calibre of the vessels in the deeper-lying structures. Its value is greatest when the injured part lies near the surface, particularly in the case of tendons, which, like those on the back of the hand, run a long distance down into the fingers, lying immediately under the skin the whole way. In the ankle and elbow, also, it succeeds

fairly well, but the difficulty of application in the case of other joints is so great that it is generally better to rely on cold.

The temperature of the water requires a good deal of judgment, especially as different people, even different parts of the body, vary very much in their degree of tolerance. With children it cannot be employed at all, their skin is much too delicate. The fingers can stand a higher temperature than the hand, and this, again, a higher one than the elbow; indeed, the point of the elbow is, so far as heat is concerned, one of the most sensitive parts of the body. The extent of surface immersed has also to be considered, as the sensitiveness increases with the area exposed. The simplest method is to place the limb in hot water, and then raise the temperature rapidly by adding more, until it is as high as the patient can bear, taking care to stir it all the while, so as to distribute the heat evenly. Two or three minutes ought to be sufficient; often the full effect is gained in one.

Heat used in this way has a wonderful power of relieving pain. The skin may not be blanched, but its sensitiveness is lowered; manipulation is more easy, and displaced tendons or other structures can often be restored to their position without the sickening sensation produced by over-stretched fibrous tissue.

Sometimes, after prolonged overwork or severe strains, the bony prominences to which the muscles are attached become sore and tender, or the tendon sheaths seem to be roughened and uneven, so that perfect smoothness of motion is lost; or in certain classes of work, where without the actual exertion being great, rapidity and delicacy of movement are carried to a very high pitch, the nerves become painful, and the muscles liable to sudden and spasmodic contractions. When this occurs the prolonged application of warmth at a moderate temperature may be relied upon to give relief, at any rate for

a time. The object is not to numb the sensibility of the part, but rather to relax the walls of the vessels and relieve the tension, so that blood may circulate more freely through the tissues, and the delicate fibres, in which the nerves end, may no longer be kept upon the stretch. This holds good even when some of the muscular fibres have been torn.

Later, when the joint is beginning to recover, heat is of value both for its own merits and as a preliminary to massage. There is then no limit to the length of time it may be applied. The hand, for example, if it is stiff from the effects of some old sprain, may be kept soaking for hours in water as hot as can be borne with the greatest benefit. The tissues become soft, everything is supple and flexible, the constant aching disappears, and movements which before were out of the question are executed with ease and freedom; only, unfortunately, it rarely happens that the whole of the improvement is retained. So far as stiffened joints, at least, are concerned, it does not seem improbable that the reputation enjoyed by many of the foreign baths is due more to the temperature of the water and the length of time the limbs are allowed to steep in it than to anything else.

Besides these there are other methods, less general in their application, which are better described in the treatment of special sprains. Ironing, for example, is often of use where large masses of muscle in the loins are stiff and painful from overwork or cold, so that the patient cannot move with freedom or hold himself erect; and hot vapour or mud baths, where the limbs are stiff and crippled from old attacks of inflammation; but remedies of this description are usually employed in conjunction with others, and do not depend for their merit upon heat alone.

Compression.—Heat and cold are only of temporary use; their influence on the vessels is exerted through the nerves and muscles, and after a time these, like other vital struc-

tures, become tired out, relax, and give way. Both of them when continued too long tend to produce the very effect they should prevent. The tissues become congested; the circulation is checked, though the actual amount of blood in the part may be greater than normal; the cavity of the joint is distended; and the soft tissues around and between the bony prominences are filled with exudation, which becomes organized, develops into tough and unyielding fibrous bands, and cripples the movement of the joint.

As compared with these the action of pressure is entirely mechanical; the measure can be graduated according to the needs of each case, and it can be kept up at any required degree for an indefinite period. When carefully and methodically applied, nothing is more efficient for stopping bleeding, or for ensuring the absorption and dispersal of blood that has escaped already. It controls the hyperæmia and checks the dilatation of the vessels, so that the outpouring of lymph is restrained within proper limits. It prevents the accumulation of fluid in the synovial cavities; assists its absorption from protected spots, so that it neither runs on to inflammatory exudation on the one hand, nor becomes organized and leads to stiffening of the joint on the other; and, above all, it relieves pain in the most wonderful way, whether it is the sharp and acute kind that comes on immediately after an accident, due to the stretching and tearing of the nerves in the ligaments and fibrous structures, or the dull aching afterwards caused by the continued tension on the capsule. In the majority of instances, if compression is properly applied, the swelling disappears by the next day, and the joint can be moved through nearly its whole range without more than a sense of discomfort.

To effect this, however, compression must be applied with a definite knowledge of what is desired, and how it is to be obtained. Merely putting a bandage on a limb that has

been sprained only perpetuates the evil it is intended to prevent.

It may be commenced at once, as soon after the accident as practicable, or heat or cold, as the case may indicate, may be applied for a short time first. In most cases the latter plan is the better; heat or cold requires less skill, and relief from pain is attained more immediately, while, if carried out effectually, time is not really lost. Besides, before a bandage can be applied, it is necessary to make perfectly certain that there is no displacement; it is hopeless trying to cure a sprained joint if any of the structures belonging to it are out of their natural position.

The method of application is all important, though the rules that guide it are sufficiently simple. The joint must be fixed in the most suitable position, not necessarily the one selected by the patient. For example, in sprains of the ankle the foot should be at right angles with the leg; when the knee is injured the joint should be slightly bent, though not nearly to the degree in which the patient is almost sure to place it; when the shoulder is involved, the arm should hang by the side.

The pressure must be applied so that it falls only on the parts that require it, not on the bony prominences, but over the tendon sheaths, and on the masses of soft tissue that fill up the interspaces between them and the bones, especially on the inner side of the limb. It must be smooth, even, and well graduated, commencing from below, and working upwards towards the trunk, and it must be elastic, so that as the swelling diminishes under its influence the bandage may still keep up some degree of compression.

For this purpose there is nothing more suitable, and, fortunately, nothing more easily obtained, than ordinary cotton wool. Pads may be made of this to fit into any depression, no matter how small, and, if not too firmly compressed, they

keep up an even amount of pressure, even when absorption underneath has effected a considerable difference in the size of the limb. Failing this, the next most useful substance is a fine-textured sponge. This may be made into pads which admit of the most perfect adjustment as regards size, shape, and thickness, and it is more easy to keep them in their proper place while the limb is being bandaged. Many other substances, however, serve on special occasions; dried moss, for instance, forms a capital substitute, and I have known even seaweed used with success. Some of the thicker and softer kinds of felt make admirable pads, firm and soft, yet quite elastic, and capable, if several layers are sewn together, of being modelled into any shape. Sometimes this firmness is of especial service. I have employed them with great advantage in sprains of the extensor tendons on the back of the wrist, when the distension has not been very great, but where there has been a large amount of creaking or grating on movement. It is difficult here to adjust pads of cotton wool sufficiently accurately, while the felt is easily shaped to suit the varying thickness of the soft parts. The pressure is distributed evenly over the whole length; the tendons are kept at rest; and the firm compression ensures the rapid disappearance of the exudation.

Pads of sponge or felt may, moreover, be soaked in lotions, if it is considered advisable, without altogether destroying their elasticity. I have not found much occasion to put this into practice, but once or twice, when the pain over small joints was very severe, the application of a lotion containing a solution of morphia afforded great relief. Of course, a certain amount of caution must be used. A thick felt pad, covered on the outer side with a layer of some waterproof material, is capable of taking up no inconsiderable quantity, but the area of the pad is generally small, and the condition of the parts beneath is not one adapted for rapid absorption

If there is the least abrasion this caution is particularly required.

It is impossible to be too careful in moulding the pads to the proper shape of the limb. This must be seen as it were through the swelling. If, for example, the ankle has been sprained, the front of the joint must be accurately fitted from the toes to half way up the leg, and all the hollows on either side of the tendo Achillis and around the malleoli filled in. If it is the knee, in addition to a circular or horse-shoe shaped cushion around the patella, there must be a firm elastic pad behind, filling up the popliteal space. This not only distributes the pressure over a larger surface and gives more resistance to the bandage in front, but forms at the same time an admirable splint, keeping the joint nearly straight, and possessing the great advantage over an ordinary back splint that it is not so absolutely and uncomfortably rigid.

In severe sprains of the wrist, when front and back of the forearm appear to be equally swollen, the compression should be applied all round the limb. This can be carried out by adopting a modification of Guérin's method of treating wounds. The injured part is well padded first and bandaged lightly; small cushions are placed between and under the fingers, and then it is wrapped in sheets of cotton wool until it is three or four times the natural size. Finally it is bandaged from below upwards as firmly as possible. If there is enough wool it is impossible to exert too much pressure. The application is hot, it is true, but it relieves the pain almost at once, and such is the elastic tension of the wool that the swelling is generally dispersed within twenty-four hours. Dusting the limb with violet powder first prevents the sensation of itching which is sometimes complained of.

Bandages used for sprained joints need not be of any

special kind so long as they lie evenly and smoothly on the limb and do not stretch. India-rubber ones, or those made of woven elastic, are strongly recommended by some; but, it seems to me, without adequate reason. They keep the limb very hot; the solid ones retain the perspiration; and it is very difficult to apply them sufficiently firmly without making them too tight and converting them into a species of torture. While the limb is being bandaged the pads may be secured in position by means of common elastic bands passed round the limb, an excellent method suggested by Dacre Fox.

At the end of twenty-four hours everything should be removed from the limb and the joint gently but thoroughly rubbed and worked. At first the skin is wrinkled and inelastic; scarcely any movement is allowed, and the patient is apprehensive of the least attempt. After massage for a few minutes all this is changed. The colour returns; the skin moves freely over the subjacent structures; the muscles lose their rigidity, and little by little the joint yields to the pressure, and allows a wider range. This rubbing must be continued until the part can be flexed and extended as far as it is in all ordinary movements. Then the bandages and pads should be reapplied until the next day, when the same process is gone through again.

Even in the most severe sprains, when the staining due to the extravasated blood reaches, as it often does, nearly up to the knee-joint, it is advisable to begin passive motion on the second, or, at the very latest, on the third day, and to repeat it every day until recovery is perfect. Pain ought scarcely to be felt. Of course, if a ligament has been torn off the bone, and pressure is exerted on the spot, it is felt acutely; but these are the places that should be avoided, especially at first. After a little manipulation the tenderness diminishes considerably. If the swelling has been thoroughly dispersed, so that there is no tension on any part of the capsule or the

tissues round, and if care is taken not to move the joint far enough to put undue strain on a ligament that has been stretched or torn, the nerves are not dragged upon or compressed, and the movement is painless.

The ankle joint is peculiarly well suited to this method of treatment. Sprains are generally caused by the foot being twisted to one side, so that the strain is thrown upon ligaments which in ordinary movements are only moderately tense. The slightest attempt at bending the foot in this direction causes intense pain, and all the muscles become instantaneously rigid. Ordinary movements on the other hand are almost painless so long as they are not carried too far. I have repeatedly seen severe sprains treated in this way recover so completely in the course of a few days, that, unless there was an exceptional amount of walking to be done, the patient could follow his ordinary occupation without danger and without pain. Of course, if a ligament is torn across, time is required before it can unite, and still more before it can be firm ; but the position in which the structures are placed by this plan is unquestionably the most favourable for speedy recovery. The ends lie in close apposition to each other ; no external force is allowed to separate them, and, what is much more important, the synovial cavity of the joint does not remain distended with fluid, keeping the torn surfaces continually apart. If it is carried out fairly and consistently from the first, it is impossible for the joint to become stiff. Adhesions between contiguous surfaces are effectually prevented by the passive motion. The free manipulation renders rigidity or contraction of the capsule impossible. Unless there is some other predisposing influence, inflammation is equally out of the question. There is no tension to excite it, and, if the compression is properly carried out, there can be no dilatation of the blood-vessels to pave the way for it. Nor need there be any fear that after-

wards there will be that peculiar sense of weakness and insecurity which is so common as a consequence of sprains. In by far the majority of instances this is due to distension of the capsule or yielding of the ligaments; or, when this does not occur, to the fact that the muscles, from being so long unused, have become stiff or rigid, and do not respond as actively or as vigorously as they ought.

Severe sprains.

The worst sprains are those in which, in addition to other injuries, ligaments are torn across or tendons dislocated. It may be weeks, or even months, before repair is perfect in cases such as these, and during the whole of this time the greatest care must be taken that no strain is thrown upon the injured part. One incautious movement before union is sound may undo all that has been done. In all other respects the treatment is essentially the same. Cold or heat as soon as possible, continued until feeling is numbed, and then compression, massage, and passive motion.

Starch bandages and other fixed appliances, such as gum and chalk, plaster of Paris, or silicate of potash, can only be recommended in special cases. They are nearly always left on too long. The limb no doubt feels comfortable so long as it is encased and motionless, but every day it grows more and more stiff. If a ligament is torn passive motion, properly carried out, does not break down the union between the ends. There is no strain upon it so long as the range of action is kept within its normal bounds. The use of ligaments is to limit movements that are abnormal in extent or direction, and if the swelling that follows a sprain is kept in check, the joint may be made to execute all ordinary ones without fear of hurt, provided it is handled carefully by one who knows how much may be done.

It need not be said that haphazard or careless movements must be absolutely forbidden. The most accurate diagnosis is necessary to make certain what structures have suffered and what have not; and there must be a thorough and exact acquaintance with the action of the joint, so that the right kind and right degree of movement may be selected; but provided this is done there is no reason why the joint should not be worked in this way from the very first. If it is carried out thoroughly adhesions cannot form.

If a tendon has been dislocated, and the sheath of fibrous tissue which maintains it in its groove torn open, or if one of the cartilaginous discs which exist in some joints, such as the knee, has been displaced, the part may be exercised without fear of reproducing the dislocation or of delaying the union of torn fibres. In the ankle, for example, it is not uncommon for the tendons on the outer side to be displaced forwards on to the bone. They are held firmly down by a fibrous sheath thrown over them, and lined with a delicate synovial membrane; sometimes this is torn, and the tendon escapes from its bed. When this has once taken place a single incautious movement on the part of the patient, before the sheath has had time to repair itself, may tear it open again and reproduce the dislocation; and if this happens more than once it is not improbable that repair never will be carried out: that the sheath will remain loose and yielding, allowing the tendons to slip backwards and forwards with the slightest twist until the use of the corresponding muscles is lost. But if passive motion is employed systematically and carefully by someone who knows what the injury is, and how best its ill-effects may be avoided, the joint may be exercised thoroughly, flexed and extended as far as is desirable, and the nutrition of the muscles permanently maintained without the least fear of this untoward complication.

There is no fear of causing inflammation; the liability to its occurrence is not increased in the least by passive motion.

An attack may be brought on by some peculiarity of constitution, such as gout or rheumatism, or by some morbid condition of the blood, inherited or accidental; or it may be caused by tension if blood or any other fluid is allowed to collect unchecked in the synovial spaces or the tissues round; but once or twice in the course of a day, slowly and firmly straightening out a joint that has been sprained will never cause this result.

The length of time that a sprained joint requires to be bandaged depends chiefly upon the severity of the injury, but to some extent upon the age and occupation of the patient. It may be only a few days, or, in the worst cases, a month, and even more. Afterwards it is usually advisable for the patient to wear an elastic support, especially when an unusual degree of work is expected, but the sooner this is left off the better, and under no circumstances should a second be bought after the first is worn out without special permission. There is an immense degree of comfort in a well-fitting anklet after a sprain. The joint is weak; it has not been used for some time; it has grown accustomed to compression, and the patient is apprehensive about it, and cannot trust it. All this disappears as soon as the anklet is put on. Then by degrees, as it begins to wear out and its pressure diminishes, the tissues grow stronger, the joint learns to do without it, and one day it is suddenly discovered that it is so loose as to be practically useless. It has done its work, and should be left off. If, however, a second is bought, and the tissues are once more subjected to a long period of elastic compression, their nutrition begins to suffer, confidence is lost, and in all probability a support of some kind or other will be worn for the rest of life. In any case an elastic bandage should not be worn at night, nor when the limb is resting, and every time it is taken off the part should be thoroughly rubbed and douched with hot and cold water to restore the circulation through it.

CHAPTER IV.

IMPERFECT RECOVERY AFTER SPRAINS — ITS CAUSES AND TREATMENT—BONE-SETTING—DOUCHING—MANIPULATION AND GALVANISM.

Recovery after sprains is very often incomplete. For the first few days, perhaps, everything progresses as well as it can. The patient is wise enough to recognize the situation, and to reconcile himself to the necessary confinement, though this, as only those who have suffered themselves know, is very often far from easy. The dread of inflammation passes off, the swelling begins to diminish, the colour of the skin changes from black and purple to green and yellow, the tender points can be touched again, and a certain range of movement is permitted once more. With good fortune this continues, until at the end of two or three weeks the injury is repaired, and the joint as sound and trustworthy as it was before. Very often, however, it happens, as time goes on, that the improvement becomes more and more slow, until, perhaps, it comes to an end altogether, and the joint is left stiff, painful, it may be, and almost useless. The tissues have been repaired, but freedom of movement does not return.

The extent to which this suffers differs very considerably. The joint may be merely a little weak and unsteady, not quite to be relied upon when any special effort is called for; or it may be so stiff and rigid as to give rise to the suspicion that the bones have grown together. It may be free from all uneasiness in ordinary circumstances, or it may be the

seat of constant aching, with frequent sharp twinges of pain. In many cases it can be moved without inconvenience up to a certain point, but the least attempt to carry it beyond this is stopped at once. Yet, in spite of this, the skin may be cool, and the tissues of the joint, to all appearance, perfectly sound.

In some of these cases there is a definite reason. A tendon is displaced or one of the internal structures thrown out of position. Fringes have grown out from the margins of the folds into the interior and are caught and dragged. The muscles have wasted and grown rigid; or some of the neighbouring bursæ have become altered in structure. But cases such as these, for this reason, must be dealt with by themselves. Those to which I wish to refer at present are different; no definite lesion is to be found in them; they do not seem to have been severely injured; there is no evidence that the laceration was extensive; yet they remain so stiff and painful as to be almost useless, without any apparent cause.

