the medium of the balloon? In my day at Bethlem patients were taken out in brakes, and future students will no doubt see them depart in air-ships.

I would say, let as many recent and curable cases of insanity as possible be treated in mental wards attached to hospitals in our great cities; and since hospital authorities would relieve asylum authorities of part of their responsibilities, a mutually advantageous arrangement might be made whereby those usually delightful sanatoriums—the county asylums—might, in addition to their other functions, be usefully employed as convalescent homes for mental cases drafted from the hospitals.

The last Blue Book shows that the yearly average number of cases, exclusive of cases of congenital insanity, in which the attack was stated to be the first in persons admitted to county and borough asylums in England and Wales during the five years 1899–1903 was 12,495. Of this number, if the figures for 1904 be taken, some 3,360 were admitted to London County Asylums, leaving 9,135 cases of first attack to be dealt with in the provinces. Supposing as many as nine of the hospitals in London having medical schools attached should maintain each a ward for mental diseases, with associated out-patient department, of fifty beds. Each bed would on an average suffice for three patients in a year, so that 1,350 recent cases could be dealt with in London yearly. This would amount to between one-third and one-half of the occurring yearly insanity in London. As regards the provinces, if eight large towns having, or likely to have, medical schools attached to their infirmaries, could similarly provide fifty beds, 1,200 mental cases could be dealt with yearly. This is between one-eighth and one-seventh of the occurring yearly insanity in the provinces, and therefore, a very small proportion indeed. But even these proportions would, with our voluntary system of support of hospitals, be very difficult, more likely absolutely impossible, to provide for. I shall not allow myself to diverge into the question of the support of hospitals, but I will say that the voluntary hospital system, like the voluntary military systems, is inefficient; that I see no reason why the charitable principle of voluntary support should not co-exist with the principle of compulsory support.

My remarks have been confined to the question of the cure of insanity; that of prophylaxis, except in regard to the prevention of relapse, has not been referred to. In considering prophylaxis in its individual and racial aspects we are naturally brought face to face with the problems of heredity. It is true that in a very large proportion of asylum cases there is a history of insanity or allied neuroses in the ascendants, but the proper significance of this fact will not be brought out until we have statistics as to the proportion of persons who, with like inheritance, nevertheless do not need asylum treatment and care; nay, it may even be are not otherwise than sane in the ordinary acceptance of that term. Next would come the inquiry as to how, by virtue of what precautions or conditions, they remain sane. As regards racial prophylaxis, if one may first of all digress for a moment, we are told by our mentors, the newspapers and politicians, that public opinion in this country is not ripe for considering the question of compulsory military service. There is, I venture to think, a proposition for the consideration of which it is still less ripe—I mean that for the sterilization of the insane and defective classes. On such a subject he would be a bold man who should venture to hustle public opinion, or shock the consciences of His Majesty's good lieges. Far be it from me to assume such responsibilities.

But I have come to the conclusion that it is time an attempt were made to arouse public opinion to the importance of putting into force the less radical procedure of forbidding, under severe penalties, of marriage to persons released from asylums; and of infliction of like penalties in all cases in which the responsibility for illegitimate procreation amongst such can be fixed. I observe that quite recently, at a meeting of public men in Lancashire, at which the growing burden of the support of the insane of that county, together with the evils attendant upon the discharge of patients recovered from asylums, was considered, it was resolved to request the Government to institute an inquiry into the whole question of the growth and prevention of insanity. What Lancashire thinks to-day England thinks to-morrow is the gist of an old saying, and I trust it may come true in the present instance.

SOME PRINCIPLES OF THE TREATMENT OF FRACTURES.*

By J. EDWARD BOWSER, M.B., C.M.,

PRESIDENT OF THE BORDER COUNTIES BRANCH, PENRITH.

[AFTER some introductory remarks, Dr. Bowser proceeded:]

To the man who has the misfortune to break one of the chief bones of his body nothing can be more important than the successful cure of his injury. The fate of that man is in the hands of his surgeon. The reputation of the surgeon is almost as closely bound up with the issue of the case.

The man in the street may have considerable difficulty in forming an opinion of the work of the surgeon who practises his art in the innermost recesses of the body, but he has no hesitation in coming to a prompt conclusion when the unfortunate victim of a fall on the previous winter's ice is seen, in the clear light of the summer sun, painfully limping through the market place, with an ankle-joint stiffened by adhesions or with one leg some inches shorter than the other.

