every appearance of being malignant. It cut like an unripe pear; it retracted and hollowed on section; on scraping with the knife it gave the well known "cry of a cancer." Cancer I thought it to be, and proceeded to do a radical operation.

The mass was sent to the pathologist, and the husband was told what we had found, what we feared, and what had been done. He was also informed that the other breast would have to be treated in the same way.

There was a delay in receiving the report from the pathologist, but as the case was so obvious one did not give the matter a second thought. What was my surprise, therefore, the evening before the second operation had been arranged for, to get word from the pathologist that the mass was an old fibro-adenoma. The news was at once communicated to the patient and her friends. The next day a circumferential incision was made and the growth removed from the remaining breast. On cutting this across, exactly the same typical carcinomatous appearance presented itself. An experienced surgeon of high standing who was present gave it as his opinion that the mass was undoubtedly carcinoma, although I had purposely told him my previous mistake. We were now in a quandary; there was this tissue in my hand presenting to the eye every known appearance of carcinoma. Should we perform a radical operation or be content with the partial one, relying on the experience we had gained from the other breast? Would we get the same verdict from the pathologist as in the other breast? We had promised the patient that we were only going to do quite a partial operation. Should we have to come later and inform her that the pathologist's report required us to do a larger one? It was a very difficult position. I decided to close my eyes to the naked-eye appearances, to shut my ears to the surgical advice of our friend, and be content with a partial operation.

Fortunately, the pathologist returned again the same verdict as in the case of the other breast—that it was an old fibro-adenoma.

These cases have been quoted to show that, though radical investigation must be urged on patients at an early stage, there are yet many pitfalls for the unwary, and the very greatest care is necessary to arrive at a correct diagnosis.

MINOR TRAUMATIC DISABILITIES OF THE UPPER LIMB.*

BY

P. JENNER VERRALL, F.R.C.S.,

SURGEON, MINISTRY OF PENSIONS HOSPITAL, SHEPHERD'S BUSH; CHIEF ASSISTANT, ORTHOPAEDIC DEPARTMENT, ST. BARTHOLOMEW'S HOSPITAL.

I HAVE used the word "minor" to exclude fractures, dislocations, and gross lesions of the vessels and nerves, but in a way it is a misnomer, as the disability caused by a fracture or a dislocation, though more complete at the time, is often more easily repaired, and as it is regarded by both patient and practitioner in a more serious light more care is taken in the after-treatment and re-education of the limb in order to ensure a perfect result. The greater disability caused by comparatively minor lesions of the upper limb as compared with similar lesions of the lower limb is, to my mind, explicable by the finer adjustment of the neuro-muscular mechanism and more sensitive connexion between brain and periphery found in the former. Unless we are professional dancers or something akin, we do not ask our legs to perform very intricate movements, and the sensation is not so acute. We are content if our legs will bear our weight and carry us along. Good evidence of this sensibility is seen in the behaviour of amputation stumps. It is quite rare to find in leg stumps what we call "pain of central origin," whereas an upper arm stump is frequently the seat of great pain, for which no local cause can be found, and on which no artificial limb has ever been worn. Bulbous nerve ends may have been excised again and again, even up to the plexus above the clavicle, and yet the pain continues. Even posterior root section often fails to relieve the pain, proving conclusively that the pain is of central origin, and a very long period must elapse before the cortical cells give up their hopeless struggle for activity. The only hope lies in active occupation of mind and body, thus diverting the nervous impulses into new channels and relieving the tension in the now useless mechanism.

I desire to call attention to the extreme importance of the presence of septic foci in other parts of the body in the conversion of a minor strain into an intractable disability. As common septic sources I would put in order of frequency the teeth (root absorption, abscess, and generalized pyorrhoëa), the tonsils (especially in younger subjects), the colon (chronic colon bacillus infection), the uterus or prostate, and the nasal sinuses. Unless these sources of infection are cleared up the

treatment of a minor lesion may prove wellnigh impossible. When these underlying causes have been excluded, the question of diagnosis turns on, first, the history of the injury—that is to say, the precise action that the patient was performing at the time symptoms first appeared; secondly, a diligent search for a spot tender on pressure; with these must be combined accurate knowledge of the structures underlying that spot; thirdly, the limb must be put systematically through its normal movements in order, noting by which of them pain is produced and whether or no pressure on the tender spot during the performance of these movements relieves the pain or not.