The severity of the sprain has nothing to do with it. It is quite as common after slight injuries as after severe ones. Indeed, it very rarely follows complete dislocation, in which the laceration is most extensive of all. It may even come on without injury if the joint has been inflamed; no matter how slight the attack, it sometimes leaves behind it stiffness that lasts for years, long after all trace of the exciting cause has passed, and without there being any gross change to explain it.

Symptoms.—Joints that fail in this way always present certain features in common. If it is a superficial one, like the knee, the skin is reddened, but not with the bright flush of inflammation, or the ruddy glow of use; it is dusky and bluish, and if the finger is pressed upon it so as to drive the colour out it is very slow in returning. Often it is cold to

the touch; the patient may declare that it feels warmer than the rest of the limb, and even complain of a constant burning pain, but as tested with the hand, or, better still, with a surface thermometer, it is decidedly cooler. Sometimes the skin is smooth and glossy, sometimes wrinkled, but it does not fall into the natural folds of the part, or glide evenly over the bony prominences beneath. It seems too tight, as if it were shrunken, and it cannot be pinched up, or made to glide from side to side. Frequently one or two spots are exquisitely tender, not merely when pressed upon, but even if a finger touches them.

The tissues around are wasted; the shape of the bones stands out too distinctly; the hollows are not filled up as they are in health. Even in joints so well covered as the hip and shoulder something of this can generally be made out by the eye, though measurements may fail. Occasionally it is concealed by swelling of the subcutaneous tissue, especially in the case of the ankle, if the leg has been allowed to hang down.

But the most striking feature is the limitation of movement. The limb in most can be bent more easily than it can be straightened; but it is seldom that it can be moved to its full extent in either direction. It is stopped abruptly as soon as a particular angle is reached; the check is so sudden and so firm that the bones seem locked together, and any attempt to force it farther only causes intense pain shooting through the joint, often most severe where the skin is so tender to the touch. Generally, though there is a sense of discomfort and apprehension, the joint can be moved up to this point without distress, but occasionally even this is not possible. The pain is so severe, and the dread so great, that before the part is touched the muscles contract and hold it rigid, almost in spite of the patients' will. It is literally beyond their power to allow the movement; the pain is so

intense that their will is overcome and control over their actions lost.

Pathology.—It is a matter of popular belief that there is in these joints a band of some kind, passing across the cavity from one side to the other, independently of the lining membrane. When at rest this is loose; as the limb moves it suddenly becomes tense, and stops it abruptly. It is possible that a structure of this kind is developed sometimes; but I have never found one myself, nor am I aware of any case in which such a phenomenon has been recorded. The belief has arisen partly from a too easy interpretation of the symptoms, partly from the fact that in exceptional instances cases have been cured in a fashion that certainly suggests an obstacle of this kind. A joint has been sprained some long time before, and for years has remained painful, and, comparatively speaking, useless; it has been rested, and bandaged, and blistered over and over again without the least benefit; any attempt to move it is stopped at once by pain; every time it is tried it becomes swollen, hot, and tender; and every time it drifts down into a worse condition than it was before. All of a sudden, something gives way, perhaps with an audible snap; there is a moment's intense pain; but movement is regained, and recovery is perfect from that instant, without after trouble or ill consequence of any kind.

A good many cases such as this have been recorded from time to time, among others by medical men, from their own personal experience. Sometimes they have been cured by a designed plan of manipulation, sometimes by an accidental fall. There is, however, a certain amount of suspicion that they are not quite so common as is generally believed, for it is in the nature of people to spread abroad as widely as they can everything that savours of the marvellous. I have myself met with very few that could be called in any way typical,

and I have not succeeded in finding either in my own cases or in those of others anything that I could consider proof of the existence of such a band.

Opportunities for examining the interior of these joints must, from the very nature of things, be exceptional; and the difficulty of explaining the symptoms is not diminished by the fact that when one does occur the result is not always unequivocal. The cartilages are seldom affected, the part they play is too passive. In long standing cases they may be thinned or have lost their polish. Sometimes there is an excess of fluid. More often the quantity is diminished, and it is thin and serous, or slightly turbid. The capsule is sometimes stretched and distended; as a rule it is swollen and stiff, so that it does not fall into its natural folds when the joint is bent. The lining is often a little roughened, either marked by ridges or sprinkled with minute outgrowths; and in many instances, where it is reflected on to the bones at the margins, it is thickened by an accumulation of lymph, holding the fibres together and making one part drag unfairly and unevenly upon the rest, or hardened by an old extravasation of blood, the remains of some larger quantity of which part has never been absorbed.

In one case, at least, I could trace the whole of the symptoms to a cause of this kind. The patient was a man of more than middle age, who came to me complaining of an exceedingly painful and tender spot over the inner side of the knee, about half an inch from the margin of the knee-cap. There was a history of his having struck the joint against a sharp piece of furniture on this particular spot some weeks before. The skin itself was freely movable, but appeared slightly raised and puffy; there was no dislocation at the time that I saw him, and it was doubtful if there had been any—at least, the patient had not noticed it. The pain on touching it was intense; steady pressure could hardly be borne at

first, but seemed to relieve it afterwards; walking, particularly going upstairs, and setting the extensor muscles in action, were both very painful. With the joint itself there seemed to be nothing wrong; there was no excess of fluid, and the tender spot was so fixed that it could have nothing to do with the formation of any fringes or foreign bodies in the interior. Either some of the fibres of the muscle inserted into the capsule had given way, or there had been a small hæmorrhage into the substance of the capsule itself. I had the opportunity of examining the joint at a later period, and was able to verify the diagnosis; the muscular fibres were intact; in the substance of the synovial membrane, corresponding to the painful spot, there was a small hard mass projecting into the cavity. It seemed to be the residue of an old extravasation; the blood had been effused between the fibres of the capsule; some of it had been absorbed; the rest, owing to the protection it received from the side of the knee-cap, escaping all pressure, had become organized and formed a small hard nodule. Probably this happens in many cases without material consequence; in this particular one it had implicated a nerve filament, and, like the little peculiar tumours known as painful subcutaneous tubercles, when it was touched it dragged or pressed on the nerve and gave rise to stabs of acute pain.

What Barwell has called dry synovitis will perhaps explain a few more of these cases. According to him a deposit of fibrinous material occasionally forms in the inner surface of certain parts of the lining membrane, probably derived from the fluid that collects in the joint when it is inflamed; and these spots may be so painful that the patient will hardly allow them to be touched, and can scarcely be persuaded to move the limb. In other instances the pain and loss of power are due to neuralgia, which sometimes attacks joints and interferes with their freedom of action, without leaving

behind any visible evidence of its existence. These can be recognized by the periodic character of the pain, and by the way in which it is limited to the places where the nerves penetrate the capsule. The skin immediately over them is exquisitely tender to the touch, and sometimes puffy, or slightly swollen; and movement is limited, because, as the joint bends, the capsule is exposed to different degrees of tension, and in certain positions the affected nerve is pressed upon or stretched. The check, however, in these is rarely so abrupt as it is in the others. In one case under my care it appeared to alternate with supraorbital neuralgia, the pain sometimes occurring in one locality, sometimes in the other, but scarcely ever being present in both at the same time. The patient, who was thoroughly overworked, was readily cured by rest and change of scene.

Explanations of this kind, however, only hold good for a very few. In the vast majority of these cases of imperfect recovery there is no band passing across the joint cavity; no thickening can be detected at the margin; there are no fringes or overgrown folds of synovial membrane, and the pain is much too definite and constant for neuralgia. The real cause is simply prolonged disuse and the changes that naturally follow it. The tissues have been starved, and are unable to work. For days and often for weeks they have been kept at rest, tightly bandaged. The amount of blood flowing through them has been enough to keep them alive and little more, and as a consequence they have lost their suppleness and flexibility, and the least movement drags and pulls upon them. The softer and more delicate the structure the more it suffers. The loose and open cellular tissue that lies around and between the joint and the muscles is especially changed. Instead of yielding in every movement and giving way at once whether it is stretched or compressed, it has grown hard and rigid from the blood and lymph that have been poured into it, and

become organized in its meshes. In one part it ties the bones together; in another it forms a hardened mass between them; in every movement it is strained or squeezed, and each time this happens it gives rise to the most acute suffering. In nine cases out of ten the change this has undergone is the immediate cause of all the trouble; and the longer it is left the worse it becomes.

Sprains of the shoulder joint, owing to its peculiar construction, illustrate this exceedingly well. The lower and inner part of the capsule is very thin, and has around it a large amount of loose tissue, so soft and delicate that it is thrown into folds when the arm is hanging by the side. No pressure falls on it so long as the limb is in the natural position; as it is raised from the side the folds are gradually straightened out, until they are put upon the stretch by the pressure of the head of the bone. Now, when the joint is sprained or hurt, this part of the capsule, owing to its softness and vascularity, is exceedingly likely to be injured; and unless active measures are taken to prevent it, the whole of it is very easily converted, first into a mass of soft, vascular lymph, and then into dense and unyielding fibrous tissue. There is nothing to prevent it. There is no pressure to close the vessels and limit the amount of lymph thrown out, or to help on the process of absorption; the folds are never opened out or separated from each other; if the joint is in the least degree painful it is kept at rest, owing to the presence of others close by ready to undertake its work, and all the time without the patient being aware of it. When he is directed to raise his arm sideways from the body he imagines he is using his shoulder joint, while, as a matter of fact, the whole of the action is being carried out by others; and this goes on until the part quietly becomes stiff and rigid. The surfaces of the folds become adherent to each other, and incorporated with the tissue round; and instead of a soft and flexible capsule,

there is a mass of shortened, rigid, and unyielding fibrous tissue, matting everything together, and not only by its strength preventing proper movement of the bones, but, by the pain it causes when any attempt is made, preventing any vigour being thrown into it.

Nor are these changes confined to joints that have been sprained. Similar ones are met with after attacks of inflammation, if the limb is kept at rest too long; and they occur with equal frequency in the soft cellular tissue that surrounds muscles and intervenes between them and adjacent structures. After that peculiar accident, popularly known as lawn-tennis leg, which is really caused by rupture of some of the deep-seated and often varicose muscular veins of the calf, and rarely or never has any connection with the plantaris tendon, exactly the same thing occurs. If the part is kept at rest too long, and the extravasation is allowed to become organized, movement is so intensely painful that walking is impossible.

The neighbouring bursæ are frequently the cause of imperfect recovery in the same way. Many of them are merely spaces in the tissues around, lined with a single layer of cells and containing sufficient fluid to enable one surface to glide freely and smoothly on another. Not unfrequently after sprains blood and lymph collect in them, and sometimes they become immensely distended. If the fluid is soon absorbed, there is no ill result; the walls contract and the cavity resumes its former size and shape; but if there is any delay, when at length absorption does take place, the softened and thickened walls are thrown into folds, the sides adhere together, and instead of there being a thin-walled sac, assisting every movement by diminishing friction, there is a rigid mass of tissue, stiffened, irregularly thickened, adhering to everything around, and dragging upon it whenever there is the least change in position.

Bone-setting.

These are the cases that have given bone-setters their reputation. The popular idea, founded upon the ignorant belief of the bone-setters themselves, that a small bone is out of place and is reduced by their manipulation, is, of course, absurd; in most of the joints of which this is said there are no small bones at all; what they really do is to tear across all the newly-organized lymph that binds together the various structures and prevents them moving freely upon each other. All organic impediments to the action of the joint are cleared away. The part is left tender, swollen, and bruised, but if the patient has sufficient faith and resolution, capable of being used, and with use the circulation becomes quickened again, and nutrition restored.

A certain amount of care and experience is required in selecting cases for this treatment, and this is where bone-setters fail. Knowing nothing of medicine and surgery, and exceedingly little of anatomy, the mere fact of a person consulting them is sufficient proof for them that a small bone is out whether it exists or not, and must be replaced. As a result the same manipulation is applied to all alike, and the most disastrous results not unfrequently follow.*

The part that is affected may be a joint or a muscle, and it may have been sprained or twisted, or have suffered in days gone by from inflammation; but if manipulation is to succeed

* The following instances in which manipulation was either attempted or proposed are mentioned by the author of one of the most recent and complete works on Diseases of the Joints (Howard Marsh) as having occurred under his own observation:—Malignant tumour of the thigh; malignant tumour of the shoulder; disease of the spine; three cases of scrofulous disease of the knee-joint; hæmorrhoids; and a case in which, after the hip-joint had already been excised, it was gravely declared that the bone was out, and must be replaced. The list could easily be extended.

certain things are essential. The skin must be cold. It may become warm if an attempt is made to use the limb, especially if it is forced, but after twenty-four hours' rest it must become cold again. The less wasting there is and the more recent the adhesions, the better the prospect of speedy recovery. Those cases are the most successful in which, from the pain and tenderness being constant at one spot, or always produced by one particular action, there is some probability of the contracted tissues being limited in extent. Hinge joints, in which the movements are, comparatively speaking, simple, and take place only in one plane, can be treated more easily than ball and socket ones, or those in which the variety of movements is more extensive. In scrofulous joints with latent caseous deposits bone-setting rarely succeeds: these cases form a large proportion of the disasters.

Careful preparation is necessary. For a week beforehand the part must be douched with hot and cold water, kneaded, and rubbed with a stimulating liniment. Neat's foot oil has the recommendation of the highest bone-setting authority, whether with the idea that some of it is absorbed, and acts mechanically, it is impossible to say. The first thing is to bring the skin back to its natural condition and colour. While this is being done no pains must be spared to localize the mischief as thoroughly as possible. The joint must be examined in every position it can be made to assume; any spot that is tender must be marked beforehand; the movements that cause an increase in the pain must be noted, both as regards direction and extent, as well as the least irregularity or unevenness as one part glides over another. It is entirely owing to their power of appreciating minutiæ of this description that some persons have acquired such a reputation for the treatment of these cases.

An anæsthetic should always be given unless there is some

special reason against it. Not only does it render the operation painless, but by ensuring that the muscles are relaxed, it enables the maximum result to be obtained with the least degree of violence. In many cases, indeed, it is necessary, in order to make the diagnosis exact ; so long as the muscles are contracted, it is often impossible to give an opinion either as to the strength or the extent of the adhesions. The obstruction itself may be of the slightest description, and the limb so rigid as apparently to have lost the joint altogether. No ordinary degree of force may produce the least effect ; but as soon as the contraction of the muscles is done away with, the mere weight of the part is sufficient to separate the adherent surfaces, and restore perfect freedom.

The patient must be placed so that the portion of the limb between the affected joint and the trunk is fixed by an assistant while the lower part is moved by the operator. In the case of the larger joints, one hand should grasp the limb immediately below, so that the thumb may press firmly on any spot that is tender ; the other must be sufficiently far off to secure proper leverage. All rapid movements should, so far as possible, be in the direction of flexion, combining with it adduction, abduction, or rotation, according to the case, so that the tension may be directed to the required spot.

To carry this out effectually two things are needed beyond all others. The one is a sense of touch so delicate that it can appreciate the least resistance or irregularity of movement ; the other an accurate knowledge, not merely of the ordinary anatomy of the part, but of the different degrees of tension that fall on the ligaments in every position of the limb.

Each joint requires a different kind of manipulation according to its construction. In the case of the shoulder, for example, the elbow must be bent so that the forearm may be used as a lever, and the arm rotated first to one side, then to the other, bringing it across the chest and carrying it round

behind the back before any attempt is made to raise it from the side. Bringing it up at once would very likely dislocate the joint. For the knee it has been recommended that the foot of the affected limb should be held by the operator between his thighs, so that when flexion is accomplished by the hand it may serve as a lever for rotation. This, however, can be better effected by the hands alone if the muscles are relaxed by an anæsthetic. The smaller hinge joints can be managed even more easily, flexion being combined with lateral or rotatory movements so far as the shape of the bones will allow.

There should be no jerking. The movements must be vigorous and forcible, but perfectly smooth; and they must be carried out thoroughly, the joint being moved to its full extent in all directions that are natural to it. Each kind of action should be combined successively with the rest, one by one, so that the tension may fall in turn upon all the different parts of the capsule.

Movements which are especially restricted or painful of course require most attention, but the others, though they may not be affected to the same extent, are not to be neglected. It sometimes happens if these are dealt with first that a considerable proportion of the main obstruction is cleared away, as it were, by side attacks, so that when its turn comes it yields more readily than it otherwise would.

Recent slight adhesions give way at once without a sound, though the sensation is generally conveyed to the hand. When they are older the noise may be as loud and clear as when a bone is broken. Probably in many cases this is due not so much to the actual tearing of adhesions as to the sudden separation of two synovial surfaces that fit accurately into each other. The noise that can be produced in this way, especially if a table or other structure is made use of as a sounding board, is well known.

If the patient is healthy and proper care is taken there is not the slightest risk of inflammation. In certain cases, no doubt, it may occur. There are plenty of instances on record in which limbs, and even lives, have been lost by reckless manipulation. But this is entirely due to the fact that the cases were unsuitable, and that sufficient precautions were not taken. When carried out properly and scientifically, rapid manipulation is not only more efficacious, but is more free from risk than the slow and tedious process of stretching the opposing tissues little by little.

There is nothing to cause inflammation in the proceeding itself. Tearing a band of fibrous tissue is not more likely to cause it than breaking a bone or dividing a tendon. A certain amount of blood escapes into the tissues; more lymph is poured out to repair the injury; but unless some grave constitutional affection is present, or it is followed by serious maltreatment, there is no reason why a proceeding such as this should excite inflammation any more than a bruise or subcutaneous laceration in any other part of the body. The capsule of a joint is always extensively torn in dislocations, but they are never followed by inflammation unless some similar cause is present, and it is difficult to understand why it should be so much feared when the injury is so much less.

The slow and gradual process, on the other hand, constantly attempting to stretch the contracted tissues, a plan that seems so safe, is one of the surest ways of exciting it. It does not matter how carefully it is managed. Each time a stiffened joint is gently worked the fibrous bands that check its movements are stretched, and very likely slightly torn; each time, in short, the tissues are sprained again, so that they become more and more tender and swollen. One of two things then must happen. Either the interval before the next attempt is not long enough for them to recover, the

heat and swelling never have time to subside, and the joint becomes inflamed, though it does not regain its freedom, or for fear of such an untoward occurrence manipulation is abandoned for a time, thorough rest enjoined, and all improvement lost; the bands regain their strength, and the stiffness becomes worse than it was before. The rapid method aims at restoring freedom at once with a single risk; in the other the danger is incurred again and again, without the chance of recovery being nearly so good.