The surgeon who occupies himself with the treatment of fractures has in these days, however, to encounter still more searching criticism. For now the skiagraphist, armed with Crookes tube and fluoroscope, throws his penetrating ray upon the very seat of injury, and points out with relentless finger the smallest deviation from the ideal osseous form. Giving substance to the shadow, he prints a permanent record of the shortcomings of the surgeon's art.

The Border Counties Branch is essentially a general practitioners' Branch, and, in districts like ours, the majority of cases of fracture come under the care of men in general practice. Yet I believe the treatment of fractures has never, certainly not in recent years, been the subject of an address or discussion at any meeting of this Branch.

It is, perhaps, no wonder that there are rivals in the field. Irregular practitioners continue to flourish in the Branch area. The Cumberland bonesetter enjoys a local reputation which is by no means confined to the less instructed members of the community. I have even heard that a Scottish professor of the art has recently raided the border city itself in quest of bones to mend. The survival of this form of irregular practice in our midst is a reproach to modern surgery.

Furthermore, during recent years important modifications have been introduced into the treatment of fractures. These new developments have taken place along two distinct and divergent lines.

The first of these consists in the early employment of massage and movement, and in a less absolute adherence to the traditional methods of immobilization.

The second line of development consists in the application of operative measures to ordinary cases of simple fracture.

The general use of the *x* rays has also introduced new factors, which demand most careful study, into the consideration of these questions.

These, then, are the reasons that have led me to think that the treatment of fractures might usefully form the subject of our consideration to-day.

It is to the first of the lines of development to which I have just referred that I wish especially to direct your attention: the early use of massage and movement and the less exclusive reliance upon the traditional methods of immobilization by means of rigid apparatus.

These modifications of treatment are due to the teaching and practice of the distinguished French surgeon, M. Lucas-Championnière. It may be interesting to recall that M. Lucas-Championnière was one of Lister's early disciples at Glasgow in 1868, and subsequently became the pioneer of antiseptic surgery in France. He contributed an eloquent panegyric of the master to the Lister Jubilee Number of the JOURNAL in 1902. Those of you who were present at the fourth centenary celebrations of the Edinburgh College in July last year, will remember that M. Lucas-Championnière then received in person the Honorary Fellowship of the college, and in April of this year a

* Presidential address delivered at Carlisle before the Border Counties Branch of the British Medical Association, June 29th, 1906.

similar honour was conferred upon him by the College of Surgeons of England.

M. Lucas-Championnière was the first to introduce early massage into the treatment of fractures. It is to him that I owe anything of value in this address. For this reason and for his personal kindness to myself I desire to record my deep obligations to M. Lucas-Championnière.

Similar methods of treatment have been carried out in London with great success by Sir William Bennett, whose teaching has been mainly instrumental in bringing about the adoption of these methods in English practice. Mr. Wallace of Edinburgh demonstrated a number of successful cases treated in this way at the annual clinical meeting of the Edinburgh Branch in February last. These new methods, though largely adopted, are still treated by most English and American writers as accessory rather than fundamental. But it is clear that they involve a reconsideration of that fundamental principle of the treatment of fractures—the principle of immobilization—a principle which has been long accepted and taught in the schools, and has, indeed, been regarded as unassailable.

By immobilization we mean the uninterrupted retention, by means of rigid apparatus, of the broken fragments of the bone, and of the neighbouring joints, in a fixed and immovable position, until firm bony union has taken place. When immobilization is spoken of in this address let me ask you to bear in mind this extended definition of the term.

Erichsen, the author in vogue when I was a student, in the eighth edition of his work on *Surgery*, published in 1884, prefaces his remarks on the treatment of fractures as follows:

The treatment of a simple fracture is a very simple business. All that the surgeon has to do is to place the fragments in proper position and in good apposition, and to retain them there. Nature does the rest. In no way can the surgeon accelerate the processes or improve upon them. By meddling treatment he may do much to retard and to disturb them.

This doctrine of *laissez-faire* very fairly represents the teaching of the majority of surgeons prior to 1895, and the influence of that teaching survives in some degree to the present day.