The vast majority of minor traumatic disabilities in the shoulder region are due to adhesions in or around the joint, the movements most frequently affected being those of abduction and external rotation. The shoulder is a simple joint, unstable in itself, and depending for its stability with the help of its own ligaments on the interaction of a complicated musculature surrounding it; its capsule is weak in all parts and actually lax beneath the joint at the apex of the axilla. Acute simple traumatic bursitis of the subdeltoid bursa is a condition described in the textbooks and frequently diagnosed, owing to the fact that tenderness is elicited below the end of the acromion process, but in my opinion it only rarely occurs. The source of trouble is much more frequently either strain of a muscular attachment or adhesions. With other more serious forms of subdeltoid bursitis we are of course familiar—such as tuberculous, gouty, or calcareous bursitis—and I would regard definite swelling in the situation of the subdeltoid bursa as an indication for taking a more serious view of the case, or at any rate for obtaining a skiagram of the shoulder.

As to adhesions, we must understand how these come about and how they can be diagnosed. We will assume that there is no clinical sign of a gross lesion and that the skiagram (if one has been taken) shows a normal joint. First we must exclude active arthritis, which may be present although the skiagram shows a normal joint. Pain and limitation of movement in all directions indicate arthritis. Sir Robert Jones expresses the matter well when he says that if there is limitation of movement in all directions there is probably arthritis; if even one movement is free there is probably none.¹ The point is important, as the treatment of the two conditions is diametrically opposed—rest for active arthritis, movement for adhesions. Adhesions commonly give rise to pain and limitation of movement in one or more directions, but not in all, and come on fairly soon after the accident. Sir Robert Jones also calls attention to a condition which he terms "confusion of joint cartilage," such as may occur from a fall on the outstretched hand, pain and limitation of movement coming on gradually about a fortnight after the injury and being due to a process of repair in the damaged and bruised cartilage during which there is vascularization of the injured area. We have here the phenomena of an aseptic inflammation, and the treatment is determined by this. If due rest be given, the symptoms clear up, but if movement be allowed or forced at this stage, the recovering cartilage is further injured and recovery is delayed. However, the later history of such cases may well be that of "adhesions." As long as there are visual signs of active inflammation in the neighbourhood and of a definite arthritis, so long must we employ rest and soothing applications. When, however, this stage has passed we may allow movement without forcing it—that is to say, active movement, but not passive. Passive movement, apart from the full mobilization of a joint under an anaesthetic, is of very limited utility, and the temptation to employ it, although very great, should be firmly resisted. This applies to all joints. Assisted active movement should commonly take the place of true passive movement in the treatment of all joint lesions. If active movement is allowed and inflammation has passed, the movement of the joint should steadily increase in range. If it does not and the range begins to lessen, inflammation is still present and a further period of rest is indicated. If the range increases steadily with active use of the joint, let well alone. If it remains stationary, especially if the limitation of movement is in one or two directions only, the joint should be mobilized under an anaesthetic. It is commonly said that gas does not give sufficient muscular relaxation, but I maintain that with gas properly administered adequate relaxation can be obtained for the mobilization of all joints, with the possible exception of the hip. Under the anaesthetic all the normal movements of the joint should be carried through to the full extent,

* Abridged from an address delivered to the annual meeting of the Essex Division of the British Medical Association July, 1922.

systematically and in order, and care should be taken to control both sides of the joint and to protect bones from fracture—by splinting if necessary. Active controlled exercises and massage should follow either on the same day or on the next day if much trauma to the joint has been produced by the operation. The correct principles of mobilization are not new, and are well recognized by orthopaedic surgeons, but are less well recognized by others, and failure to realize them permits patients to have recourse to less orthodox ways in order to obtain correct treatment. There is one more condition which, to the best of my knowledge, has not previously been described, but is not very rare. Owing to long continued strain of the arm in a person unaccustomed to great exertion, abduction of the shoulder becomes limited in extent when an attempt is made to perform it with the arm in the coronal plane. If, however, the arm is brought forward, a painful snap is felt (or even heard) over the front of the joint, and the arm can then be freely abducted. I have recently been investigating this condition, and ascribe it to a slipping to and fro of the short tendon of the biceps over the lesser tuberosity of the humerus and the subscapularis tendon, which immediately underlie it. I thought that possibly there might be a bursa in this situation, but I have examined some twenty subjects in the dissecting room and have found no trace of a bursa. I think the condition is purely mechanical, and the results of treatment confirm this view; ordinary treatment fails entirely to produce a cure, but if the elbow be flexed and the arm brought well forward by a sling so as to relax the biceps, and a pad be strapped in place over the short tendon of the biceps just exterior to the coracoid process, cure is certain in two to three weeks.