I must not be understood to advocate indiscriminate employment of forcible movement in all cases alike; it is just this which has brought it into disrepute, and caused such opposition; only where other things are equal, adhesions in connection with sprained joints are far better broken across, once for all, than repeatedly strained and stretched. There is no difficulty in supplying examples in proof of this from what may be called accidental bone-setting. The following case, for example, that came under my notice a short time since is an instance. The patient was a strong, healthy man on active service, who had been invalided home owing to the condition of his knee. (I may remark that a very large proportion of the more striking cases occur in connection with this joint.) He had sprained it severely some months before in a fall from his horse, and as it was a considerable time before anything could be done for him the swelling became enormous. Then it was kept absolutely quiet in a straight position for three weeks. Cold was applied, but not compression. At the end of that time the joint was exceedingly stiff and painful, but still he managed to get about upon it, and it improved gradually, up to a certain point. It could be straightened out fairly well, but could only be bent through about twenty degrees; as soon as this angle was reached it came to a dead stop, and any attempt to carry it farther only caused the most intense pain

and made the swelling worse. At the time that I saw him he was so disabled that he was only able to go upstairs with difficulty. The joint was very slightly swollen; so far as could be detected nothing was out of place. All that could be found was a very tender spot on the inner side of the knee-cap, where the pain was always most intense. Circumstances at the time rendered it unadvisable that an anæsthetic should be administered, and a few days after he was completely cured by an accident. Coming downstairs he tripped suddenly, throwing involuntarily the whole of his weight on the affected limb, felt something snap, and fainted away from the pain. When he recovered the joint was a little tender over the old spot, but it could be moved as freely as the other. There was no increase in the amount of the swelling, and the pain was gone, nor did it return.*

* Strange cures of this description are not limited to joints, as the following extract shows:—"Persons given to meditation must often have found ample material for speculation in endeavouring to imagine what train of thought could have prompted the introduction of certain surgical procedures, or led to the first trial of this or that therapeutical agent in the treatment of a particular disease. What, for example, could have stimulated the first idea of curing sciatica by stretching the sciatic nerve; certainly the task of finding a train of thought which should conduct to that conclusion would be a severe one. Many such methods have doubtless been suggested by a real or fancied analogy between them and certain natural accidental occurrences, and in this sort of observation charlatans in all ages have shown themselves singularly apt. We may quote a couple of instances of recent occurrence, where the cure was effected under circumstances which must have suggested to bone-setters their violent and unscientific, but occasionally successful manipulations. In one case the person had been almost bedridden for many weeks from sciatica; still suffering acutely from the attack, but a trifle less in pain, he hobbled forth to get the benefit of a little fresh air; at a crossing he was roughly pushed by a passing vehicle, and after a desperate but unavailing effort to preserve his equilibrium he fell on the road in the midst of a fairly dense traffic. It was only when he had regained the side

A very similar one was narrated to me a short time since by another patient. According to his own account, he had fallen down, with his arm outstretched, some time before, and had dislocated his shoulder. It was reduced by a surgeon, but, for fear of the dislocation recurring, the arm was kept bandaged closely to the side for nearly six weeks. At the end of that time he could scarcely move it, and was almost convinced from the stiffness of the joint that the dislocation had never been reduced at all. It got better, however, by slow degrees, until he was able to move his arm in all directions, except upwards and outwards; the least attempt at this was stopped at once by a sharp stab of pain on the inner and under side of the joint. This continued until one day, about four months after the original accident, falling down again in much the same way, he felt a sudden snap, which hurt him intensely for a moment. Probably this was due to the rupture of a band, or of some contracted portion of the capsular tissue; at any rate, he found to his astonishment that his arm was from that moment practically free. Nothing could afterwards turn him from the belief

walk that he began to feel astonishment at the, to him, remarkable agility shown in jumping up and running to a place of safety. The sciatica had quite disappeared, and had not returned four years later. In case number two a strain had been followed by severe pain on movement over the outer condyle of the right elbow, which lasted for several months, almost incapacitating the sufferer from pursuing his occupation as a hairdresser. There was no obvious lesion, but no treatment was attended with any benefit. One night, on leaving work, he had to find his way along a dark passage, in which the cellar door had inadvertently been left open. Against this he struck himself violently on the painful spot, giving rise to such pain that he nearly fainted. Within a day or two, however, as the effects of the bruise disappeared, the other pain was now noticed to be absent. The facts are rather curious, although it must be confessed it is not easy to see how to formulate any practical rules of treatment as a deduction therefrom."—*Medical Press and Circular.*

that the same kind of fall had both dislocated and reduced his shoulder joint.

Forcible manipulation is especially successful in old sprains of the ankle. The kind of case that requires it is easily recognized. The skin over the joint is red and shining, as if it were stretched too tightly; as soon as it is pressed upon the colour disappears, but it is very slow in returning; firm pressure often causes the surface to pit, especially where there is much subcutaneous tissue; and the temperature is always low.

There is no displacement or dislocation; the outline of the bones is natural, though the depressions are partly filled up, and the prominences rounded off; and the tendons can, generally speaking, be traced to their grooves. The position, however, is awkward; when standing upright the sole does not rest flat upon the ground; movement is limited, and exceedingly painful at certain spots; and there is constant aching, especially at night or after any exertion. In several cases such as this, by putting the patient under an anæsthetic and working the joint thoroughly, I have succeeded in restoring perfect freedom of movement, sometimes at the first attempt. It is essential to recollect in dealing with this part that though the original injury may have appeared to be confined to the ankle, the other joints of the foot rarely escape entirely; and that even if they are so fortunate, they have been kept continuously at rest as much as the ankle, and have undergone similar changes. For want of this precaution, I have seen more than one case fail at the first, and only succeed when the manipulation was extended to the others too.

Sprains of the wrist, again, often leave the fingers stiff and rigid for weeks, long after all heat and swelling have disappeared. In a case recently under my care the patient had fallen, about three weeks before, down a flight of steps, bend-

ing his right wrist-joint beneath him. According to his own account, he lay for some time (how long he scarcely knew) unconscious; and on coming round found that his arm was intensely painful, and that there was an enormous swelling over the back of the hand and wrist, extending some distance along the forearm. This was reduced by careful bandaging, so that when I saw him it had almost disappeared, though there was evidence in the staining of the skin by the elbow how severe the injury had been. The hand was cool and painless so long as it was left alone, but he had not the least power over his fingers; they lay nearly straight, not apparently hurt, slightly swollen it is true, so that the shape of the joints was too rounded and uniform, but with nothing else about them to show that they had been injured. With the aid of the other hand he could almost bend them down into the palm, though it gave him considerable pain; but as soon as they were released they sprang back again almost mechanically. He was directed to have the part thoroughly kneaded and steamed for a few days; and at the end of the week was placed under an anæsthetic, and every joint in the fingers and wrist systematically worked through its full range. The next day the hand felt very sore, and was slightly more swollen, but this soon disappeared under massage. Movement was slow, and executed with great deliberation, but the range was much wider, and he was encouraged to use it freely. Two days after full power had nearly returned, and he was able to resume his work.

After forcible manipulation joints require the same kind of treatment as after a recent sprain. The limb must be bandaged at once, before there is time for swelling to set in, and kept absolutely at rest for twenty-four hours. Pain at first is often severe. The next day it should be soaked for a few minutes in hot water, thoroughly rubbed and kneaded, and worked systematically through its whole range. If the

adhesions have been completely ruptured and swelling is prevented by compression, this is almost painless, even at the first. In exceptional instances the bandages may require to be replaced, but the sooner they are left off, and the more the patient is encouraged to use the part, the better. Massage and passive motion must be kept up every day until the action of the joint is perfect.

Recent cases need nothing more. At first there is always some reluctance to use the part ; pain and stiffness do not vanish instantaneously, whatever a bone-setter says. The joint is awkward, and feels insecure, and especially if it is in the lower limb, may swell a good deal and ache severely after exercise ; but if the whole of the mechanical impediment has been removed and the patient has sufficient resolution, recovery is only a question of time. But in older cases, and especially those in which there is conspicuous wasting, this is not enough. The adhesions may have been broken down, and passive motion may be free in every direction, but in spite of all the patient's endeavours to use it, the joint only too often continues helpless and incapable of active work. The muscles and nerves have been so long disused that their nutrition has suffered. Their strength and vigour are impaired, and until they have recovered the joint cannot work.

Exercise, of course, is the most effectual remedy for this. When it can be carried out the cure is rapid and certain, but in many cases it seems impossible. Sometimes there appears to be an actual inability to make use of the muscles, as if the power of the will was unable to reach them. Sometimes the sense of insecurity is so great that the patient cannot be persuaded to place sufficient trust in them. Whatever the cause may be, the first thing is to improve the circulation through them. It has been at such a low ebb for such a length of time that when a sudden demand is made upon it it is unable to respond.

Heat and cold applied alternately, in the form of a douche, act as a most powerful stimulus. The skin, of course, receives the chief effect, and sometimes, especially with the needle douche, more has been done than was desirable; but the circulation through the whole part is quickened; the volume of blood increases; the nutrition of the tissues is carried on more as it is in normal health, and the muscles and nerves soon begin to regain their power. Aided by galvanism and other measures, it is surprising how soon this restores tone to the muscles, and causes the absorption of chronic exudations that perhaps have remained passive and unaltered for years; only, partly from the very ease with which it may be applied, it is not advisable that it should be carried out without suitable supervision; or more harm than good may easily be done.

Manipulation, again, is of the greatest value in arousing latent muscular activity. Elaborate accounts have been written from time to time of what has been called the movement cure, and many varieties of manipulation have been described in connection with it, but, so far, at least, as the treatment of sprains is concerned, it does not seem clear that they possess any great advantage one over the other. The principle in them all alike is to exercise the muscles according to their strength, to stretch them out, and manipulate them without fatigue. In most cases the greatest benefit appears to be obtained by making use of the different plans successively, beginning with that which calls for the least effort on the part of the patient.

Simple extension, gradually straightening out the muscles, one after the other, with some degree of force, until a distinct sensation of resistance is experienced, is especially useful in the earlier stages, immediately after the adhesions have been broken down. Sometimes the muscles are irritable, and inclined to painful spasmodic contraction; or hard knots form

in their substance, possibly due to rupture of a few of the fibres; or a certain degree of soreness and tenderness of skin makes itself felt over them. Whatever it may be these conditions are relieved by slowly but firmly extending, one after the other, the various groups of muscles that lie around the joint, and applying firm and even pressure.

What are known as resistive movements are of wider application. In these the patient either carries out a definite course of action against the resistance of the operator, who is able to select any particular group of muscles, and regulate exactly the amount of work, or the latter makes use of his strength to oppose some voluntary action on the part of the patient, compelling him to give way. The former of these methods is by far the most useful. The secret is to keep the opposing force well within the limits of the patient's strength, making use alternately of flexion or extension, or of rotation inwards or outwards, as the case may be. Exercise of this description possesses wonderful influence on the nutrition and activity of the tissues, not the muscles only; and with a reasonable amount of care it may be kept up for a considerable time each day without over-fatigue. The other plan tires out the muscles at once, and is too exhausting to deserve strong recommendation.

In some cases it is possible to substitute for the hand of the operator mechanical contrivances, arrangements of wheels and levers adjusted to resist any individual movement that may be wished, and capable of being graduated exactly by the patient to suit his own strength. The action, however, is not quite the same. The resistance of a spring or an elastic band cannot be graduated like that of human muscles, guided by an experience of what is required; and unless very carefully superintended the progress of cases treated in this fashion is apt to be very uneven and irregular.

Galvanism is another remedy that may be used with the

best result in cases such as these. It is true it is impossible for anyone who is not a specialist in the subject to undertake to form an elaborate diagnosis, or to give a definite opinion as to the extent to which degeneration has spread in particular directions. But without attempting this, and even leaving special and unusual cases aside, there is no inconsiderable number of others in which it may be employed with immense benefit under the guidance of simple and ordinary rules. The object is different. It may be impossible, without special education, to give an accurate opinion from the electric phenomena alone as to the condition of the muscles, and the probable course of the degeneration; but this is not what is wanted. The diagnosis has been made already. Galvanism is employed, like massage and other remedies, solely as a means for improving nutrition and restoring energy. For this it is one of the most valuable applications known, and if only there is a fair general knowledge of its use, and the method of its employment, it may be applied in a very large number of cases with the greatest benefit.

Faradisation by itself is only required exceptionally. Its action even when applied to the muscles is mainly on the nerves and their motor ends, and this is rarely needed. In one case, however, under my care, after a third or fourth application, it restored to full use a limb that had been crippled for over a twelvemonth. The patient was a young man, tall, and of good muscular development; while at sea about a twelvemonth before I saw him he had strained his knee in getting out of the hatch. His account of the accident was perfectly clear. He had to take a step of great height to obtain a purchase for his foot, and to raise himself up at the same time with his hands; while doing this, pulling on his knee joint with all the strength of which he was capable, from a position of extreme flexion, he felt something snap; there was a moment of intense pain, and he fell back

almost helpless. When his knee was examined it was full of fluid, but there was no displacement, and it was not locked. It was thought at the time that it was merely a sprain, and that if it were kept bandaged for a week it would get well. In spite of this, however, it was nearly a month before he could rest any weight on it; and even before this he noticed that the muscles which bend the joint were slowly contracting, and that he was gradually losing the power of straightening it out. This grew worse and worse, until at length he was so disabled that he was forced to lay up and consult a surgeon, who placed him under an anæsthetic and straightened the limb by main force. He could walk better after this, but was still compelled to wear a leather splint to keep the joint extended. As soon as he left it off the knee began to bend itself in a manner entirely beyond control, and, of a morning particularly, it was only after great effort, and with much pain, that he was able to stand upright. To complete his misfortune, he had slipped off the kerb-stone and sprained his knee again only a few days before. Since this the loss of control had been worse than ever; it was only with the greatest effort that he could get the limb straight at all; the morning that I saw him he had fainted twice in the attempt; his health was failing, and he was reduced by pain and by the loss of his appointment almost to a state of despair.

On removing the splint it was at once apparent that the whole limb was wasted from disuse. There was no discoloration, swelling, or pain; and the only tender spot was the one on the inner side of the knee cap, of which almost all patients complain. The muscles on the front of the thigh had suffered most severely; the flexor ones at the back felt unusually firm and hard, though their bulk, as compared with those of the opposite side, had diminished too. The strangest thing was, that while looking at him, the knee gradually began

to bend, until in about three minutes it had reached a right angle without the patient having the least power of preventing it. The movement was perfectly smooth and quiet. There was no cramp; the hamstrings felt somewhat firmer, and that was all. It required the exercise of very considerable strength to bring the limb again into a straight position.

I recommended at first that the limb should be thoroughly encased in a plaster of Paris splint, thinking that the muscles would soon become tired out by the unyielding resistance, assisted by the pressure, but it was of no use; and after a few hours it had to be removed on account of the pain. It did not seem advisable to try the action of local sedatives; the case had lasted too long for them to be of any permanent service, and the patient would not submit again to an anæsthetic, so that it was not possible to manipulate the joint freely. Under these conditions I determined to try the effect of faradization, applied to the weaker muscles on the front of the limb. During the first application he was able to extend the limb with much greater ease; and after the third he could do it entirely by himself, when the current was not being applied. In short, he was completely cured, and returned to his occupation, though the limb, when I saw him again some months later, had not yet regained its normal proportions.

At such a distance of time after the accident it was not possible to ascertain the precise nature of the injury he had sustained. No one who saw him and who witnessed his anxiety to return to duty would have entertained for a moment the suspicion of hysteria. There was apparently some obstacle to the transmission of stimuli down the nerve into the muscle; the influence of the will could not make its way along it. One set of muscles was in consequence seriously weakened, and the opposing ones, with their vigour unimpaired, kept the limb constantly contracted. Fara-

dization apparently opened up the path for the passage of other stimuli.

When the wasting arises simply from disuse, galvanism is more effectual than the interrupted current. It is a mistake to think that its effect is to be attributed in any way to the production of muscular contraction. If the nerve centres of the spinal cord are involved, it is impossible to prevent degeneration or wasting. The influence of the continuous current on nutrition is to be attributed to its chemical action, to its influence on the circulation, and to the way in which it promotes the absorption of waste products and the regeneration of broken-down elements. It must always be remembered that the nutrition of the tissues is ultimately dependent on the circulation of the lymph outside the walls of the vessels. The blood circulates in these, its fluid constituents passing out through the walls and permeating the tissues in all directions. The muscular fibres lie bathed in a nutritive fluid, which requires to be constantly replaced, and its renewal is dependent much more on the activity of the tissue elements themselves than on the circulation through the vessels. This, without the other, is of little service. If the tissues are leading an active and energetic life, the circulation of the lymph is carried on at its best ; if they remain sluggish and passive, it stagnates around them, the part is badly nourished, and the tissues become sodden and œdematous. In this condition of things the regular and systematic employment of galvanism is especially indicated. Whether its influence depends on chemical processes or not, it causes the swelling to disappear, quickens the circulation, brings back the colour to the skin, and restores the activity of nutrition in a manner equalled by nothing else. Faradization may be used in certain cases, and is of great assistance sometimes in conjunction with the constant current ; but so far as muscles are concerned in everything

beyond the mere production of contraction, the latter is far the most useful.

Generally speaking, it is sufficient that the limb should be galvanized every other day, alternating it with massage, for five or ten minutes each time. In certain cases it may be used more frequently, but there is often a tendency, especially on the part of the patients, to over-galvanize the limb. Disappointment must not be felt if it is some time before any decided improvement makes its appearance. The regeneration of the tissues must be a slow process; absorption and nutrition may be assisted, but they cannot be hurried.