The conception of prolonged immobilization as the dominant principle in the treatment of fractures was probably arrived at by a too exclusive attention to the solution of continuity of the bone, and a neglect of the associated injuries of the soft parts—injuries due partly to the original traumatism, but also in large measure to the treatment employed.

This conception was impressed upon the student at an early period of his curriculum. In his course of systematic surgery he was introduced to the subject of fractures by means of a study of museum specimens and drawings of fractured bones. His attention was concentrated on the various bony displacements and deformities, the insufficiency or exuberance of callus, the success or failure of osseous repair. He saw nothing of the lesions of the soft parts, the persistent oedema, the atrophied and adherent muscles, the stiffened joints, the general insufficiency of the limb for its function of prehension or locomotion.

Even in the hospital the student saw little of the functional disabilities entailed by the old methods of treatment, for that treatment too frequently came to an end with the removal of the splints, and the patient was discharged, to recover, slowly and painfully, as he best could, the full use of his limb. The modern use of the *x* rays favours this one-sided view of the phenomena of fractures, for it demonstrates the condition of the bones, but can tell us nothing of that of the surrounding tissues. The public speak of a broken arm or leg, the surgeon of a fractured humerus or tibia. The surgeon's language is more exact, the popular term perhaps more truly comprehensive.

The mechanical ingenuity of generations of surgeons has been lavishly expended in devising splints and apparatus more or less complicated for the treatment of fractures—and the cry is still they come.

The special treatises on fractures which have appeared for the first time or in new editions during the last two years, such as those of Stimson and Scudder in America,

and Hennequin and Loewy in France, abound in illustrations of such apparatus. In Hennequin's book there are no less than sixteen illustrations from photographic process blocks, showing in dramatic sequence the various stages of the application of the author's plaster splint for fractures of the humerus.

For every kind of fracture of every bone in the body there is a varied and extensive choice of apparatus of immobilization. This variety of method itself suggests some imperfection of principle.

Is, then, immobilization the one all-important and absolutely essential condition for the successful treatment of fractures? Is it necessary in every case alike, and must it be maintained without interruption until bony union is complete? Does it entail any hurtful consequences which might be avoided by some other method of treatment? Above all, does it afford the best condition for the full recovery of the function of the limb?

It may be said at once that absolute immobility is not essential to bony repair.

The extremities of a broken rib unite rapidly and perfectly in spite of the incessant respiratory movements. This takes place not only in simple fractures but also in resections where there is actual loss of substance, as in excision of a portion of the rib for empyema.

The same phenomena are observed in fractures of the clavicle, in which reduction is often incomplete and deformity frequent, and in which none of the numerous rival methods of treatment can claim to secure absolute immobility, and yet failure of bony union is exceedingly rare.

On the contrary, in fractures of the bones of the cranial vault, where the fragments are perfectly immovable, it has been pointed out by Sir William Bennett that specimens of non-union can be found in every museum.

In fractures of the long bones treated by simple extension, without splints, immobility of the fragments does not exist, and yet sound union occurs. In Hennequin's method of treatment of fracture of the femur by extension, the thigh alone is placed in a wire gutter with the knee flexed, and the patient is allowed to sit up in bed from the beginning of the treatment. There is perfect freedom of movement of the knee and hip-joints, and yet some of the leading surgeons of France consider that this method of treatment gives better results than any other.

The older authors themselves, while insisting on the necessity for immobilization, were accustomed in cases of non-union, to recommend that the broken extremities of the bone should be freely and forcibly rubbed against one another.

Many fractured bones have united in a satisfactory manner without any formal treatment at all, either because the fractures escaped recognition or because they occurred in localities where surgical aid was unobtainable. It has even been said in regard to Colles's fracture, which was formerly regarded as a sprain of the wrist, that it would have been much better for the patients had Colles never demonstrated that in these cases a fracture really existed, so unfavourable have been the results of immobilization.

These observations in man are confirmed by comparative pathology. M. Cany, a veterinary professor of Paris, has pointed out that certain fractures in the dog cannot be treated by apparatus, but unite perfectly well, without deformity, if the dog is kept shut up in a narrow space and thus prevented from running and jumping about.

My distinguished predecessor in the presidential chair, Sir James Crichton-Browne, contributed, in a letter to the *Spectator* of October 14th last, an observation which opportunely illustrates this point. The letter is as follows:

To the Editor of the "Spectator."