It is in the elbow that we find the commonest injuries. Golf, tennis, and cricket have each of them their characteristic strains. Flexors and pronators from the inner condyle, extensors and supinators from the outer, are liable to strain in turn, and it is the key to comprehension of these injuries to realize that excessive tension of a muscle is felt at its origin no less than at its insertion. The pathology of such injuries is usually as follows: a few fibres are torn off from their bony origin, the periosteum is raised, and there is haemorrhage both subperiosteally and into the interstices of the muscle fibres with all the ensuing phenomena of inflammation and fibrous tissue formation, possibly aggravated, as I have already mentioned, by the presence of some septic focus elsewhere in the body. In addition to these muscular lesions the elbow-joint or superior radio-ulnar joint may be the seat of traumatic arthritis, or of adhesions; the diagnosis and treatment are on the same lines as those already indicated for the shoulder.

The commonest muscle to be injured is the flexor carpi ulnaris. Although a flexor of the wrist the most important action of this muscle is a restraining one, preventing undue abduction of the hand, and it is commonly injured in returning forehand a hard drive at tennis or in removing a large and rocky divot from the ground at golf. Pain is felt over the inner condyle at the time, but the game can usually be finished, and it is not until evening that the arm stiffens—that is to say, not until the haemorrhagic infiltration of the injured area is considerable. If immediate treatment be applied cure is usually rapid, but this is rarely possible, as we are not consulted soon enough. If opportunity occurs, a firm pad placed over the injured spot and strapped on will limit effusion and immobilize the muscle. The arm should be rested in a sling, if possible. Massage at this stage is unnecessary and may do harm.

The common tennis elbow is usually caused by a back-hand stroke. Its onset is similar to that of strain of the flexor carpi ulnaris, and pain is felt over the origins of the brachioradialis and radial extensors. The exact pathology of this lesion has long been in doubt. Probably in the majority of cases it is due, like other similar accidents, to muscle rupture, and can be treated as such; but in April, 1921, Osgood² of Boston described his own personal experience and gave a review of the literature, which is very instructive. After describing the mode of onset he notes the common symptoms of a sudden unexpected sensation of weakness and pain running down the forearm, leading the patient to drop objects; he notes also that the pain and the tenderness differ in severity with different positions of the forearm; but this is to be expected whatever the causation. The same applies to the slight swelling and increased feeling of elasticity, which he also mentions. X-ray appearances are negative, as was to be expected. He gives the various theories of etiology that

have been advanced: (1) tearing of muscular origins; (2) periosteal injury and periostitis; (3) post-influenzal periostitis; (4) injury to radio-humeral capsule; (5) arthritis of the radio-humeral joint. Unquestionably all of these occur and are responsible for the symptoms in certain cases; in my opinion the first two are those commonly to blame. He goes on to describe his own condition, which I have not seen, or at any rate have not verified, but which is well worthy of attention. He was treated in the usual way without permanent benefit. Dissection was made to see if a bursa were commonly present in this situation, and such a bursa was found beneath the conjoined tendon over the radio-humeral joint. An operation was performed on him under local anaesthesia, and an extremely sensitive area was found with outlines of a dirty greyish-white, but with no distinct sac. This was removed and found to be chronic inflammatory tissue. This operation cured him, and subsequent dissection showed the bursa present in seven consecutive elbows examined.

Dr. Osgood has performed a very useful service in calling attention to the presence of this bursa and its tendency to inflammation; but we frequently meet with inflamed bursae, and it is not always necessary to dissect them out. If we make use of appropriate non-operative methods, and pay attention to the possibility of septic foci elsewhere in the body, and remember, with thanks to Dr. Osgood, the possible existence of the bursa he describes, we may reserve excision of the inflamed area for extremely chronic and refractory cases in the same way as with cases of prepatellar bursitis which resisted treatment by other means.

In golf the pronator radii teres muscle comes into action to a degree not commonly realized, particularly in mashie, and niblick shots out of bad ground, in the performance of which obviously forcible pronation causes the club to bite into the ground. I have never seen strain of this muscle of any great severity, but I can well imagine it occurring in a not over-muscular player.

