MASSAGE AND REMEDIAL EXERCISES

IN MEDICAL AND SURGICAL CONDITIONS

BY

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ILLUSTRATED

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TO MY MOTHER

WHO HAS ALWAYS TAKEN SO MUCH INTEREST

IN ITS PROGRESS THIS

BOOK IS DEDICATED

PREFACE

SOME years ago it occurred to me that although there were many excellent books on massage and exercises, there was none that was quite suitable as a text-book for senior students, for those recently qualified, or for junior teachers in training for the Chartered Society's examination. There were various good elementary text-books, and there were advanced works like Dr. Mennell's *Massage: its Principles and Practice*; but the former type did not seem to me to contain sufficient information for students preparing for the Conjoint Examination, while, in order to profit by the latter, a far more extensive background of knowledge and experience was necessary than would be possessed by any medical gymnast at the beginning of her career. It was in the hope of in some measure supplying this want that the present work was written.

The book makes no claim to originality. It has been my object merely to give an account of various modern methods of treatment, and to indicate, as far as possible, where further information about them can be obtained. At the same time I have personally tested most of these forms of treatment.

The exercises suggested are gathered from many sources—often forgotten sources. It is impossible in a work of this kind to avoid mentioning many of the well-known movements first classified and named by Dr. Arvedson, or by Ling, Ostrom, and other Swedish or Danish specialists. Other exercises have been seen at gymnastic displays or demonstrations at many different times and places. A certain number I have worked out myself, though even those I have 'invented' may, as likely as not, have been 'invented' before. I must, however, offer my very grateful thanks to Miss Angove and her staff at Guy's Hospital for all I learnt while working under her, as well as for the experience I was able to gain in the treatment of heart and lung conditions.

I have made little or no attempt to describe special massage manipulations, partly because the illustrations necessary to make such description effective would have taken up more space than could be spared, and partly because this has already been done most fully and beautifully by Dr. Mennell in his book on massage, as well as in other works on the subject. I have been careful to use only such terms as are contained in the Society's syllabus, or such as would be understood by

every medical gymnast. When advising *passive movements*, I have tried in every case to make it quite clear whether *relaxed* movements (the only *true* passive movements) or *forced* movements are to be used, since the term 'passive movement' has been a fruitful source of misunderstanding in the past.

In describing the various treatments, I have paid considerably more attention to some subjects than to others. My aim has been, in fact, to provide most details where other books provided least. I have, for instance, given fairly full notes on the treatment of fractures, and have tried to suggest approximate dates on which to begin the movements, guided by my own experience and that of others, and by the study of the works of many authorities. As regards other conditions—scoliosis, for example—almost too much information is available. It is impossible even to summarize all the different systems of treatment. In such cases, therefore, I have tried to point out the general principles on which treatment should be based, leaving my readers to work these out in practice, with the assistance of the lectures and demonstrations which the C.S.M.M.G. is so generous in providing for its members.

I wish to take this opportunity of expressing my most grateful thanks to all those from whom, directly or indirectly, I have learned so much in the past—those under whom, or with whom, I have worked at different times, and all the authors from whose works I have derived such valuable information. These are too numerous to mention individually. I should like, however, to express my sense of obligation to Dr. Arvedson, on whose system I was trained; and to Dr. Mennell, whose books and lectures have been as great a help to me as they have doubtless been to hundreds of my fellow-workers.

My thanks are also due to Miss Prosser, Sister-in-Charge of the Massage Department at the Middlesex Hospital, for very kindly reading the book in manuscript, and for many valuable suggestions; also to the Rev. G. W. Hart, C.R., for help in correcting proofs; and to my sister, Mrs. Panton, for the line drawings for *Figs.* 126, 127, and 128.

Special acknowledgement is due to Miss Coleman for her invaluable help in preparing the photographic illustrations of the exercises. These were all taken as moving pictures, and, after the whole film had been seen on the screen, the positions which gave the best idea of each exercise were chosen for reproduction. It was thus possible to obtain an effect of movement and activity, as well as, in some cases, of actual muscle action, which would have been impossible in ordinary 'still' photographs. Thanks to Miss Coleman's assistance, and the most successful work of the British Instructional Film Company, I hope these illustrations may be of real value.

Finally, I have to thank all those who have so kindly allowed the use of illustrations from their books : Messrs. John Wright & Sons Ltd. for permission to use *Figs.* 2, 3, 5, 8, 18, 22, 85, 93, 112, 115, 118, 124 (from Hey Groves' *Synopsis of Surgery*) ; *Figs.* 4, 15 (from the same author's *Modern Methods of Treating Fractures*) ; *Figs.* 69, 104, 141 (from Miller's *Medical Diseases of Children*) ; *Figs.* 105, 106, 135, 139 (from Wakeley and Buxton's *Surgical Pathology*) ; and *Figs.* 103, 151 (from French's *Index of Diagnosis*) ; Messrs. Macmillan & Co. and the Oxford University Press for permission to reproduce respectively *Figs.* 111, 117, 120, 121, 123, 132, 133, and 138 (from Tubby's *Deformities*) ; and *Figs.* 6, 7, 19 and 24 (from Page and Bristow's *Treatment of Fractures and Dislocations in General Practice*). If any acknowledgment or thanks due to any of those who have directly or indirectly helped me in the preparation of this book should have been accidentally omitted, I trust they will pardon me.

NOËL M. TIDY.

Great Missenden,
October, 1932.

MASSAGE AND REMEDIAL EXERCISES

IN MEDICAL AND SURGICAL CONDITIONS

CHAPTER I

FRACTURES: GENERAL CONSIDERATIONS

Varieties — Causes — Displacement — General symptoms — Healing — Complications — Principles of treatment — Manipulations and movements commonly required at various stages.

THE medical gymnast, as we well know, is required to deal with many different forms of injury. Cases of recent fracture, dislocation, sprain, or rupture of muscle are very numerous in our hospital departments, as well as amongst our private patients. Moreover, we find ourselves constantly confronted with the late results of injury, such as stiffness of a limb due to the formation of adhesions within or around one or more of its joints. We may be called upon to treat a fracture on the day after its occurrence, or after an interval of six months; we may have to deal with a fractured phalanx or a fractured femur. We shall be well advised, therefore, to give a good deal of consideration to this subject.

A fracture has been defined as the interruption of the continuity of a bone. This interruption, however, may be complete or incomplete. The varieties, causes, and symptoms are briefly summarized below. For further details, the larger text-books should be consulted.

Varieties.—

Fractures may be classified as follows :—

INCOMPLETE.—(1) *Greenstick*; in which the bone is bent, and broken only part of the way through its shaft; this type is found only in children. (2) *Fissured*; consisting of a mere split of the bone without displacement of the fragments.

COMPLETE.—(1) *Simple*; in which the skin is intact. (2) *Compound*; in which the broken bone has pierced the skin. (3) *Comminuted*; in which the bone is splintered, or broken into several pieces. (4) *Impacted*; in which the broken bone-ends are driven into each other. (5) *Complicated*; in which there is injury to some organ or important structure in the neighbourhood of the fracture.

SEPARATION OF AN EPIPHYSIS, occurring in young people before the bones are completely ossified, has also to be considered.

Causes.—

SPONTANEOUS FRACTURES are those which take place owing to bone disease, general or local, which causes the bones to be unduly brittle.

TRAUMATIC FRACTURES are those due to violence. The force causing a fracture may consist of: (1) *Direct violence*, as when the arm or leg is broken by a wheel passing over it, or by a blow. (2) *Indirect violence*, in which case the force is transmitted to the bone through some other part of the body, as when the clavicle is broken by a fall on the hand, or the tibia and fibula by a fall on the feet. (3) *Muscular action*, as in fracture of the patella due to a sudden contraction of the quadriceps extensors.

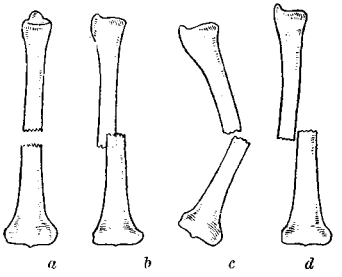

Fig. 1.—Types of displacement in fractures. *a*, Lateral displacement; *b*, Angulation; *c*, Overlapping; *d*, Rotation.

Displacement.—

Fractures may be transverse, oblique, or spiral in form, the transverse fractures generally being the result of direct, the oblique and spiral fractures of indirect, violence. The displacement of the fragments may consist of: (1) *Lateral displacement.* (2) *Angulation*, in which the fragments, instead of being in a line, form an angle with each other. (3) *Overlapping*, resulting in shortening of the bone. (4) *Rotation*, or twisting of the distal fragment. (*Fig.* 1.)

General Symptoms.—

The symptoms of fracture at the time of injury, or shortly after, are *unnatural mobility*, *crepitus* (grating between the broken bone-ends), *deformity*, *pain*, and *loss of function*. The muscles go into spasm; the more mobile the fragments, the greater the spasm. It is, in fact, due to a 'protective reflex', designed to keep the fragments in position. It disappears fairly soon when the limb is supported and immobilized, so that it is rarely seen in the massage department. *Swelling* soon follows, and may be intense, extending over a great part of the injured limb. It persists for a time, and then gradually subsides. Its disappearance may be considerably hastened by the use of massage.

The surgeon makes his diagnosis partly by observation of the symptoms, but most fractures are now X-rayed as a matter of routine. The X-rays are also used later to ascertain whether the fragments have remained in the correct position after reduction, whether union is taking place, or whether the screws are holding in a bone which has been plated. The masseuse should make a point of seeing the plates of the case she is treating.

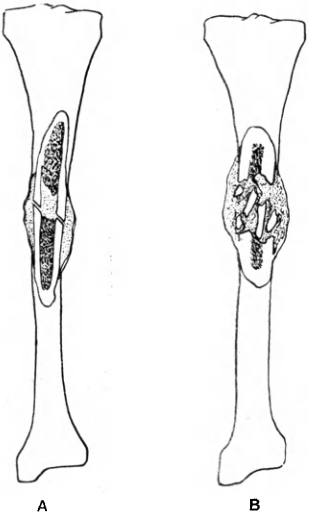

Fig. 2.—Cats' tibiæ showing method of fracture repair. A, Simple fracture, with external, internal, and intermediate callus; B, Comminuted fracture, with large callus mass in which the small fragments are embedded.

Healing.—

When a bone is broken, swelling takes place within twenty-four hours. This is partly due to hæmorrhage into the tissues, and partly to slowing of the venous circulation, with increased exudation of lymph.

Between the broken bone-ends a clot forms. This is invaded and consumed by the white corpuscles, and its place taken by granulations formed by cells from the periosteum. Through this soft mass grow new blood-vessels. The new tissue is formed not only between the bone-ends, but outside these beneath the periosteum; and it also fills up the space where the medullary cavity of the bone would be. The new substance is known as *callus* (*Fig.* 2). That outside the normal limit of the bone beneath the periosteum is called *external callus*, that in the interior of the bone *internal callus*. Both of these are included under the term *temporary* or *provisional callus*, because they are ultimately absorbed, and disappear. That between the bone-ends is called *intermediate* or *permanent callus*.

When union by callus is complete, the osteoblasts bring about a deposit of bone salts in the soft tissue, gradually hardening it. Osteoclasts pass into the new bone, and hollow out the cavities, making its structure less dense. The process resembles the ossification process in normal bone. Finally the provisional callus, internal and external, is absorbed.

TIME NEEDED TO OBTAIN UNION.—This varies in the different bones, depending on the thickness of the bone, the richness of its blood-supply, and the amount of separation between the fragments. For instance, the radius unites in about 7 days, the humerus in 12 to 14, the femur not for a month or more. If a fracture involves the articular surfaces of a joint, and the broken part is exposed to the synovial fluid, little callus is formed, and sometimes bony union does not take place (Mennell).

EFFECTS OF EARLY MOVEMENT ON THE PROCESS OF UNION.—Movement at the site of a fracture in the recent stage promotes callus formation, and *excessive* movement produces a large amount of callus which may impair mobility in the nearest joint. This is an important point, and one too often forgotten. Too strong early movement may defeat its own object, and reduce mobility instead of increasing it.

DELAYED UNION AND NON-UNION.—The time required to obtain union also varies in different individuals. *Delayed union* may be due to some general disease, such as severe anæmia, syphilis, etc., or to some local disease of the bone, e.g., osteomyelitis. *Non-union* may be due to the same causes; to extensive loss of bone substance, as in a gunshot wound; to the action of synovial fluid on the fractured bone-ends, as in fracture of the neck of the femur; or to the fact that muscular or ligamentous fibres have become interposed between the fragments, as in certain cases of fractured olecranon or patella. In the last two classes of fractures, *fibrous union* only takes place—that is, the fragments are united by fibrous connective tissue only, and not by bone.

Complications.—

INJURIES TO JOINTS.—The fracture may extend into a joint, the movements of which may be seriously restricted by imperfect replacement of the fragments, or by excessive callus formation. The joint may later be attacked by osteo-arthritis, following on the traumatic arthritis due to the injury.

INJURIES TO THE SKIN, in compound fractures. In these cases, bacteria may enter and infect the wound, unless proper precautions are taken.

INJURIES TO BLOOD-VESSELS.—These consist of: (1) *Hæmorrhage*, due to tearing of large vessels. (2) *Blocking of a Large Artery.* If such a vessel be *partially* occluded, the result is ischæmic contracture (*see* p. 26); if it be *completely* blocked, in such a position as to cut off practically the whole blood-supply of the limb, the result is mortification (gangrene). Either of these conditions may also be caused by over-tight bandages, or by improperly

applied splints or plaster. (3) *Thrombosis* (*see* Chapter XX) of veins in the neighbourhood of the fracture. This is manifested by the sudden development of cramp-like pain in the part, by an increase of swelling, and by marked tenderness along the line of the affected vein. Anything that appears to be abnormal in the circulatory condition of the injured limb must be immediately reported to the surgeon. In cases of suspected thrombosis, all treatment must be stopped.

INJURIES TO NERVES.—A nerve may have been injured at the time the fracture occurred. In this case, symptoms appear at once. If the nerve is actually severed, there will be immediate paralysis and anæsthesia of the parts supplied by it. The surgeon will at once suture the nerve.

A deep-lying nerve may become involved in forming callus, or compressed by displaced bone; in this case, the symptoms develop gradually. It is the duty of the masseuse to notice and report them.

PRINCIPLES OF TREATMENT

The aims of the surgeon and of those who co-operate with him in the treatment of fracture are, firstly, to obtain accurate anatomical alinement, and, secondly, to restore perfect function to the limb. The methods employed include: (1) *Splinting;* (2) *Physical Methods;* (3) *Operative Methods.*

1. SPLINTING, OR OTHER MEANS OF SUPPORT, with the application of traction if necessary. A great deal of difference of opinion exists among surgeons with regard to the kinds of splints suitable for various fractures, and also as to the length of time during which they should be worn. Since it is the business of the masseuse to carry out the orders of the surgeon under whom she works, it is necessary that she should be able to apply any kind of splint correctly. To put on a splint 'as you found it' is not always an ideal arrangement! We shall, therefore, try to mention most of the splints commonly used, and to describe more fully certain methods of strapping and bandaging. We shall not attempt to deal with special splints of unusual or complicated form. These must be seen in order to be understood.

2. PHYSICAL METHODS.—These include massage and movement; electrical treatment; light or heat. The old or *classical* treatment of fractures after reduction consisted of splinting and fixation of the limb until union was firm. This ensured a good *anatomical* result, but since the joints had in the meantime become stiff, and the muscles wasted, the *functional* result often left much to be desired. Then certain surgeons began to advocate the use of massage and early movement in the treatment of fractures, and this method, meeting with much opposition at first, has now been largely adopted. Possibly some of its practitioners have shown a lack of judgement in applying it, but unquestionably the method has been of immense benefit to victims of these accidents.

The Advantages of Physical Treatment.—Briefly summed up, these are as follows:—

Massage in the early stages relieves muscular spasm, and reduces pain and swelling. It also helps to maintain the circulation in the muscles, counteracting in some measure their tendency to waste.

Massage and Movements Together.—(1) *Assist callus formation* by producing a minute amount of friction between the bone-ends, and so slightly increasing the inflammatory reaction; and by bringing a better blood-supply to the part by their mechanical and reflex effects. (2) *Prevent the formation of adhesions* in the joint nearest the site of injury, as well as in those further removed from it; also between tendons and their sheaths, or between any

other soft tissues in the neighbourhood of the fracture. (3) *Check the atrophy of the muscles.* Faradism is sometimes used for the same purpose while the limb is still on the splint, since the muscles can thus be made to contract without causing a movement at any joint. At a late stage, *exercises*—including forced and active movements—can stretch or break down any adhesions which may have become organized in spite, or in the absence, of early treatment. They also increase the strength of the muscles, and restore the function of the limb as a whole. In fractures of the lower extremity, the last point is especially important. Skilled re-education in walking after fracture of any part of the limb would save many patients the pain and inconvenience of flat-foot, knock-knee, or similar misfortunes.

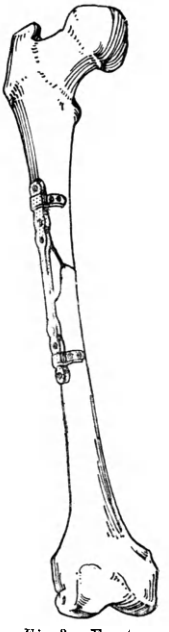

Fig. 3.—Fracture of shaft of femur treated by plating.

3. OPERATIVE INTERFERENCE. — Certain cases call for such measures as: (1) The fixation of fragments by plating, wiring, screwing, or insertion of bone-pegs. (2) Bone-grafting. (3) Operations undertaken to reduce the displacement in fractures in which this cannot be done by manipulation.

PLATING.—Long steel or silver plates are most often used, extending well above and below the site of the fracture, and being fixed to the fragments by means of screws (*Fig.* 3). Proper external splinting is essential in these cases, or deformity occurs, and the screws become loose.

WIRE is sometimes used to fix the fragments together, as in the case of fractured olecranon or patella. In the former, a long screw is sometimes inserted instead, being driven downwards from the superior surface of the olecranon process into the shaft below. Wires or metal bands are also used to bind together the fragments in an oblique fracture of the shaft of a long bone (*Fig.* 4). Torn aponeuroses are sometimes joined together by sutures of catgut, the bones being kept in position by this means.

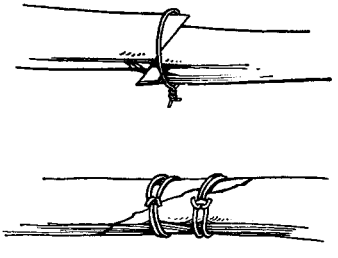

Fig. 4.—Treatment of fracture by wiring. In the upper figure the wire is loose and the fragments are not adjusted; this leads to chafing, delayed union, and secondary sepsis. In the lower figure are shown exact restitution, tight twisting, and efficient fixation.

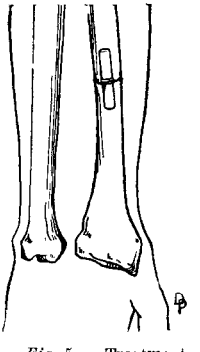

Fig. 5. — Treatment of fractured radius by intramedullary peg.