Sir,—When we were living at Whitehill, Colvend, in the autumn of 1881, a tortoise-shell kitten, from a neighbouring cottage, became a paying guest, spending most of its time with us, amply requiting by its pretty ways the tit-bits and petting bestowed on it. It was a good mouser and hunter, and in one of its expeditions after big game—rabbits—had the femur of its left hind leg fractured about the middle of the shaft, either by a stone thrown at it, or by a trap or tumble. It came home limping painfully, dragging the leg, and for a couple of days was restless, and evidently suffered much.

At that time it discovered for itself that the easiest position was to lie on a soft-cushioned ottoman or window seat; with the injured leg hanging over the edge. This position it then adopted, and habitually maintained for three weeks. The

weight of the limb produced the necessary extension, and union took place in the most satisfactory way without shortening.

(Signed) JAMES CRICHTON-BROWNE.

It is probable that Sir James was more interested in the psychological than in the surgical aspect of this case, but I am none the less fortunate in being able to adduce the evidence of an unimpeachable witness in support of my argument.

Immobilization in some form is necessary to secure union in cases of marked displacement of the fragments where the displacement tends to be reproduced after reduction. But if union does not take place in these cases without immobilization it is because the ends of the bone are removed from one another, not because a slight degree of movement takes place at the seat of fracture. It is the fact of displacement, not the fact of mobility, that interferes with union.

The fear of displacement has been, however, exaggerated. In many fractures, after accurate reduction, and with simple precautions, the tendency to displacement is not so great as has been supposed.

The fleshy bellies and the tendons of the muscles form a sleeve-like splint, which surrounds the bone and tends to keep it in position. The strong fascia and connective tissue of the limb plays a similar part. The insertions of the muscles, fascia, and ligaments into the bones assist in holding the fragments in place.

The periosteum is rarely completely ruptured all round the bone. In most cases, as was first pointed out by Ollier, its continuity is preserved on one side, forming the so-called periosteal bridge, which unites the two fragments, lessens the tendency to displacement, and takes an important part in the subsequent repair. Many x-ray photographs show a growth of bone taking place along this periosteal bridge.

In impacted fractures where it is undesirable for any reason to reduce the impaction there is, of course, no tendency to further displacement; and in some fractures where actual impaction has not taken place the dentated shape of the bone is an obstacle to further displacement.

In certain cases, as we have seen, immobilization is required in order to prevent displacement. Experience, however, has shown that, even in these cases, the length of time during which immobilization is necessary may with advantage be materially shortened. The tendency to displacement becomes less as the date of the traumatism becomes more remote, and for our purposes may be disregarded long before bony union is complete.

Does immobilization entail any hurtful consequences? A long list of pains and disabilities can readily be brought forward in answer to this question.

It would, perhaps, be unfair to adduce gangrene of the limb as one of the results of immobilization. Yet, no doubt, those surgeons who have had the misfortune to be responsible for such a dire catastrophe applied their splints and bandages with the best intentions, and the disaster that befell them was directly due to an excess of zeal for this doctrine of immobilization.

Though gangrene is happily rare, unfavourable consequences of a lesser degree are of common occurrence. Indeed, they are to be seen to some extent in every case of fracture which has been kept in splints in the old fashioned way for six or eight weeks.

Wasting of the muscles, stiffness of the joints, weakness of the limb, and pain on attempting movement, are the usual phenomena to be observed on the removal of the splints.

As Sir James Paget said, these are the cases that bone-setters cure. As a rule these conditions can be ultimately overcome by prolonged massage and movement, or by forcible manipulation under anaesthesia. But often the full use of the limb is never completely regained. Indeed, both surgeons and patients appear to be somewhat easily satisfied that a certain amount of permanent disability is the inevitable result of a fracture.

In reality, these disabilities are due not to the fracture, but to the treatment. Are they not the result of the obsession of the surgeon, who, beset by the idea of the exact restitution of morphological symmetry, is blind to the concurrent deterioration of the physiological value of the limb? To seek, at all costs, an exact restitution of form is often to strive for an unattainable and illusory

ideal, while sacrificing the true object of treatment—the complete restoration of function.