The strength of the current should always be moderate, though it is difficult to lay down definite rules. It is not possible to be accurate without the aid of delicate and complicated instruments. Specifying the number of cells gives little or no idea; allowance, for example, must be made for difference in the resistance of the skin in different parts of the body. Where it is thin, or where there is a large number of sweat glands, the current passes more easily than it does elsewhere; and the resistance diminishes with moisture, with pressure, and with the length of time the current is applied, because after it has been passing some time the blood circulates more freely through the superficial parts. It should never cause the least suspicion of pain; if actual contraction is desired, each muscle must be stimulated in turn by applying the electrode to its motor point; or if the nerve that supplies the muscle is more easily accessible contraction may be produced in this way, but the weakest current that will effect this must always be used. In the case of galvanism the size of the electrodes is a most important consideration. The strength of current passing through the body from a certain number of cells is, other things being equal, dependent on the extent of their surface. Consequently, where there are large masses of muscle, as in

the back, and where, accordingly, large plate-like electrodes are employed, a current of proportionate strength should be used. If they are large enough, and kept well moistened, there need be no fear of injuring the skin.

When galvanism is used, for its refreshing action, after faradization or to relieve the sensation of fatigue, the positive pole should be applied to a point more distant from the trunk than the negative in order to obtain as far as possible an ascending current. In other circumstances the cathode is placed directly over the structure it is intended to galvanize, and either held there or slowly moved over it in the direction of the fibres. The latter method is much more stimulating; the current is always varying in intensity, being most vigorous immediately under the electrode, and the energy with which it acts upon the muscles beneath is constantly changing as it moves over their surface; so that in addition to the chemical influence it possesses it calls out moderate contraction of all the fibres in turn. The rapidity of the movement is as important as the strength of the current, owing to the suddenness in the variation, when the position of the electrodes is changed.

Even when there is no atrophy galvanism has a very beneficial influence on sprains in their later stages. The action of the muscles is often embarrassed and attended by a sense of stiffness and fatigue; the tissues are swollen; the skin feels cold, and the muscles do not respond readily. The injury has been repaired, it is true, and there is no definite alteration in the structure of the part, but it does not perform its function properly, and recovery is not perfect. The circulation requires a stimulus; the conducting power of the nerves is enfeebled; the muscles need educating again, as it were; their contraction is not orderly, as it should be; they do not assist each other, and the movement is not passed on from one to the other as smoothly and

evenly as it is in health; the result is a sensation of pain, which prevents freedom of action, and by encouraging the patient to keep the part at rest delays convalescence more and more. Under these conditions the thorough electrization of the whole, using the interrupted and constant currents alternately, often effects a cure in a very short space of time, especially if it is assisted by massage. If the whole of the mechanical obstruction has been removed by bone-setting or forcible manipulation, nothing restores power and freedom of movement more easily or more quickly.

PART II. (SPECIAL).

CHAPTER I.

SPRAINS OF THE LOWER LIMB.

The foot and ankle.

SPRAINS of the foot and ankle have been dealt with at such length that little more need be said about them. They are exceedingly common at all ages, and vary from the most trivial twist with a moment's pain to injuries that are little less severe than fractures, and often take much longer getting well. In many respects they illustrate even better than sprains of other joints the beneficial effects of compression and early passive motion. Heat or cold may be used at first, until the part is numbed, and the acuteness of the pain has passed off, but nothing prevents effusion better, or gets rid of it more readily, than elastic pressure properly applied. The slightest cases may be treated with massage from the first; in the most serious it should never be delayed more than twenty-four hours, and the sooner passive motion is commenced, and the more thoroughly it is carried out, the less the risk of stiffness or weakness being left. Afterwards, when the risk of inflammation has subsided and the immediate effects of the injury have been repaired, douching with hot and cold water, friction, manipulation, not only of the ankle, but of the joints of the foot as well, and galvanism may be employed to restore tone to the tissues and prevent

œdema when the part is used. In the worst cases, especially those in which there has been dislocation of the tendons, an elastic support is often required for some time afterwards; but it should never be worn continuously, only when special exertion is contemplated. Every time it is removed the joint should be thoroughly douched and kneaded, and when the first has become so loose as to be useless a second should never be obtained unless it is expressly ordered.

There are certain complications in connection with sprains of the joints of the foot that are peculiar to them, and not unfrequently give rise to serious inconvenience.

Dislocation of the peronæi tendons from their grooves behind the outer ankle is one. It may be caused by a single wrench in a previously healthy joint, the sheath that confines them being torn so that they slip forwards on to the bone; but in most of the cases that I have seen the joint had been sprained several times before, and although there had never been complete displacement, it is probable that the constant repetition of the injury had caused the sheath to stretch until it became too weak to resist. Reduction is easy, but the greatest care is required to prevent the displacement returning. It is at least a month before the sheath can be repaired, and the patient should not be allowed to use the joint, except in the most limited fashion, for five or six weeks. Massage and passive motion should be practised daily from the first. If recurrence takes place the dislocation is very likely to become permanent.

The existence of varicose veins around the joint always adds to the gravity of a sprain, particularly in the case of a person advanced in life; and in this respect minute vessels, which give rise merely to a mottled, bluish appearance of the skin, are more to be apprehended than when one or two of the larger trunks only are involved. The actual amount of blood lost may not be of any great moment, but

the tissues are badly nourished, absorption is carried on slowly, and convalescence is liable to be protracted. The subcutaneous tissue remains hard and rigid; it is a long time before the muscles regain their freedom of action, and the part often becomes swollen and œdematous. In one or two instances I have known a sprain act as the starting point for very extensive thrombosis.

Flat foot is another trouble that is not uncommon. In most cases it arises from rupture and failure of union of the anterior portion of the internal lateral ligament; but sometimes it is due to inflammation, generally of rheumatic origin, affecting the ligamentous structures in the sole of the foot; and occasionally it follows injury to the peronei muscles. These, as Duchenne has shown, take a much larger share in preserving the antero-posterior arch of the foot than is usually believed; and when they are injured or overworked, so that the greater part of the tension falls upon the ligaments, sinking of the arch, with severe pain, is inevitable. I have known flat foot produced in this way by failure of the muscles, without the ankle being involved. The patient, a young, athletic man, in whom there could be no suspicion of hysteria, received a violent blow from a piece of furniture on the outer side of his leg. The pain passed off; a bruise was left, and nothing more was thought about it; but in the course of a few days he began to suffer very severe pain, running up the leg, whenever he rested any weight upon the foot; and by degrees this became so bad that he could only walk a few steps without stopping and lifting the foot off the ground. The relief obtained by this was immediate, but the moment the weight was placed on it again, all the old suffering returned. The arch, while he was resting, was normal; as soon as the foot was pressed down the muscle began to yield; one of the main ties was lost; the anterior pillar began to slip forwards, and the whole strain fell upon the ligaments,

stretching them and causing sickening pain. These cases nearly always need a temporary support, such as a spring fitted into the waist of the boot. Afterwards, when the injury is repaired, and strength has been restored by manipulation, tip-toe exercise, massage, galvanism, etc., this may be dispensed with, but many patients find such comfort from it that they prefer to continue using it. The tendency to recurrence is checked by slightly increasing the thickness of the heel of the boot along the inner side; this throws the weight more on to the outer side of the foot, and saves the arch considerably.

Injury to the lower epiphysis of the tibia is not common, and fortunately, when it does occur, it does not often affect the growth of the bone. I have, however, met with several instances in which this has been arrested as a consequence of what was apparently merely a sprain, and in which serious deformity was caused by the continued growth of the fibula.

Sprains of the leg.

Lawn-tennis leg.—Sprains of the leg are of interest from the frequent occurrence of what is commonly called lawn-tennis leg, though it was well known long before lawn-tennis was ever played. Men of middle age, whose weight is beginning to increase, and whose muscles are somewhat out of training, are most liable to it. I have never known it occur in women, and it is decidedly rare among the labouring classes. It is noteworthy, as bearing upon the cause, that in a very large proportion of patients there is distinct evidence of gout, not necessarily of any acute attack, but of those indefinite forerunners which are often as distinctive. Generally speaking it is caused by a sudden and violent effort, a spring forward to take a ball, for example; but the merest slip is enough, and occasionally it takes place without even

this. I have known it happen to a patient who was strolling quietly along a level road, on which there was not even a projecting stone.

The symptoms are exceedingly characteristic. Suddenly and without the least warning there is a sensation of a violent blow upon the calf of the leg. The patient stops instantly, lifts his foot from the ground, and nearly always looks round to see if someone has not struck him with a stick or a stone. Rest his weight upon the leg he cannot, and all power of walking is lost. The toes are pointed downwards; the heel cannot be made to touch the ground; the gastrocnemius is contracted, and the relaxation of the muscles of the calf necessary to enable the body to come forward over the foot before the step is taken is impossible. When the part is examined, there is generally nothing to be seen; but there is an exceedingly tender spot in the substance of the calf, and sometimes a slight depression can be felt. Later on, marks of bruising make their appearance, yellow at first, but gradually becoming darker as the colouring matter approaches the surface, and, generally speaking, most plain at the ankle, even when the painful spot is near the knee. This, however, is liable to be modified if the part is well bandaged. In one or two cases I have noted a slight degree of puffy swelling behind the ankle, and it is said that occasionally the foot is deflected a little from the straight line.

The usual explanation of this striking accident is that it is the result of the rupture of an exceedingly small muscle, known as the plantaris, situated in the substance of the calf. The muscle itself is in many respects most peculiar; it is very deeply placed, lying under the largest muscle of the calf, is itself exceedingly short and weak, being rarely three inches long, and is provided with a prodigiously long tendon, which either joins the tendo Achillis at the back of the heel, or else is attached to the bone in close proximity to it.

Whether rupture of such a structure can take place or not is almost impossible to prove ; the fact is commonly asserted, and it is usually admitted as an explanation of the symptoms, but I am not aware of any instance in which it has been actually shown. It is quite certain that the same effect may be produced by other causes.

This explanation, for example, does not answer when the same accident occurs twice in the same leg at different places. A striking instance of this recently came under my notice, the interval between the two occurrences being only a few weeks. On the first occasion the middle of the calf of the leg was the part involved ; on the second it was at least four inches lower down, and nearer to the ankle.

The second accident was precisely of the same nature as the first ; there was the same sharp stab of pain, with tenderness and swelling, and the same feeling that it was impossible to place the foot upon the ground ; but clearly it could not have been due to the tendon being torn a second time. It never could have united sufficiently firmly in such a short space of time to enable it to resist a force strong enough to break it across in a part where it had not been previously hurt. The scar could not have become as strong as the original structure.

Hood considers that it is the result of the rupture of some portion of the muscular or tendinous structure of the calf, without specifying it more particularly, and this may be correct in those cases in which a depression can be felt with the finger. Rupture of the plantaris, a deeply-seated and very small muscle, could never cause this. I am strongly of opinion myself that in the vast majority of these cases the tendon has nothing whatever to do with it, and that the real cause is to be found in connection with the deep-seated veins that lie between the muscles, and form large and often varicose plexuses. The size and importance of these

veins are scarcely sufficiently appreciated. They often form large tumours lying between the deep and superficial muscles; they are frequently the seat of inflammation in connection with gout; in some places they become blocked by coagula, which subsequently undergo various forms of degeneration; in others their walls become thinned and softened; they are subject to the greatest variations in pressure, and if there is the least strain rupture is exceedingly easy. If this takes place there is at once a large extravasation of blood, and all the characteristic symptoms follow; there is sudden acute pain; the muscles are kept in a state of spasmodic contraction; œdema sets in, especially if the limb is allowed to hang down; the blood soaks down behind the malleoli, especially the inner one, leading to deep discoloration, and if the part is kept at rest, and means are not taken at once to promote the absorption of the extravasation, the surrounding structures become bound together by the effusion that follows, and free use of the muscle is impossible. I have known rupture occur in a similar fashion in other parts of the body, in the thigh for example, and in the palm of the hand, and lead to precisely the same results.

These cases, if treated as they should be, invariably get well within a few days; but the treatment is diametrically opposed to that which is most suitable when a muscle is torn. When this occurs everything should be done to bring and to keep together the broken ends, so that they may unite as speedily as possible; the limb should be kept at rest; a splint should be applied, and no strain of any kind allowed to fall upon the injured part until it is thoroughly repaired. If this is tried in the case of lawn tennis leg, it produces the worst possible result; in a week or ten days the patient gets up on crutches, or if he is fortunate with a crutch and a stick; the foot is held in a position of extreme eversion; the knee and ankle are kept absolutely rigid; the

limb is swung round in walking as if it were made of wood, and it is many weeks before full action is regained.

On the other hand exactly the opposite method, that which is adopted when a varicose subcutaneous vein gives way, answers here perfectly. As soon as possible after the accident the patient should be placed in the recumbent position, with the injured leg raised above the level of the body, and should be kept in this position for five minutes, the limb being meanwhile rubbed downwards towards the trunk. The swelling begins to subside at once; the calf is emptied of all superfluous blood and returns to its normal size, and the distressing feeling of tension begins to disappear. Then, while the leg is still in this position, it should either be bandaged firmly or, as Hood recommends, covered from below upwards with strips of adhesive plaster, each an inch and a half in width, from two inches above the ankle joint to above the thickest part of the calf, as strapping is applied in the treatment of chronic ulcers of the leg. As soon as this is done the patient should be directed to walk about the room, and to place the heel firmly, or at least fully, on the ground at each step. For the first dozen steps he will probably hesitate, and will limp more or less; but after a short time, finding that his pain is diminished or possibly removed, he will gain confidence, and will walk with a pride in his own performance which is very interesting to witness. "Until this point is reached he should not be allowed to depart; for, if he does not walk properly before he leaves the surgeon, he will hesitate still more when alone, and will be likely to return to the ungainly progression which he exhibited at the commencement of the interview. Success in walking, in the first instance, will depend largely upon the temperament of the injured person. A resolute man, who believes in his doctor, will walk at once, while a more timid patient will require coaxing and urging. The chief trouble will be with the sceptical man, who has his own

'views' about the injury, and who will express them in such questions as 'Well, but do you not think there is a risk of inflaming my leg?' 'Shall I not make the internal wound larger?' and so forth. With reasonable care neither to jerk the leg nor to twist the ankle on uneven ground, the patient, as soon as the plaster is applied, may walk about as usual. By the third day the plaster will be somewhat loose, and the patient will say that he is not quite so comfortable as before, and is less inclined to trust his leg. The strapping should be reapplied, and he will at once feel more secure and better able to walk. Four days may elapse before the next strapping, which may be left untouched for a week, but the application should be continued at intervals until the patient is quite convinced of his ability to do without it. On the first occasion very little pressure is desirable, and mere laying on of the plaster will be sufficient. Subsequent strappings should be tighter, but never so tight as to produce a sense of unpleasant constriction, a rule which must be especially borne in mind in applying the first and last piece. The amount of walking should be increased daily, and after the third day the patient should go up and downstairs freely in the usual manner. Until then his ascents and descents may be infantile" (Hood). I would only add to this that each time the strapping is changed the limb must be rubbed and kneaded, to prevent stiffness following; and afterwards when it is left off the same treatment should be kept up until the patient feels that he can trust his leg as implicitly as he did before it was hurt. Not unfrequently it is some little time before the muscles recover.

Sprains of the knee-joint.

The stability of the knee depends almost entirely upon the ligaments and tendons. Partly owing to this, partly to the wide range of movement and the immense leverage, sprains are exceedingly common and often very serious. The

slighter cases in which no important structure is torn, and the joint does not become filled with fluid until some hours have passed, do not need a special description. The joint is so superficial that cold is easily applied and is fairly effective, but the sooner it is replaced by compression the better, taking care to fill up the hollows around the patella and behind in the popliteal space. The pain if it continues may be relieved by arranging around the joint over the bandages a set of Leiter's coils with ice-cold water circulating through them. Massage and passive motion should be commenced on the second day. Even in slight cases the extensor muscle shows evidence of wasting a week or two after the accident, and if this cannot be altogether prevented, it is very important to check it as early as possible.

Ruptured ligaments.—When an important ligament such as the internal lateral or one of the crucials has given way a starch or a plaster bandage, or some other form of fixed apparatus, may be required for the first few days; but only under very special circumstances should it be continued for more than a week. Strict rest so far as active movement is concerned should be enjoined until union is sound. Firm pressure should be applied and the greatest care taken that no strain is thrown upon the injured structure by any incautious action; but the bandages should be removed and the joint and surrounding muscles thoroughly kneaded and worked every day. Afterwards, when at the end of a month or six weeks the patient is once more trusted with his joint, a retentive apparatus such as an elastic knee cap, or in the more severe cases, a metal and leather splint must be worn for some months to protect the joint from any sudden twist and prevent the risk of recurrence.

Loose ligaments.—A great deal of inconvenience and not a little anxiety are frequently occasioned in rapidly growing children by a peculiar laxity of the ligaments, which,

though it is common more or less to all the joints, is especially serious in the knee. Slight degrees of it are not unusual and merely lead to early fatigue and a disinclination for any prolonged exertion; but actual displacement may occur and then it becomes important; for when this has happened once a much slighter degree of force is sufficient to produce it again. The patella is frequently slipped to one side, generally the outer, owing to the inward inclination of the knees that accompanies this condition. Sometimes the internal semilunar cartilage is displaced, producing in a minor form all the symptoms of what Hey called internal derangement of the knee joint. Even the tibia, in extreme cases, may be abnormally movable upon the femur, and the fibula upon the tibia, so that the bone can be pushed altogether out of its natural position without causing the least pain. Vague rheumatic pains occurring in the joints (so-called "growing pains") are often associated with this, and not unfrequently, especially towards evening, there is a tendency to fulness and excess of fluid in the synovial cavities.

The prognosis is nearly always good; as children grow older the tendency disappears; but there are exceptions, and in any case it is desirable to prevent even temporary or partial displacement. Not only, whenever it occurs, does it increase the liability of the joint to injury, but it gives rise to pain and inconvenience, and necessitates abstention from active exercise for some considerable time.

Retentive apparatuses of all kinds are injurious in these cases, and, if used at all, should only be worn when unusual exertion is undertaken. Elastic ones by their continuous pressure diminish the amount of blood circulating through the part and weaken it; metal ones hamper the action of the joint and muscles, and by their weight increase the work. The joint requires to be strengthened and kept in moderate

exercise without being strained. Regular work with varied but selected exercises; manipulation; resistive movements; friction; massage; douching and bathing with sea-salt, combined with suitable constitutional measures, soon effect a change; and as the muscles grow stronger the ligaments become firmer and the joint regains its security.