PEGS OF BONE OR IVORY are employed in transverse fractures, the peg being placed in the medullary cavity of each fragment (*Fig.* 5); or to fix

small portions of bone in place—for instance, the great tuberosity of the humerus, when this has been separated from the main bone.

BONE-GRAFTING is generally the operation chosen when much of the bone substance has been destroyed. The graft is taken from the patient's own tibia if possible, though it can be obtained from another man or from an animal, and is incorporated by various methods into the fractured bone.

Operations, then, are performed in cases of non-union of the fracture; of extensive loss of bone substance (as in crushing accidents, or as the result of gunshot wounds); and of serious displacement irreducible by manipulation; also in the majority of cases of fractured olecranon or patella, in which, otherwise, fibrous union only is to be anticipated, and in which therefore much time is saved, much inconvenience obviated, and all risk of re-fracture avoided.

MANIPULATIONS AND MOVEMENTS COMMONLY REQUIRED AT VARIOUS STAGES OF AN AVERAGE FRACTURE

In order to avoid needless repetition when giving an account of the treatment of particular fractures, the special manipulations and movements required at the various stages of any average fracture will now be considered in detail.

The treatment of a fracture may be divided, roughly, into three stages: (1) *First, or recent stage*, before firm union has taken place; (2) *Second stage*, when union has taken place with sufficient firmness for the patient to perform ordinary, but not forcible, movements; (3) *Third stage*, when union is quite stable, and the risk of re-fracture or deformity is at an end.

First, or Recent Stage.—

CONDITION.—As soon as the accident happens, the muscles go into spasm, causing severe pain. Swelling soon appears, and may be very extensive. If a joint is involved, it becomes the seat of traumatic arthritis, while if the injury is in the neighbourhood of ankle or wrist, there will be tenosynovitis of the sheaths of the flexor or extensor tendons. Pain and aching may persist more or less through the acute stage, though some fractures are more painful than others.

In a few days, adhesions tend to form, not only in the joint involved, or in that nearest the site of the injury, where they are due to the acute inflammation, but also in other joints of the limb as a result of non-use and passive congestion. The tendons at wrist and ankle may adhere to their sheaths, forming yet another obstacle to free movement.

THE AIMS OF TREATMENT in this stage will be to relieve muscular spasm and pain, to reduce the swelling, and to prevent the formation of adhesions and the consequent loss of mobility. To these ends, we shall make use of:—

MASSAGE.—

Reflex Stroking to get rid of the spasm, if still present. This must be done very slowly, evenly, and rhythmically. It is generally performed centripetally, but this is not essential, as the pressure should be too light to affect the circulation mechanically.

Effleurage—very light at first—should take the place of the stroking as soon as the spasm has passed off, in order to reduce the swelling. It probably brings about its effect partly by mechanical means and partly by reflex action. It should at first be used well above the site of injury, so as to clear the lymphatics in this region, and then lower down, so as to press on the exuded fluid into the vessels which have been emptied to receive it. A return to the upper part of the limb should be made after this. For instance, if we are treating an injury in the region of the wrist, we shall begin our effleurage on

the upper arm, from elbow to axilla ; we shall then pass to the forearm, and later return to the upper arm.

Kneading is next added, perhaps on the following day. The parts of the limb at a distance from the fracture may be kneaded with the palm of one hand, or even of both, provided the site of injury is adequately supported in some way ; but in the vicinity of the break finger kneadings are safer at first, as these small manipulations are less likely to disturb the bony fragments or drag on the inflamed structures than are the larger hand movements. Like the effleurage, the kneading should be begun well above the injury, and be brought gradually closer to it. The site of the fracture must be avoided during this period. If it is touched, the inflammation, and consequently the pain, will be increased, and the callus may become 'irritable', and may be formed in excess. In certain situations, e.g., near joints, the consequences of this will be most serious.

Frictions.—These may be given from the beginning to the uninjured joints of the limb. After three or four days they may be given to the nearest joint, provided the actual site of injury is avoided. There are cases, however, in which this procedure must be deferred, as in displaced epiphyses.

MOVEMENTS.—The joints well away from the fracture may generally be moved, or rather the patient may move them himself, from the beginning, provided that the site of the fracture is supported meanwhile. For example, a patient who has sustained a Colles's fracture may move his fingers from the first day, and his elbow and shoulder from the second, so long as the wrist and radio-ulnar joints are efficiently controlled.

As a rule, the first movement may be administered to the joint nearest the fracture after a few days, e.g., to the wrist in a Colles's fracture in about four days, and to the shoulder after fracture of the surgical neck of the humerus in about eight. The site of the injury should be most carefully supported until union is quite firm. The movements should be in very small range at first. In some fractures we have to wait till some definite degree of union has taken place before allowing movement, as in the case of a fractured olecranon. In fractures due to indirect violence, the *last* movement to be prescribed is generally that which was the cause of the original injury, and which would therefore tend to re-displace the fragments, or put further strain on torn ligaments or muscles, as eversion in Pott's fracture. With regard to the kind of movement, some hold that *relaxed passive movement* is best in the earliest stages, others that *assisted active movement* should be given from the outset. The relaxed movement, though excellent in the hands of an expert, is not so safe in those of a less skilled worker, because of the difficulty of ensuring that the patient *does* relax all his muscles. If he does *not*, the movement becomes an eccentric resisted one. All but the most experienced will be wiser to keep to the assisted active movements.

We have said above that the movements should be in very small range at first. They should be increased gradually, the patient carrying the movement a little further each day. Unless improvement continues to take place, we are evidently not doing enough. The question remains : How are we to know if we are doing too much ? We shall not go far astray if we remember that the treatment of fractures until union is quite firm, and we reach the stage for 'forced movement', should not be painful, and if we also keep in mind the fact—so often emphasized by Dr. Mennell—that any increase of pain at the site of the fracture, or of swelling in the limb, or any decrease of mobility in the joint affected, means that we have done too much, and should reduce the amount of active work, or even omit it for a time.

This rule holds good in the second stage as well as in the first. Many a

masseuse has been blamed for allowing a joint to become stiff through insufficient movement in the first week or ten days. She is quite probably to blame, but often for having done too much in the early stage rather than too little, the over-strong movement having increased the inflammation in the part, and so given rise to excessive output of callus, or the formation of denser adhesions. At the same time, someone has said that he who has *never* done too much probably always does too little. Fortunately, a single small error of judgement is rarely irreparable—I am not, of course, referring to gross blunders—and if the above rules are observed, errors should be reduced to a minimum.

Any fracture which can be adequately supported will be the better for immersion for 5 to 10 minutes in the whirlpool bath, if this is available.

Second Stage.—

CONDITION.—In untreated cases there will be considerable muscular atrophy and stiffness of joints. If the fracture has been treated from the beginning, the wasting will not be marked and the stiffness will be slight or absent. In any case, there will be imperfect function of the limb as a whole.

THE AIMS OF TREATMENT during this stage will be to restore muscular strength without putting any undue strain on the bone until union is quite firm. During this period, also, the splints are permanently removed, and the patient is encouraged to use the limb.

MASSAGE, then, will be increased in depth.

MOVEMENTS.—The *active movements* will be continued, and *free exercises* added. Patients with fractures of the lower extremity will begin to practise leg and foot exercises, without, however, taking the weight of the body on the limb ; those with upper extremity injuries will progress from easy movements to ordinary free exercises, such as 2-Arm-swinging forward and backward, 2-Arm-flinging, gentle Wrist-shaking, etc., and to ordinary use of the arm, but not to laborious work. *Resistance*—not too strenuous—may be added during this period.

Third Stage.—

CONDITION.—The bones are now quite firmly united. Some stiffness and weakness may remain. In cases hitherto untreated, both may be very considerable.

THE AIMS OF TREATMENT are to stretch or break down adhesions, and to strengthen the muscles.

MASSAGE should be strong and vigorous, consisting of all movements, including tapôtement.

FORCED MOVEMENTS may now be given to stretch adhesions, but in the cases which have been treated from the beginning most of the final mobilization can be done by means of quick vigorous active exercises. Very stiff joints may have to be manipulated under an anæsthetic. Patients with leg injuries begin to walk without support, and re-education in correct walking is essential. (Exercises for stiff joints are described in Chapter VI.)

CHAPTER II

FRACTURES OF THE UPPER EXTREMITY

Splinting and Support—Clavicle—Scapula—Humerus—Ulna—Radius—Bones of wrist and hand—Volkmann's ischæmic contracture.

It must be clearly understood that the times for special movements, etc., given below are *approximate* only. No two fractures are alike. Allowance has to be made for the amount of displacement, the mobility of fragments, the greater or less bruising of surrounding tissues, and the persistence of inflammation. Differences in individuals of age, temperament, or general health have also to be considered. It is impossible to dogmatize in the matter of fractures; common sense is all-important in dealing with them. Recent fractures need much skill and gentleness. The administration of very early movement is sometimes possible for an expert in this type of work when it should not be attempted by a less experienced worker.

Splinting and Support.—

Mr. Slesinger, of Guy's Hospital, in a lecture given on this subject at the C.S.M.M.G. Conference in October, 1925, said :—

"With a few very special exceptions, the force that causes the fracture is the force that causes the displacement. Displacement, when once reduced, does not tend to recur, except by the weight of the distal part of the limb. I do not believe that when a bone has been accurately reduced the pull of the muscle tends to cause redisplacement, because every muscle has an opponent acting in the opposite direction. It becomes clear, therefore, that the main object of a splint is to resist the weight of the distal part of the limb in causing redisplacement, and that if such weight is not acting, or can be counteracted in some other way, there is no need for a splint at all."

Position in which the limb is to be put up.—Our object in the upper extremity is to give support to those muscles which act against the pull of gravity, rather than those which are assisted by it, since the latter group will naturally be at an advantage during recovery. The 'anti-gravity' muscles are the abductors and elevators of the shoulder, the flexors of the elbow, the supinators, and the extensors of the wrist. As a rule, therefore, in arm fractures, the shoulder is put up in abduction, the elbow in flexion, the forearm in supination, and the wrist in extension.

The splint should only be kept on as long as there is danger of displacement. To retain it longer causes unnecessary stiffness, and retards the restoration of normal function.

THE CLAVICLE

The clavicle is most commonly fractured at about the middle of the shaft; far less frequently at the acromial extremity, and still less often at the sternal extremity.

Fracture of the Shaft

This fracture is generally due to a fall on the hand, that is, to indirect violence.

DISPLACEMENT.—The outer fragment is depressed by the weight of the

arm, and carried forward and inward ; the inner fragment is held firmly in place by the rhomboid ligament.

Treatment.—

FIXATION.—One of the following five methods will probably be used :—

1. The 'Handkerchief' Method with sling, 2 weeks.—This is by far the commonest, and is quite easy to arrange. In its simplest form it consists of two triangular bandages folded round thin rolls of cotton-wool. They are fastened round each shoulder, being tied at the back. The loose ends of the bandages are then tied together behind, so that the shoulders are drawn well backward (*Fig.* 6). It is more comfortable for the patient if the bandages are replaced by loops of lint, and fastened together at the back by a strong piece of roller bandage or linen sewn so as to avoid knots. The arm is meanwhile supported in a 'St. John' sling, i.e., one which is tied over the sound shoulder. It should be kept taut under the elbow, in order to prevent a downward drag on the clavicle. An additional bandage is sometimes used to bind the arm to the body, especially at night. After the brace' is discontinued, the sling is generally retained for another week.

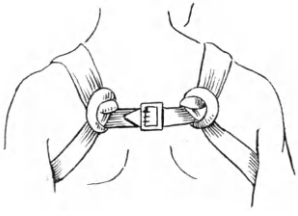

Fig. 6.—'Handkerchief' method of supporting a fracture of the shaft of the clavicle.

2. Sayre's Method, 3 weeks.—An elaborate method of fixation with adhesive plaster, rarely encountered by the masseuse, since it cannot conveniently be removed for daily treatment. It has the disadvantage of preventing all movements of distal joints.

3. Wharton Hood's Strapping with sling, 2 to 3 weeks.—This is applied in cases where the patient wishes to use the arm soon after the accident. Three strips of adhesive plaster 1½ inches wide are employed. The first is placed over the site of the fracture and carried down over the chest to a point just above the nipple, and down the back to a point 2 inches below the inferior angle of the scapula. The other two strips each overlap half the first. A sling is worn which supports the elbow, but leaves the forearm free.

4. Large Arm-sling, with a pad in the axilla ; the arm bandaged to the body.

5. Traction Apparatus, 3 weeks.—In cases where it is desirable that there should be no excess callus formation or sign of deformity (e.g., in women), the patient lies flat in bed, with a sand-bag between her shoulders, the arm being kept in abduction by a light traction apparatus (Page and Bristow).

PHYSICAL TREATMENT.—

Position of Patient during Treatment.—(1) If there is no displacement, sitting, with elbow supported. (2) If displacement is likely, lying, with the arm supported on a cushion close to the side, and the forearm across the chest.

Massage.—This is rarely necessary ; if required, it may be begun at once. It should include the whole of the arm, the neck, the chest (pectoral muscles), and upper part of the back.

Movements.—Gentle active movements of *fingers*, *wrist*, *elbow*, and *radio-ulnar joints*, are given from the beginning, and the patient is allowed to use the hand carefully. *Shoulder movements* : Rotation (in the humero-scapular joint, with the arm at the side)—7th day. Flexion, extension, and abduction—8th to 11th day, according to the mobility of the fragments. Increase gradually to elevation.

Occasionally, where no mobility or tendency to displacement exists, rotation may be begun on the 3rd day, and the other movements on the 5th.

EXERCISES.—These should be begun in about three weeks, and should be performed in the gymnasium, as well as practised at home. Arm-swinging forward and backward, 2-Arm-bending and -stretching, Neck-rest position, placing the hand behind the lumbar region (*see Figs.* 30–32, p. 73) are all suitable, and later stronger exercises are added. All movements of the shoulder girdle must be practised assiduously (*see* exercises for stiff shoulder, p. 71). *Light work* should be possible in a month, or a little less, and full use of the arm in 6 to 8 weeks.

Fracture of the Acromial Extremity

This is generally due to direct violence. There is little displacement, but the outer fragment may be tilted downwards by the weight of the arm, in which case the shoulder drops.

Treatment.—

FIXATION.—(1) If there is no displacement, a *sling* only is worn, kept taut under the elbow. (2) If the shoulder drops, *strapping* may be used to support the elbow, applied as follows: A pad of adhesive strapping, enclosing a layer of wool, is placed over the acromial extremity of the clavicle. It must have the adhesive side outwards. A bandage about 4 inches wide—linen, not gauze—is passed under the elbow, a layer of felt or wool being placed between it and the skin, carried up to the shoulder, and tied in a knot over the pad. The free ends are then passed across the chest and back and are tied over a pad of wool under the axilla on the sound side. The elbow should be well drawn up before the first knot is tied (Page and Bristow). (*Fig.* 7.)

Fig. 7.—Method of supporting a fracture of the acromial end of the clavicle.

PHYSICAL TREATMENT.—

MASSAGE AND MOVEMENTS.—Treatment is the same as that for fracture of the shaft, but may be advanced a little more quickly.

Fracture of the Sternal Extremity

Due to direct or indirect violence; generally to a blow on the shoulder. Greenstick fractures in children are common in this situation.

Treatment.—

FIXATION.—A *sling* is generally all that is required.

PHYSICAL TREATMENT.—As for the acromial extremity.

THE SCAPULA

The body of the scapula is usually the part injured. Fractures of the neck, acromion process, and glenoid cavity are rare.

Fracture of the Body of the Scapula

DISPLACEMENT.—This is as a rule very slight, because of the support afforded to the fragments by the large number of muscles attached to the scapula.

Treatment.—

FIXATION.—*Adhesive strapping*, extending over the whole of the scapular region, and carried round to the front of the thorax on the affected side. A large arm-sling is also worn for 3 weeks. The sling should be retained for a week after the strapping is removed.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting, the arm supported by the side or in slight abduction, on a cushion on a table. The sling may be removed for treatment.

MASSAGE may be begun at once; it is on much the same lines as that given for a fractured clavicle, though the operator is hampered by the strapping; special attention should be paid to the deltoid and supraspinatus. The actual site of the fracture should be avoided.

MOVEMENTS.—

Hand, wrist, elbow, and radio-ulnar joints, from the beginning.

Shoulder.—Movements in the gleno-humeral articulation may be given from the 3rd day, beginning with rotation, since this movement can easily be administered without involving any other joint of the shoulder girdle. Flexion and extension must be given carefully, and in small range at first; abduction

30 degrees for the first few days. The operator
the scapula while giving movements.
el.—The arm should have been brought up to
the 2nd week, and after this should be raised

displacement; but if adhesions are allowed to
isabling, and will probably necessitate manipu-
n should this be done, the result is not always

begun in from 3 to 4 weeks, and are similar
vicle or other shoulder injuries. *Light work*
month or 5 weeks, but *heavy work* should not

Fracture of the Acromion Process and Neck of Scapula

These are both rare injuries. In both cases the displacement of the outer fragment is downwards.

Treatment.—

FIXATION.—For acromion process, as for acromial end of clavicle (p. 11). For neck, *abduction splint or plaster*, 3 to 4 weeks.

PHYSICAL TREATMENT.—

MASSAGE.—In both cases from the beginning.

MOVEMENTS.—*Acromion process*, as for acromial end of clavicle, but progress should be a little slower. *Neck*, distal joints from beginning; *shoulder*, 10 to 14 days.

Fracture of the Glenoid

Generally a fissure fracture through the lower part of the glenoid cavity.

Treatment.

FIXATION.—*Abduction splint or plaster*, 3 to 4 weeks, sling 2 weeks more.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting, the arm resting on the splint for 10 to 14 days; then supported in abduction, in sitting or lying.

MASSAGE.—As for the body of the scapula.

MOVEMENTS.—All from the beginning, except that the arm should not be brought below shoulder level for about 3 weeks (Page and Bristow).

THE HUMERUS

The humerus may be fractured in so many different parts that it is impossible to consider them all in detail. At the upper extremity we may have fracture of the surgical or anatomical neck or great tuberosity; the shaft may be fractured in its upper, middle, or lower third; while at the lower extremity we meet with supracondylar fracture, T- or Y-shaped fractures into the elbow-joint, fractures of either condyle, and separated lower epiphyses. We shall therefore take as typical, fracture of the surgical neck, of the middle third of the shaft, and the supracondylar fracture, adding where necessary a few notes on the other varieties.

Fracture of the Surgical Neck

This is a much commoner fracture than that of the anatomical neck. It is due to direct or indirect violence, and is sometimes impacted, or it may be complicated by a dislocation of the shoulder.

DISPLACEMENT.—The fracture is generally transverse. If not impacted, the upper fragment is abducted by the supraspinatus, and the lower one drawn upwards by the deltoid, coraco-brachialis, biceps, and triceps, and inwards by the adductors attached to the lips and floor of the bicipital groove. It is a painful injury, because the lower fragment presses on the nerves of the brachial plexus.

COMPLICATIONS. — Involvement of the axillary vessels, or the circumflex nerve.