In many fractures no apparatus, however rigid, can be applied firmly enough to maintain perfect position of the fragments. The mechanism of retention cannot act directly on the bone itself. It can only act through the medium of the soft parts, which by their nature are unfitted to sustain without injury the required amount of pressure. The results of immobilization in the restitution of form are consequently relative and not absolute. This may be seen in any series of radiographs of united fractures, as, for example, those published recently by the New Sydenham Society. To take one case out of many there given, Plate 5 in Fasciculus 19 is a radiograph of a case of Colles's fracture which received very careful and systematic treatment at one of the largest London hospitals. The fracture was twice carefully reduced—once under chloroform, and was immobilized first in a plaster-of-paris case, and subsequently in wooden splints. "At the end of thirteen weeks of well-skilled treatment," says the author of the accompanying description, "the usual deformity remained conspicuous, and in addition the wrist and fingers were much stiffened." The radiograph shows the deformity to be well marked.

The belief in the harmlessness, and, indeed, beneficence, of prolonged rest received a powerful impetus during the latter half of the nineteenth century from the teaching of Mr. Hilton. That surgeon, in his classical work on *Rest and Pain*, specially emphasized the value of rest in local injuries.

He makes, however, some important admissions. "It is possible," he says, "and may be probable, that a temporary alteration and a diminished elasticity of articular cartilage may occur"—as a result of prolonged rest—"that the ligaments may become feeble, and the synovial membrane unmindful of its duties," "that the bones may lose their firmness, and the muscles their strength from disuse"; "but such deteriorations," he concludes, "are only temporary."

The fear of irreparable injury to the structures of a joint by long-continued rest Hilton held to be essentially unfounded, and in support of his opinion he describes the celebrated case of the "Chinese lady's foot," in which the articular surfaces were perfectly entire and healthy, even to microscopical examination, in spite of lifelong immobilization. It may, perhaps, be asked, What was the physiological value of these microscopically-perfect joints? Were they not convincing illustrations of the inutility of mere morphological perfection?

For the rest, the swing of the pendulum is not a phenomenon confined to the political world. At the foot of the same page which contains Hilton's doctrine of the harmlessness of immobilization of joints, Mr. Jacobson, the editor of the eighth edition, quotes a number of observations by Sir James Paget, Mr. Butlin, and M. Teissier of Lyons, in which intra-articular adhesions, fibrous ankylosis, erosions of cartilage, and various other injuries to the joint structures had resulted from the long-continued immobilization of joints previously healthy.

In Germany the same phenomena have been observed experimentally in animals.

Sir William Bennett, however, believes that the pain and stiffness that so frequently result from prolonged immobilization are nearly always due to the matting and adhesion of the soft parts at the seat of fracture rather than to intra-articular alterations, or, as some have supposed, to bony deformities.

He dissected a leg in which a fracture of both bones 3 in. above the ankle had occurred two months previously. The fracture was firmly united in fairly good position. The ankle joint was fixed and immovable, though itself healthy. The anterior tibial muscle was firmly adherent to the bone. The muscles and tendons at the posterior aspect of the fracture were also intimately adherent to the bone by a mass of cicatricial tissue in which the posterior tibial nerve was imbedded and could only be liberated by careful dissection. When the adhesions had been divided the ankle joint could be freely and easily bent.

Muscular wasting from disuse is a constant result of immobilization, and is a cause of weakness and functional impotence which may persist for a long time.

Associated with the atrophy of the muscles there is a

concurrent and consequent atrophy of the bones. We know from the study of development that in all animals the size, strength, and solidity of the bones are in direct proportion to the volume and power of the muscles attached to them. I have already quoted Hilton's admission that the bones may lose their firmness, as well as the muscles their strength, from disuse. The truth is that the bone, the muscle, the motor nerve, the nerve centre itself, are differentiated parts of one organ of motion. Lesions of one induce lesions of the other, and our therapeutical measures should take account of them all.

Mobility is the pre-eminent function of the limbs. How can conditions carefully planned for the purpose of rendering movement impossible be the best conditions for the restoration of that function? If such were the case it might well follow, as Mr. Wharton Hood pertinently says, that the discipline of an Indian fakir would form a suitable preparation for the calling of an acrobat. So long ago as the year 1841 Mathias Mayor, a celebrated surgeon of Lausanne, wrote:

Is it not repugnant to good sense and enlightened reason to admit that it is necessary to give every possible care and attention to injuries of the soft parts when they exist alone, but that, on the contrary, the same lesions may with impunity be entirely ignored when complicated with injuries of the subjacent bones?