In the treatment of cases which have had no early treatment or are refractory, but in which for the time at least there is no question of any operative measures, all septic foci must first be sought for and adequately treated until the toxic output has entirely ceased. Secondly, complete rest to the part must be obtained. The guide to correct treatment lies in an accurate knowledge of the functions of the injured muscle; the limb must be fixed in a position which relaxes the injured muscle while allowing as full play as possible to the uninjured ones. This is not always easy, but it is unsound treatment to limit the function of a limb more than can be avoided, as the muscles will require re-education and strengthening later. There is no method so good as a carefully applied plaster case or a plaster splint, which has the advantage that it is removable and therefore permits of massage. Where massage is unobtainable, or there is doubt that the patient will continue to wear the splint when not under the eye of the medical man, it is better to apply a plaster case for about six weeks, and rely on functional activity of the arm to restore use and power after its removal. By massage we seek to remove the effete products of inflammation and to loosen the limiting fibrous tissue that has formed. The affected area is moderately tender, though not as tender as it was when first injured. Massage to the required spot should be deep and vibratory and performed with the hand and not with a mechanical vibrator with an insensitive surface and of a force difficult to control. The pain produced should be little or absent, and the force of the pressure and vibrations should increase *pari passu* with the relief of the patient and the diminished sensation of resistance to the fingers. At the same time conservative centripetal massage should be given to the other muscles in order to keep up their tone and circulation, and controlled exercises given to these other muscles in such a manner as not to strain the injured part. This principle of relaxation applies to nearly all the minor injuries of which I am speaking; the essential point is to know exactly what position produces relaxation. The rest is easy.

In strains of the origin of the flexor carpi ulnaris the ulnar nerve is often thickened and tender and displaced or displaceable forwards even to the front of the internal condyle. Associated with this may be definite symptoms of ulnar neuritis, pain and tingling in the little and ring fingers, and so forth. The degree of mobility of the ulnar nerve in this region varies considerably under normal conditions. I have not been able quite to make up my mind whether these are cases of injury to an abnormally mobile nerve or whether the nerve is actually loosened by the injury, for abnormally

mobile nerves do not give rise to any symptoms. I am inclined to think that the injury loosens the nerve and also causes a traumatic neuritis; the nerve passes under a fibrous arch from which a certain number of the fibres of the flexor carpi ulnaris actually arise, and which may well be broken, thus liberating the nerve. This is a most painful condition, however it arises; it is treated initially by placing a soft wool pad behind the condyle and strapping it in place. In old-standing cases I have no hesitation in operating. The nerve is cut down on behind the condyle and either transplanted definitely to the front of the condyle and sutured into a bed made for it in the flexor muscles, or fixed back into its normal position by a strip of periosteum turned down from the humerus. Either of these proceedings will cure the condition, as the neuritis rapidly subsides when the nerve is no longer subject to recurrent injury.

The ligaments round the elbow, with the exception of the orbicular ligament, are of comparatively slight importance, and the trouble here is rarely ligamentous in origin. Similar muscle strains to those mentioned above occur in the insertions of the biceps, brachialis anticus, and triceps, and can be easily diagnosed by the situation of the tenderness and the pain on movement; they are readily treated on the same lines by relaxation of the damaged muscle. It is rarely necessary to suture the ruptured tendon. Bursitis of the bursa around the insertion of the biceps also occurs, but is not deserving of any special mention.

Partial or complete rupture of a muscle belly, such as the biceps, should be treated by complete relaxation of the muscle, and two pads strapped in position so as to approximate the divided ends and limit effusion. Union is always by fibrous tissue, and some degree of permanent impairment of function must always be anticipated, the degree depending on the extent of the injury. While massage may be employed as soon as the initial inflammation passes off, no movement of the muscle should be allowed until repair is complete. Suture of a muscle belly is, in my opinion, useless, as the union being by fibrous tissue only, the muscle degenerates, and either a fresh rupture occurs or the fibrous tissue stretches when any great strain is put upon it. Where rupture has taken place, either through tendon or, more commonly, at the junction of tendon and muscle belly, open operation for repair by suture and careful after-treatment hold out good prospects of cure and should always be attempted.