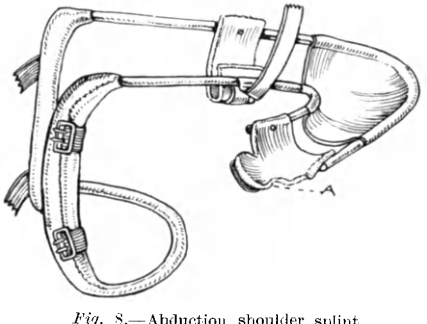

Fig. 8.—Abduction shoulder splint. A, Adjustable cock-up for wrist.

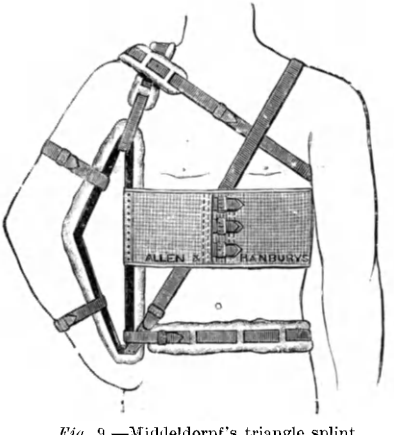

Fig. 9.—Middeldorpf's triangle splint applied for fracture of humerus. In this case straps are used instead of bandages.

Treatment.—

FIXATION.—The arm is put up in abduction, either at shoulder level or a little lower. The apparatus used may be: (1) *Abduction splint*; 2 weeks. (*Fig.* 8). (2) *Middeldorpf's triangle* (*Fig.* 9). This is a somewhat clumsy splint, and difficult to bandage comfortably and securely into position; but is otherwise excellent. It should first be fastened to the patient's side, with turns of the bandage round the body and over the sound shoulder. The arm and forearm should next be bandaged to the other two sides of the triangle, a separate bandage being used for each, so that the forearm may be freed, and movement given to the elbow while the upper arm and shoulder are kept immovable.

(3) *Abduction plaster*, 2 weeks, especially for children. (4) When there has been much displacement, and difficulty in maintaining the fragments in position, a *Thomas arm splint* is used to produce traction, a weight and pulley being attached. In all cases a sling is worn for about a fortnight after the splint is discarded.

IMPACTED FRACTURES are put up either on an *abduction splint*, as those which have been reduced by open operation, or simply in a sling with a pad in the axilla.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting, the arm resting on the splint during treatment for the first week. After this time, it may be removed from the splint for treatment, and supported in abduction by firm cushions. It may be lowered a little from day to day.

If the patient has his arm in a sling, the fracture is presumably one in which there is little danger of displacement. It may be supported in the sling during treatment, or the forearm may rest on a cushion on the patient's crossed knees.

Patients with fractures of the upper and middle parts of the humerus should sleep in a chair, or well propped up with pillows in bed, for about 10 days.

MASSAGE.—*1st week*: If the patient is wearing a Middeldorpf's triangle, the bandage should first be removed from the upper arm, leaving that on the forearm in place. Massage of neck, chest, back, shoulder, and upper arm is given. Special attention should be paid to the deltoid, but the site of fracture must be avoided. The upper arm bandage is then replaced, and the forearm freed and raised on a cushion, while massage and movements are administered to it. If a metal abduction splint is being used, all bandages or straps on the arm may be loosened or removed.

Fig. 10.—Showing the operator's method of support while giving movements to a case of fractured surgical neck. The same grasp may be used for a dislocated shoulder, with stronger upward pressure in the axilla.

MOVEMENTS.—The bones unite in 8 to 12 days.

Elbow, wrist, and hand, from the beginning, the upper arm being supported on the splint.

Shoulder.—All movements may be given after about 8 days, and gradually increased in range, except rotation, which should be postponed till the 12th or 14th day, and then be administered with great care.

When beginning to give either relaxed or assisted active movement to the shoulder, the site of fracture must be very carefully supported; in fracture of the right humerus, the operator should stand at the patient's right side, place her left hand in the axilla, holding it firmly under the neck of the humerus, while her right hand grasps the patient's elbow, his forearm supported on her own (*Fig.* 10).

In cases where there is impaction, or the fragments are not mobile, movements may be begun earlier; some surgeons recommend movements from the beginning. If given in this early stage, they should be in very small range at first.

It is inadvisable to delay giving movements longer than is absolutely necessary, as adhesions form easily round the shoulder, and are most disabling later.

EXERCISES.—Gentle exercises may be begun in 3 to 4 weeks. The patient should be able to do light work in about 6 weeks, and full work in 8 to 10.

TREATMENT OF CIRCUMFLEX NERVE INJURY.—*See* Chapter XII.

Fracture of the Middle Third of the Shaft

This may be caused by direct or indirect violence.

DISPLACEMENT.—The fracture at this level is usually oblique or spiral. The displacement is lateral, with overlapping of the fragments. If the fracture is above the level of insertion of the deltoid, the upper fragment is drawn inwards by the adductors; if below this level, it is drawn outwards (abducted) by the deltoid (*Fig.* 11).

COMPLICATIONS.—*Non-union*, often due to some fibres of the triceps being caught between the broken ends of the bone. *Injury to the musculospiral nerve*, either at the time of fracture, or (more often) by its involvement in the forming callus. In the first case, symptoms appear at once, or almost at once; in the second, about 10 days after the accident. They must be reported at once to the surgeon in charge of the case. (*See* Chapter XII.)

Treatment.—

FIXATION.—(1) *Gutter-splints*, from shoulder to elbow, with a small arm-sling, only supporting the forearm, and not taken beneath the elbow; 3 weeks. (2) *Middeldorpf's triangle, or special abduction splint*; 3 weeks. This is used if the upper fragment is abducted, in order to bring the lower fragment into line with it. (3) *Traction by a Thomas arm splint*, if displacement cannot otherwise be reduced; 3 to 4 weeks.

Fig. 11.—Displacement in fracture of middle of shaft of humerus.

A sling is worn for 7 to 10 days after removal of the splints.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—This will be according to the splint used; if the arm is on an abduction splint of any kind, the position is as for fracture of the surgical neck (*see above*); if the arm is at the side, it is supported in this position by a cushion placed on the patient's lap beneath his forearm.

MASSAGE.—From the beginning, special attention being paid to the deltoid. The site of the fracture must be supported very carefully. The whole arm, chest, and back of the shoulder must be treated.

MOVEMENTS.—The bone unites in 10 to 14 days.

Wrist and hand movements, from the beginning. *Pronation and supination*, 3rd to 4th day. *Elbow*, 6th to 8th day. *Shoulder*, 8th to 10th day (rotation last).

If the fracture is in the upper third of the shaft, elbow movements may be begun earlier, but shoulder movements should be delayed, the reverse being the case if the fracture is in the lower third.

EXERCISES.—Free exercises may be given at the end of 5 weeks, such as pulley exercises, 'crawling up the wall', hand-placing behind the lumbar region, neck-rest position, etc. In 6 to 8 weeks arm exercises as for stiff shoulder (*see* p. 71). In about 8 weeks the patient should be able to do light work, and full work in 10 to 11 weeks.

TREATMENT OF NON-UNION.—This is not a very common complication,

but we come across cases occasionally in fractures of this bone, or of others. If union is long delayed, or does not take place at all, special treatment is needed. If the patient is suffering from any general or local disease, he will be receiving appropriate medical attention. If no definite disease is present, or during the time that any such condition is being dealt with, massage and movements of a special kind, often combined with Bier's passive congestion treatment, are most effective.

Application of Bier's Bandage.—A flat rubber bandage is fastened round the arm a few inches above the site of the fracture, and drawn tight enough to compress the veins of the arm, but *not* the artery. The radial pulse should be taken at both wrists, and its strength on the two sides compared. It may

the bandaged side, but must on no account be stopped, This is important, as the most serious results would follow brachial artery, even for a short time (*see* p. 26). The d, and finally purplish, but should not be painful. It is best ding the bandage in place for 10 to 15 minutes only, and to lually to an hour or more at a time. The purpose of this crease the amount of blood in the region of the break, so pro- nutrition and encouraging healing.

ND Movements.—After the bandage has been removed, the levated, and well supported by firm cushions. Quick and e and kneading are applied, followed by gentle hacking over acture, one hand being used to support the bone. This part needs great care. Some workers prefer to begin by giving than hacking; but the latter is more effective, at all events provided it is done carefully.

not forced) and free active movements are given to elbow and erator supporting the fracture throughout. This treatment should take place every day. Sometimes the massage and movements are used without the congestion bandage, and are often quite successful in bringing about union. Both the hacking and the quick movements are given with the idea of producing a small amount of friction between the bone-ends, and thus setting up a slight amount of inflammation which will increase the blood-supply.

If union is being prevented by tissue interposed between the fragments, an operation will be necessary.

Fig. 12.—Supracondylar fracture of the humerus.

Supracondylar Fracture

This is a common fracture in children, and is due to ndirect violence, such as a fall on the hand.

DISPLACEMENT.—The lower fragment passes backwards and upwards behind the upper fragment (*Fig.* 12).

As in all fractures in the neighbourhood of the elbow—except a fractured olecranon process—there is a tendency to excessive callus formation.

COMPLICATIONS.—(1) *Myositis ossificans.* If a large amount of callus is formed, some bone-cells may escape into the brachialis anticus. so that a deposit of bone takes place in the muscle, and seriously interferes with movement of the joint. (2) *Ulnar nerve involvement* at the time of the injury, or during healing (*see* Chapter XII).

Treatment.—

FIXATION.—As in all elbow fractures—again, except that of the olecranon—the elbow is put up in what is sometimes called the 'Robert Jones position',

i.e., in full flexion and supination. To maintain this position, the forearm is bandaged to the upper arm by a figure-of-eight bandage, or fixed by adhesive strapping, a pad being placed in the hand and kept in place by a turn of the bandage in order to prevent overmuch flexion of the wrist and drag on the extensor muscles (*Fig.* 13). The elbow is drawn well forward, and secured there by a bandage carried round the body. This position is chosen for two reasons: (1) It keeps the flexors and supinators at their shortest, and (2) It prevents the escape of osteoblasts into the surrounding tissues, especially the brachialis anticus, and the danger of myositis ossificans is thus avoided. The position is maintained for a fortnight, and after this a 'collar and cuff' are put on, arranged so that the flexion may be gradually reduced (*Fig.* 14).

PRECAUTIONS.—It is most important that the circulation should not be impeded. As this bandage is usually put on by the surgeon after the fracture is set, and not removed for two or three weeks, when its place is taken by the 'collar and cuff,' or by a sling, it is not very often that the masseuse has to apply it. Still, she is sometimes called upon to do so, and it is most important that it should not be too tight. For precautions, *see* p. 27.

Fig. 13.—Robert Jones position; full flexion and supination. The bandage which fixes the arm to the body is omitted.

Fig. 14.—'Collar and cuff' method of support.

PHYSICAL TREATMENT.—Treatment is often not begun for a fortnight. Massage is not as a rule necessary for children in these cases. In adults, even if the arm is not massaged, movements of fingers and wrist should be practised, and shoulder movements (not rotation) carefully given in small range from the beginning, but the elbow must not be moved. The callus is often 'irritable', and may be formed in excess, seriously interfering with the function of the joint if movement is given too early or too strongly. If other treatment is ordered during this early period, it should be carried out as follows:—

POSITION OF PATIENT.—The patient is treated in the sitting position. The bandage round the body is removed, and the arm being slightly abducted, a cushion is placed between it and the body, and beneath the elbow. The figure-of-eight bandage must be removed, but it is well to replace it temporarily with a short piece of bandage tied round the wrist and arm to keep the elbow in position, or with a narrow piece of zinc oxide strapping.

MASSAGE.—The whole limb should be treated; in the first days, to reduce the swelling, and later, to prevent atrophy of the muscles. Frictions are given to the shoulder and wrist. The site of the fracture must be given a wide berth.

MOVEMENTS.—The patient should move the *fingers* and *wrist* actively from the beginning, extension of the wrist being especially necessary.

Gentle relaxed and assisted active movements of the *shoulder* are also permissible. Rotation is best left for a few days, and then care must be taken to see that there is no accompanying movement in the radio-ulnar joint.

Later Stage.—

Elbow movements are not as a rule given till the end of the second week. (They are *occasionally* given at 10 days.) After the 'collar and cuff' or sling have taken the place of the bandage described above, the patient should perform active movements in small range, assisted or free. Pronation may be combined with extension, and supination with flexion, of the elbow. The shoulder should be moved freely. The movements are gradually increased in range, but great care must be taken to see that the patient retains the ability to flex and supinate the forearm fully. If he shows signs of limitation of these movements, the arm should be replaced in the Robert Jones position for a time.

EXERCISES.—Gentle free exercises may be begun in about 21 to 24 days; stronger movements from 4 weeks. The patient should be able to use the arm fairly freely in 4 to 5 weeks, and normally in 6 to 8 weeks.

T-shaped and Y-shaped Fractures into the Joint

These occur in adults and not in children. They are supracondylar fractures with a line of fracture running down into the joint.

Treatment.—

The same as for supracondylar fractures, but all movements should be delayed 2 or 3 days. If displacement is serious, an open operation is performed, the fragments being fixed by a Y-shaped plate posteriorly. Full movement in the joint is rarely recovered.

Separated Lower Epiphyses of the Humerus (*internal or external condyle*); Separated Upper Epiphysis of the Radius

In the case of all separated epiphyses, accurate reposition is essential, otherwise there may be interference with the growth of the bone, this being specially disastrous in the forearm or lower leg, where two bones lie side by side; since if the growth of one ceases while that of the other proceeds normally, serious deformity will be the result.

Treatment.—

The treatment of these cases is on the same lines as the supracondylar fractures, but even greater care is needed, and progress is a little slower. Sometimes the arm is kept in the Robert Jones position for 3 weeks. Massage is not as a rule ordered during this period.

Other fractures in the region of the elbow-joint are treated in much the same way as the above. Fractures, for example, of the internal or external condyle of the humerus, or of the capitellum, may be advanced more quickly than separated epiphyses; but all need great care. Injuries in this region are, in fact, the most difficult of all to deal with; and often even the most skilful treatment by both surgeon and masseuse fails to produce perfect function.

THE ULNA

The commonest fractures of the ulna are those of the *olecranon process*, and of the *shaft*. Fracture of the *coronoid process* sometimes complicates dislocation of the elbow. It may be treated as a supracondylar fracture of the humerus. Myositis ossificans is always a danger in a case of fractured coronoid.

Fractures of the Olecranon Process

This fracture may be caused by direct violence, as by falls on the elbow; or by muscular action of the triceps.

Cases with Displacement of Fragments

The fragments are generally separated, since, however the accident occurred, the upper fragment is drawn up and tilted forward by spasm of the triceps.

Treatment.

SURGICAL TREATMENT.—This fracture is generally treated by open operation, the fragments being wired together, the wire being passed through canals bored transversely through each fragment and joined at one side (*Fig.* 15). Sometimes, instead, a long screw is driven down from the top of the process into the shaft.

FIXATION. — (1) *Sling* for 3 weeks, the elbow at a right angle. (2) Occasionally, *internal angular splint.*

PHYSICAL TREATMENT AFTER OPERATION.—

Massage from the beginning, avoiding the region of the scar. The stitches will be removed about the 10th day. The splint, if one is used, may always be removed for treatment.

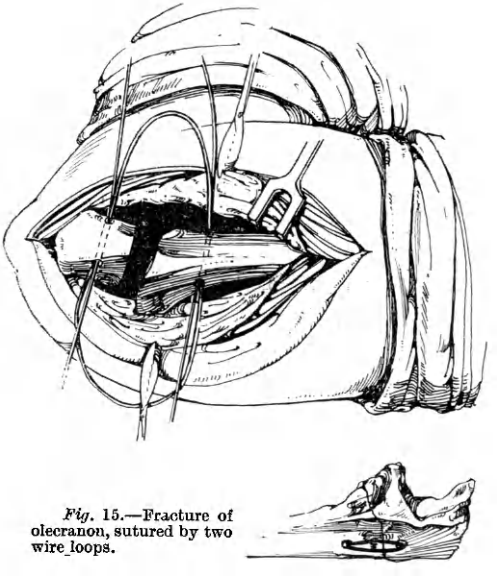

Fig. 15.—Fracture of olecranon, sutured by two wire loops.

Movements. — *Fingers, wrist, and shoulder* from the beginning. *Elbow and radio-ulnar joints*, from 10th day, active assisted movements at first, and then free ones. *The movements must never be forced.* Inflammation recurs easily in these cases, and the masseuse should watch the elbow carefully for any signs of its re-appearance. Ulnar nerve involvement is rare, but the possibility should not be forgotten.

Cases without Separation of Fragments

In a few cases the fragments do not separate, because the fibrous tissue extending from the tendon of the triceps has not been torn, and so holds them together. It must be remembered that this fibrous tissue would very easily give way if rough or injudicious movement were permitted. These cases are not treated by operation.

Treatment.—

FIXATION. The arm is put up with the elbow fully extended, and the forearm supinated on a *long anterior gutter-splint* from the axilla to the hand, 2 to 3 weeks. The patient, when up, should not let the arm hang by the side for long periods, but should, whenever possible, support it in abduction.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—In lying or sitting, the arm in abduction, supported in its whole length by hard cushions.

MASSAGE.—The operator must place the fingers of one hand above the olecranon process, and hold it in position while treating the upper arm. Massage may be given from the beginning, but the work on the triceps must be carefully done.

MOVEMENTS.—*Hand, wrist, and shoulder* (the latter when the splint has been *re-applied*), from the beginning. *Elbow region*: pronation and supination, 8 days; flexion of elbow, 10 days, in small range at first, increasing gradually.

FREE EXERCISES.—4 weeks. Light work may be undertaken in 5 to 6 weeks, but full work is not safe for 2 months or over.

UNWIRED CASES WITH SEPARATION OF FRAGMENTS

These are cases in which the patient is not a suitable subject for operation, or has refused it. They are very difficult to treat, the union not being firm for a month; and re-fracture easily occurs. Sometimes, if the fragments cannot be brought close together, only fibrous union takes place.

Treatment.—

FIXATION.—*Long anterior splint*, 3 weeks, followed by sling for 10 to 14 days, the flexion of the elbow being gradually increased.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning, very light and careful at first. The olecranon process must be supported when treating the upper arm (*see above*). It is safer not to treat the back of the arm—triceps—for a few days, and work on this muscle must never be over-strenuous.

MOVEMENTS.—*Wrist and fingers* from the beginning. *Shoulder* (with splint on) from 2nd or 3rd day. *Elbow*: pronation and supination, 8 days; flexion, 12 to 14 days in very small range, and with the process very carefully supported.

FREE EXERCISES.—5 weeks. The arm may be used freely, but carefully, after about 6 weeks, but heavy work must not be undertaken for at least 10 weeks.

Fracture of the Shaft

This fracture occurs as the result of direct violence—blows or falls. It is most common in children. It may be a complete fracture, or of the greenstick variety. The break is generally transverse. Union takes place most quickly in the upper part; the lower the position of the fracture, the more slowly does the bone unite. Fracture of the shafts of both ulna and radius are described below under RADIUS.

DISPLACEMENT.—This is rarely marked and often absent.