We have seen that many serious evils result from immobilization in fractures. The extent to which these evils exist is difficult to determine. Statistics show that the results of treatment leave much to be desired. Professor Helferich of Kiel gives the following statistics of the results of treatment of fractures of the thigh:

Out of 121 cases of fracture of the shaft of the femur 34 per cent. were completely cured in the sense that the patient was again able to work. The average duration of time before a cure was obtained was thirteen and a half months. Sixty-six per cent. remained permanently damaged. Out of 19 cases of fracture of the neck of the femur 12 per cent. died, 12 per cent. were cured, 76 per cent. sustained permanent damage.

"The causes of these unfavourable results are to be sought," says Helferich, "in the following:

- "Displacement of fragments,
- Stiffness of the neighbouring joints,
- Sometimes hypertrophy of callus,
- Delayed union,
- Pressure on nerves,
- Persistent pain,
- Oedema of the limb."

But he gives us no assistance in determining which of these causes are most frequently in operation.

"These facts," continues Helferich, "emphasize the teaching that the details of treatment are all-important in the ultimate result. The fate of the patient rests in the hands of the surgeon."

Early massage and movement enable us to avoid many of the unfavourable results of immobilization, and this method constitutes the best treatment for the repair of the fracture and for the restoration of the function of the limb.

It is not my purpose to describe the details of the application of these methods. Time would not permit it. They are fully described for each fracture by M. Lucas-Championnière in his work, *Traitement des Fractures par le Massage et la Mobilisation*, published in 1895, and by his pupil and assistant, Dr. Dagrón, in his treatise, *Massage des Membres*, published last year.

It is necessary, however, to say that the massage employed differs entirely from that of the professional masseurs. It consists in a soft, smooth, uniform, above all painless, mobile pressure in the direction of the venous current. At first little more than a caress, the degree of pressure is progressively increased so as to act gradually upon the deeper structures. Ordinarily, massage is practised from the very beginning of the treatment, and repeated daily in *séances* of half an hour's duration.

Massage prepares the way for movement. After massage, passive movements of the joints, which before had been impossible on account of the pain that they caused, become surprisingly easy. They are, therefore, always practised at the end of the *séance* of massage.

These movements, whether passive or active, are necessarily of slight extent, being limited by two imperative

conditions—they must be painless, and they must not cause new displacements of the bony fragments.

Active and passive movements may be usefully combined, the voluntary movements of the patient being guided and controlled by the hand of the surgeon.

During all these manipulations, both of massage and movement, the limb, and especially the seat of fracture, is carefully supported upon a cushion, or by an assistant, or by the disengaged hand of the surgeon.

What are the results we seek to obtain by massage and movement in the treatment of fractures?

The first and most striking result of massage is the relief of pain. This is prompt and decided to a degree that is almost incredible until one has verified it for oneself. Sir William Bennett gives several examples, of which I quote one: He saw the patient at St. George's Hospital on the third day after a comminuted fracture of the femur at the middle of the shaft. The limb was tense, swollen and discoloured, the patient shrieking with pain. Sleep had been impossible for three days. Massage was applied by Bennett. The pain was at once alleviated and ceased altogether in fifteen minutes. While the massage was still going on the patient fell into a sound sleep. The explanation of this analgesic action is probably complex. The tension of the limb is diminished by the mechanical unloading of the tissues. The spasmodic contraction of the muscles is relaxed. There is probably also some reflex action on the nerves.

The influence of massage in relaxing muscular spasm is clearly shown by an observation of Dr. Dagrón of Paris, who, at the Hôtel-Dieu, has several times seen dislocations of the shoulder become spontaneously reduced while the muscles of the region were being massaged. The action of massage in relieving pain is a sufficient justification in itself for the adoption of this method of treatment.

Massage not only removes pain, but also swelling. This is the mechanical action of massage.

The swelling at the site of a recent fracture is due to the extravasation of blood from the fractured extremities of the bone and from the lacerated vessels in the neighbourhood, the escape of lymph from the torn lymph vessels and spaces, the vascular engorgement, and the serous effusion.