In the neighbourhood of the wrist, where there are many tendons lubricated by a complicated system of tendon sheaths, teno-synovitis is naturally common. Perhaps the commonest site is along the tendons of the extensor communis digitorum. Simple teno-synovitis is caused by strain or excessive use of a tendon; the sheaths and parts around become inflamed and the lubrication defective. To treat such a condition by counter-irritation with iodine while permitting the full use of the tendons is like pouring water over an overheated car engine while allowing it to continue running with insufficient oil. This much used simple remedy will only cure the slightest cases, and is not really economical in time. If teno-synovitis of the extensor tendons be treated for a few days by complete rest of the fingers on a long cock-up splint and either counter-irritation or cooling lotions be applied, cure will really be more rapid; if the finger extensors alone are affected, it is not necessary to include the thumb, and thus the hand is not entirely disabled during treatment. Teno-synovitis thus treated will soon subside, but there is a special form which is particularly obstinate. It occurs in people—mainly women—who either play the piano very frequently or who have frequent need in their occupation to span the hand widely, as in the movement of playing an octave or grasping a large object in one hand. The symptoms are absolutely characteristic. There is a general sensation of weakness in the hand and pain and tenderness on pressure over the deep groove on the back of the radius, in which the tendon of the extensor longus pollicis runs, and along the tendons of the flexor and extensor carpi ulnaris. As may be readily noted on one's own hand, these two latter are synergic muscles in abduction of the thumb, preventing the abduction of the whole hand at the same time as the thumb. It may be worth mentioning that, as I wrote in the BRITISH MEDICAL JOURNAL³ some years ago, in such patients as these the deep groove of the extensor longus pollicis may be converted into a narrow canal by overgrowth of bone and thick fibrous tissue. To such an extent may this occur that I have twice been compelled to operate to free the tendon and flatten out the groove by chiselling away bone. The results of operation were absolutely successful, and it can quite easily be done

under a local anaesthetic. In the milder form of this condition, rest from piano playing and the avoidance of all actions which necessitate a wide grasp, such as holding a large vase, supplemented perhaps by wearing a wrist strap for a time, may suffice to cure, but I have found it necessary on some occasions to fix the wrist and hand in plaster with thumb abducted and hand deflected to the ulnar side for six weeks. This, being a much more drastic performance, has, in addition, a curative effect upon the functional element which is usually present in these cases, leading the patient to complain greatly of what cannot be a very severe pain.

To the prevalent custom of wearing a wrist-strap more or less permanently after a strain in the region of the wrist I have no objection, provided the patient be encouraged to dispense with the strap as much and as soon as possible, or at least to wear it only when engaged in some laborious work or sport. The strap gives a comfortable feeling of support, supplements the annular ligaments, and at the same time limits and controls the movements of the tendons as they pass through them, thus making a useful transition stage between absolute fixation and free movement. An elastic knee-cap, on the other hand, has a permanently constricting effect on the underlying vasti muscles, on which a large part of the lateral stability of the knee depends, and produces wasting and weakness of them, owing to inhibition of their blood supply and limitation of their activity. It is quite otherwise with the wrist, for the simple reason that in the wrist, with the exception of the pronator quadratus which lies deeply and the lower part of the flexor carpi ulnaris, there is no acting muscle to constrict and only a collection of practically avascular tendons.

Another disability that I would mention is mallet-finger, about which a series of letters appeared recently in the BRITISH MEDICAL JOURNAL; it is due to a rupture, partial or complete, of the extensor tendon on the dorsum of the last interphalangeal joint. It arises from a blow on the end of the finger, as in an ineffectual attempt to catch a cricket ball, and is often neglected in the early stages. The finger should be kept straight for three weeks on a straight palmar metal gutter splint. At the end of this time, if the rupture has been incomplete, the patient will be able to extend the joint voluntarily. If not, the tendon must have been completely torn, and an open operation for suture of the tendon, followed by splinting, is the only method that will suffice. In old-standing cases the structures on the flexor aspect may be so contracted that the finger cannot be straightened, and the question of amputation of the distal phalanx will arise.