Treatment.—

FIXATION.—The forearm is put up in supination with the elbow flexed to a right angle and supported by: (1) *Gutter-splints*, either one on the posterior aspect, or two, one anteriorly and one posteriorly, 2 to 3 weeks (3 to 4 weeks for fractures of the lower third); (2) *Plaster* (3 weeks) for children. The arm is placed in a large sling. If it is to remain supinated, the elbow must be fixed: this is specially necessary in children.

GREENSTICK FRACTURES are put up for about the same period, in plaster, with pads so placed as to correct the bending of the bone, or, if the deformity is very slight, in a sling only. In the case of very active and restless children

—in fact, in most small boys—it is sometimes as well to splint the fracture for a week lest a second accident should render it complete.

PHYSICAL TREATMENT.—

GREENSTICK FRACTURES.—If the arm is in splints or in a sling, massage may be begun at once, and all movements given carefully from the beginning.

COMPLETE FRACTURES.—

Massage.—This may be given from the beginning, or when the plaster is removed. The arm should be left lying on the splint during treatment for the first week.

Movements.—The upper third of the bone unites in 8 to 10 days, the middle third in 10 to 14; in the lowest inch union does not take place for 3 weeks (Mennell).

Fractures of upper third (union 8 to 10 days): (1) Wrist and fingers, from the beginning. (2) Elbow, 7 days. (3) Pronation and supination, 8 to 10 days.

Fractures of middle third (union 10 to 14 days): (1) Fingers, from the beginning. (2) Wrist, 5 days. (3) Elbow, flexion and extension, 7 days. (4) Pronation and supination, 10 to 12 days.

Fractures of lower third (union 16 days to 3 weeks): (1) Fingers, from the beginning. (2) Elbow, 5th to 7th day. (3) Wrist, 8th to 10th day. (4) Pronation and supination, 10 to 14 days or later.

Free Exercises.—3 weeks; lower third, 3½ to 4 weeks. Heavy work must not be done for 6 weeks. In children, whose arms have been in plaster for 3 or 4 weeks, all movements may be begun as soon as the case is removed.

THE RADIUS

Fractures of the Head and Neck

Treatment.—

Fractures of the head or neck and separation of the upper epiphysis are treated in much the same way as other fractures in the neighbourhood of the elbow, that is, they are put up in *full flexion and supination* for 2 or 3 weeks according to the severity of the injury. The physical treatment is similar. (*See* p. 16.)

Fracture of the Shaft

DISPLACEMENT.—The lower fragment is pronated by the pronator quadratus, and also by the pronator radii teres, if the break is above the insertion of that muscle. The upper fragment is probably always supinated by the biceps, even if the fracture takes place below the insertion of the pronator radii teres, the biceps being by far the stronger muscle of the two. There is also an angular displacement towards the ulna, which may be the most serious part of the injury, as it may lead to *cross-union*, i.e., union of the radius to the ulna; or by altering the shape of the radius it may interfere with its proper movement round the ulna.

Treatment.—

FIXATION.—The forearm is put up in full supination, the elbow being flexed to a right angle. This position is maintained by: (1) *Gutter-splints*, anterior and posterior (2 to 3 weeks). In children, the elbow must be fixed, or the forearm will not remain supinated. (2) *Supination plaster*, 2 to 3 weeks. In either case, a sling is retained for 1 to 2 weeks after the splints are discarded. Occasionally, when the displacement has been great, the forearm is fixed in supination with the elbow *extended* for 2 weeks. The limb should be kept raised as much as possible.

PHYSICAL TREATMENT (say of middle third).—This is much as for the fracture of the shaft of the ulna (*see* p. 21).

Fracture of the Shafts of both Radius and Ulna

This is a common fracture in children. It may be caused by indirect or direct violence. If by the former, the fractures are generally oblique, the radius giving way in its upper, the ulna in its lower third ; if by the latter, the fractures are transverse and at the same level.

DISPLACEMENT.—This varies, but the broken bone-ends generally overlap, and there is angulation and rotation. The upper fragment of the radius is supinated, the lower pronated (*see above*, FRACTURE OF SHAFT OF RADIUS).

Treatment.—

FIXATION.—It is most important that this fracture should be successfully reduced, and the bones kept in the correct position, otherwise cross-union may occur between the two bones, or they may unite in such faulty positions as to render rotatory movements of the forearm almost impossible.

The forearm is put up in full supination, with the elbow flexed to a right angle, and so fixed. This is maintained by : (1) *Special supination splints*, including the elbow, 3 to 4 weeks. (2) *Fixed plaster*, in children, 3 to 4 weeks. (3) *Removable plaster case*, in adults, for the same time. (4) If the bone-ends cannot otherwise be kept in place, traction is applied by means of a *Thomas arm splint*, or some similar apparatus.

PHYSICAL TREATMENT.—*If the arm is in splints.*

MASSAGE.—From the outset. The arm should be left resting on the splint for 10 days. When, later, it is removed for treatment, the site or sites of the fractures must be very carefully supported.

MOVEMENTS (e.g., middle of shaft).—*Fingers*, from the beginning. *Wrist*, very carefully, from 10th to 12th day. *Elbow*, 14 to 18 days. *Radio-ulnar joints*—pronation and supination—3 weeks.

FREE EXERCISES.—4½ to 5 weeks. The patient should be able to use the arm freely in about 6 weeks, but should not undertake laborious work for 8 or 9 weeks. If the arm is put up in plaster for 3 weeks, massage and all movements may be begun as soon as the plaster is removed. Light exercises at 4 weeks, strong exercises at 6 to 7 weeks.

SURGICAL TREATMENT.—If the fracture cannot be otherwise reduced, the surgeon will resort to open operation. Either the bones are merely replaced in position by this means, or if, after reduction, the displacement tends to recur, they are either plated or fixed into place with bone pegs.

POST-OPERATIVE TREATMENT.—This may begin after 10 to 14 days, with massage and gentle movements. Pronation should be delayed till the end of the third week.

Colles's Fracture

Probably no fracture appears more frequently in our massage departments than does this, and in private practice also we are constantly called upon to deal with it. It is generally the result of a fall on the outstretched hand, with the wrist extended. It is commonest in middle-aged or old women.

DISPLACEMENT.—The fracture is a transverse one through the lowest inch of the radius, sometimes accompanied by a breaking off of the styloid process of the ulna. If this process is not broken, the internal lateral ligament is badly wrenched or torn. The lower fragment is displaced and rotated backwards, displaced radially and rotated radially, and displaced upwards (Slesinger). This displacement causes the typical 'dinner-fork deformity'

(*Fig.* 16). The hand is also displaced, with the lower fragment of the radius, to the outer side. The fracture is often an impacted, and sometimes a comminuted one.

The wrist-joint is the seat of traumatic arthritis, and an intense synovitis of the sheaths of the flexor tendons is always present; occasionally those of the extensors are affected as well, though in a less acute degree. The wrist and hand are generally much swollen at first, and very painful. Bruising may extend well up the forearm, or even into the upper arm. There is a particularly tender point over the internal lateral ligament.

The sooner the displacement is reduced, the better are the prospects of obtaining a correct position of the lower fragment. If this remains displaced slightly backwards, as is sometimes the case, flexion will be limited, and the grip weak; and a certain amount of visible deformity will remain. Union takes place in about 7 days.

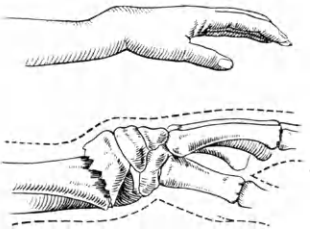

Fig. 16. — 'Dinner-fork' deformity and displacement in Colles's fracture.

Treatment.—

FIXATION.—The wrist is generally put up in slight dorsiflexion and ulnar deviation, the forearm being halfway between pronation and supination. The apparatus used to maintain the position may be: (1) *Carr's splint*, with a large arm-sling. This splint is too well known to need description. (2) *Anterior and posterior gutter splints.* The posterior splint extends from the elbow to the knuckles, leaving the metacarpo-phalangeal joints free, the anterior from the elbow to just above the wrist (Page and Bristow), with sling as above. The splints are twisted in such a way as to maintain the ulnar flexion at the wrist.

Occasionally, when there has been extreme displacement of the bone, the

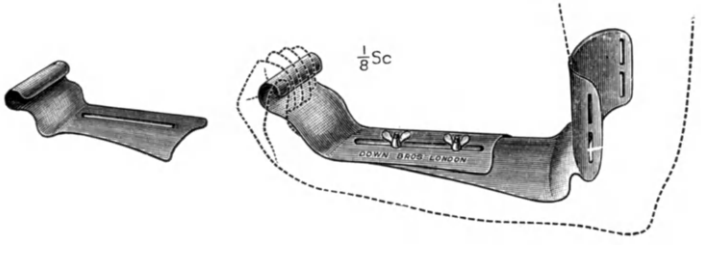

Fig. 17.—Todd's splint for Colles's fracture.

wrist is put up in full flexion and supination on a right-angled wooden splint, or a special metal one known as *Todd's splint* (*Fig.* 17). This is not kept on for more than about 24 to 48 hours.

This method of fixation keeps the fragments in good position, but is very painful, and tends to stretch and weaken the extensor muscles. If the splint used is a right-angled wooden one, great care is necessary in bandaging it into place. It is somewhat difficult to apply with sufficient firmness to keep the hand in the desired position, without making the bandages too tight and constricting the circulation.

After its removal, a Carr's splint is sometimes applied; or the wrist is put

up in extension on a straight splint, with a large pad of wool or a tennis ball in the hand, in order to restore dorsiflexion of the wrist.

As a rule, the splints are retained for 7 to 10 days, though some surgeons prefer them to be left on for rather longer, while others remove them in 5 days. In some cases of impacted fracture, or in those where there is no displacement and no mobility of the fragments, no splint at all is used, but merely a sling.

A disadvantage of very early removal of splints appears to be that the patient, nervous and apprehensive, keeps all her muscles in contraction in order to prevent the slightest movement of the wrist, and thus produces pain and stiffness in both wrist and fingers. After the removal of the splint, even at a later period, a bandage kept round the wrist for a few days affords slight support, and gives confidence to the patient.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting, the arm supported on a cushion on a table. The arm may be allowed to rest on the splint during treatment for the first 3 or 4 days, or may be carefully removed to a hard cushion from the 3rd day.

MASSAGE.—From the beginning. The whole arm and hand should be treated, much effleurage being given to reduce the œdema. Special attention should be paid to the internal lateral ligament. A painful spot often remains here when all other tenderness has disappeared. Gentle frictions should be given over it from about the 3rd day.

MOVEMENTS.—*Fingers*: Active movements should be given from the beginning, the patient being told to move them herself as much as possible between treatments. *Elbow*: Flexion and extension may be given from the beginning after the splint has been replaced. *Shoulder movements*—especially in old people—are advisable from the beginning, with the splint in position. The elbow should be held firmly in its semiflexed position when giving rotation, or pronation and supination may be included in the movement. *Wrist*: Flexion and extension may be given in small range from the 3rd or 4th day. *Radio-ulnar joints*: Supination and pronation may be added on the 5th to 7th day.

In cases where the fracture is known to be impacted, or there is no mobility of fragments, movements may be given even earlier.

EXERCISES.—These should be possible in about 2½ to 3 weeks. All inflammation should by then have subsided. They should consist of such exercises as turning the door-handle, or using the wrist machine, if available, and pronation and supination, holding a rod or poker (not too heavy); wrist shaking, backward and forward and laterally; making a fist, or squeezing a rubber ball. Later the stronger exercises, as for 'stiff wrist' (*see* p. 78) may be added.

The patient should be ready to do light work in about a month, and hard work in 6 to 8 weeks.

A Colles's fracture may be complicated by an accompanying injury to the shoulder, consisting of a bruising of the cartilage. Pain arises in the shoulder two or three weeks after injury. It should be treated by rest and massage only for three weeks, and then movements should be begun (Mennell).

Chauffeur's Fracture

This is very common at the present day, and is so called because it often occurs as the result of a blow from the starting-handle of a car. It is a fracture across the styloid process of the radius into the wrist-joint. There is generally no displacement.

Treatment.

FIXATION.—(1) Short *cock-up splint*, leaving the fingers free, 10 to 14 days, or longer; then a sling only, for 1 week. (2) *Plaster*, for a similar period.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning.

MOVEMENTS.—*Elbow*, *shoulder*, and *fingers*, as for Colles's fracture. *Pronation and supination*, 7 days. *Wrist*, 9th to 10th day.

Separated Lower Epiphysis of the Radius

This, in children and young people under the age of 20, corresponds to Colles's fracture in the adult, the displacement being similar.

Treatment.—

PHYSICAL TREATMENT.—This is on the same lines as that of Colles's fracture, but should be advanced much more slowly, since unless the fragments are in quite correct relation to each other, serious deformity may result, as the growth of the radius may cease, the epiphysis becoming prematurely united to the diaphysis, while that of the ulna continues.

MASSAGE may be begun early, though this is not necessary in small children, whose muscles do not readily waste. It is advisable to delay flexion and extension of the wrist for 7 to 10 days, and pronation and supination for a fortnight.

BONES OF THE WRIST AND HAND

Fracture of the Scaphoid

This is a most troublesome injury, and the result of treatment is often unsatisfactory. There is rarely bony union between the fragments; pain persists for a long time; arthritis may develop in the wrist-joint, and permanent weakness may result (Page and Bristow).

The scaphoid is the only carpal bone commonly fractured. It is generally broken across the middle by a fall on the wrist.

SYMPTOMS.—There is pain in the 'anatomical snuffbox', and tenderness which takes a long time to disappear entirely.

Treatment.—

FIXATION.—(1) *Cock-up splint*, with the wrist in full dorsiflexion, the fingers free, and the thumb in abduction and opposition, 3 to 4 weeks; followed by a bandage for a week or so. (2) *Plaster*, in a similar position.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning; the hand should be left lying on the splint during treatment for about a week; when removed, it should be carefully supported in dorsiflexion.

MOVEMENTS.—*Fingers and elbow*, from the beginning. *Radio-ulnar joints*, 4 to 5 days. *Wrist*, 4 weeks.

EXERCISES.—6 to 7 weeks. Full work: 3 months.

SURGICAL TREATMENT.—In cases where there is serious displacement, the bone is sometimes removed. The prognosis is not very good, and movement is rarely complete.

POST-OPERATIVE TREATMENT.—As above.

Fracture of the Base of the First Metacarpal

(*Bennett's Fracture*)

This fracture is common in boxers. The base of the first metacarpal is split up by the impact of the trapezium.

DISPLACEMENT.—There is a longitudinal split upwards and backwards from the base, involving the carpo-metacarpal joint. (This, it will be remembered, is the 'saddle joint', in which *opposition* of the thumb takes place). The distal fragment is displaced backwards, carrying the rest of the thumb with it.

Treatment.—

FIXATION.—The thumb is fixed in abduction and opposition, by one of the following methods—(1) The hand is bandaged over a *tennis ball.* (2) A *special splint* is used. (3) The thumb is fixed in position by *plaster.*

PHYSICAL TREATMENT.—

MASSAGE.—The whole arm should be treated from the beginning.

MOVEMENTS.—*Wrist and fingers* (gently) at once. *Thumb,* 7 to 10 days. The hand may be used freely in about a month, but strenuous use (as boxing) is not advisable for 2 to 3 months (Page and Bristow).

Fracture of Other Metacarpal Bones

Treatment.—

ONE ALONE.—The hand is bandaged over a *tennis ball* for a week, with a sling. Massage and all movements may be given from the beginning.

MORE THAN ONE.—Fixation is as above, or a special plaster splint is applied. Movements are given from the third day.

The curve of the tennis ball is just sufficient to maintain the correct curve of the metacarpal bones.

Fracture of the Phalanges

These fractures may be of the shaft, head, or base of the bone. The fracture of the shaft has the best prognosis.

Treatment.—

FIXATION.—The affected finger or fingers are partially flexed at all joints and kept in position, either by means of *strapping and a pad,* or of small *gutter splints* ; or they may be bandaged over a *tennis ball.* In the case of fractured shaft the apparatus is retained for about 14 days ; in the other cases for a few days only.

PHYSICAL TREATMENT.—

MASSAGE.—If required at all, it may be begun at once ; the whole arm should be treated.

MOVEMENTS.—Fractured shaft, 7 to 10 days ; fractured head or base, 2 to 3 days.

VOLKMANN'S ISCHÆMIC CONTRACTURE

A few words are necessary on the above subject, since the condition is so much more common in the forearm and hand than elsewhere. It consists of a contracture of muscles, together with nerve injury, and is due to compression of the arteries and veins in the limb.

ETIOLOGY.—It is commonest in children, generally in those under twelve years of age. The cause is a partial and temporary stoppage of both arterial and venous circulation in the part. (A *complete* stoppage would produce gangrene). This partial deprivation of arterial supply causes degeneration of the muscles, and the blocking of the venous return causes increased exudation in the tissues.

The actual cause of the stoppage is either : (1) *Pressure on the vessels* by splints, plaster, or tight bandages, especially in the neighbourhood of the elbow ; or (2) *Injury to the arteries and veins,* or partial occlusion of them, due to the trauma itself, or to disease of the vessels.

PATHOLOGICAL CHANGES.—These are found in the muscles, nerves, and skin : (1) The muscles degenerate, and are replaced by connective tissue. They harden and shorten, and are often found to be matted together. (2) The nerves are compressed by this 'scar tissue'. Probably they also are affected by the cutting off of their blood-supply. (3) In the skin, trophic changes, resembling those found in a lower motor neuron lesion (*see* p. 110) appear.

SYMPTOMS.—*At the time of compression* (say of vessels at the elbow) : (1) Severe and increasing pain. (2) The hand and fingers become swollen and discoloured—first red, then blue—and blebs (blisters) appear. (3) A very short time suffices for serious damage to be done. 'Claw-hand' appears in twenty-four hours, but even a few hours' compression may do irreparable injury. (4) Ultimately, if the pressure be not relieved, there is necrosis (death) of the skin and muscles on the front of the arm below the elbow.

AFTER-EFFECTS.—(1) The flexor muscles are hard and contracted, and stand out prominently when stretched. (2) *Position of the hand and arm.* The elbow is flexed, the forearm pronated, the wrist a little flexed, the metacarpo-phalangeal joints hyperextended, and the interphalangeal joints flexed (claw-hand). The fingers cannot be straightened unless the wrist is fully flexed. Later, the thenar eminence wastes, and the thumb lies on the same plane as the fingers ('monkey hand'). (3) *Loss of sensation.* This occurs in varying degrees—at once, if the nerves are actually damaged, or later if they are involved in the scar tissue. There may be complete sensory loss in the hand, and the nerves of the forearm may be hypersensitive. Sometimes all passive movement causes pain.

Treatment.—

PROPHYLACTIC TREATMENT.—Great care should be taken in applying splints and bandages—especially to the limbs of children—not to have them too tight anywhere. If swelling is still present, or likely to be present later, allowance must be made for it. In applying a short anterior forearm splint, the masseuse should see that its upper end does not press on the structures at the bend of the elbow. An arm put up in the Robert Jones position may also be bandaged too tightly in the attempt to get the flexion quite full. In any of these cases, the following procedure should be observed :—

1. The radial pulse should be taken at the wrist, and its strength compared with that in the opposite limb.

The finger should be pressed on the patient's hand, so as to whiten the part, and the operator should see if the blood returns immediately on removal of the pressure. If there is the least doubt as to the correctness of the splint or bandage, it should be removed and re-applied. It is far better to do so needlessly than to risk such serious harm to the patient.