This swelling rapidly disappears during massage. The volume of the limb is diminished, the tension relieved, absorption hastened, and the normal circulation restored. As the swelling diminishes the limb becomes supple, the joints lose their stiffness, and movement is facilitated. Secondary oedema is prevented.

Massage and movement prevent adhesions, and maintain the flexibility of the joints. Adhesions between adjacent structures, bone, muscles, tendons, and tendon sheaths do not form, because the so-called plastic lymph which gives rise to them is removed by massage, and the immobility that permits their formation is obviated by daily movement.

Muscular atrophy no longer occurs when massage and movement are employed. The intramuscular circulation is maintained, tissue metabolism is promoted, tonicity and contractility are preserved.

Though massage and passive movement favour these desirable results, it is probable that voluntary movement is still more useful in preventing muscular atrophy, inasmuch as it excites the natural functional activity of the different associated parts of the motor apparatus—the muscle, the nerve, the nerve centre. Even the higher volitional centres are thereby exercised, and this may be advantageous in the case of patients whose sensory functions are more highly developed than their will-power.

Voluntary contraction of the muscles, apart from designed movement, has been advocated as a means of physical culture. It is said that muscular development is thereby promoted to a greater degree than by ordinary gymnastic exercises.

This form of muscular exercise may be usefully employed in the treatment of fractures, movement of the broken extremities being prevented either by the simultaneous contraction of opposing muscular groups, or by the support of the surgeon's hand. It may be practised by the patient while the limb is in splints. Kocher of Berne recommends this form of exercise for certain fractures treated by extension, in his work on *Fractures of the Humerus and Femur*.

The intimate effect of massage upon contused muscles and nerves has been studied experimentally by M. Castex of Paris. He subjected dogs to double and symmetrical traumatizations of the limbs—fractures, sprains, and contusions. One side was massed by a specialist, the other left to spontaneous repair. After some months the dogs were killed, and the traumatized parts examined microscopically by independent histologists, thus eliminating the personal equation. The results were published in the *Archives Générales de Médecine* (1891). The drawings there reproduced show very clearly the following lesions in the muscles not massed:

1. Fibrillation of the muscular fibres.
2. Hyperplasia of the connective tissue, with an increase in the number of nuclei.
3. Interstitial haemorrhages.
4. Engorgement of the blood vessels, with thickening of the outer coat.

The microscopical appearances of the muscles that had been subjected to massage were normal in every respect. Similar phenomena were revealed by the examination of the nerves, but in addition the nerve fibres were compressed by the connective-tissue hyperplasia in the non-massaged limb.

M. Gourewitch of St. Petersburg has carried out a series of experiments on rabbits with analogous results. He produced symmetrical fractures of both fore-limbs, one of which was massaged, the other immobilized. In the massaged limb muscular atrophy was prevented, and bony union took place more firmly and more quickly than in the immobilized limb. These observations are reproduced by Dr. Guermonprez of Lille in his book, *Etudes sur le Traitement des Fractures des Membres*, published during the present year in Paris.

That massage and movement favour osseous repair is confirmed by clinical observation. It is to be accounted for by the removal of the haematoma from the seat of fracture, by the early restoration of the circulation, and by consequence of the nutrition of the limb, and by the stimulating effect upon the formation of callus of the slight movements at the seat of fracture.

Massage shortens the duration of treatment. This is a great practical advantage. Many of the factors we have already considered conduce to it. The chief factor, however, is the condition of the nerves, muscles, and joints of the limb at the moment when bony union is complete. Instead of being crippled by immobilization, they are fit and ready for immediate use. Bennett estimates that the time that requires to elapse before a patient is permitted to resume his ordinary occupation is diminished by at least one-third.

Massage and movement may be employed with advantage in the majority of the cases of fracture. Extreme mobility of the bony fragments or the existence of displacements capable of being reproduced are contraindications to the employment of massage and movement, at least as immediate treatment. But the amount of consolidation necessary to ensure us against these secondary displacements is obtained more quickly than is generally admitted, and both movement and massage may be resumed at an early date with every prospect of success.

The treatment of fractures by the methods of M. Lucas-Championnière has been adopted by certain surgeons in almost every European country, and the published results are sufficiently numerous to place the value of the treatment beyond doubt.