Disabilities of the hand I propose to treat in a somewhat general manner, with more reference to general principles than to detail, as it is obviously impossible to cover every possible lesion. If we leave out such developed functions as piano playing, the functions of the hand may well be described as only two, grasping objects and picking up objects, and it is these two functions which we must endeavour to restore after injury. Apart from gross destruction of the hand or nerve injuries, the actual division of tendons and the after-results of cellulitis claim our chief attention. Owing probably to the greater complexity of their tendon sheaths, repair after suture is much less satisfactory in flexor than in extensor tendons, and although suture of cut finger flexors should always be carefully performed, when both flexor tendons of a finger are divided, a most guarded prognosis should always be given as to the subsequent utility of the finger; in manual labourers the hand is often more useful without the damaged finger than handicapped by a useless digit that impedes the action of its fellows. I do not, however, wish to be unduly pessimistic, as it is often possible to obtain a good result by careful after-treatment. Suture of extensor tendons is always promising, and even when there has been such a loss of tendon length that end-to-end suture is impossible, grafts of fascia lata are usually successful. I will say nothing of the immediate treatment of septic hands and fingers, except that acute inflammation is an indication for rest, and that too early movement should be avoided, as recovery of function is not hastened, but hindered thereby.

In order to be able to grasp an object satisfactorily flexion of at least two fingers is necessary, the possession of a thumb advisable but not essential, and a wrist capable of dorsiflexion essential if the grip is to be a strong one; for a good grip of a round object the preservation of the form and mobility of the transverse arches of the hand is of prime importance, and therefore the physiotherapy or, if necessary,

the operative interference with the metacarpal joints must not be neglected. The due mobility of these transverse arches is also of importance in picking up objects, as without it, although opposition of the thumb may be free and unimpaired, the thumb cannot reach farther than the middle finger, and the fourth and fifth fingers cannot be used in conjunction with it. Abduction and opposition of the thumb are easily lost after septic wounds of the palm. If opposition is defective a band of adhesive strapping round the hand, keeping the thumb in opposition and preserving the palmar arches, reapplied as progress is made and the band loosens, is quite effective. For deficiency in abduction a series of small plaster splints moulded to the first interdigital space will gradually restore function.

Fingers may become stiff from a variety of causes, but assuming them to be potentially mobile and useful—that is to say, that all the structures essential to their mobility are present—their restoration to function is a purely mechanical problem. In dealing with the problem elsewhere¹ I described certain methods of treatment by metal splints and plaster that I had devised. I still use these methods and find them effective, but others have published other devices equally good, and the principles involved are in the main identical. If a masseuse move a stiff finger to and fro repeatedly, resistance is induced, often unnecessary pain, and a certain amount of reactionary inflammation. Should massage alone without mechanical aid be employed, the hand should have a preliminary bath treatment, preferably paraffin, and the massage immediately after should be confined to a single movement of the affected joint in each direction to the full extent possible without pain; the patient should then be encouraged and re-educated in active movements. I strongly disapprove of forcible mobilization of stiff fingers under an anaesthetic; though applicable to other joints, this method is not satisfactory for the fingers, and more gradual methods are indicated. The classification and the principles of treatment I advocate are as follows:

A. Fingers flexed when wrist is dorsiflexed, extension possible with wrist flexed. This, the type of ischaemic contraction due to shortening of flexor tendons, is best treated by Sir Robert Jones's method, the joints being straightened serially, beginning distally, leaving each joint in the deformed position until all the joints distal to it have been corrected, and retaining that correction by continued splinting, ending up with dorsiflexion of the wrist.

B. Wrist movement free, one or more fingers flexed at all three joints, contraction unaffected by position of wrist. One must aim at obtaining extension without losing flexion. I employ a metal splint extending beyond the fingers and terminating in a bar, fixed to the hand by plaster. To the affected fingers loops of adhesive plaster are fixed and tapes are tied between these and the bar. By gradual tightening of these tapes extension is obtained, but every day the tapes are released and the finger is brought back to its original flexed position and the tape then retied. There is then no loss of flexion; should this be noticed, extension is being carried out too rapidly and one must call a halt.

C. Free movement at the metacarpo-phalangeal joint, distal joints flexed. Gradual straightening on metal palmar gutter splints will suffice, flexion being preserved by daily movements, as before.

D. Metacarpo-phalangeal joints stiff in hyperextension, distal joints straight or slightly flexed. The important principle in treatment consists in getting the metacarpo-phalangeal joints to pass the dead point or straight line position. For this condition I use an ordinary short cock-up splint (which keeps the wrist dorsiflexed) with attached to it a quadrilateral wire loop springing from its palmar surface at the wrist and extending to the level of the metacarpal extremities. To this the fingers are flexed by tapes; daily movement as before.