2. *No child* ought to be allowed to leave hospital for at least twenty-four hours after his fracture has been splinted for the first time. In any case, the patient, or his parents, should be warned to report *immediately* to his doctor if there should be—at any time—any sign of pain, œdema, or discoloration.

3. If any such signs are noticed, the masseuse should let the doctor know at once, and pending his arrival the bandages or splints must be removed. Massage should be applied to the muscles, and passive movements to the wrist and fingers, and the splints must not be re-applied until the circulation is normal again. The fracture must, of course, be supported during the process.

REMEDIAL TREATMENT.—The prognosis is not good in these cases, but a substantial improvement can often be obtained.

SPLINTING.—The contracted structures are gradually stretched by a

succession of splints. The following (Robert Jones method) or some variant of it, is most often used.

First Position: The wrist and metacarpo-phalangeal joints are fully flexed, and the interphalangeal joints are extended. The fingers are separately splinted in this position.

Second Position: A splint reaching to the wrist is applied over the finger-splints, the metacarpo-phalangeal joint being now extended. The wrist is still flexed.

Third Position: A splint is put on over the others from finger-tips to elbow. It is gradually altered as the wrist is brought from flexion to hyperextension. The final position is maintained for some weeks.

PHYSICAL TREATMENT DURING THE PERIOD OF SPLINTING.—

MASSAGE.—The hand may be massaged whenever the splints are removed for alteration, and the arm and forearm be treated daily. The extensors of the wrist may receive stimulating massage, but the flexor aspect of the forearm must be treated with gentleness, kneading—with the palm of the hand or with the fingers—and effleurage being the best movements. It is well to soak the patient's arm in hot water before treatment, in order to soften the tissues. The whirlpool bath, if available, is better still.

MOVEMENTS.—Passive and active movements to elbow and shoulder must not be neglected. Extension of the elbow and supination of the forearm are important, as these movements are limited. (The existence of the original injury—fracture or dislocation—may of course have to be considered in the early stages.) When the splints are removed, stretching manipulations and active movements may be given; e.g., at the early stage when the interphalangeal joints have been splinted in extension, but the metacarpo-phalangeal joints are still flexed, passive and active extension are given to the latter.

If the hand is not splinted as described above, but massage and movements alone are used plus some simple splint, the result is rarely so satisfactory. The splint may have a hinge allowing the extension of fingers and wrist to be gradually increased, but it is very difficult to keep the small fingers of a child in good position unless they are splinted separately, or even to prevent the hand from slipping backward on the splint, so that the wrist is no longer fully extended. The massage treatment should be carried out as above, and the passive movements should follow the same principles as the Robert Jones method of splinting, the finger-joints, the metacarpo-phalangeal joints, and the wrist-joint being extended successively, and the splint altered from time to time.

SURGICAL TREATMENT.—Operations are occasionally performed, the muscles being freed from scar tissue, and the nerve branches dissected out. The affected muscles are lengthened. Their tendons are sometimes divided and attached to those of other healthy muscles performing similar actions, if such exist. The results of operation are rarely very satisfactory.

POST-OPERATIVE TREATMENT.—(1) As soon as ordered, massage may be carried out in the way described above. (2) The mobility regained at the operation must be maintained by passive movements. (3) All muscle groups should be re-educated, flexors as well as extensors. (4) Faradism may be used to stimulate individual muscles.

CHAPTER III

FRACTURES OF THE LOWER EXTREMITY

Femur—Patella—Tibia—Fibula—Tibia and fibula—Bones of foot—Re-education in walking.

THE FEMUR

We will consider as typical fractures those of: (1) *The neck;* (2) *The shaft* (upper, middle, or lower third); (3) *The lower extremity*, involving the knee-joint. But first it is necessary to say something about the splinting of these fractures.

SPLINTING OF THE FEMUR.—It is essential, in almost all cases of fracture of the femur, to apply *traction* to the injured limb, in order to correct any overlapping of the bones, and consequent shortening of the leg; and to maintain this traction until union is firm, as otherwise re-displacement may be brought about by the pull of the powerful muscles of the thigh.

In applying traction to a limb, it is necessary that there should be some fixed point from which the stretching force can act—that is, as well as traction there must be *counter-traction*. This counter-traction is obtained in various ways by the different types of splints.

1. *The Thomas splint* is, in one or more of its forms, familiar to all. The simplest variety consists of a leather-covered ring, which should fit accurately round the upper part of the thigh, lying close below the tuberosity of the ischium. From this ring two side-bars pass downwards, and are joined at their lower ends by a notched cross-piece. The limb is supported in the splint by flannel slings stretched between the side-bars. Two bands are affixed to the sides of the limb by means of circular strips of adhesive plaster or by some similar method. Below the level of the foot these bands are fastened to a flat piece of wood, or 'spreader', which in its turn is attached to the cross-piece at the end of the splint. Sometimes, instead of being thus attached directly to the end of the splint, the bands are fixed to a sliding bar placed across it, and this may be drawn down by means of a screw connected to the end bar of the splint, so that the amount of traction may be increased at will (*Fig.* 18). The pressure of the ring against the ischial tuberosity provides the counter-traction. The end of the splint rests on a block or sand-bag, so that the leg is kept clear of the bed; or the leg is slung from a beam overhead. This form of splint is often used for children and young people. In adults the traction is more often applied by means of a weight and pulley.

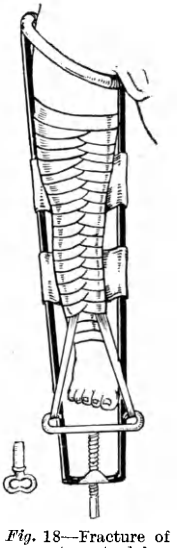

Fig. 18—Fracture of femur treated by Thomas's splint.

2. The more elaborate forms of the application of traction cannot be described here. Many of these, like the *Hodgen splint*, use the weight of the patient's body as counter-traction by raising the foot of the bed six inches or more on wooden blocks. This obviates the necessity of the ring pressing on the ischial tuberosity, and thus avoids the danger to the patient's skin from friction in that region. The hip may be kept more or less flexed according to the height at which it is slung up from the bed. If it is to be *abducted* the overhead beam is placed diagonally across the bed, being nearer its edge on the patient's sound side at the head, and nearer the injured side at the foot (Balkan beam). In the Hodgen splint, and in some varieties of the Thomas, the knee is slightly flexed.

3. *'Gallows' splint* for small children. Both legs are slung up vertically at right angles to the trunk by means of strapping and cords to a bar over the child's bed. The weight of the body exerts the traction.

4. *Plaster* is sometimes used, in the form of a spica round the affected limb and the pelvis. This is generally for the purpose of maintaining the limb in abduction.

5. *Transfixion pins and extension caliper.* Sometimes, instead of fastening the leg to the end of the splint, or direct to a weight and pulley apparatus, by adhesive strapping, bandages, etc., the fixation is carried out by means of a steel rod taken right through the lower extremity of the femur, or by a caliper apparatus resembling a pair of tongs, which grips the femur firmly just above the condyles, but does not penetrate deeply into the bone. The weight is attached to this apparatus. These methods, provided that the patient can bear them and that there is no danger of sepsis, have the advantage of leaving the knee free, so that it can be moved from the beginning, and subsequent stiffness in the joint be avoided.

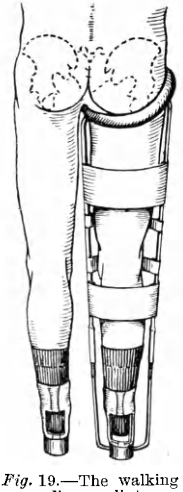

Fig. 19.—The walking caliper splint.

All these splints should have a footpiece so arranged that the foot is kept at a right angle with the leg. Great care must be taken in restoring to its correct position any part of the apparatus which has been removed for treatment. If no nurse is in attendance, the care of the patient's skin becomes the responsibility of the masseuse. This needs special attention in cases where counter-traction is obtained by pressure on the tuberosity of the ischium. The skin here may be drawn upwards or downwards from under the ring, so that the same part does not always receive the pressure.

The walking caliper is used when it is considered advisable for the patient to walk, but when union of the bone is not sufficiently strong to allow of the weight of the body being safely transmitted through the injured limb to the ground. The walking caliper resembles a Thomas splint, but the ends of the side-bars, instead of being joined by a cross-piece, are inserted into the sides of the heel of the boot (*Fig.* 19). They are of sufficient length to keep the patient's heel at least $\frac{3}{4}$ in. above the upper surface of the heel of the boot—so that the body weight is transmitted from the ischial tuberosity to the ring of the splint, on which it rests, and thence down the side-bars to the heel of the boot, and so to the ground, and does not pass through the bones and joints of the injured leg, which, as it were, hangs free within the splint. The heel of the boot of the sound leg is raised $\frac{3}{4}$ in.

Fractures of the Neck

Fractures in this region may take place high in the neck close to the head, or low down near the trochanters. The former corresponds to what is often called an 'intracapsular', the latter to an 'extracapsular' fracture. Neither term is quite accurate, because either fracture may be partly within and partly without the capsule, since this ligament is attached much nearer to the trochanters in front than at the back. The high fracture is most common in elderly or old women, and takes place as the result of indirect violence, generally of a trivial character. The low fracture occurs most frequently in working men of middle age, and is usually caused by direct violence—e.g., a blow on the great trochanter.

DISPLACEMENT.—The lower fragment is displaced upwards and rotated outward (*Fig.* 20). The leg is therefore adducted and rotated out, and there is more or less shortening. Impaction sometimes takes place, especially in fractures due to direct violence. Bony union is the rule in the lower fracture; but in the higher one, non-union, or fibrous union only, is common.

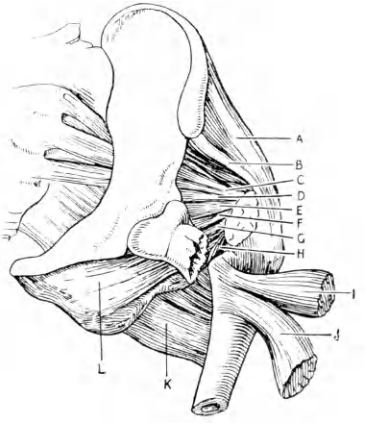

Fig. 20.—Displacement in fracture of neck of femur. A, Gluteus medius; B, Gluteus minimus; C, Pyriformis; D, Gemellus superior; E, Obturator internus; F, Gemellus inferior; G, Obturator externus; H, Quadratus femoris; I, Psoas major; J, Iliacus; K, Gluteus maximus; L, Obturator externus. (*After Gray.*)

Treatment.—

Treatment of Old and Weak Patients

FIXATION.—These are not kept in bed longer than is absolutely necessary, owing to their liability to develop lung troubles. They are generally allowed to sit up in bed, and the legs are kept in abduction by *sand-bags*. In a few weeks a walking caliper, or plaster case, is fitted, and the patient is encouraged to get about, even if the fracture shows no sign of union. There are, however, some old and very feeble patients who are never able to walk again after the accident.

PHYSICAL TREATMENT.—If ordered, this consists of gentle massage as soon as the patient has recovered from the shock of the accident. Gentle active movements are added in a few weeks. The patient needs assistance in walking with a caliper, and later, if she is able to discard this, she must be helped to walk as correctly as possible.

Treatment of Younger and Stronger Patients

FIXATION.—The fracture is set, and maintained in abduction for two months, either by: (1) A *plaster spica*; (2) A *Thomas or Hodgen splint*; or (3) *Special abduction splints.*

Sometimes the leg is supported by *sand-bags* for a month after any of the above are removed.

PHYSICAL TREATMENT.—If the limb is on a Thomas or Hodgen splint:—

Massage.—Effleurage and kneading may be applied at once to any part of the limb that can be reached without disturbing the apparatus. Frictions

round the knee-joint and lateral movement of the patella are important. The lower leg is covered by strapping, but the foot and ankle may be treated.

MOVEMENTS.—*Toes and ankle*, from the beginning, the foot-piece being removed. The *knee* cannot be moved while the traction apparatus is in place, but contractions of the quadriceps without movement of the joint are safe and necessary, and will prevent—or at least minimize—the otherwise inevitable atrophy of these muscles. *Contractions of the glutei and abdominal muscles* may also be practised by the patient.

After Removal of the Fixation Apparatus

MASSAGE.—*Brisk massage* of the whole limb may be given. The calf muscles and glutei need special attention.

MOVEMENTS.—*Knee Movements* must be begun, and practised assiduously, as stiffness in this joint is one of the most unfortunate consequences of a fracture of the femur at any level. The patient will begin by trying to flex the knee actively with the help of the operator, who supports the thigh, and later, forced movements must be added.

Hip Movements.—Flexion and extension may be fairly easily regained, as probably the patient has made sufficient movements of the trunk to prevent serious fixation; abduction and inward rotation present the greatest difficulty. The movements must be gradually increased, with perseverance on the part of both patient and masseuse.

When the Patient Gets up

The patient may be allowed to get up at the end of the 3rd month, or later, according to the condition of the bone as ascertained by means of the X rays. He is now given a walking caliper. At this stage two points in the treatment stand out as specially important: (1) *The patient must be content to resume activity slowly and gradually.* If he sits for hours with his foot resting on the floor, or walks until he is exhausted, he will suffer from severe and persistent swelling of the lower leg and foot, which will be most difficult to cure. This applies not only to all cases of fractured femur, but in some degree also to injuries of the bones of the lower leg. (2) *The muscles of the leg should be assiduously exercised* during the time he is walking with a caliper, and not putting weight on the limb; otherwise, when he discards his caliper, he will develop flat foot or some similar disability, owing to their weakened condition.

EXERCISES such as the following may be given.—

A. In half-lying or lying.—2-Leg-abduction and -adduction (*a*) free, (*b*) resisted. Leg-abduction and -inpressing. Leg-rotation-in, concentric and eccentric. Alternate- (or 2-) knee-updrawing (*a*) free, (*b*) resisted. Leg-outstretching (resisted).

B. In sitting or stride-sitting.—(On table) Leg-swinging (*a*) free, (*b*) with weight attached to foot. Knee-bending and -stretching. (On stool) Knee-rotation in and out. All foot exercises except those for eversion (*see* p. 84).

C. In standing (on the sound leg).—(Between two chairs) Leg-swinging forward and backward. (Between two chairs) Leg-forward and -backward-carrying (slowly). (Between two chairs) Knee-upbending and lowering. (On low platform or stool) Leg-circling (*a*) free, (*b*) resisted.

Later, when the patient actually begins to take weight on the injured leg, his standing and walking should be most carefully supervised. This is a matter which is often disregarded. Every patient after an injury to the lower extremity tends to evert his foot; every one is a potential victim of flat-foot. This fact

cannot be too much emphasized. If necessary, the boot should be raised on the inner side.

For *re-education in walking*, *see* p. 44.

Free exercises for stiff hip and knee (*see* pp. 80–82) are added at this stage.

Fractures of the Shaft

Upper Third

DISPLACEMENT.—The upper fragment is flexed by the psoas and iliacus, abducted by the glutei, and outwardly rotated by the short muscles attached to the great trochanter; the lower one adducted and drawn upwards.

Treatment.—

FIXATION.—The hip is put up in flexion and abduction, and traction applied by means of one of the above-described splints.

Middle Third

DISPLACEMENT.—The upper fragment is flexed by the iliopsoas, and drawn inward by the adductors; the lower tilted backwards by the lower part of adductor magnus, and drawn upwards by the hamstrings and rectus femoris. There is generally a good deal of overlapping, with marked shortening of the leg (*Fig.* 21).

Treatment.—

FIXATION.—Traction by *Thomas splint*, *gallows splint*, *plaster*, etc., the leg in a line with its fellow.

Fig. 21. — Displacement in fracture of middle of shaft of femur.

Lower Third

DISPLACEMENT.—This may be considerable, making the injury a very serious one. The lower fragment is tilted backwards by the gastrocnemius; the upper is adducted and flexed. The upper end of the lower fragment may press on vessels or nerves in the popliteal space; the upper fragment may pierce the rectus or crureus.

Treatment.—

FIXATION.—Traction by a *Thomas* or *Hodgen splint* with the knee flexed.

In all these cases, the splints are worn for about two months—a little less in fractures of the lower third—and are sometimes succeeded by support by sandbags for another month. The *walking caliper* may be worn for two months or more.

PHYSICAL TREATMENT.—In all fractures of the shaft the physical treatment is similar to that described above for fractures of the femur generally.

T-Shaped Fractures into the Knee-joint

DISPLACEMENT.—The fracture is a transverse one just above the condyles, and a vertical line of fracture runs down into the joint. It is analogous with the T-shaped fracture at the elbow. There is traumatic arthritis of the knee-joint, and much swelling.

Treatment.—

FIXATION.—*Traction* with the knee in extension, 4 weeks or longer. Later (after the 2nd month), *walking caliper*, for about 2 months.

PHYSICAL TREATMENT.—

MASSAGE.—As for fractures of shaft.

MOVEMENTS.—*Foot and ankle* from the beginning. *Hip*, as far as apparatus allows, as soon as possible. *Knee*, end of 4th week. The movement must be very gentle at first, and never forced.

Later treatment as for other fractures of the femur.

OPERATIONS ON THE SHAFT.—Sometimes, owing to the impossibility of getting the fragments into place by manipulation, open operations have to be performed. Most often the bone-ends are fixed in position by means of a plate extending well above and below the site of fracture.

POST-OPERATIVE TREATMENT.—

Fixation.—The supports used are the same as for those fractures where the bones are set without operation. But they have to be retained longer, since in these cases union takes place very slowly, and any strain on the ununited bone may loosen the screws. The patient will have to remain in bed for a more extended period, and will be obliged to wear his walking caliper for many months.

Physical Treatment.—This is on the same lines as for the other cases. The knee should be moved as early as the surgeon will allow, otherwise the long course of fixation produces that terrible stiffness of this joint which is the despair of the unfortunate masseuse who is given the case some months after injury. The scar needs proper care (*see* p. 68).

THE PATELLA

Stellate Fracture, or Fracture without Separation of Fragments

This fracture is caused by direct violence, such as a fall or blow on the knee It consists of cracks radiating outwards from the centre of the bone. Neither in this fracture, nor in that in which the bone is definitely broken into several pieces, do the fragments separate, because the anterior ligament of the knee—the continuation of the quadriceps tendon—remains intact, and holds them together.

Treatment.—

FIXATION.—The leg is put up with the knee in full extension on a *back splint* of some kind, with a foot-piece, for 10 to 14 days. After this, a short back splint, walking caliper, or other appliance to keep the knee straight, is used for 3 to 4 weeks.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning.

MOVEMENTS.—*Ankle, toes, and lateral movement of the patella*, from the beginning. *Knee*: flexion may be begun from the second or third day, gently and in small range. Strong movements are inadvisable during the first month.

Transverse Fracture

This is a much more serious injury, the result of muscular action—that is, of a sudden and strong contraction of the quadriceps, generally made by the patient in order to save himself from falling.