Diverticula from the synovial membrane forming rounded swellings where depressions naturally exist are of frequent occurrence in the knee after sprains. Those that protrude through the posterior ligament or by the side of the ligamentum patellæ are of entirely fresh formation. In other instances, as when the bursa under the semimembranosus becomes distended, they are merely dilatations of a pre-existing sac. Occasionally they are formed in connection with outlying bursæ or synovial membranes, by the head of the fibula for example, in connection with the biceps tendon. In some people there appears to be a special tendency to them; they make their appearance at an early age and affect many joints at the same time. As a rule they are not the product of a single severe sprain, but of frequently repeated slight twists or wrenches; I have met with several instances, for example, among railway guards.

In many cases these cause but little inconvenience and may be left alone; but the larger ones, and especially those that are connected with the joint, often give rise to such a sensation of weakness as to disable the patient from following any active employment. It is difficult to prove that the joint is actually weaker than its fellow, but there is the constant feeling that it is on the point of giving way. Tapping the cyst, removing its contents, and applying pressure gives temporary relief, but almost always the sac refills. In most instances elastic knee-caps and similar appliances do more harm than good. The firm pressure gives at first the feeling of increased strength; but this soon disappears with use,

and meanwhile the other structures around the joint waste and grow weaker. Excision is the only treatment that is of any permanent benefit, and if the patient is healthy and proper precautions are taken this may be done with perfect safety. I have removed the bursa from under the semi-membranosus on four occasions with complete success. The neck by which it communicates with the joint should be followed up as far as possible between the muscles, by flexing the limb and separating them, and then sutured and cut away. Its walls are so thick and tendinous that a ligature passed round it rarely holds satisfactorily. Passive motion should be commenced on the third or fourth day, as soon as the wound is healed; and the patient may be allowed to walk about at the end of a week or ten days, retaining a bandage, with a firm but elastic pad in the popliteal space for some time longer.

As Morrant Baker has pointed out, in certain cases of osteo-arthritis these cysts attain an enormous size and make their first appearance under the surface a long distance from their origin. Occasionally they point half way down the leg in the substance of the calf, and under these circumstances I have known them suppurate and lead to disorganization of the joint.

The bursæ, of which there is a great number in the neighbourhood of the knee joint, sometimes give rise to lasting inconvenience long after the immediate effects of a sprain have subsided. At the time of the accident they are filled with blood, and when the effusion that follows becomes organized, the walls are left thickened, rigid, and covered with irregular outgrowths, projecting as bands or fringes into the interior. Instead of reducing the amount of friction and assisting the action of the joint, they increase it and make the movement more difficult. Very often crackling or grating can be felt as one surface glides over the other; and occa-

sionally, when a pedunculated outgrowth is caught and squeezed against the bone, there is a stab of severe pain. This is of frequent occurrence in the bursa patellæ, and in that which lies beneath the ligamentum patellæ, between it and the bone. Not so long since a patient, a woman of middle age, with rather stout and shapeless limbs, was sent to me, complaining that she had received a blow on the knee some months before, and that ever since she had suffered such an amount of inconvenience that she could scarcely get about. Walking had become very painful; going upstairs was bad, but on coming down there was such a sense of insecurity that she was obliged to cling to the banisters. On examining the joint it appeared slightly enlarged, but most of the swelling was below the knee-cap on each side of the ligamentum patellæ, caused by the enlargement of the bursa, which exists naturally in this situation, and which is always larger and more prominent in women than it is in men. It was over this that she had received the blow, and here on firm pressure could be felt a large loose body, which, when the muscle was relaxed, slipped easily under the ligament from one side of the joint to the other, causing sickening pain each time.

Growths of this kind, like foreign bodies in the joint, should be excised without delay. There is no need to remove the whole bursa, unless its walls are thickened or the interior is very much roughened; and the cure is permanent.

Internal derangement of the knee.

The knee joint is occasionally the seat of a peculiar kind of accident, which, for want of a better name, was called internal derangement by Hey, who first described it. It is extremely painful; it occurs during perfect health from most trivial causes; if it happens once it is always liable to occur

again; and after a time the joint is very likely to become seriously crippled.

It is undoubtedly connected with two flattened structures in the joint known as the semilunar cartilages. Roughly speaking, they form two circles, lying side by side between the bones. The margin of each is the thickest part; from this they slope off gradually towards the centre, where there is a perforation. The circumference, especially that of the internal one, is attached to the bone more or less firmly all round; but the part corresponding to the centre of the joint, where the two cartilages touch each other, is much the most secure. At this point each of them is interrupted for a short distance, and the four ends so formed are firmly united to the bone beneath. The outer cartilage forms nearly a complete circle, so that its ends lie close together; the inner, on the other hand, barely forms two-thirds of one. This peculiarity of shape, and the presence of several accessory bands, tend to make the inner of the two the more fixed. It scarcely moves at all in ordinary actions of the joint, following closely the head of the tibia, to which it is attached, and expanding a little when the weight falls on it. The outer one, on the other hand, glides backwards and forwards freely. In internal derangement one or other of these cartilages is loosened from its attachments, or separated completely, so that it slips out of position and locks the joint.

A characteristic description of this peculiar accident is given by Knott, of Dublin, who has suffered from it himself on repeated occasions. It first occurred to him when he was a boy as he was walking quietly along. All of a sudden, without having sustained any wrench or twist of which he was conscious, he was seized with such agonizing pain on the inner side of the knee joint that he half fell, half sat down on the ground, sick and faint, with a sensation of utter helplessness. The knee was slightly flexed; he could not

move it one way or the other, and voluntary power over it was entirely lost. Instinctively he applied his hands one on either side of the joint, and made as powerful pressure as he could in the hope of relieving the suffering. This caused the flexion to diminish; when suddenly the pain again became almost intolerable, a clicking sensation was conveyed to his hand and his ear at the same time, and perfect relief came at once. He managed to walk away, and no after trouble of any kind followed.

After that the accident happened to him on many occasions; he noticed that it never occurred during active movement, but only when the muscles were off their guard; and that if the knee joint was slightly bent, the least force applied so as to turn the toes outwards was sufficient to cause it. So long as he walked with his toes turned in the joint felt secure.

Hey's account is closely similar. He describes the knee as being not unfrequently affected with an internal derangement of its component parts, as a consequence of trifling accidents, and states that the trouble is now and then removed as suddenly as it is produced by the natural movement of the joint, without surgical assistance of any kind; but that it may remain for weeks or months, and then become a serious misfortune, as it causes a considerable degree of lameness.

"The disorder may happen with or without contusion. In the former the symptoms are equivocal, until the effects of the contusion are removed. When no contusion has happened, or when the effects of it are removed, the joint with respect to its shape appears uninjured. If there is any difference from its usual appearance, it is that the ligament of the patella appears more relaxed than in the sound limb. The leg is readily bent and extended by the hands of the surgeon, and without pain to the patient. At most the degree of un-

easiness caused by this flexion or extension is trifling, but the patient himself cannot freely bend or extend the limb in walking; he is compelled to walk with an invariable and small degree of flexion; yet in sitting down the affected joint will move like the other."

Internal derangement, no doubt, may be caused in many ways. The most common is that mentioned by Knott, striking the inner side of the great toe, when the knee is slightly bent; but it may occur in extreme flexion, sitting upon the heels for example; in flexion combined with abduction, or in extreme extension, when there is no weight resting upon the limb, as when at football a vigorous kick misses its aim. I have known a player drop suddenly in an almost fainting condition from the pain. With this exception the violence that causes it is nearly always of the most trivial description.

In acute cases the severity of the pain and the locking of the joint are the most prominent symptoms; the patient can hardly stand; walking is impossible, and the joint in a few minutes becomes filled with fluid. Recurrent cases are more easily recognized. The pain is less severe and the patient is generally aware of something having slipped out of place. Sitting upon a high chair he can swing the leg backwards and forwards without much inconvenience; but as soon as the weight falls on the limb in standing the joint feels fixed. Flexion is possible, though painful; complete extension is out of the question, and there is a well-marked limp in walking. In many cases a distinct prominence can be made out by the side of the patella on the inner or outer side of the joint, according to the cartilage affected; but as this depends entirely on the direction of the displacement it is wanting in not a few. Minor examples of internal derangement are of common occurrence in youths who have outgrown their strength, the cartilages being unduly movable, but not being torn from their attachment or displaced completely. There

is merely a moment's pain, generally felt most severely on the inner side of the joint, with the sensation of something giving way, and a slight amount of effusion afterwards; but this, if often repeated, may become serious.

Knott is convinced that, at least in his own case, the displacement consists in the posterior part of the internal cartilage gliding forwards from its position until it is caught between the bones. This forces them apart, like a wedge, and stops the movement of the joint. The muscles around contract at once, and become rigid, so that voluntary action is out of the question for the time. Afterwards, when they are tired out, and the joint fills with fluid, the power of movement returns. In the majority of instances, however, it is the anterior attachment of the internal cartilage that is stretched, or, in complete derangement, torn away from the bone. It was so in the four cases in which I have operated, and in the bulk of those collected by Allingham. Occasionally the disc is separated from the coronary ligament and rolled up into the intercondyloid notch, or split longitudinally; and sometimes when the foot has been twisted inwards the external cartilage is torn, but these are much more rare.

"When the knee is flexed the anterior part of the internal semilunar cartilage glides backwards on to the head of the tibia; if the leg is then rotated outwards, the internal semilunar cartilage will be drawn in between the internal condyle of the femur and the head of the tibia. A sudden movement of extension will then cause the internal condyle to roll on to too much of the internal semilunar cartilage. Now, as extension is always combined with external rotation of the tibia, the inner tuberosities of the latter must make a sweeping movement forwards and outwards. The internal cartilage will be held by the femoral condyle, and as the tibia makes its curve forwards and outwards the coronary ligaments will be stretched in the milder forms, torn in the more severe

ones" (Allingham). External rotation of the leg in the semi-flexed position leads to displacement of the internal cartilage; internal rotation to that of the outer.

Immediate reduction, if the derangement still continues, is essential. It is true that, if left, the disc may slip back of its own accord, or from some accidental movement, but only after all the tissues have been softened and stretched by the synovitis that follows. Hey recommended making the patient sit on a high chair, facing the surgeon, who should grasp the limb firmly, extend it until it was as straight as the circumstances would allow, and then rapidly flex it again. Later surgeons have reversed this proceeding, flexing the limb to its fullest extent first; rotating (inwards when the internal is displaced), and rapidly extending. This has the advantage of being less painful.

Whichever way is adopted, while it is being done firm pressure must be made with the thumb of the disengaged hand over the position of the displaced cartilage. As soon as free movement is restored the limb is carefully padded with cotton wool, and thoroughly bandaged to prevent any accidental redisplacement, and to limit the effusion that is almost certain to follow. If this is not checked at once the capsule and the ligaments become softened and yield, the natural tension of the joint is lost, and the displacement may occur again. When once a commencement has been made these two things act and react continually on each other; each displacement causes a fresh amount of effusion; each time the effusion occurs it makes the displacement more easy. At length, if the case is neglected, the distension becomes chronic and the joint is seriously disabled, though it must be admitted that when this has happened the displacement does not cause so much pain as it did.

After the effusion has been absorbed it is advisable to wear a retentive apparatus for some months, especially when

indulging in any exertion which, like lawn tennis, has a tendency to produce this derangement. If it has only happened once, an elastic knee-cap, strengthened and padded opposite the internal cartilage, may suffice; but care must be taken with an appliance of this description that more harm than good does not result. It must never be worn at night; and when it is taken off the knee should be thoroughly rubbed and kneaded to restore the circulation through it, or else the tissues waste and the elastic becomes so comfortable that it is regarded by the patient as indispensable.

In those cases, however, in which one of the attachments of the cartilage has been torn, so that there is a definite displacement recognized by the projection it forms beneath the skin, or in which the ligaments that retain it have been so stretched that it has become unduly movable, this is not sufficient. Either a mechanical contrivance must be worn, to check all irregular movements of the leg when the lateral ligaments are relaxed, or the joint must be opened and the offending cartilage stitched into position or excised.

The simplest appliance consists of two well-padded metal plates accurately fitted round the knee-cap, one on either side, and held together above and below by short straps. These plates are connected together by a steel spring passing horizontally across behind the joint, so that when the splint is in position they press firmly on the unprotected portion of the capsule, where the displacement is most likely to occur. If this does not answer, the best kind of apparatus is formed on the principle of two lateral bars jointed opposite the knee, and connected together above and below by a circle round the limb, formed partly of metal and partly of leather. An additional strap across the joint above and below the patella is sometimes of service. This is heavier and more cumbersome, but much more efficient than the former in checking

irregular movements of rotation in either direction. Flexion and extension are not impeded. It must be admitted that to have to wear for the rest of life an appliance of this kind, however well it fits, is a very serious drawback, and there can be no question that, at least, in the young and healthy, and where there is no constitutional taint, it is infinitely preferable to adopt the alternative, and have the cartilage either stitched to the head of the tibia or excised. Annandale has adopted the former method on several occasions with conspicuous success. There is, however, always the risk of relapse owing to the adhesions that form not being sufficiently strong to stand a frequently-repeated strain. I have known this occur in more than one case. Excision, on the other hand, is not attended by a greater amount of risk, leaves the joint as strong as it was before, and is final. I have performed it on four occasions, and have had every reason to be satisfied with the result. The fear of weakening the security of the joint by removing one of the cartilages is quite unfounded. When they are intact they are of very little use; as Bland Sutton has shown, they are merely survivals of the distal terminations of muscles long since obsolete in man. When they are loosened or separated from their attachments they are a positive source of weakness and of danger, and the joint distinctly gains by getting rid of them.

Sprains of the hip and thigh.

The hip joint, owing to its construction and the immense strength of the muscles and ligaments around it, is seldom sprained. The weakest part, and the one that suffers oftenest, is the neck of the femur. In childhood it is the most frequent seat of disease; in adult life, when it is at its strongest, accidents are rare unless the violence is extreme; in old age it gives way with the slightest jerk; the ligaments and capsule escape.

Internal derangement of the hip.—Forcible abduction of the limb, as when, for example, a person falls with the legs apart in jumping from a carriage in motion, sometimes causes a very peculiar kind of injury. The patient cannot stand or walk upright. The toe of the affected limb is pointed forwards, and the hip joint slightly flexed. As soon as the weight of the body comes upon it in taking a step there is a stab of intense pain shooting down the inner side of the thigh. Lying down the limb can be moved freely in all directions, although neither extension nor abduction in the flexed position can be carried to their full limit. Nothing can be felt externally, and no swelling can be made out round the joint. A certain amount of roughness can, however, be felt in certain movements.

What is the actual lesion in this accident remains uncertain. If left to itself the symptoms slowly subside; synovitis sets in, and when this gets well the joint can be used again without much pain. As, however, recovery does sometimes take place suddenly after forcible manipulation, it is possible that something is caught inside the joint, and it has been suggested that it may be the round ligament driven under the transverse bar that closes in the cotyloid notch. Manipulation might draw it out and recovery be rapid and complete, or synovitis set in, and the same result follow more slowly from the distension that accompanies it. Whether this is so or not, it is extremely advisable to place the patient under an anæsthetic as soon as convenient, and examine carefully any movement that appears restricted.

Effusion into the bursa under the psoas muscle, where it lies in front of the hip joint, is not uncommon after overexertion, and may occasion great anxiety owing to its presenting many of the symptoms of hip disease. The limb, however, if flexed can always be rotated freely, and without causing pain. In general the pain and limitation of move-

ment subside after a few days' rest, but I have known one or two cases in which recovery only became perfect after blistering and counter-irritation had been carried on for some weeks. Cases of this kind require the most careful watching, as, though the bursa does not open into the hip-joint in childhood, the barrier between the two is a very slender one, and not unfrequently disappears as age advances.

Atrophy of the extensor muscle of the thigh is a rare consequence of strains. It may involve the whole of the muscle or only a part, one of the great divisions, for example, of which it is composed, or a smaller portion still. In a case that was recently under my care, a gap could be distinctly felt on the front of the limb, about half-way between the hip joint and the knee. It gave the impression that the muscle had been torn across, and never reunited, though, according to the patient's statement, it was impossible for it to have been produced in this way. The gap made its appearance slowly and gradually after a strain, nothing being noticed for some days, and it kept steadily increasing in width week by week. Moreover, the electric reaction of the whole muscle was depressed, and there was a general loss of tone and firmness. Lücke, who has thoroughly gone into the question, has shown that there is an actual loss of the contractile substance in these cases similar to that found by Valtat in the atrophy following inflammation of a joint. There is no neuritis or other affection of the nerves, and no extravasation of blood; the wasting may follow either a blow or a strain; and its rapidity is in no way measured by the severity of the injury. There is often a certain amount of pain of a rheumatic character, and not unfrequently a slight amount of effusion into the knee joint; but this is probably passive rather than active, allowed to take place by the relaxation of the capsule of the joint that always follows loss of tone in the extensor muscles.

Displacement of the sartorius.—The fibrous expansion given off by the sartorius to the capsule of the knee joint is occasionally torn across, and the muscle displaced. More frequently, as in an instance under my own care, the rupture was partial, causing a soft, ill-defined, but very tender swelling over the inner side of the knee for some considerable time. The accident befell a man who was sitting tailor-fashion on the floor, when a companion tripped over him, and fell across his knees. The amount of bruising that followed was very remarkable, and contraction of the muscle was attended with considerable pain for some months.

Rider's sprain.—The adductor muscles on the inner side of the thigh occasionally give way under the semi-voluntary grip by which a rider secures his seat when his horse swerves or bolts round. There is a sudden sharp contraction, a sensation of something giving way, and a feeling that the hold on the saddle is gone. A dull aching pain sets in at once, and grows worse and worse with every attempt to proceed; the part begins to swell as the blood pours out from the torn vessels; a peculiar warm trickling sensation is felt down the inner side of the leg, and, as a rule, the rider is compelled to dismount. When standing, the symptoms are not quite so severe, but the least attempt to bring that group of muscles into play again, or to remount, makes them tenfold worse.