These methods exert very great force, but can be graduated to a nicety; correction is gradual and gives no pain, and the range of movement is never lost. Tape traction is better than elastic, as there is no tendency on the part of the patient to resist it. Finally, employment of the hand, at first in gymnastic exercises and later in actual work, will put the finishing touches on the treatment.

REFERENCES.

- ¹ Sir Robert Jones: *Injuries to Joints*. Oxford War Primers. ² Robert B. Osgood: *Radio-humeral Bursitis, Epicondylitis, Epicondylalgia (Tennis Elbow)*. ³ An Abnormality of the Tendon Grooves of the Radius, *BRITISH MEDICAL JOURNAL*, May 10th, 1919. ⁴ Stiff Fingers, with Special Reference to Methods of Treatment by Metal and Plaster Splints, *Journal of Orthop. Surgery*, June, 1919.

THE DOSAGE OF RADIUM.

BY

DAWSON TURNER, M.D. EDIN.,

IN CHARGE OF THE RADIUM TREATMENT AT EDINBURGH ROYAL INFIRMARY.

THE duration of the application is a most important element in radium treatment, and it is one which there may be a tendency to overlook in institutions where large quantities of radium are available. Consider, for an example, a dose of 500 mg. hours, which would be a fair dose to administer to a small rodent ulcer. This dose might be given by 10 mg. of radium for fifty hours, or by 50 mg. for ten hours, or by 500 mg. for one hour. Does anyone contend that similar effects would be produced in each case? I have no hesitation in making the affirmation, based upon an experience of twenty years, that for each case there is a certain optimum combination of milligrams and of hours, and that this question is one for the radium expert to decide. Levin and Joseph,¹ from an experimental study of the influence of radiations on the development and growth of the crown gall on plants, have shown that the primary effect of radium or x-ray radiations consists in the inhibition of the proliferating power of the cancer cells and not in their direct destruction. The crown gall, tumour-like formation on plants is so called because the growth frequently appears where stem and root join (called the crown). It is due to a parasite and can be induced artificially by inoculating a plant with an agar culture of the micro-organism. Plants were inoculated by these observers and some were submitted to radiation and some kept as controls; the control plants developed large crown galls, the others none or stunted growths containing true tumour cells. Cancer cells go through a cycle of (1) youth, (2) maturity, (3) old age. At one time they are actively dividing and at another they are not, and it has been shown that they are more susceptible to radiations when their nuclei are dividing than when they are in any other stage. In certain stages they may be as immune as normal tissues.

The lesson to be learned from a consideration of these facts is that in order that the dose of radium may be effectual it must be applied for a certain time, for it is only by a prolonged application that we can make fairly sure of catching all the cancer cells in their susceptible stage. We may therefore conclude that small amounts of radium for prolonged periods are more likely to prove beneficial than large amounts for short periods. The oven may be too hot and the bread will be burned on the outside instead of being baked throughout.

To take another point: suppose one possesses 100 mg. of radium, in what quantities is it best to put it up into tubes? The answer depends mainly upon the nature of the diseased condition to be attacked, upon its situation, its area, its volume, and upon whether the radium is to be applied externally or buried in the growth. Take the case of a lymphosarcoma—perhaps the most susceptible of all growths to radium—of the size of a large orange; in this case it would be best to have the radium put up in 5 or 10 mg. portions in separate tubes, so that they could be distributed throughout the mass, and particularly arranged like sentinels around the borders of the growth, for in this way the central parts will be receiving cross-fire radiation from all the tubes, but the peripheral parts will only get efficient radiation from the peripherally placed tube which happens to be nearest. In order that the whole of a growth may be efficiently and uniformly radiated the radium should theoretically be uniformly distributed throughout it—in fact, the desideratum would be to scatter radium like pepper from a pepper pot throughout the mass. Though this is for several reasons impracticable yet the more nearly we can approach to it the better. Dr. Stevenson's needles are a means to this end. Small tubes are filled with the radium emanation and are enclosed in hypodermic needles for embedding in the neoplasm. There is a disadvantage which applies to all cases in which the emanation is used, owing to its steady loss of strength—namely, that the dosage is not known unless the tubes have been tested for their emanation strength before being employed and unless a table of their rate of decay be consulted. As the time element in radium treatment, as I have endeavoured to show, is important, emanation tubes have the disadvantage that they would have to be replaced from time to time by freshly charged ones. Where the application is external this would be easily done, but in