DISPLACEMENT.—The ligamentum patellæ, as well as the bone, is torn across; therefore the upper fragment is drawn up for a considerable distance by the quadriceps, leaving a gap of from ½ in. to 1 in. between itself and the lower fragment. The torn fibres of the ligament may interpose themselves between the broken parts and prevent bony union from taking place even if the fragments can be brought and kept together. In fact, unless an operation is performed, fibrous union is the rule. If the gap is wide, this is a serious matter,

as the extra inch or so let into the quadriceps tendon prevents these muscles from locking the knee firmly in extension, and the patient complains of its 'giving way under him .

SYMPTOMS.—There is always much swelling—the knee-cap seems to lie in a bag of fluid. The gap between the fragments can easily be felt.

Treatment.—

SURGICAL TREATMENT.—In nearly all cases, except those in which the patient is too old or too delicate, these fractures are treated by open operation, the two fragments being wired together.

SUPPORT.—As a rule no splint is worn. The patient is kept in bed with the knee in extension, on a pillow, with several layers of wool and a firm bandage over the dressings. Later (2 to 3 weeks) the patient is generally allowed to get up and walk, wearing a caliper or back splint, which is retained for about 6 to 8 weeks.

PHYSICAL TREATMENT (Post-operative).—

MASSAGE AND MOVEMENTS.—

First 3 *Days.*—(1) Massage of thigh ; special attention to quadriceps (especially vastus internus). (2) Massage of lower leg, ankle, and foot. (3) Active movements of toes and ankle.

3*rd to* 4*th Day.*—(1) Lateral movement of patella ; the gauze dressing should not be removed ; care must be taken not to press on the wound (a U-shaped incision below and round patella). (2) Frictions (gently) at back and sides of joint. (3) Hip movements (assisted), the leg being supported with knee in extension.

After 7 *Days.*—Quadriceps contractions may be taught, and the patient instructed to practise them by himself. *Flexion and extension of knee* may be begun in very small range on the 8th or 9th day.

After 10 *Days.*—The stitches are generally removed on the 10th day, when the wound should be well healed.

Manipulations on the thigh may be given more deeply ; effleurage is carried over the sides of the knee ; deep frictions are taken all round the knee joint, and round the patella itself, to stretch adhesions. No strain must be put on the recently healed wound, but it should be carefully and gradually loosened from underlying tissues by frictions should it have become adherent.

Movements of knee may be increased in range, the patient turning on to his sound side.

End of 2*nd Week.*—Light hacking may be added, for the quadriceps and calf muscles. At this stage the patient is often allowed to get up and walk, wearing a caliper or back splint. It would not yet be safe for him to take the weight of his body on the flexed knee, but he should practise flexion and extension in side-lying, sitting, etc. Rotation of the knee, in semiflexion, must not be forgotten.

After 3 weeks he may sit on the side of his bed or on a chair, and the knee may be flexed in this position, supported at first by the operator, and the support withdrawn gradually and at first only for a short time.

EXERCISES, without the body-weight, for hip and ankle must not be forgotten.

After 1 *Month.*—The knee should now be capable of flexion to a right-angle or more. Strong exercises (without weight) may now be given to restore mobility.

After 2 *Months.*—When the caliper is given up, all exercises for a stiff knee (in standing or other positions) may be practised. Re-education in correct walking is essential. The leg should be normal in 8 to 10 weeks.

CASES IN WHICH THE PATELLA HAS NOT BEEN WIRED

The result is rarely as satisfactory as in the cases treated by operation, since the chances of bony union are remote, and it is difficult to reduce the gap between the fragments, because no means of support has been devised which will keep them in *close* apposition. The course of treatment is a protracted one.

Treatment.—

FIXATION.—The knee is put up in full extension, on a *back splint* with a foot-piece. Some kind of strapping or other apparatus is applied to keep the fragments as close together as possible.

Later, the patient wears a walking caliper, a short back splint, a short leather case, strengthened with metal bars and laced on, or some form of plaster support.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Half-lying, the leg resting on the splint. If strapping is removed for treatment, the upper fragment must be firmly held down by the operator until the support is re-applied.

MASSAGE AND MOVEMENTS.—

1st Week.—(1) Massage from the beginning; much effleurage is necessary to reduce the swelling, which is generally considerable. On the 2nd or 3rd day, kneading may be added. (2) Active movement of toes.

2nd Week.—(1) At the beginning of the week, lateral movement of the patella may be given, great care being taken to keep the fragments together. (2) Active movements of ankle. Too strong dorsiflexion is unsafe, as this throws the quadriceps into action, to fix the origin of the tibialis anticus.

10 to 14 Days.—Careful flexion of the knee may be begun in very small range. (Hip and knee are flexed together, the foot being drawn up along the bed. The knee should be extended passively.)

End of 3rd Week.—(1) The splint may be removed for treatment, and the limb supported on a firm pillow. (2) Flexion of the knee is gradually increased, but must not be forced. The patient may lie on the sound side. (3) Gentle tapôtement may be used over the quadriceps, and the patient be taught to contract these muscles. Fairly deep frictions may be given round the knee and patella.

4th Week.—The knee may be flexed over the side of the bed, with careful support at first. Later, gentle leg-swinging is practised in this position. Foot drill, in sitting, should be added as soon as possible.

During this week, or in some cases earlier, the patient will be allowed to walk with a caliper or other splint. He should be made to walk as correctly as is possible with a stiff knee, and should be taught foot exercises to be done in standing as well as in sitting. At this stage he often ceases to come for treatment, the apparatus being worn for some months, sometimes being replaced by one having a hinge which allows of a *limited* amount of flexion at the knee. Before leaving, he should be taught knee exercises without the body weight, e.g.:—

EXERCISES.—Sitting (on table) Leg-swinging + knee-bending and -stretching. Standing (on sound leg) Leg-swinging (knee swinging loosely). Standing (on sound leg) Knee-upbending. Crook-sitting Knee-updrawing. Side-lying Knee-flexion and -extension. Stride-sitting Knee-rotation in and out.

When the surgeon allows the patient to dispense with supports altogether, he should return for a short course of strong exercises, and any errors in walking must be corrected.

The patient's age and health must, of course, be taken into consideration in choosing the exercises.

THE TIBIA

Fracture of the Head

This may be caused by direct or indirect violence, the latter consisting of a twisting or wrenching of the knee.

DISPLACEMENT.—Either tuberosity, or both, may be broken off. In the latter case, the fracture involves the knee-joint.

Treatment.—

FIXATION.—The knee is put up in extension. If both tuberosities are fractured, with displacement, and the knee-joint involved, a *Thomas* or similar splint is used for 3 to 4 weeks, followed after another week by a *walking caliper* for about 2 months. If one tuberosity only is involved, with little displacement, a *back splint* with foot-piece is used. In some cases with no displacement the knee is merely supported on a pillow, with sand-bags.

PHYSICAL TREATMENT.—The severer fractures, involving the joint, are treated much as the T-shaped fractures of the lower end of the femur. The fractures of one tuberosity, or both, *without displacement* are dealt with as follows :—

MASSAGE.—From the beginning. The operator should place one hand above the knee when kneading the quadriceps, in order to prevent drag through the ligamentum patellæ on the upper part of the tibia.

MOVEMENTS.—*Toes*, from the beginning. *Ankle*, 3rd day; dorsiflexion and inversion should be given gently at first, especially if the external tuberosity is involved, because of the attachment of the tibialis anticus to this part of the bone. *Hip*, 3rd day. *Knee*, 10th day. This type of fracture is generally painful, and however carefully the movements are given they are very apt to cause increased pain. If so, they must be omitted until it has subsided. It is for this reason a difficult fracture to treat. The patient may have moved the knee actively in quite small range, and apparently felt no pain at the time, and yet will complain next day of severe pain and aching during the night, though no signs of increased inflammation are visible. The same amount of movement in another apparently similar case will give no trouble. On the whole, especially in young patients, it seems better to delay giving the movements for a few days, and to restore the mobility later.

When the patient is allowed to walk with the caliper: Exercises without the body weight; foot exercises.

When the caliper is discarded: Strong knee exercises; re-education in walking.

Fracture of the Shaft

The commonest site of fracture is between the middle and lower thirds of the bone. The injury may be the result of direct violence, producing a transverse fracture; or of indirect violence, causing one of the oblique or spiral type.

DISPLACEMENT.—This is slight as a rule, and there is no shortening if the fibula is not broken. There may be angulation, or slight rotation in the oblique fractures.

Treatment.—

FIXATION.—(1) *Back splint from above the knee*, with foot-piece, and two side splints suitably placed. *Pads* are often used to prevent angulation. (2) *Plaster case*, from above the knee to the toes; later cut into halves, preferably anterior and posterior, so that one half may be removed for massage.

PHYSICAL TREATMENT.—

MASSAGE AND RE-APPLICATION OF SPLINTS.—Massage may be given from

the outset, if the limb is in splints; or, if in plaster, as soon as the latter has been cut into halves. The limb should be left resting on the splint during treatment for about 8 days. Great care should be taken in replacing the splints after treatment. If pads are being used to control angulation, the masseuse should make a note of their exact position before removing them. If the deformity is so slight as not to be noticeable to anyone but an expert, a mark with a flesh pencil may serve as a reminder. The foot must be kept quite straight on the splint, or very slightly inverted.

Mr. Handfield-Jones, in a lecture delivered to the members of the Chartered Society in February, 1928, and published in the May journal of that year, having emphasized the importance of the correct replacement of pads, and the unfortunate results to the patient if any angulation of the tibia is allowed to persist, says: "As a matter of fact, you should not always blindly replace splints, pads, and straps as you found them, but should act as the position of the limb demands. Let me therefore describe to you how you judge whether a fractured tibia is properly aligned. Stand at the foot of your patient and, looking up the whole length of the leg, see that the following bony points are in a dead straight line. (1) The inner surface of the metatarso-phalangeal joint. (2) The inner border of the patella. (3) The tip of the anterior superior spine of the ilium. Then sit beside the limb so that the eyes are on a level with the bone, and you will readily appreciate if there be any sagging of the fragments toward the splint, or any tilting forwards under the skin."

MOVEMENTS (period of union 10 to 12 days).—*Toes*, from the beginning. *Ankle*, 5th day. The foot-piece of the splint should be unscrewed while giving the movements, or if it be fixed, the splint may be drawn down a little, with very careful support of the limb. The movements should be administered gently, and the bone below the site of the lesion firmly supported while giving inversion and eversion, lest the lower fragment should be rotated. *Knee*, 8th to 10th day, with careful support.

End of 3 or 4 Weeks.—The splint is removed; exercises without the body weight may be begun.

End of 5 to 6 Weeks.—The patient generally begins to walk, sometimes with an ambulatory plaster, i.e., one applied to the leg from below the knee to the ankle (Page and Bristow).

Re-education in correct walking is essential.

In *oblique* fractures with much displacement the patient may have to wear a splint for a much longer period, and the giving of movements will have to be postponed. In these, and in compound, comminuted, or complicated fractures—which are generally the result of street accidents—the whole treatment must be modified. The X-rays will determine the degree of union present at any time, and on this the treatment depends.

Fracture of the Internal Malleolus

(*Wagstaffe's Fracture*)

This may occur either as the result of violent inversion or violent eversion of the foot. In the latter case the malleolus is torn off by the drag on the deltoid ligament, which may hold while the bone gives way. It may be combined with a Pott's fracture.

DISPLACEMENT AND SYMPTOMS.—The displacement is slight or absent if the fibula is not broken. There is a good deal of swelling, i.e., traumatic arthritis of the ankle.

Treatment.—

FIXATION.—The foot is put up at right angles to the leg: (1) On a *back splint*, or (2) In *plaster*, for 3 weeks.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning; as for Pott's fracture, except that the

site of the fracture on the *inner* side must be avoided. The foot should rest on the splint during treatment for the first week.

MOVEMENTS.—*Toes*, from the beginning. *Knee*, from 3rd day, with splint on, or with the ankle properly supported. *Ankle and foot*: flexion and extension, 5th day. (*a*) *If the injury was caused by inversion, and the deltoid ligament is undamaged*, eversion 6th to 7th day, inversion 7th to 8th day. (*b*) *If caused by eversion*, movements as for Pott's fracture (*see below*).

2nd Week.—The splint may be removed for treatment, the knee being semiflexed on a cushion.

3rd Week.—Foot and leg exercises without body weight.

5 to 6 Weeks.—Walking allowed; re-education; foot exercises in standing.

THE FIBULA

We shall here consider: (1) Fractures of the upper extremity or upper two-thirds of the shaft; and (2) Fracture-dislocations of the ankle and foot, comprising (*a*) Pott's fracture, and (*b*) Dupuytren's fracture.

Fracture of the lower part of the shaft, or of the external malleolus, without dislocation, receives similar treatment to Pott's fracture, but may be advanced more quickly. The treatment of a separated lower epiphysis of tibia or fibula is much the same as that for the Pott's fracture.

Fractures of the Upper Extremity and Upper Two-Thirds of the Shaft

These are as a rule trivial injuries, if the tibia is intact. They are generally caused by direct violence.

DISPLACEMENT.—This is slight as a rule. In a *high* fracture there may be traumatic arthritis of the knee, with swelling; in a *low* one, swelling of the ankle and foot.

COMPLICATION.—If the head is the site of fracture, there may be injury of the external popliteal nerve as it winds round to the front of the leg, causing dropped foot (*see* Chapter XII).

Treatment.—

FIXATION.—No splint is required, but adhesive strapping or a bandage is sometimes applied.

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning.

MOVEMENTS.—*Toes*, *foot*, and *ankle*, from the beginning; also quadriceps contractions. *Knee*, 3rd day.

EXERCISES (without body weight).—7 days. *Walking* is generally permitted at 10 days, and exercises for knee or ankle, in standing, may be given if required.

Pott's Fracture

This is an oblique fracture of the fibula just above the inferior tibio-fibular articulation, combined with either rupture of the deltoid ligament, or fracture of the internal malleolus (*Fig.* 22). It is caused by indirect violence—that is, by a violent eversion of the foot.

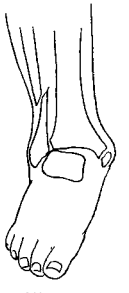

Fig. 22.—Pott's fracture.

DISPLACEMENT.—Owing to the low fracture of the fibula, the ankle-joint is rendered insecure, the astragalus being no longer held firmly between the lower ends of the tibia and fibula. It is further weakened by the tearing of the strong deltoid ligament, and, sometimes, by the giving way of the internal malleolus. The foot is therefore displaced outwards by the forcible eversion;

it may also be displaced backwards. In the latter case, dorsiflexion is limited. There is much swelling and pain, with arthritis of the ankle-joint.

COMPLICATION.—Flat- or weak foot is a late complication.

Treatment.—

FIXATION.—The foot is put up in dorsiflexion to a right-angle, and in full inversion. The apparatus used to maintain this position may be:—

1. *A back splint, with foot-piece.*—The latter may be fixed to the main splint by a screw, so that it can be so inclined as to support the foot in inversion. If, however, it is of one piece with the main splint, the foot must be kept inverted by means of cotton-wool padding under its inner border. The back splint reaches above the knee. Additional security is sometimes obtained by means of two side splints, which should rest on the edges of the back splint, and which are strapped or bandaged into position.

2. *Plaster*, which may later be divided so that it can be removed for treatment.

Either form of support is retained for about 3 weeks.

PHYSICAL TREATMENT (For a case of average severity, with definite outward displacement).—

POSITION OF PATIENT.—The limb is left resting on the back splint, or on the posterior half of the divided plaster, for 6 days. It is most important that the splint should be correctly re-applied after treatment.

MASSAGE.—From the beginning. Thigh, leg, and foot should be treated in the usual way, and the patella moved laterally.

MOVEMENTS.—*Toes*, from the beginning. *Hip movements* are given, with the splint in position. *Ankle*: flexion and extension may be given from the 5th day, carefully in small range. *Knee*, 6th day, the foot being carefully supported. *Mid-tarsal joints*: inversion of the foot may be given from the 6th or 7th day, with eversion in small outer range only. At no time during treatment should the foot be carried into full eversion.

2nd Week.—The splint may now be removed for treatment, and the leg placed, in slight flexion, on a firm pillow. The massage should be gradually deepened, and the range of the movements increased. If there has been backward displacement, extension of the ankle must not be forced.

EXERCISES.—Exercises in sitting may be given at the end of the 3rd week, or during the 4th. The patient may be walking on crutches. The foot must not be allowed to hang down for long periods at first (*see* p. 32).

Leg-swinging, Foot-bending and -stretching, Sitting Toe- and heel-raising, and Foot-inversion, Toe-flexion and -extension, etc., are all suitable.

WALKING.—This will probably be permitted in about 6 weeks in an average case. The patient should always have the sole and heel of his boot raised on the inner side for 2 to 3 months after he begins to walk, so as to avoid the great danger of flat-foot with eversion. He ought not to walk much until he can wear a boot comfortably. *Re-education in walking* is vitally important; it is fully dealt with on p. 44.

If the patient's leg has been kept in a fixed plaster for 3 weeks, and not treated during this period, fairly vigorous massage may be given, and all movements, active and passive, (not, of course, eversion) may be started as soon as the plaster is removed. Exercises without superimposed body weight may be begun a day or so later.

Dupuytren's Fracture

DISPLACEMENT.—This is a very serious injury. The interosseous ligament connecting the tibia and fibula is ruptured, and the astragalus is forced

up between the two bones. There may be fracture of the lower end of the fibula, or of the tibia, or of both bones. The foot may be displaced backwards, inwards, or outwards, as well as upwards.

Treatment.—

FIXATION AND PHYSICAL TREATMENT.—These are on the same lines as for Pott's fracture, but progress must be a good deal slower. The giving of all movements should be delayed 2 to 3 days. (If the displacement of the foot was *inwards*, the foot is put up straight, not in inversion, and movements of eversion are given before those of inversion.)

WALKING is probably not allowed for 8 to 10 weeks.

SURGICAL TREATMENT.—If the displacement cannot be satisfactorily reduced, an open operation will be necessary. The tibia and fibula are bolted together, or the loose fragments of bone are removed.

POST-OPERATIVE TREATMENT.—Massage may be begun, on the usual lines, on the day after operation. Movements should not be given for 10 days.

TIBIA AND FIBULA

This fracture is common in adults. It may be due to direct or indirect violence. In children it is generally caused by direct violence, as by being run over.

DISPLACEMENT.—

DIRECT VIOLENCE produces a transverse fracture of both bones at the same level (*Fig.* 23). There is generally much lateral displacement, and angulation may be very marked. The fracture is often compound, the broken end of the tibia protruding through the skin, or the soft tissues being severely damaged at the time of the accident.

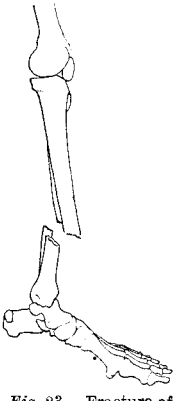

Fig. 23.—Fracture of tibia and fibula.

IN FRACTURES PRODUCED BY INDIRECT VIOLENCE each bone gives way at its weakest part, the tibia at the junction of its middle and lower third, and the fibula near its upper end. The fractures are spiral or oblique. There is a good deal of overlapping, and rotation of the lower fragments is often considerable. Swelling in these fractures may be very great.