The kind of injury is well known, and is usually recognized at once. It is due to the rupture of the tendon that stands out under the skin on the inner side of the thigh; sometimes it gives way near the bone, so that the gap can be felt, but more often the muscular fibres are torn away from it without leaving any distinct interval. The extravasation is often very extensive, and it may be weeks before the last traces of the staining finally disappear. Every endeavour must be made to keep it as much as possible within bounds. A stirrup leather may be tied tightly round the part as a temporary

measure ; but a much more effectual method is to buckle a long strap of webbing round the thigh, outside the breeches. It must be well padded, on the inner side, over the point where the muscle is torn, and coming up in front and behind, should cross over the hip and be carried round the waist. Where the laceration is complete, some such appliance may be permanently required.

Rider's bone.—A long slender spine of bone which is occasionally met with in connection with these tendons probably has its origin in the same kind of injury. It is known as rider's bone, from its being found chiefly in those who have spent a large proportion of their lives in the saddle. Sometimes it causes a good deal of inconvenience by the way in which it interferes with the flexibility of the part; but more often its existence is hardly known, as it lies buried in the substance of the tendon itself. If the history is inquired into, it is always said to have developed after one single severe strain; but comparing it with similar formations in other tendons, it seems more probable that it is due to the constant bruising to which the muscles are subjected. Probably it is formed from the organization of lymph thrown out from time to time.

Rider's bursa.—Other troubles also are produced in this way. A soft fluctuating swelling sometimes makes its appearance underneath the tendon high up in the groin. So long as the muscle is in action it is tense and firm, as soon as it is relaxed it becomes soft and flaccid ; but it cannot be dispersed, or even reduced in size by pressure. In one case under my care, considerable improvement was effected by rest and blistering, but I am afraid it was not permanent. The patient was a man who had been accustomed to a great deal of rough riding, and it seemed to cause him considerable annoyance. The thing of which he complained most was a sensation of weakness, similar, apparently, to that

which is so often experienced in the hand when there is a ganglion on the back of the wrist; but it was doubtful if there was any actual loss of power. The swelling had made its appearance slowly, and was still increasing when he came to see me, so that it evidently was not due to any extravasation. Most probably it resulted from the effusion poured out after repeated strains; and, as he could not give up his occupation, it is certain to increase, until it ends either in inflammation and suppuration or else in the formation of a bursa.

CHAPTER II.

SPRAINS OF THE UPPER EXTREMITY.

The shoulder.

In the shoulder-joint everything is subordinated to variety and rapidity of action. The capsule, with the exception of one part, is so long that it only becomes tense when the movement is extreme; and the muscles take the place of ligaments, executing, controlling, and restraining action with a precision that would be impossible if it were regulated by passive and unyielding fibrous tissue. Sprains, therefore, are comparatively rare, and when they do occur the brunt falls upon the muscles rather than the ligaments.

Dislocation of the biceps.—In a few instances the long tendon of the biceps has been displaced. In one that came under my notice the patient was able to dislodge it at will, and, by twisting the arm with the other hand, make it shift back again into its groove. No snap could be heard, it is true, nor was there any marked difference along the front of the arm when the two sides were compared; but the inability to raise the arm from the side at one moment, and the free range of action after reduction had been effected, left little doubt as to the nature of the injury. Passive motion was good, but painful. There was no prominence on the front of the shoulder, such as has been described in other instances, but this might have been accounted for by the recent date of the accident.

Effusion into the subdeltoid bursa.—Blood or lymph allowed to collect after a sprain in the bursa that lies beneath

the deltoid may give rise to great inconvenience. A kind of crepitus is often present and can be felt and heard by the patient when the arm is raised and the shoulder grasped firmly from before backwards. Contraction of the deltoid is very painful, from the pressure it exerts on the deeper structures, and the patient can only just lift the arm from the side. Later, when the staining is beginning to show itself beneath the margin of the deltoid and organization is setting in, adhesions sometimes form across the sac, tying the opposite surfaces together, or outgrowths project into it from the walls, and then not unfrequently the pain on movement is so great that the muscle is scarcely used at all, and wastes to a serious extent.

A similar thing may occur in connection with the loose cellular tissue that lies between the shoulder blade and the wall of the chest. In one case under my care the patient, who had on a previous occasion suffered from several fractures in different parts of his body, was so firmly convinced that his collar-bone was broken that nothing could make him believe the contrary. He had sustained, certainly, a severe fall on his shoulder, and was badly bruised; there was great difficulty in raising his arm from the side, and the whole region was much swollen; but there was no displacement, and the tenderness was general, not limited to any one definite spot, as it would have been in the case of a fracture. On manipulation, however, the most distinct crepitus could be obtained, especially when the arm was lifted up, and the shoulder grasped from before backwards; and it was so definite in character, and so perceptible to the patient, that he was absolutely sure that it came from his collar-bone. Not until ten days had passed, and he could use his limb freely in all directions without pain, would he admit that the fracture (if it was one) had united much more rapidly than those he had sustained on a previous occasion.

Cases of this kind should be treated by massage and passive motion from the first ; and if they do not show speedy improvement the part should be well douched with hot and cold water, and active counter-irritation employed. The longer they are left the slower convalescence becomes, owing to the inner part of the capsule growing unduly rigid.

The wasting of the extensor muscles, which so commonly follows sprains of joints, is especially noticeable in the case of the shoulder. The difference between the two sides may be conspicuous within the first few days. The deltoid, which gives the joint its smooth and rounded outline, is the first to show the change ; the shoulder is flattened on its outer side, and the points of the bone beneath are too prominent. Then it spreads to the muscles that cover in the shoulder blade behind. Only after a considerable interval does it involve the rest, and as the whole limb is affected, more or less, then probably as the result of confinement and disuse. In those cases in which the wasting is general the atrophy is merely a form of fatty degeneration ; when the extensors only are attacked it is essentially different, dependent upon the influence that is exerted upon the muscles through the nerves that supply the joint, and similar to that which sets in after attacks of synovitis. It is in these cases that galvanism, combined with massage and other remedies, is so useful ; but even in the most successful it takes very much longer for the muscle to regain its substance than to lose it.

All sprains and injuries of the shoulder need the most careful and persistent passive motion from the first to prevent the joint becoming stiff. The capsule at the lower and inner part is very thin, and has around it a large amount of loose tissue, so soft and delicate that it is thrown into folds when the arm hangs by the side. In this position no pressure falls upon it. As the limb is raised the folds are gradually

straightened out. Now this part of the capsule, from its softness and vascularity, always suffers when the joint is sprained; and unless active steps are taken the whole of it is converted, first into a mass of soft vascular lymph, and then into dense and unyielding fibrous tissue. There is nothing to prevent it. There is no pressure to close the vessels or limit the amount of lymph poured out; the folds are never separated from each other or opened out, and if the joint is painful it is not used, others close by undertaking the work without the patient being aware of it. When he raises his arm sideways from the body the joint at the shoulder never moves; the whole of the action is carried out by others; and this goes on until organization sets in and the part becomes stiff and rigid. The surfaces of the folds adhere to each other, and become incorporated with the tissues around, and, instead of a soft and flexible capsule, there is a mass of shortened rigid and unyielding fibrous tissue, matting everything together and preventing all movement of the joint in the opposite direction. The muscles waste away; the bony prominences stand out unduly; the rounded contour is lost; the arm cannot be lifted from the side; rotation of the limb is almost impossible, and the patient is unable to place the hand upon the head. The joint is almost rigid; the whole of the movement, or nearly the whole, is apparent only, and is really due to the freedom with which the shoulder blade moves upon the chest.

Cases of this kind require the bone-setter's treatment. The part must be well steamed and douched for several days, and then, while an assistant fixes the scapula by pressing it down upon the thorax, the arm must be manipulated freely in all directions, combining rotation inwards and outwards with abduction and extension until the range of action is thoroughly restored. Then there may be a day's respite; but after this manipulation must be commenced again and carried out every day, combining with it massage, galvanism, and, after a time,

active overhand exercises until the muscles have thoroughly recovered. Not until movement is perfectly free and the two arms are once more the same size can the cure be considered complete.

Synovial diverticula.—Large cysts communicating with the joint are occasionally met with on the front of the arm and in the infraclavicular fossa, and are nearly always said to have been produced by a sudden strain. The joint, however, in these cases is always seriously involved, and it will be found that, though they may have been made worse by an accident, these cysts are in reality the product of a form of osteo-arthritis.

Sprains of the elbow.

All injuries of the elbow joint are attended by an enormous amount of swelling, which makes its appearance within a few minutes of the accident. In adults this does not interfere materially with the diagnosis, as the bony prominences are sufficiently marked to be felt distinctly; but in children in whom sprains, dislocations, partial fractures, and separation of one or more of the epiphyses are exceedingly common, it adds very greatly to the difficulty. Unless the injury is plainly of a trivial character, it is always advisable in such cases to insist upon examination under an anæsthetic. Without assistance of this kind it is almost impossible to make certain of the exact nature of the injury, whether it is merely a strained ligament or partial separation of the articular surface of the humerus.

In addition to these there is a peculiar injury only met with in children, concerning the nature of which there is still some question. It is caused by the way in which careless people swing them round by the hands or lift them across a road, and is rarely seen immediately; for though the child cries out with the pain, there is no distinct or objective sign

of anything wrong. By-and-bye it is noticed that the arm is not used as freely as the other ; that it is held constantly in one position, the elbow slightly bent, and the palm of the hand looking downwards ; and that the child always cries when it is touched. If the elbow is held firmly with one hand, while the forearm is made to rotate slowly from side to side, there is a clicking or snapping sensation, perceptible both to the ear and the touch. Then something is felt to slip, and in general free use of the joint returns immediately. But sometimes this is not so easy ; reduction does not take place at once ; the peculiar sensation continues, and may even become more plain, until it is difficult to distinguish from the crepitus of fracture.

The accident appears to be caused by the radius, on which nearly all the weight falls when a child is lifted up by the hand, slipping out from under the ligamentous collar that holds it in place. The head of the bone is smooth and rounded and the neck scarcely marked, so that this can take place easily. Reduction is effected by flexion and rotation of the forearm, sometimes in the pronated, sometimes in the supinated position ; and if the displacement is rectified and the arm kept quiet for a day or two, the power of painless movement is rapidly regained.*

Sprains of the wrist and forearm.

The tendon sheaths and the muscles are the structures that suffer most in strains of the forearm. The tendons themselves rarely sustain much hurt. They are formed of such tough bundles of fibrous tissue closely woven together that if they escape being torn in two, or wrenched from the muscle to which they belong, they generally escape altogether. The sheaths, however, in which they lie make up for them in this respect. They are so delicate that they are

* J. Hutchinson, Jun., " Annals of Surgery," 1885.

torn and bruised with the least degree of violence, and the relation they bear to the tendon is so accurate that the slightest alteration makes itself felt.

Tenosynovitis.—An unusual amount of work falling upon a group of muscles that are not trained to bear it is sufficient. The tendons no longer move smoothly in their sheaths; a hot, burning sensation is felt each time the muscles contract; there is a feeling of tenderness and fulness over them; the temperature of the skin is raised, and as the tendons play backwards and forwards a sense of crepitation and rustling as when two surfaces of silk are being rubbed together is communicated to the finger. Sometimes this is perceptible to the patient; at others it can only be elicited by carefully applied pressure. Naturally it is felt most plainly where a number lie close together beneath the skin, as on the front of the ankle joint or the back of the wrist. In situations such as these, any unaccustomed exertion, walking, for example, some distance unusually fast, or feathering in rowing at the commencement of the season, or even carrying a heavy weight in the hand, is sufficient to cause it.

Lawn tennis arm.—The same symptoms (with the exception of the rustling) are produced by over-exertion when the tendon is attached directly to bone without the presence of any investing sheath of synovial membrane. A common instance of this is met with in a variety of what it is the present fashion to call lawn tennis arm, though a similar thing was described long since in Australian diggers. There is a tender spot about the middle of the forearm, on the outer side of the bone, corresponding to the attachment of one of the muscles that is used especially in back-handed strokes; and sometimes the tenderness is so great that I have known it the source of great uneasiness. The skin appears slightly swollen and raised above the normal level; but it is quite

white, even whiter than the surrounding part, and the swelling so soft that it can be appreciated much better by the eye than by the touch. In moderate cases it is limited to this point, and the muscle itself is not affected; only when it contracts there is a feeling of soreness and stiffness, not, perhaps, amounting to actual pain. In severe ones the swelling extends over the whole muscle.

In both these cases the effect is essentially the same. Owing to the increased wear and tear more blood flows through the part; a larger amount of exudation is poured out into the tissues; the skin becomes more sensitive, so that it feels sore and tender when even light pressure falls on it; and the action of the muscles is difficult and painful. Crepitation or rustling can only be felt where there is a space in which friction can take place.

Sprains of the wrist.—In sprains of the wrist, as when a man falls down with his hand and forearm doubled up beneath him, the injury is much more serious. The whole of the stress falls on the ligaments and tendons at the back of the joint; the soft and delicate tissues underneath are crushed together. Swelling sets in immediately. At first, while the tendon sheaths are being distended, it is limited to the back of the wrist and a little way up the forearm. Soon it shows itself on the back of the hand; then it spreads along the forearm, and makes its appearance on the front where the tissues were crushed and squeezed at the moment of the fall. The skin grows hot and tender; movement at the wrist is lost; the joint is kept nearly straight, and can neither be bent nor extended; the former movement is too painful, because then the extensor tendons are pressed against the part of their sheath that has sustained the severest hurt; the latter is almost impossible, as tendons cannot work when their sheath is distended with fluid. Even the fingers suffer in the same way; though a certain amount of flexion is permitted, they

cannot be bent into the palm of the hand or completely straightened out.

After a few days the bruise begins to come out near the elbow (generally on the front of the joint) and, perhaps, in the hand; the colouring matter from the blood soaks by degrees into all the surrounding structures, and spreads along the looser planes of cellular tissue until it reaches the skin. The swelling slowly diminishes, remaining longest over the tendons; the tenderness becomes localized, being chiefly felt over that part of the back of the wrist which corresponds to the spot where the tendons were crushed; movement becomes more free; the amount of grating and creaking grows less, and if no adhesions have formed, and there are no other troubles to hinder the progress of recovery, voluntary power slowly comes back, though even in a moderately successful case it is sometimes months before all the thickening disappears and the joint can be completely flexed.

Sprains of the wrist require energetic treatment or some stiffness is sure to be left. This is dependent on many things, and in a measure cannot be helped. But its degree and persistence are regulated almost entirely by the amount of the effusion and the changes it undergoes. If it is slight and quickly reabsorbed, movement soon returns. When the amount is large and the structures around are softened and infiltrated, it takes much longer. In the worst cases where it is allowed to become organized the power of movement may be lost altogether. The tendons may be so glued to their sheaths by adhesions that movement of one in the other is hopeless.

Heat and cold are both excellent if applied thoroughly and at once; they check the effusion and numb the pain; but by far the most effectual remedy is uniform compression from the first. Splints should never be employed, and fixed bandages are most injurious. Pads of some elastic substance

should be shaped to the limb, so that the pressure may fall upon the swollen tendon-sheaths and not upon the bones, and fastened lightly in their places ; and then the whole limb should be wrapped round with sheets of wool and firmly bandaged so as to secure uniform and elastic pressure.

Massage and passive motion must be commenced the next day, and continued every day. The rubbing at first must be light, affecting the skin only, and then the deeper structures. Tender spots must be approached very carefully ; they need even more attention than the rest, but, unless it is very cautious, manipulation makes them more painful still. Every movement must be commenced at the end of the limb, working gradually towards the trunk. Properly managed, and combined with passive motion, the relief this gives is immense ; the pain is exceedingly slight ; the swelling is dispersed, and the chances of after stiffness are materially lessened.

Passive motion in the same way must be employed every day. The loose tissues around the tendon sheath are softened and thickened ; the surtace of the synovial sac is rough from the rapidity with which the new cells are formed to line it in place of the old ones ; and it is irregular from the swelling of its folds and fringes. Unless movement is begun at once this must end in some degree of stiffness. It need not be repeated often at each sitting ; once is quite enough, but it must be thorough, and every joint and every tendon near the part that has been injured must be worked through its whole range of action. Slight and faint-hearted attempts, apparent movements really taking place at another joint are useless, and throw discredit on the treatment. They do not prevent the formation of adhesions, or break down those that are already established ; they merely pull and strain on the stiffened structures round, and make them painful and tender without setting them free. Recent

adhesions are easily separated by definite and well-regulated manipulation without any fear of exciting inflammation. Even after they have become organized it is safer, as has already been shown in speaking of joints, to break them down thoroughly and effectually with one single effort than to keep perpetually straining and worrying them. Weak and ineffectual attempts, carried on haphazard without a definite object in view, do more harm than good. They increase the pain, cause more lymph to be poured out, prevent the absorption of that which is already there, and help it to accumulate until, as the adhesions grow thicker and stronger, the prospect of recovery becomes more remote than ever.

In the later stages, when the signs of bruising have already disappeared, if the movement of the tendons remains painful and constrained, more energetic treatment is required, just as in cases of imperfect recovery after other sprains. The limb should be douched with hot and cold water, and thoroughly shampooed. Tendons, even when stiff, move more freely after prolonged soaking, and though they do not retain the whole, some degree of improvement is always left. Stimulating liniments, especially those containing the aromatic oils, should be well rubbed in; light flying blisters painted every two or three days over and around any spots that are especially tender; galvanism employed to restore tone to the muscles; everything, in short, should be done that can make the blood circulate more freely through the part or improve its nutrition.

If, however, the tender spots are definitely marked, and if they become more painful and tender regularly after certain movements, these methods rarely secure more than temporary relief. Something further is required.

In some cases there is the residue of an old blood clot, forming a little hard irregular mass that is pressed upon

when the tendon is stretched. In others there is an adhesion across the sheath or between it and the tendon that occupies it; or there are fringes in the interior continually shifting their position and keeping up a certain amount of effusion by bruising the sheath whenever the tendon moves. Whatever it is, when the pain can be traced definitely to a cause of this kind, the patient must be placed under an anæsthetic to avoid suffering, and to secure complete muscular relaxation; the part must be thoroughly examined, and the adhesion, if one is present, broken down, or the foreign body removed. Whatever the cause of the continued tenderness, it very rarely happens that it is of a nature to be cured by prolonged rest. In the great majority of instances it is due to its having been rested too long already. Most of the crippled joints and tendons that are met with after sprains are due to the fact that passive movement has not been employed sufficiently early or sufficiently thoroughly; and they are only to be cured by the adoption of measures that must be energetic in proportion to the delay.