The majority of modern writers admit its efficacy as an accessory method, though sometimes not without an *arrière-pensée* for the time-honoured doctrine of immobilization.

It has been my object in this address to contrast the two methods of treatment which we have been considering. It may be asked whether these two methods are really incompatible with one another—whether it is possible to secure the benefits and at the same time avoid the risks of both.

Uninterrupted immobilization, as defined at the outset of these remarks, is obviously impossible where massage and movement are employed.

But the use of simple means to avoid displacement may usefully be combined with massage and movement—the retentive apparatus being usually removed and replaced daily. Complicated apparatus should be avoided. Extension by weight and pulley and the placing of the

limb in such a position that the muscles are relaxed and the long fragment brought into line with the short one are useful principles applicable to many fractures.

Whatever apparatus is employed should be discontinued at an earlier period than was formerly the practice. Mr. Watson Cheyne, in his *Manual of Surgical Treatment*, 1900, in the course of a judicious appreciation of these methods, writes that while not prepared entirely to discard splints, he is "inclined to think that massage and movement may be largely associated with their use, not only without any risk to the union, but actually with great advantage to the patient."

For ourselves, in our treatment of fractures, while giving due care and attention to the passive organs of motion—the bones—let us not forget the higher physiological value of the active organs—the muscles and nerves.

Let us bear in mind the aphorism inscribed by M. Lucas-Championnière on the title-page of his book, "Le mouvement c'est la vie," and his further comment, "Immobilization is the beginning of death."

NOTE CONCERNING THE BACTERIOSCOPIC ANALYSIS OF EXCREMENTAL POLLUTION.

By E. KLEIN, M.D., F.R.S.

IN the bacterioscopic analysis of shellfish, water, and other materials polluted with excremental matters the MacConkey medium (sodium taurocholate, peptone, glucose, litmus, water) in Durham fermentation tubes is admittedly of advantage, since it allows the free development of *B. coli communis* and other coli-like microbes, whereas it exerts a certain restraining influence on some other microbes. It is now admitted, I think, what I have for many years (since 1895) insisted on—namely, that in judging of excremental pollution the *B. coli communis* or the typical *B. coli* is that species to which our attention should be particularly directed in the analysis, for while we know that this particular species is the typical microbe of sewage and excremental matters the distribution and derivation of other kinds of coli-like microbes is still more or less undetermined. Unfortunately the MacConkey medium makes no selection between typical and atypical *B. coli*, nor does it exclude a number of other microbes capable of producing acid and fermenting glucose, amongst these notably some liquefying microbes present in shellfish as also in other materials.

It is well known that one of the principal differential characters of *B. coli communis* is its power to ferment lactose, a character not possessed by many species of coli-like microbes, which are, nevertheless, possessed of the power of fermenting glucose. This character of lactose fermentation could, therefore, be used at once in the preliminary tests for *B. coli communis* if we substitute glucose for the lactose in the ordinary MacConkey medium; by this a distinct simplifying of the analysis could be achieved. I have put this proposition to the experimental test. Ordinary MacConkey medium (that is, containing glucose) and MacConkey fluid with lactose, instead of glucose, were inoculated in parallel series with high dilutions of sewage, of human faecal matter, with the fluid of shellfish (oysters, cockles, winkles) derived from polluted layings, as also of shellfish (oysters) from clean layings. The results were highly satisfactory, for whenever the lactose MacConkey tubes showed in 24 to 48 hours' incubation at 37° C. redness and gas, subsequent subcultures in the differential media proved the presence of the typical *B. coli communis*, whereas in a considerable number of instances after redness and gas in the glucose, that is, ordinary MacConkey tubes, subsequent subcultures failed to denote the typical *B. coli*—that is, the *B. coli* which changes neutral red broth from cherry colour into fluorescent green, which bubbles ordinary nutrient gelatine, which causes redness in and coagulation of litmus milk, which produces indol in ordinary broth, which on Drigalski-Conradi medium produces at 37° C. in 24 hours largish red colonies with red halo, and which at 37° C. in 24 to 48 hours produces acid and gas in litmus lactose peptone water. In those instances in which the lactose MacConkey tubes remain unchanged, or become bleached and without gas, it may be taken for certain that the *B. coli communis* is not present, although in the parallel ordinary MacConkey tubes redness and gas had been produced.