Treatment.—

FIXATION.—

CASES WITH SLIGHT DISPLACEMENT.—The foot is put up in dorsiflexion to a right-angle, and the knee in extension by means of: (1) *A back splint with side pieces* (3 weeks). Pads may be used to correct angulation. This may be followed by a divided plaster case for 2 to 3 weeks, the patient walking on crutches; or (2) *A fixed plaster case*, divided after 7 to 10 days.

CASES WITH MARKED DISPLACEMENT.—(1) *Traction* is applied by means of a Thomas splint or other apparatus for about a month, generally followed by a divided plaster; or (2) *Plaster* from the beginning, divided later.

PHYSICAL TREATMENT (of cases on splints, or in removable plaster).—

POSITION OF PATIENT: REMOVAL OF SPLINTS.—The limb should be left resting on the splint for about 10 days, and when it is removed for treatment it should be most carefully supported, the operator's hand grasping the limb firmly above and below the site of the fracture. Great care must be taken to see that it is supported in its whole length, so that the weight of the part of the limb below the fracture never falls on the soft callus. Accurate replacement of the splints, and of the pads if these are in use, after treatment, is also of supreme importance (*see* p. 38).

MASSAGE AND MOVEMENTS.—Massage of the thigh may be given from the beginning, with frictions round the knee, avoiding the site of the break in high fractures of the fibula; also lateral movement of the patella.

2nd Day.—Active movements of the toes may be begun.

3rd Day.—Effleurage of the lower leg, with careful support of the site of fracture, may be added; also frictions round the ankle, and massage of the foot.

4th Day.—Finger kneadings to the muscles of the lower leg, as far as they can be reached, with very careful support, and avoidance of the sites of both fractures.

2nd Week (*7th Day*).—Flexion and extension of the ankle, in small range.

8th Day.—The leg may be kneaded carefully with the hand.

Inversion and eversion of the foot may be added. The masseuse must give firm and careful support above the ankle, lest rotation should occur at the site of fracture.

10th to 12th Day.—Flexion and extension of the knee.

End of 4th Week, during 5th Week, or when allowed by the surgeon, the splint may be given up. It is generally replaced by a divided plaster; patients who have worn this from the beginning retain it for a few weeks longer. The patient begins to walk on crutches. Exercises for foot and knee, without taking weight on the limb, are given.

8th Week or Later.—The patient begins to walk, first with the help of his crutches, and putting only a little weight on the injured leg. He then gives up one crutch, walking with the other alone; then he takes to two sticks, then to one only, and finally walks without support.

RE-EDUCATION IN WALKING is given, and leg exercises are practised, gradually increasing in strength. The patient should walk normally in 9 to 10 weeks.

SURGICAL TREATMENT.—If the fragments cannot otherwise be got into correct position, they are treated by open operation, and the fragments of the tibia fixed into place by a plate, wire bands, or a bone-peg. The fibula is not plated.

POST-OPERATIVE TREATMENT.—This begins at 10 to 12 days on the same lines as described above; the *support* must be even more carefully maintained.

NON-UNION.—Should union not take place, the treatment is carried out on the same principles as that applied to the humerus when it fails to unite (*see* pp. 15, 16). The Bier bandage may be put on just above the knee. The pulse should be taken at the ankle, either at the point where the anterior tibial artery lies on the front of the tibia, or at that where the posterior tibial artery lies behind and below the internal malleolus.

THE BONES OF THE FOOT

Most important of these are fractures of the astragalus and of the os calcis.

Fractures of the Astragalus

The *body* or the *neck* may be broken. These fractures are often associated with injury to or dislocation of other bones about the ankle. The ankle-joint itself may be dislocated, or the astragalus displaced. Fractures of the body must necessarily involve the ankle-joint, and their treatment is rarely completely successful, the foot often remaining very weak and painful.

FIXATION.—The foot is put up in dorsiflexion to a right angle, the position being maintained by: (1) *Plaster*, for 6 to 8 weeks; or occasionally (2) *A back splint*, with foot-piece.

Treatment.—

PHYSICAL TREATMENT (Body of Astragalus).—Treatment is rarely ordered in the early stages of these fractures. If the plaster is divided, or if a splint is used, massage may be given from the beginning, with lateral movement of the patella, quadriceps contractions, and active movements of the toes.

MOVEMENTS OF ANKLE AND FOOT.—*Flexion and extension*, 3 to 4 weeks. *Inversion and eversion*, 4 to 5 weeks.

WALKING will probably not be allowed—except with crutches—for about 3 months.

If the *neck* is fractured, the movements may be given about a week earlier, and the patient may be able to walk in 7 to 8 weeks.

Fractures of the Os Calcis

The *body* of the bone may be broken by direct violence, as by falls on the feet. The astragalus may be displaced, and the arch of the foot flattened. Often both heels are injured. The *posterior surface* of the bone is sometimes torn off by violent contraction of the calf muscles.

FRACTURE OF THE BODY

Treatment.—

FIXATION.—The foot is put up in dorsiflexion to a right-angle, in plaster, or on a splint (2 to 3 months).

PHYSICAL TREATMENT.—

MASSAGE may be given from the beginning, if the fixation apparatus permits.

MOVEMENTS.—*Toes*, from the beginning. *Ankle and foot*, 1 month.

WALKING.—3 months or more.

The result is rarely quite satisfactory, pain in the heel often persisting, owing probably to traumatic arthritis of the joints in the neighbourhood of the injury.

FRACTURE OF THE POSTERIOR SURFACE

Treatment.—

The rarer fracture of the posterior surface is generally treated by operation, the separated part being fixed into position by a bone peg.

FIXATION.—The foot is put up in plantar flexion in plaster or on a special splint (6 weeks).

PHYSICAL TREATMENT.—

MASSAGE.—From the beginning.

MOVEMENTS.—*Ankle and foot*, 14 to 18 days.

WALKING.—6 to 8 weeks.

Fracture of the Metatarsal Bones

One or more of these may be broken, generally as a result of direct violence, as by crushing of the foot. Injury of the first metatarsal is the most, that of the fifth the least, serious.

DISPLACEMENT.—This is rarely marked. The worst feature of the injury is the damage to the anterior transverse arch of the foot. This fact must be borne in mind, especially during the later stages of treatment.

Treatment.—

FIXATION.—*Adhesive strapping* may be put on round the foot to maintain the anterior arch. In more serious cases, as in fracture of several bones, including the first, *plaster* or a *back splint* (2 to 3 weeks).

PHYSICAL TREATMENT.—

MASSAGE.—Of the whole leg, from the outset.

MOVEMENTS.—*Hip and knee*, from the beginning. *Ankle*, from 3rd day. *Toes*, 5th day (more serious cases 7th to 8th day).

EXERCISES (without body weight).—These may be begun : In fracture of the first metatarsal, 3 to 4 weeks ; of the fifth metatarsal, 7 to 8 days.

WALKING.—In fracture of the first metatarsal alone, in about 6 weeks. Of the first metatarsal and others, 2 months. Of the fifth metatarsal alone, 3 weeks.

If the patient walks too soon, the anterior arch may collapse and metatarsalgia (*see* Chapter XVI) may develop. In cases of severe injury, he should wear suitable supports. Exercises, both before and after walking is attempted, should be directed towards strengthening the muscles which maintain this arch (*see* Chapter XVI), as well as the longitudinal arches.

Fracture of the Phalanges

DISPLACEMENT.—This is slight, as a rule.

Treatment.—

FIXATION.—Generally no splint is required, but sometimes an ordinary back splint with a foot-piece is used for 2 to 3 weeks. A cradle must be put over the feet in either case, when the patient is in bed.

PHYSICAL TREATMENT.—

MASSAGE.—From the outset, if required.

MOVEMENTS.—*Hip, knee, and ankle*, from the beginning. *Inversion and eversion*, 3rd day. *Toes*, 4th to 5th day.

EXERCISES (without body weight).—In 3 weeks.

WALKING.—In 4 weeks. Full and correct use of the toes in walking must be enjoined.

RE-EDUCATION IN WALKING

This is most important in *all* fractures of the lower extremity, since the wasting and loss of tone of the leg muscles, however slight, causes the foot to fall into the position of weakness—that is, into eversion. This leads to collapse of the arches, or, at all events, to a 'weak foot', with pain, diminished mobility, and loss of the 'spring' in walking. In Pott's or Dupuytren's fracture, this disastrous result will inevitably follow the injury unless proper measures are taken to prevent it, since, apart from the general weakening of muscles, the structures on the inner side of the foot—especially the deltoid (internal lateral) ligament, one of the most important supports of the longitudinal arch through its connection with the 'spring' ligament, and the tibiales anticus and posticus—are wrenched by the accident, the ligament being possibly torn right across.

Dr. Mennell has pointed out the supreme importance of regaining the correct *co-ordination* necessary for walking. Weakness of any muscle or group of muscles, from whatever cause, will interfere with this co-ordination, not only because these muscles contract with lessened force, but because the latent period between the reception of the nerve stimulus by the muscle, and its resultant contraction is lengthened, so that it no longer acts in time with the healthy muscles, the latent period of which is normal.

Exercises to re-establish co-ordination may be begun some time before it is safe for the patient to take the weight of his body on the injured limb. All the movements of leg and foot required in walking may be practised without his standing on this leg at all. Every masseuse should read Dr. Mennell's

chapter on re-education in walking in which he describes and classifies these 'exercises without weight', which are so valuable at the stage of recovery after fractures, or other conditions of injury or weakness.* Most of these exercises are now used everywhere, and have been found most successful.

EXERCISES BEFORE THE PATIENT IS ALLOWED TO WALK.—These consist of Leg-swinging, Knee-bending and -stretching, Foot-bending and -stretching (heel- and toe-raising) and Foot-inversion.

Leg-swinging (sitting on a high table). This is also a mobility exercise; but the patient should swing not only the injured leg but the sound one as well, and they should be swung alternately, not together. Later, he should combine the forward swing of the leg with dorsiflexion of the ankle, and the backward swing with plantar-flexion. *Knee-bending and -stretching + Foot-bending and -stretching* may be done combined as above, with resistance to the knee movements.

Alternate heel-raising is practised, the patient sitting on a stool; and then *Alternate toe-raising* (dorsiflexion of the ankle), in the same position. *Heel- and toe-raising* follows. This consists of dorsiflexion of one foot at the same time as plantar-flexion of the other. Inversion of both feet together must also be practised, as well as flexion and extension of the toes.

THE TAKING OF WEIGHT.—The patient is at first allowed some support, e.g., he may stand between parallel bars, or between two chairs. He has now to be taught the correct method of taking steps. He stands with the feet together, and both pointing straight forward (close-standing). He then moves the injured foot forward in a straight line, and places the heel on the ground. The heel of the sound foot is then raised, the weight transferred to the injured one, the front of which is brought down. The weight is to be taken on the outer border of the foot, and the toes are to be pressed firmly on the ground. Then the sound foot is brought up alongside it, and the forward step with the injured foot is repeated. After this has been done several times, the process is reversed, the sound foot is moved forward, and the heel of the injured (back) foot raised, the weight of the body being brought over the forward leg. The injured foot is then carried forward past the sound foot, and the heel placed on the ground as above. The support is now gradually withdrawn.

After this, *heel-and-toe walking* along a line is practised. The patient should be carefully supervised, and no incorrect step allowed. Eversion of the foot must be guarded against all the time, and the patient must not be allowed to acquire a limp—a habit which, once contracted, is most difficult to eradicate.

Ordinary leg exercises are now undertaken, not forgetting those suitable for flat-foot; also exercises for any joint or joints in which the movements are not complete (*see* exercises for STIFF JOINTS, Chapter VI).

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* *Massage: its Principles and Practice*, chapter XX.

CHAPTER IV

DISLOCATIONS

I. Dislocations of the upper extremity: Acromio-clavicular joint—Sterno-clavicular joint—Shoulder—Elbow—Wrist—Thumb. II. Dislocations of the lower extremity: Hip—Dislocation or injury of the knee—Ankle—Sacro-iliac strain.

A DISLOCATION, or *luxation*, is a condition in which the articular surfaces of the bones forming a joint are completely displaced from each other by violence—generally indirect—and remain so displaced. *A sub-luxation* is one in which the joint surfaces remain partially displaced from each other. *A sprain* is one in which the surfaces, though separated from each other by violence, return of themselves to their normal position.

All these conditions, if due to trauma, are accompanied by more or less severe stretching or tearing of the structures in, or surrounding, the joint. Ligaments, muscles, tendons, synovial sheaths or membranes, or cartilage, may also be injured. The results in the more serious traumas may be arthritis, myositis, and possibly tenosynovitis. There is generally extravasation of blood from the injured vessels of the structures, causing *contusion* (bruising).

SYMPTOMS.—

At the time of the injury.—(1) When the injury occurs, there is intense, sickening pain, worse than that of a fracture; the patient is often conscious of a tearing sensation different from the sensation of breaking or snapping of a bone. The pain is less severe later, unless the displaced bone is pressing on a nerve. (2) There is deformity of the limb. (3) The joint is fixed. (4) The function of the limb is lost.

After reduction.—(1) Dull, aching pain, increased on movement. (2) Swelling, often marked, of the limb; and all signs of acute inflammation. (3) Bruising, variable in extent, appearing after a few days.

At a later period.—(1) Adhesions form round the joint, with limitation of movement. (2) The muscles acting on the joint atrophy to a greater or less degree, impairing the strength of the limb.

Certain dislocations, especially those of the shoulder and temporo-mandibular joints, are liable to recur.

COMPLICATIONS.—These are similar to those found in conjunction with fractures.

INJURIES TO BONES.—(1) *Fracture-dislocations*, in which a bone is broken, as well as joint surfaces displaced—as in a Pott's fracture, or a fracture of the neck or shaft of the humerus, with dislocation of the shoulder. (2) *Injury to the periosteum*, when the inflammation in that membrane causes an out-throwing of osteoblasts, either impeding the movements of the joint, or lodging in the nearest muscles; e.g., causing myositis ossificans in the brachialis anticus in a case of dislocated elbow.

INJURIES TO NERVES, causing paresis or paralysis; e.g., the circumflex nerve may be injured in dislocation of the shoulder, or the ulnar nerve in dislocation of the elbow.

INJURIES TO THE SKIN in compound dislocations, when the end of one of the displaced bones is driven out through the skin. In these cases, as in compound fractures, we have to remember the danger of infection.

INJURIES TO BLOOD-VESSELS; similar to those occurring in fractures (*see* p. 3), hæmorrhage, ischæmia, or gangrene.

I. DISLOCATIONS OF THE UPPER EXTREMITY

ACROMIO-CLAVICULAR JOINT

This is generally the result of direct violence, a blow or a fall on the shoulder.

DISPLACEMENT.—The clavicle is displaced upwards.

Treatment.—

FIXATION.—It is easy to replace the bones in their correct position, but difficult to keep them there, since the weight of the arm drags the scapula downwards away from the clavicle. The method of support is the same as that for fracture of the acromial end of the clavicle (*see Fig.* 7, p. 11). The arm is kept in this position for about four weeks (sometimes a sling is used as well), and then a sling only is worn for another fortnight or three weeks.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Lying, with the forearm across the chest. Later, sitting with the elbow supported, as for a dislocated shoulder.

MASSAGE.—From the beginning. The strapping is best left in place during treatment for the first few days. If for any reason it should be removed, the elbow must be pressed upwards, and the arm kept in that position.

The neck, chest, shoulder, and arm should all receive attention. The deltoid must be specially considered; next to it in importance is the pectoralis major. When all inflammation has disappeared, tapôtement may be added.

MOVEMENTS.—(1) Of *hand, wrist, elbow, and radio-ulnar joints*, from the beginning. (2) Of *shoulder*, 2 to 3 weeks, beginning with simple elevation (shoulder shrugging), and rotation in and out in the humero-scapular joint with the arm in adduction.

A little later flexion and extension of the shoulder may be added, and then abduction to about 45 degrees. The masseuse should progress gradually to abduction to a right angle and above, and finally give rotation in this position. The elbow should be supported during movements of the shoulder girdle for the first 3 or 4 weeks. After 6 to 7 weeks free exercises may be practised.

RESULT.—However skilfully this injury is treated, some deformity may remain, the bones being often not quite correctly in place. But as a rule the slight displacement causes no disability.

STERNO-CLAVICULAR JOINT

A rare but troublesome injury.

DISPLACEMENT.—As a rule, the clavicle is displaced forwards and upwards.

Treatment.—

FIXATION.—A pad of strapping is fixed over the joint to keep it as far as possible in place. The arm is supported in a sling, and is sometimes bandaged or strapped to the body. This position is maintained for 3 weeks. Later, a sling only is worn for 2 to 3 weeks.

PHYSICAL TREATMENT.—This is similar to that of dislocation of the acromio-clavicular joint. Pressure should be applied over the joint, especially during elevation, in order to afford support.

RESULT.—Recurrence is common, and some deformity generally remains. The functional result is usually good, though the appearance of the joint may be unsightly. Full strength is often not regained till about 3 months after the injury.

Recurrent cases, and those where pain is a constant feature, are sometimes treated by operation. The interarticular cartilage of the joint is removed, and fibrous ankylosis takes place. Since this interferes gravely with the movements of the arm, it is only undertaken as a last resource.

SHOULDER

This is the commonest of all dislocations, and one that every masseuse will certainly be required to treat at some time.

CAUSES.—The shoulder may be dislocated by direct or indirect violence, i.e., by a fall or a blow on the joint itself, or by a fall on the outstretched hand, causing a violent abduction of the arm. The latter form of violence is the commoner cause.

VARIETIES.—Four kinds of displacement are recognized :—

SUBGLENOID.—The head of the humerus passes out through the lower part of the capsule, and remains beneath the glenoid cavity, resting on the axillary border of the scapula. This form is not very common. Though the humerus must pass through this position, it rarely remains there.

SUBCORACOID.—The humeral head passes forwards and downwards, and comes to lie below and external to the coracoid process. This is the commonest form of dislocation.

SUBCLAVICULAR.—Occasionally, it passes still further inwards and lies below the clavicle. This is rare.

SUBSPINOUS.—In this case the humeral head is driven backwards and downwards into the infraspinous fossa, where it lies below the spine of the scapula. This form also is rare, the long head of the triceps usually preventing the bone from passing in this direction.

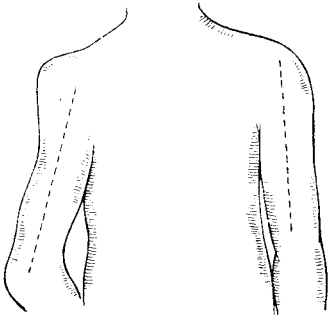

Fig. 24.—Diagram to show flattening and angulation of shoulder and direction of axis of arm in dislocation of subcoracoid type.

SYMPTOMS (Subcoracoid type).—

BEFORE REDUCTION.—(1) Intense pain is felt at the time of the accident. (2) The shoulder is flattened on top, and the acromion process is prominent, making the contour appear angular instead of rounded. (3) The elbow cannot be brought to the side, and the axis of the arm is oblique instead of vertical (*Fig.* 24). (4) The shoulder is almost, or entirely, fixed, so that the arm is quite useless. (5) The head of the humerus can be felt in its new position, and not in the glenoid cavity.