Ganglion.—Strains of tendons, if often repeated, are liable to lead in certain cases to dilatation of the sheath, or to the development from it of small hernial protrusions known as ganglions. General dilatation is rare, and is frequently confused with tubercular disease; ganglions are met with wherever there is a tendon sheath, but especially around the wrist. They form small rounded swellings by the side of the tendon, or over it, tense and elastic, and generally hard, but this varies with position. As a rule they are painless; occasionally they press upon a nerve, and give rise to sharp stabs of pain in certain movements; and not unfrequently they are attended by a peculiar feeling of weakness. The muscle is well nourished, and apparently as strong as it should be, but there is a sensation of want of security about its action that prevents its being used with freedom.

The ordinary method of treating these little cysts is to crush them by direct pressure, and squeeze the contents into the surrounding tissues, so that they may be absorbed. Sometimes they are punctured, or injected with iodine, or divided horizontally with a tenotomy knife, so as to separate the cyst from the sheath; but none of these methods is quite satisfactory. They often succeed, it is true; but, even when the cyst does not return, it is very common for a hard irregular mass to be left behind, interfering with the action of the tendons, and causing an unsightly tumour. I have known a swelling of this kind persist unaltered for twenty years in spite of continued attempts by kneading and other measures to get rid of it.

When it is desired to remove them thoroughly and finally, it answers much better to dissect them out. There is no difficulty unless they have been ruptured and squeezed several times before; they separate readily from everything around except the tendon sheath. Generally they are firmly attached to this, and often when the uniting band is severed the tendon may be caught sight of, lying in its groove, and showing that the cyst was in communication with its sheath. If the operation is done carefully, and the hand kept on a splint for a day or two after, the cure is effectual, and the scar can scarcely be seen at the end of a week. If, however, the cyst has been much handled first, particularly if several unsuccessful attempts at squeezing it have been made, it must be left for some time before attempting any such proceeding.

Sprains of the hand and fingers.

Some of the bony prominences around the wrist occasionally stand out in a way that almost justifies the conclusion at which the patient nearly always arrives, that a small bone has been put out. The styloid process of the ulna on

the inner side of the wrist is a favourite spot for this. It is often unduly prominent after an attack of gout or rheumatism, and, even when it is certain there has been no injury, it is frequently described as being out. So with the base of the metacarpal bone of the middle finger, which, when the wrist is strongly bent, raises up the skin on the back of the joint. This often forms a projection that varies in size from time to time, and occasionally appears quite suddenly after even slight exertion. Probably it is due to a strain of the tendon attached to this point, and to the amount of effusion thrown out round the bone, but it is nearly always asserted that something is out of joint.

Displacement of the extensor tendons on the back of the wrist is not uncommon, and from the way in which it recurs with every movement of the hand sometimes causes serious annoyance. Complete dislocation, with rupture of the sheath, on the other hand, is rare, except in association with other severer injuries.

Sprain fracture of the thumb.—The thumb is liable to a peculiar injury, the nature of which has only recently been explained. It follows in general a severe strain. The ball of the thumb swells up at once, and all power of bending it into the palm of the hand or bringing it towards the other fingers is lost. On the back of the bone, where it joins the wrist, there is a projection, not, however, as large as it would be if the joint were dislocated. Pressure reduces it at once; but as soon as the pressure is taken away it returns with a visible and painful jerk. The length of the bone is unaltered. These symptoms are caused by an oblique fracture running through the base of the bone, where it joins the wrist, splitting off that part which lies buried under the muscles. The projection on the palmar surface that renders the joint secure is torn off, and as a consequence the displacement

keeps returning. Crepitus can easily be felt by pressing the two broken surfaces together. The ultimate deformity, if the nature of the injury is not recognized, is not so serious as might be imagined, but the movement of the joint is interfered with for some considerable time. (Bennett.)

Internal derangement of the fingers.—The finger joints are liable to a variety of internal derangement similar to that which has long been known in the thumb. In structure they are hinge joints admitting free movement so far as flexion is concerned, but exceedingly little in any other direction. On the under surface of each there is a plate of fibro-cartilage, similar in structure to the discs in the knee, and, like them, helping to deepen the socket in which the head of the bone rotates. In fact, this is the chief bond of union between the bones, but while it is so firmly united to one that it is almost impossible to tear it off with any reasonable degree of force, the fibrous tissue that binds it to the other is soft and flexible, so as not to interfere unduly with the action of the joint. Sometimes it happens in severe wrenches, especially when the finger is forced backwards, that this plate of cartilage is torn from its attachments and slips up between the bones, so that when the force is past they cannot resume their natural position.

Mitchell Banks has shown how this occurs in the joint between the index finger and the hand, in which it is most common; and I have met with several instances, not only there, but in other joints also. It is an exceedingly painful accident, often causing fainting and sickness. The deformity is very conspicuous, especially on the back of the joint, though it is not so great as that of a true dislocation or when a bone is broken. The finger is kept slightly bent. By using the other hand the patient can move it through a

considerable angle, but he cannot either straighten it out or bend it into the palm. No amount of force produces any effect on the displacement; it is due to the cartilage which has slipped between the ends of the bones and prevents them moving freely on each other. Until this is released from its position the deformity must remain unrelieved. If left to itself the finger generally recovers a good deal of its power, but the appearance is very unsightly.

Dupuytren's contraction of the palmar fascia dragging down the ring and often the little and middle fingers until they are rigidly fixed in the palm, can, in many instances, be traced to a strain. Sometimes it is a single one forcing the ring finger back in over-extension; more frequently it is constantly repeated, such, for example, as the pressure caused by leaning the weight in walking upon a round-headed stick, especially during convalescence after severe illness. In ordinary cases the first thing to attract attention is a small hard nodule in the palm of the hand, at a point corresponding to the lowest of the transverse creases into which the skin is thrown, and to the interval between the ring and little fingers. It is not painful unless pressed upon or roughly handled, and does not at first give rise to any inconvenience; there is merely a hardened spot, where the tissues are bound together. Soon, however, the skin begins to waste and lose its flexibility; the fat disappears, and it becomes tied down to the fascia beneath. Then prolongations may be noticed running from this point upwards towards the wrist, and downwards to the fingers. The latter are much the stronger, and if the process continues, the ring and little fingers become more and more flexed by the contraction of these bands until they are held down immovably in the palm. One of these two fingers is generally the first; but often both of them suffer, and sometimes the middle and

even the index as well. When the bending is complete, the finger catches in everything like a hook, so that it is liable to be pulled back and hurt, and becomes the source of extreme annoyance from the way in which it interferes with every action, even such apparently trivial matters as shaking hands.

Much may be done to prevent this in its early stages by massage and continued extension, straightening out the fingers whenever an opportunity offers and wearing a light splint at night. Few, however, take the trouble, and as a rule no attention is paid to it until the contraction is already advanced and the finger bent down. When this takes place nothing but operation can restore it.

Sprains of the fingers always leave behind them a certain degree of stiffness, arising from confinement in a straight or nearly straight position. In old people this alone, without any injury, is sufficient if it is kept up for a few days ; and, therefore, in every case in which splints are required for the forearm, and still more if the hand or fingers have been hurt or strained, passive motion and manipulation must be commenced at once and continued regularly until the confinement is dispensed with, and even after that. Moving each finger joint separately and quietly does not disturb any part of the hand or forearm that has been broken or otherwise hurt. As a rule in injuries of this part of the body the splints that are used are unnecessarily large, and certainly are kept on much too long. The fingers when released have a smooth and glossy appearance, and are peculiarly round and uniform in outline. At first they cannot be bent in the least. After a little while they can be pressed down into the palm, with a good deal of pain ; but as soon as the pressure is released they fly back as if on springs ; and in spite of massage, bathing, and galvanism it is often many weeks

before even a moderate degree of control is regained. Not unfrequently the pain is so great when movement is attempted that it is necessary to place the patient under an anæsthetic and forcibly break down all the adhesions before anything further can be done.

CHAPTER III.

SPRAINS OF THE BACK AND NECK.

Sprains of the back and neck are sufficiently common and important to deserve separate consideration. The structures concerned are exceedingly complicated; there is an immense number of separate joints of various shape and size, and in addition there is the spinal cord running in a canal down nearly the whole length, and giving off nerves which pass out on either side between the bones. Nor do the injuries themselves vary less in character and severity. In some they are exceedingly slight; in others the consequences are as serious as any that occur in surgery. Some, too, have gained a most unenviable notoriety from their connection with railway accidents; for whatever may be the truth as regards many of these cases, whether they are deceptions or not, there can be no question that sometimes very considerable injuries are produced by the way in which the backbone, and the structures in connection with it, are strained and wrenched when the body is thrown violently backwards and forwards as it is in collisions.

One of the most singular features in connection with these accidents is the way in which the backbone itself, and the muscular and ligamentous structures around it, are ignored. Even in the ordinary accidents of every-day life there is a great tendency to lay everything that is serious or lasting to the credit of the spinal cord. In railway cases there is no hesitation at all; if any serious result ensues it must be the consequence of damage this structure has sustained, or of inflammation following it; little or no attention is paid to

anything else. Yet it is difficult to see why the other structures should enjoy immunity. The vertebral column is easily strained, especially in the cervical and lumbar regions; the ligaments may be torn or stretched; the nerves bruised or crushed; the smaller joints between the segments twisted and wrenched; and the muscles detached from their bed and torn across, or thrown into such a state of cramp that they become rigid and unable to work. Results, in short, of the most serious description may easily occur and leave lasting evidence of their existence behind, when the spinal cord itself escapes completely.

The following case which was under my care some years ago is an example of the difficulty there is sometimes in distinguishing injuries of the spinal column from those of the spinal cord. The patient, who was a young, healthy man of good physique, slipped in getting out of a barge and pitched head-foremost into the hold among some bales of goods. The shock was in a measure checked by his hands, or he would have broken his neck. As it was he lay for some moments unable to extricate himself, with his head doubled under him and his chin driven down upon his chest. He did not lose consciousness; there was no concussion or other injury to his brain; there was no fracture or dislocation, though, owing to the severity of the shock he had sustained, he was unable to stand upright, and his spinal cord had not suffered any serious hurt, for after he had recovered from the shock he was able to move his arms and legs freely. Sensation was not impaired; there was no tingling or feeling of pins and needles; nor was there that peculiar sense of constriction as if a string were tied round the body, of which so many patients complain. The stress had fallen on the muscles and ligaments at the back of the neck; these, no doubt, were severely strained, and it seems probable from what followed that the

nerves running from the spinal cord had suffered in the same way.

The next day the shock passed off. He slept but little during the night, and he still felt giddy when he attempted to sit upright; but he had recovered his natural colour and expression, and the pulse and temperature were normal. He had completely lost, however, the power of moving his head or neck; the least attempt, especially nodding, brought on severe attacks of pain, shooting up over his head and behind his ears on each side, so that he sat either with his chin resting on his hand, or with his thumbs behind his ears and his fingers grasping his face. Indeed, without support of some kind, he seemed unable to hold his head upright. He complained of his back and neck feeling weak, as if he were going to be paralyzed, mistaking, as Hood has pointed out, the fear of movement due to the pain it causes for actual loss of power. The skin was exceedingly tender, as it is over every sprained joint, and there was a certain degree of swelling, very ill-defined in outline, over the part that had been most severely strained. What caused him most apprehension, however, was the difficulty that he felt in opening his mouth. He could shut it easily enough, but slight as is the muscular effort required to move it in the opposite direction, it was almost too much for him. The muscles which act from the upper part of the chest, and help to form a fixed point from which the lower jaw can work, were unable to work. Either they had been injured themselves, or the nerves supplying them had been strained at the moment of the fall, and were unable to carry the necessary stimuli. For the same reason his breathing was shallow and his speech slow and deliberate.

In a few days this began to pass away; the sense of strength returned, and movement became more easy; but for a long time a peculiar sensation could be detected in the

neck when the head was turned from side to side, as if two roughened surfaces were being rubbed against each other, or some dense fluid, such as extravasated blood, were being squeezed to and fro in the meshes of the cellular tissue. Gradually this, too, disappeared, but, in spite of repeated blistering, the stiffness still persisted in the back of his neck. Improvement went on fairly rapidly up to a certain point, but then came to a standstill. Forcible manipulation, however, assisted by thorough kneading, soon effected a cure.

In this case the mischief was well defined, the ultimate recovery, though it was delayed for some time, was complete, and there was no inflammation or other complication. The cord itself was not injured, though at first there was reasonable ground for suspicion; the whole of the symptoms were due to the damage the muscles and ligaments had sustained, and to the way in which the nerves were stretched.

In all probability, as Page has pointed out, many of the cases of what is sometimes called railway spine may be accounted for in this way. The symptoms, because they are serious and persistent, are referred to the spinal cord, instead of to the structures which surround and are intended to protect it.

Strains are felt most severely where a rigid and a flexible segment meet, where, for example, the neck or the lumbar region joins the thorax, which, from the attachment of the ribs and for other reasons, is more rigid than the rest.

Sometimes the strain falls on the smaller joints, though it is rarely possible to find direct evidence of their being hurt. There are so many of them; they lie so close to each other; and the amount of movement possessed by each is so slight. More frequently the brunt of the injury is borne by the fibrous tissue, and the muscles on the back and side of the vertebral column. With regard to these, the part played by the fibrous tissue is entirely mechanical. Close under the sur-

face there is a broad sheet of extraordinary strength, extending outwards over the muscles, binding them down, and protecting them so far as it can from being overstretched. A little deeper it is more delicate and vascular, forming sheaths for all the separate slips, and uniting them closely to each other. Deeper still it becomes strong again; but here the fibres are short and irregular in direction, running between the prominences with which the bones are covered, and acting the part of ligaments. This fibrous tissue cannot stretch. When the violence is so great that the muscles are overcome, or so sudden that they are caught unawares, it resists as long as it can; then it gives way, rarely at any one single spot; more often here and there, where it is attached to the bones, or becomes continuous with the muscles.

The muscles, on the other hand, are active ligaments. Not only do they move one bone upon another, but, within certain limits, they are the agents by which the extent of the movement is regulated. When those limits are passed, and not till then, the purely passive fibrous bands are called into play.

The result is that, as a rule, in accidents of this kind, the muscles suffer to a very serious extent. Sometimes they are overstretched, and lose their power of contracting; or they are seized with cramp; or crushed and bruised; or torn from their attachments. Sometimes there is a great effusion of blood into their substance, so that they become swollen and painful, and sometimes the fascia that surrounds them is split open and they slip out of their position and become dislocated.

Dislocation of muscles.—Callender and others have shown how muscular dislocation may occur where long and slender slips lie embedded side by side among shorter and stronger ones, surrounded, and at the same time separated from each other, by fibrous tissue. In all ordinary move-

ments, carried out in an orderly fashion, with a definite object in view, the action spreads, as it were, from one muscle to the next. Very few are carried out by the contraction of a single one. Nearly all involve not only those immediately necessary, but those also by their side, which are more or less parallel in their course. The shape and consistence alter together, so that their mutual relations remain unchanged. But when contraction is sudden and spasmodic, it sometimes happens that one of these, growing instantly hard and tense, slips from its bed between the rest, tears its fibrous sheath, and becomes dislocated.

This is most common in the neck, for here the movements are rapid and extensive, while the muscles are long and slender. The head is suddenly twisted round to look in some awkward direction; there is a sudden sharp stab of pain, often causing the patient to cry out; something appears to be caught, and the head is held fixed. In a minute or two, when the acute pain has subsided, it can generally be brought nearly straight again; but it requires considerable effort, and it cannot be turned so as to face in the opposite direction, or even kept straight for long. As soon as it is allowed to assume the position of least discomfort, it bends over once more to the affected side. Careful examination in these cases sometimes shows a tender spot on the contracted side, slightly too prominent. If this corresponds in position and direction to a muscular slip, and if, when the part is manipulated, the swelling disappears, and full and painless mobility is instantaneously restored, it can hardly be doubted that the symptoms were due to the dislocation of one of these, which has slipped back into its place again. In some cases an audible snap has been heard by the patient at the moment of reduction; and, in one under my own care, an incautious movement on the part of the patient, before repair was complete, reproduced the displacement.

It is more common for the swelling to disappear gradually and for voluntary power to return by slow degrees. In these cases it is probable there is no real dislocation; the muscular fibres are either in a state of painful and spasmodic contraction, such as is common in the leg after unusual exertion, or they have been torn and strained, so that movement is painful until the injury is repaired, and the extravasated blood absorbed again.

I have never met with any similar unmistakable dislocation in the loins, though, no doubt, from the description given by Callender, its occurrence is quite possible. The patient, he narrates, was carrying a heavy weight on his shoulders, when he suddenly slipped, and, in spite of all he could do, was swung round by the momentum. The pain for the moment was intense, and though it did not continue his back remained stiff, so that he could not move with freedom. On examining the part there was one very tender spot in the muscles by the side of the spine, where a decided irregularity could be detected; this was diagnosed as a dislocation. The patient was instructed to repeat, so far as he could, the movements he went through as he fell; and while doing this firm pressure was made on the painful spot. The swelling disappeared at once; full power of movement was regained; and the stiffness completely vanished. The case was completed, and the diagnosis verified by a subsequent repetition of the accident.

In any injury of this description, even if a dislocation is not certain, it is always worth while to carry out some simple manipulation such as that described above. Whatever may be the reason, whether it relaxes spasm, or whatever it does, it is a fact that immediate relief is sometimes gained by this, though the symptoms may not be characteristic. In one case under my care there was no history of an accident at all. The patient was a young man, healthy enough himself, but of

rheumatic and gouty parentage. He had been sitting incautiously in a draught when overheated; and was attacked by muscular rheumatism. Curiously enough, however, the pain was limited to one side, and almost to one spot; had he met with an accident, I should at once have suspected the existence of a strain. In spite of the history, however, I determined to try the effect of sudden vigorous contraction, and accordingly made him sit down on a low seat, with his feet firmly pressed against the wall in front, so that the pelvis should be securely fixed. The tender spot was carefully marked, and then it was explained to him that he must stoop forward as low as possible, and at the word of command suddenly straighten himself up. One arm was placed under his chest to assist him in this, and the thumb of the other hand firmly pressed upon the tender spot. The patient carried his part out loyally, in spite of the pain, and was completely cured at the second attempt. Some pain and stiffness returned in the course of the next day, but determined extension and contraction of the muscles involved relieved him without further assistance.

It is very important in accidents of this kind to get a perfectly accurate account of the way in which it happened, and the smallest details often prove of great importance. The chief difficulty is to determine whether the seat of injury is one of the smaller joints, or a muscular slip by the side of it. Sometimes a soft and rather indefinite swelling can be made out beneath the skin; more often there is merely local tenderness, with a sensation of stiffness, or of inability to execute some particular movement, amounting in some cases, as has been already mentioned, even to a suspicion of paralysis in the patient's mind. Bruising is rarely seen, owing to the depth at which the injured part lies.

If the situation corresponds with the position and direction of some slender slip of muscle, the assistance of the patient

must be called in, and what is required of him thoroughly explained. There are two ways in which reduction may be effected; sometimes one succeeds, sometimes the other. In the first the patient is placed in an attitude that relaxes the injured part, and then, while the hand or finger is firmly pressed upon it, is made to bring it suddenly and vigorously into action. In the second, which is rather the better—for it is very difficult at once, and when suffering pain, to move the back or neck quickly in any given direction at a moment's notice—the body is placed so that the dislocated slip is put upon the stretch, and held in that position by the operator, while the patient endeavours to straighten himself up against the resistance. The muscle suddenly contracts, alters its shape and consistence, and, from the relief that is experienced afterwards, must, apparently, slip back again into its bed. Sometimes there is a sharp feeling of pain at the moment, and the preliminary stretching is always disagreeable, but the use of an anæsthetic is, of course, impossible.

Myalgia.—The most common trouble, however, after sprains of the back or neck is what is usually described as muscular rheumatism. It may be the result of unusually severe, or of unusually prolonged effort; nothing is felt at the time, or for a few hours; then, generally speaking at night, a peculiar aching sensation begins to make itself felt. The skin is often tender to the touch, especially over the points that correspond to the exit through the fascia of the cutaneous nerves; but there is no heat or redness. The tissues show no sign of bruising; steady pressure, though unpleasant at first, gives relief rather than causes pain; and, except as a result of disturbed rest and sleep, there is no fever or constitutional disturbance. There is merely a constant wearing pain, with a sensation of stiffness and want of power, that renders rest for any length of time impossible, and

entirely prevents the patient holding himself upright or moving about with freedom.

From the identity of the symptoms in these cases with those of myalgia, due to gout or rheumatism, there can be no doubt that in both there is some similar cause affecting the nutrition of the part. During contraction a much larger amount of blood flows through the muscles than during rest, and the blood vessels are dilated. After excessive work or overstrain the waste products accumulate, and fresh material to replace that which is exhausted is not supplied in sufficient quantity. Probably in those who are young and healthy this is not of material consequence; it merely causes a certain amount of muscular stiffness, which soon subsides when the part is rested; in older people and those who suffer from gout or rheumatism, the equilibrium is not restored so easily; the effects last longer, and are much more severe.

The most common situation for this is in the loins, owing to the large masses of muscle situated there, and to the way in which they are called upon for sudden exertion in lifting weights; but it may occur anywhere, even in the extremities. Wherever it is, care must be taken not to confound it with other disorders. It is not uncommon for affections, even of distant parts, to be attended by pain in various regions of the spine. To say nothing of examples which must occur to everyone, I have known the back-pain of incipient small-pox treated as lumbago, and massage has before now been vigorously applied to a case of stone in the kidney.

Local treatment is sufficient in the milder cases; but it is so common for an outbreak of some hitherto unsuspected disorder to follow a strain that constitutional measures should never be neglected. Just as an injury to the foot is often the apparent cause of the first attack of gout, so many of the muscular strains of the back owe, at any rate, their persistent character to the presence of some similar ailment.

It is for this reason that attention to diet is so necessary; and that such drugs as colchicum, iodide of potash, chloride of ammonia, the carbonates of the alkalies, and others prove so useful. Only it rarely happens that any indication as to which of these is likely to prove most beneficial can be derived from the condition of the back itself. This is only to be ascertained by inquiring into the previous history of the patient, and investigating the other symptoms that are present. In other words, local measures should be employed to relieve the pain and stiffness, and to restore the condition of the muscles as soon as possible; but it must not be forgotten that the general state of the patient in most instances needs quite as much attention.

Warmth always gives relief. The simplest method is to wring a piece of flannel out of water as hot as can be borne, or to roast it in front of a fire, and press it firmly upon the affected area, renewing it from time to time as it cools. The skin becomes red; more blood circulates through it, and probably a considerable amount is diverted from the deeper parts; the congestion is relieved for the time being; the waste products are carried away, and the stiffness diminishes. Or bags of hot sand, or salt, may be used; they retain the heat longer, and from the way in which they can be fitted into any irregularity of surface, are particularly suited to certain parts of the body. If this is not convenient, the electric brush may be tried, passing it regularly over the surface of the skin after drying it thoroughly to increase the resistance. It is probable that the benefit derived from this is due almost entirely to the influence it possesses on the blood-vessels, and not in any way to the chemical effects of the current.

Baths.—Hot water or vapour baths are almost too well known to require mention. Turkish ones also enjoy a great reputation, especially for recent cases, and among those who

are accustomed to them. For others, they must be recommended with a certain amount of caution, and the subsequent treatment in any case requires much more attention than it usually receives. At Aix, for example, the patient, after his bath, is quickly dried, wrapped in blankets, and carried in a sedan chair to his hotel. As soon as he reaches his apartment he is lifted into bed, still swathed like a mummy, covered up with additional blankets and a quilt, and left to perspire for a longer or shorter period. After twenty minutes or half an hour he is carefully rubbed down by an attendant who has accompained him from the bath. Where this is impracticable, the patient should at least be very careful not to hurry away, but to remain two or three hours if necessary, and, above all, to make sure that he is properly covered up.

In obstinate cases douche baths may be employed, conjointly with vapour baths. The patient should be seated on a wooden stool, with the feet immersed in warm water to avoid chill, and jets directed against his back in any required direction. The size of the jet must be regulated by the pressure, and by the temperature of the water; but it is rarely advisable for it to be more than a quarter of an inch in diameter, and it is always best to begin with warm water, and gradually replace it by cold. The effect is greatly enhanced by massage afterwards.

Those who have never tried these baths, or who suffer either from giddiness and a feeling of fulness in the head, or from a sensation of faintness after their use, may be recommended to take local ones with perfect safety. If the patient is in bed, a cradle may be placed over the body so as to leave a space round him, beneath the bedclothes, and the steam of a kettle introduced by means of properly-arranged tubing, taking care not to scald the legs. Where he can sit on a chair, it is more convenient to arrange a mackintosh, or, if

this is not available, a blanket, round his neck, so as to reach the floor on all sides, and then to place under the seat a spirit lamp with some boiling water. Both these methods ensure copious perspiration within a very few minutes, and possess the advantage of not affecting the patient's head or interfering with respiration. Further, there is less risk of catching cold afterwards, and aggravating or reproducing the original trouble; if the bath is taken of an evening, the patient can be placed in bed at once, and nearly always can make sure of some hours' refreshing sleep.

At Aix-les-Bains, according to Dr. Stewart, the method is more highly elaborated. When the patient is sent to have a steam bath (the Berthollet, as it is termed), he is directed to an apartment which contains a wooden box, with a round hole in the movable lid. After undressing, he steps into the box, and is shut in all but the head, the round hole being occupied by his neck. Immediately a valve on the level of the floor is opened, the hot vapour rises about him, and he soon begins to perspire freely. The perspiration running down his brow trickles from his face. Presently he feels the streams flow down his sides and legs, and very speedily a feeling of oppression and debility comes on. After ten or twenty minutes the bath is opened up, the patient carefully dried, and removed to his hotel.

Hot water baths act in the same way. The beneficial effect they exercise is almost entirely due to their temperature, and is proportionate, within limits, to the length of application. The salts that they contain, whether neutral, alkaline, or sulphuretted, are of little consequence. If they exist in certain degrees of concentration, they stimulate the cutaneous circulation, but that is all. For this reason peat or mud baths are, as a rule, more efficacious. The one feature common to all bathing establishments which enjoy a high repute is the temperature of the water, and pro-

bably the benefit derived from the use of the baths (as distinguished from a sojourn at the place) is mainly due to this.

Friction, either with the hand or with a flesh brush, is very grateful in these cases. The direction should be upwards, towards the head, and the strokes light and rapid. The effect is, to a certain extent, the same as that of heat; there is a temporary contraction of the vessels near the surface, followed by a more lasting dilatation and more rapid circulation of the blood. It possesses, however, in addition, considerable influence on the nerves of sensation, and it is not improbable that it is felt even more widely than this would imply. At least, it is difficult to explain on other grounds the power of allaying some forms of nervous excitement and inducing sleep which steady friction along the back undoubtedly possesses.

Stimulating liniments, containing camphor, ammonia, or turpentine, may be usefully employed in conjunction with either friction or heat. Sprinkling a few drops of turpentine on the heated flannel before applying it is generally sufficient, or some of the liniment may be rubbed in with the hand. This acts as a counter-irritant, temporarily withdrawing the blood from the deeper parts towards the surface, and where the stiffness and pain have lasted some time is more effectual than either heat or friction by itself. If the tenderness is limited to one or two spots, and especially if these correspond to the places where the nerves perforate the fascia, blistering fluid, painted on once or twice, according to the thickness of the skin, answers better still.

In exceptional cases more powerful applications, even the actual cautery, may be used. How these act is not clear; they may merely withdraw blood from the deeper parts, or they may act in some way through the nervous system; for there is little doubt that certain organs are always in definite

nervous relation with parts of the surface of the body, and are affected when these are in any way stimulated. However this may be, there is no question that sometimes this agent may be employed in relieving deep-seated pain, especially about the bones, with conspicuous success.

When the skin feels sore and tender after a sprain, the essential or aromatic oils often give great relief. Many of the quack remedies employed to soothe pain, even the deep-seated pain of acute gout, owe what merit they possess almost entirely to these. A favourite application in Germany, known as Hoffmann's balsam of life, consists of an alcoholic solution of balsam of Peru and seven of these aromatic oils mingled together. They may be either painted on the skin, and left exposed, or dissolved in spirit in various proportions, and covered over with oiled silk to prevent too rapid evaporation. Menthol is one of the most convenient, and acts especially well when mixed with camphor or croton-chloral, so as to form a thick oily liquid. Probably in this instance, too, the relief is in no small measure due to the effect produced upon the cutaneous nerves.

Anodynes.—In certain cases minute quantities of morphia, belladonna, or veratria may be combined with these. It must, however, be remembered that if chloroform is used as a solvent, a considerable amount may be absorbed through the skin, particularly if friction is used at the same time, and that in spite of the comparative thickness of the cutaneous covering of the back and the paucity of sebaceous glands. Belladonna plasters, which are recommended by some, not only share with all other plasters the objection of being dirty, but have the additional disadvantage of sometimes causing an acute attack of eczema.

The hypodermic injection of anodynes, such as morphia, may occasionally be necessary, but it is always as well to postpone this until all other remedies have been exhausted.

The very ease with which it gets rid of the pain is its greatest danger. It rarely cures the complaint, though it gives a temporary sensation of comfort, and is only too likely to be required again before many hours are past.

Ironing.—Besides these there are other remedies—ironing, for example—which are especially suited to deep-seated and large muscular masses, such as exist on either side of the spine in the loins. The patient should lie in bed, rather on his face, with the body supported by pillows in as comfortable a position as possible, and should turn from side to side as occasion requires. A well-warmed piece of flannel (great stress is laid by some on its being unwashed) is then stretched over the affected part, and the muscles on either side of the backbone thoroughly ironed in all directions with an iron as hot as can be borne, using considerable pressure at the same time. The best for this purpose are those of rather small size, with the edges and angles well rounded off, so that they may be pressed into all the depressions between the bones without causing pain.

Acupuncture, again, though it is rarely employed nowadays, and seems, like bleeding, to have gone out of fashion, is at times very efficient in removing chronic muscular pain. How it acts is not thoroughly explained. Ordinary long darning needles answer very well. They are simply thrust through the skin deep into the muscles, and withdrawn again after a few minutes. If the plan is successful they leave behind a bright red areola, which varies considerably in size and duration in different cases, and probably is dependent on the condition of the nerves that are stimulated. The pain is exceedingly slight, especially if the thrusts are made firmly and rapidly, and the punctures scarcely bleed.

Galvanism is very successful in removing muscular stiffness after cold or injury. The skin should be well sponged over with warm salt and water to prevent irritation, and a stationary current employed, reversing the direction occasionally. The electrode applied over the muscle should be of large size (a zinc plate covered over with leather, well moistened, answers as well as anything, as it may be cut or bent to any shape), and the current used of proportionate strength. Then, before leaving off, a smaller electrode may be substituted, and passed over the whole of the surface with a weaker current (if possible in an ascending direction) so as to secure its refreshing action and remove any sensation of fatigue. The sittings should not last longer than five or ten minutes, and it will generally be found that every other day is sufficient, especially if kneading or ironing is used on the alternate ones.

Massage, if thoroughly carried out, is more successful still. Its action is most refreshing and invigorating. Under its influence the aching and stiffness disappear, the blood circulates more freely through the muscles, the waste products are carried away, nutrition improves, and strength and voluntary power begin to return at once. It seems to possess the same restorative influence over the deeper structures that friction has upon the skin.

Percussion and kneading are both recommended. The former is the easier, and does not require so much skill or experience; but it only affects superficial parts, and is altogether of more limited application. The ulnar side of the hand may be used, or an instrument which bears a general resemblance to a hammer, with a stem of whalebone to secure elasticity, and a head faced with rubber. With this, held very lightly, the whole of the stiff and painful part of the back is thoroughly percussed, the number of strokes rising

to as many as three or four hundred in the minute, until the skin begins to glow.

Kneading is of greater service, but requires practice before the full benefit can be obtained. The object is to compress and relax alternately the deeper-lying muscles, and to squeeze their contents onwards, so as to ensure a more rapid flow of blood and lymph through the substance. Consequently the movement must be regular, definite in direction, and well ordered.

A muscle at rest receives an exceedingly small quantity of blood, compared to that which flows through it when it is contracting. So long as it is doing no work, the lymph which fills all the interstices is almost stagnant; the fibres are very slow in getting rid of their waste, and in receiving a fresh supply. As soon as the muscle begins to act, the vessels dilate, the current of blood is quickened, the lymph is driven on at a much faster rate, and the nutrition improves beyond all measure. This is helped to no slight extent by the alteration in the shape of the muscles. These are incased in a comparatively unyielding fibrous sheath, differing in strength and density in different places. The lymph collects underneath this, filling up all the clefts and spaces left between the fibres. Each time the muscle contracts it compresses some of these, and causes others to dilate, so that it alternately sucks and drives the fluid on. And, as a matter of fact, it is well known that the flow of lymph, as well as that of blood, through the substance of a muscle, increases immensely as soon as it begins to work.

Massage aims at imitating this. Its object is by rolling and kneading the muscles to increase the flow of blood and lymph through them, get rid of the accumulated waste, and stimulate nutrition by supplying fresh material in larger quantity. If carried out thoroughly it is certain to give relief,

but it is not a thing to be undertaken rashly, without previous training and without some knowledge of anatomy. Massage and rubbing are not synonymous terms.

Supposing the lumbar region to be affected, the patient must be placed upon a couch of convenient height and well supported from underneath by cushions, so that the muscles of the loin may stand out beneath the skin without being contracted. The operator should stand over him, at a suitable distance, so that his movements are not cramped; and then with both hands, moving one after the other, knead and squeeze the muscles, first on one side and then on the other, rolling them, as it were, away from the middle line, and pressing them onwards and upwards towards the head. The whole hand must be used, the fingers, as it were, being insinuated as far as possible under and between the groups of muscle, the skin being allowed to glide to a certain extent over the structures beneath. Then if there is any very painful spot left, the muscles may be grasped with the hands and firmly kneaded with the thumbs, moving them round and round in small circles, intersecting each other over it so as to knead and squeeze the structures round it from all sides.

The pressure should be gentle at first, and then gradually become firmer and firmer. No liniment or oily substance can be used, as it weakens the grasp of the hands and tends to defeat the object of the manipulation. If it is desired it may be rubbed in afterwards. The rate of movement must vary with the thickness and depth of the tissues to be manipulated, and with the amount of pressure used. Within reasonable limits, the slower the better. There is a great tendency on the part of many, who are supposed to practise massage, to use much too much force, and to make all the movements too rapid. Five minutes, as a rule, is sufficient for a sitting, though it is often beneficial to apply an ascending constant

current to the muscles for a minute or two more afterwards. It answers better to repeat the manipulation later on in the day than to continue too long at one time. The golden rule is never to fatigue the patient, or to produce the least degree of tenderness or bruising. Those who have not had much experience or a thorough training are very apt to overdo it.

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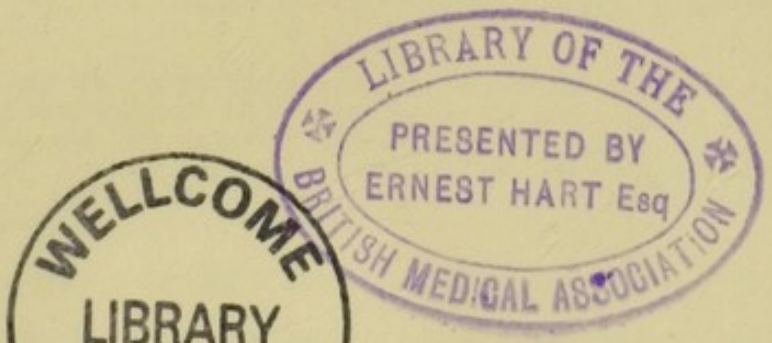

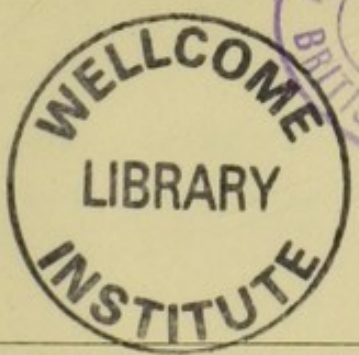

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