AFTER REDUCTION.—(1) The usual symptoms resulting from a dislocation are present ; there is often much pain and swelling, and sometimes extensive bruising. (2) Adhesions are very liable to form, and, if they are allowed to do so, are most crippling ; hence the necessity of early movement, especially in elderly people.

COMPLICATIONS.—

FRACTURE of the great tuberosity or surgical neck of the humerus.

INJURY TO THE CIRCUMFLEX NERVE.—This is a not uncommon occurrence. A watch should be kept for it, and it should be reported at once, or the masseuse may be blamed for a bad result which is in no way her fault. She should take care to see that the deltoid does contract, and if there is any doubt about it, the sensation in the skin over the muscle should be tested, and the surgeon should be consulted. A slight circumflex injury is often the cause of a belated recovery from this accident. It may never be discovered—or by the time any one thinks of looking for such a thing, the nerve, which may have been only bruised or concussed, may have partially or completely recovered. In the meantime, the deltoid having wasted or the joint become stiff, the masseuse is blamed for unskilful treatment. A lesion of the circumflex nerve in a shoulder injury is much more easily missed than is an ulnar lesion in an elbow injury. The masseuse must realize that the patient may be able to perform weak abduction with the supraspinatus, the nerve supply of which is probably intact.

RECURRENCE OF DISLOCATION. — This happens more frequently in the shoulder than in any other joint. It calls for special treatment (*see* p. 50).

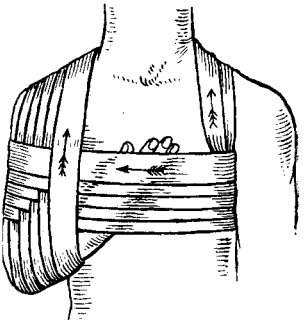

Fig. 25.—Bandage for dislocated shoulder.

Treatment.—

SUPPORT.—

1. *The arm may be bandaged to the side with the elbow supported*, so as to prevent any abduction and hold the head of the humerus in contact with the glenoid cavity (*Fig.* 25). The bandage is put on under the patient's clothes. It is worn for a few days, then replaced by a large arm-sling, which must be kept taut beneath the elbow. The support is maintained for about 3 weeks or a month. Sometimes a sling only, instead of the bandage, is worn under the clothes for a few days, after which the patient may be allowed to dress—provided the clothes are made to fasten in front and put on like a jacket—and wear the sling outside. During the early stages, he must be cautioned not on any account to remove his sling or interfere with the bandage without permission.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting, the arm supported on a table of sufficient height to keep the elbow pressed upward and prevent the humerus from being dragged out of the glenoid fossa; yet low enough for the arm to be kept close to the side, and not abducted.

MASSAGE AND MOVEMENTS.—

1*st Day.*—If the injury is treated on this day, gentle stroking over the whole arm and shoulder should be given. The bandage should be left in place.

2*nd Day.*—The bandage is to be removed. Effleurage and careful kneading of neck, chest, shoulder, and arm to reduce swelling. Active movements of fingers, wrist, elbow, and radio-ulnar joints. The elbow movements are most important, as it is essential that the tendon of the long head of the biceps, passing as it does through the shoulder-joint, should not be allowed to adhere to its own sheath or to any surrounding structures.

3*rd Day.*—Add active flexion and extension of the shoulder in small range, increasing daily.

Active movements are in this case to be preferred to passive, it being essential that the strength of the muscles should be maintained, since they form the main support of this joint.

4th Day.—Add rotation in and out with the arm in adduction, the elbow being carefully supported.

5th Day.—Add abduction, beginning by circumduction of the arm in small range; increase daily. While abduction of the arm is being performed, the operator should place her hand under the axilla, pressing in an upward direction, in order to support the head of the humerus, and prevent its again making its way out through the still weakened capsule (*see Fig.* 10, p. 14). The grasp is similar to that for a fractured surgical neck.

6th Day.—Frictions round the shoulder. Gradually deepen the massage of chest, shoulder, and arm, giving special attention to the deltoid and pectoralis major.

8th Day.—Abduction should now have reached 90 degrees. Advance to elevation above this level.

10th to 12th Day.—Add rotation in and out with the arm in abduction. These movements should not be forced.

For the subcoracoid form of dislocation, give rotation *in* first, and later rotation *out*, and for the subspinous, in the reverse order.

3rd week, or when all inflammation has disappeared.—Vigorous massage, with hacking of the muscles; deep frictions round the joint to stretch adhesions. Increase in range of all active movements.

4th Week.—Free exercises, beginning with 'crawling up the wall', and other flexion and extension movements, later adding those for abduction and rotation. The patient may be given carefully selected home exercises.

The arm should be normal in about 5 to 6 weeks if both the operator *and* the patient have done their best. Elderly patients are sometimes difficult to manage, and the masseuse is often unduly alarmed about the possibility of redislocation. It *is* a possibility, but as Dr. Mennell has remarked, "It is safer to administer movement freely during the first week after dislocation than during the third, if the joint has been immobilized meanwhile." If early active movement is not given, the muscles which, as observed above, *are the main support of the joint*, become weak and wasted, and when attempts are made to stretch or break down the adhesions which have meanwhile formed, disaster may easily occur.

TREATMENT OF COMPLICATIONS.—

FRACTURE OF HUMERUS (*see* p. 13).—If there is displacement of bone, the arm has to be placed in some degree of abduction in spite of the dislocation. Open operation is sometimes necessary to replace the humeral head in the glenoid cavity.

CIRCUMFLEX INJURY.—This also necessitates abduction of the arm. The difficulty in this case is the impossibility of any but the weakest *active* abduction. The treatment is much as usual, but the arm must not be brought down to the side till the deltoid is sufficiently recovered to bear the stretching. Passive, or almost passive, abduction and elevation must be given, with very careful support. The patient should be treated in the lying position. (*See also* CIRCUMFLEX PARALYSIS, Chapter XII.)

RECURRENT DISLOCATION.—This is treated either by the *wearing of an appliance* to prevent abduction of the arm beyond the danger-point (about 70°), or by *open operation.*

The operation is interesting. A strip is cut from the posterior border of the deltoid, but left in connection with the muscle at its upper part, its blood- and nerve-supply being kept intact so that it shall not atrophy. The free end is then brought forward through the quadrilateral space, and fastened to the anterior border of the deltoid in front. When the arm is abducted it forms a sling below the joint, thus strengthening it at its weakest point, and keeping

the head of the humerus in place. (Some surgeons say that when the deltoid contracts in abducting the arm this strip also contracts, affording still more efficient support.)

AFTER-TREATMENT is directed towards strengthening the arm and shoulder muscles.

ELBOW

The displacements which occur in the region of the elbow and superior radio-ulnar articulations are: (1) *Dislocation of both radius and ulna.* (2) *Dislocation of the radius alone.*

1. Dislocation of Radius and Ulna from the Humeral Articular Surfaces

(True Dislocation of the Elbow-joint)

CAUSE.—A fall on the elbow or hand, i.e., forced extension of the elbow.

DISPLACEMENT.—By far the most common type is *posterior* dislocation. The radius and ulna are displaced backwards and upwards behind the humerus, the anterior ligament being stretched or torn, and the coronoid process often fractured as well.

SYMPTOMS.—

BEFORE REDUCTION.—(1) The elbow is held in slight flexion and cannot be moved. (2) The lower extremity of the humerus can be felt at the front of the bend of the elbow, or below it. (3) The back part of the elbow projects, the projection being formed by the olecranon process.

AFTER REDUCTION.—The general symptoms of a dislocation—pain, swelling, etc.—are present.

COMPLICATIONS.—These are similar to those accompanying fractures in this region.

ISCHÆMIC CONTRACTURE (*see* p. 26).

MYOSITIS OSSIFICANS may occur even if no bones are broken, because the periosteum is so much torn that it becomes the seat of considerable inflammation; hence its activity is increased, and it throws out numerous bone-cells. If the coronoid process or the internal condyle are fractured, the danger is even greater (*see* p. 16).

INVOLVEMENT OF THE ULNAR NERVE, or occasionally of other nerves (*see* Chapter XII).

CUBITUS VALGUS OR VARUS, abnormal increase or decrease of the carrying angle.

Treatment.—

FIXATION.—The elbow is put up in full flexion, and supination in the Robert Jones position (*see Fig.* 13, p. 17) for 2 to 3 weeks; sometimes only for 10 days.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Sitting; the arm supported by a cushion, in slight abduction.

MASSAGE AND MOVEMENTS.—While this dislocation—unlike that of the shoulder—is very unlikely to recur, and therefore early movement would seem to be indicated, we have to consider the possibility of myositis ossificans, even if no fracture complicates the injury. For this reason, movements are not given for 7 to 10 days. Some surgeons prefer to keep the arm immobilized for 2 to 3 weeks, with massage only. The author has, personally, never known any harm to result from careful movements, given in small range at the earlier period. The arm should certainly be kept in the Robert Jones position for at

least a fortnight, after which great care must be taken not to lose the full flexion which has thus been preserved. The maintenance of this position, therefore, as in other injuries of the elbow, fulfils the threefold purpose of assisting the anti-gravity muscles, preventing limitation of the movement which is most difficult to regain if lost, and eliminating the danger of myositis.

1st Day.—Stroking to relieve muscular spasm, if present; otherwise, effleurage.

1st Week.—Massage of the whole arm, especially effleurage and careful kneading above the elbow, to reduce swelling. The arm may be unbandaged, but the elbow must not be moved (*see* treatment of SUPRACONDYLAR FRACTURE, p. 17). Frictions round the wrist and shoulder; massage of the hand and fingers. Active movements of fingers and wrist; *adduction* of the wrist should not be allowed to become pronation. Circumduction of the shoulder in small range may be given.

7th Day.—Very careful pronation may be added.

8th to 9th Day.—Extension of the elbow may be begun. (Pronation may be combined with extension and supination with flexion.)

End of 3rd Week (sometimes during 3rd week).—The arm is now put in a sling, or is supported by a 'collar and cuff', the hand being lowered daily (*see Fig.* 14, p. 17); a few days later the arm is left free for part of the day, and the sling is gradually given up altogether. The range of movements must now be increased by degrees, the operator being careful to see that the ability to flex the elbow to its full extent is maintained. When all inflammation is gone, vigorous massage is given to the whole arm.

End of 4th Week, or a little later.—Free exercises should be practised assiduously to regain full extension or pronation, if either is limited; also to increase the strength of the muscles, and restore function to the limb (*see* p. 75, STIFF ELBOW).

5th Week.—The strongest exercises may be given.

2. Dislocation of Radius alone

The radius may be displaced (*a*) forwards or (*b*) downwards.

a. DISPLACEMENT FORWARDS

The radius lies in the radial depression above the capitellum.

SYMPTOMS.—

BEFORE REDUCTION.—The bone can be felt to be displaced. The patient can neither flex nor extend the elbow, though he can pronate and partially supinate the forearm.

Treatment.—

This is a much less serious injury than dislocation of both bones; there is no danger of myositis ossificans. Still, all injuries to the elbow-joint should be approached with caution.

FIXATION.—Robert Jones position for a fortnight. After this period, a sling, or 'collar and cuff', is worn for another ten to fourteen days, the arm being gradually lowered from the fully flexed position to a right angle.

PHYSICAL TREATMENT.—

MASSAGE AND MOVEMENTS.—

1st and 2nd Days.—Massage as for dislocation of both bones.

5th Day.—Flexion and extension of the elbow, pronation and supination, in small range at first.

2½ to 3 Weeks.—Free exercises.

4 Weeks.—Strong exercises.

b. Displacement Downwards

This is the 'pulled elbow' of small children, generally caused by the child's falling when being held by the hand. The radius is drawn out of the orbicular ligament. The child can bend the elbow and straighten it, but cannot fully supinate the forearm. The elbow is painful, and the child does not use the arm.

Treatment.—

Reduction is easy, and treatment is rarely required. If ordered, it consists mainly of persuading the child to use the arm again, with exercises and sometimes gentle massage.

WRIST

This is a rare accident, of which not much need be said. The dislocation, when it does occur, is more often a *posterior* than an *anterior* one, and is not infrequently complicated by a fracture of the radius into the joint.

Treatment.—

FIXATION.—If there is no fracture, the wrist is generally only bandaged and the arm placed in a sling. The condition may be treated as a severe sprain, and movements of fingers and wrist given from the beginning.

Similar treatment is given for *uncomplicated dislocation of the lower or the upper row of carpal bones.* If the dislocation is complicated by a fracture, the wrist will either be put in plaster in dorsiflexion, or on a short *cock-up splint* for 2 to 3 weeks.

PHYSICAL TREATMENT.—

Massage may be given from the beginning, with active movements of the fingers.

Movements of the Wrist.—These may be given gently from the 7th to the 10th day, if the wrist is on a splint or in a removable plaster.

Similar treatment is given after removal of a *dislocated semilunar.* This bone when displaced can rarely, if ever, be manipulated into position. The results of treatment in this case will not be perfect ; movement of the wrist will be incomplete in range, but the disability should not be a serious one.

THUMB

(*Carpo-metacarpal or Metacarpo-phalangeal Joint*)

In the first case, the metacarpal bone is displaced outwards and backwards on the trapezium ; in the second, there is backward displacement of the phalanx on the metacarpal, caused by violent hyperextension of the thumb (Page and Bristow). The former is the more serious accident, because of the importance of the movements which take place in the saddle-joint—flexion, extension, abduction, adduction, and opposition.

Treatment.—

FIXATION.—In either case, fixation is maintained for a fortnight ; in the case of the carpo-metacarpal joint, by plaster or splint ; in that of the meta-carpo-phalangeal by plaster or strapping.

PHYSICAL TREATMENT.—

Massage and Movements.—When the splint or plaster is removed, massage of the forearm and hand and active movements are given.

The prognosis is better in the case of the metacarpo-phalangeal joint than in that of the carpo-metacarpal.

N.B.—The corresponding joints of the other fingers are rarely dislocated.

II. DISLOCATIONS OF THE LOWER EXTREMITY

HIP

(For CONGENITAL DISLOCATION, *see* Chapter XVI).

Traumatic dislocation is rare because of the great stability of the joint and the strength of the ilio-femoral ligament, fracture of the bone, i.e., of the neck of the femur, being far more common. Only very great violence produces an injury of this kind. The damage may consist of a *simple* dislocation, with tearing of the lower part of the capsule, or of a more severe and *complicated* lesion, with rupture of the ilio-femoral ligament and fracture of the acetabulum.

DISPLACEMENT.—The displacement may be *anterior* or *posterior*. In either case, the head of the femur passes out of the joint through the lower part of the capsule, and then either forward or backward, the latter direction being the more common.

POSTERIOR DISLOCATION takes place when the thigh is adducted, inwardly rotated, and flexed, the patient generally being in a stooping position. Something heavy falls on his back, or he stumbles when carrying a heavy weight on his shoulder (Robert Jones). The femoral head passes out of the lower and back part of the capsule, and then up on to the dorsum ilii.

ANTERIOR DISLOCATION occurs while the leg is abducted and externally rotated.

SYMPTOMS.—

POSTERIOR DISLOCATION.—(1) The hip is slightly adducted and rotated in; also slightly flexed. (2) The mobility of the joint is lessened, and the limb before reduction is rigidly fixed by spasm of all the thigh muscles. (3) There is apparent shortening of the leg, the great trochanter being above Nélaton's line. (4) The abnormally situated head can be felt.

This displacement is therefore similar to the congenital variety.

ANTERIOR DISLOCATION.—(1) The leg is slightly abducted, and outwardly rotated, with the foot in eversion. (2) There is no apparent shortening as a rule. (3) The displaced head may be felt in the groin.

Treatment.—

SIMPLE FORM

Recurrence is very improbable, therefore early movements are indicated and the patient will not be long disabled.

SUPPORT.—As a rule, none is required in a simple dislocation; the patient remains in bed for about a fortnight, and is then allowed to get up and walk. Some surgeons put the thigh and pelvis in plaster, and the patient walks in a week with the plaster still on.

PHYSICAL TREATMENT.—Massage and all movements may be given from the beginning, the movements being at first in small range, and being gradually increased. They are best given actively. Care should be taken with regard to the movement which was the cause of dislocation.

14 *Days.*—Massage and movements are continued. Re-education in walking is begun.

3 *Weeks to* 1 *Month.*—Free exercises, gradually increasing in strength and range.

The limb should be *normal* in 5 to 6 weeks.

In this, and in cases of knee injury, it is important to see that the bedclothes do not press on the feet. A cradle should be used.

COMPLICATED DISLOCATION, WITH RUPTURE OF ILIO-FEMORAL LIGAMENT AND FRACTURE OF THE ACETABULUM

SUPPORT.—This is a very serious injury. The limb is put up in full normal abduction in *a plaster spica*, including both hips, so constructed as to prevent tipping of the pelvis—which would cause scoliosis (6 to 8 weeks).

Occasionally, traction is applied, the leg being kept in abduction, by means of a *Thomas splint* (Balkan beam, etc.). This is suitable for elderly and obese people.

PHYSICAL TREATMENT.—When the plaster is removed, gentle movements may be begun, and when the patient begins to walk, re-education will be very necessary. It is impossible to give dates for movements, etc., in the case of an injury of this kind. It must be carefully treated in co-operation with the surgeon.

The patient in the Thomas splint is treated in the same way except that massage is possible from the beginning, in so far as the limb can be reached without disarranging the traction apparatus.

For details of early massage, *see* FRACTURE OF NECK OF FEMUR (p. 31).

DISLOCATION OR INJURY OF THE KNEE

Under the heading of injuries to the knee-joint we have a great number and variety of different conditions. It is impossible to describe them all in a work of this size. We shall, therefore, consider one or two of those with which we are most often confronted, or which are most typical: (1) *Dislocated knee.* (2) *Dislocated patella.* (3) *Slipped semilunar cartilage.* (4) *Injury to the internal lateral ligament.*

1. Dislocated Knee

Dislocation pure and simple is rare. There is almost invariably damage to the bones as well. The spine of the tibia may be broken off, or one or both of the crucial ligaments ruptured, as well as part of the capsule. *Dislocation* may occur anteriorly, posteriorly, or laterally. Lateral *subluxation* is more common, one or other of the lateral ligaments being damaged in the process.

The injury is a very serious one, since unless the crucial ligaments heal well and firmly, the knee will always be unstable. For this reason the joint is invariably immobilized for a long period. Six weeks at least are necessary for the complete repair of ligaments, and in such a joint as the knee, which depends for its stability on its ligaments rather than on the conformation of its bony surfaces, it is well to allow a little extra time.

Treatment.—

SUPPORT.—(1) The knee is put up in extension, either in plaster or on a back splint, for about two months. (2) Later, a *walking caliper* is provided.

PHYSICAL TREATMENT.—This is rarely ordered in the early stages, but though movement of the injured joint in the first weeks is not advisable, much may be done by judicious treatment to prevent atrophy of muscles during this period.

MASSAGE may be given from the beginning, special attention being paid to the quadriceps.

MOVEMENTS.—*Lateral movement of the patella* may be added in a week, and *quadriceps contractions* in about 10 days, unless the anterior ligament is seriously injured, when they must be postponed till the end of the 3rd week.

Faradism (graduated contractions) may be begun at the same time. No movement must be allowed to take place in the joint.

After 2 months.—Movements may be given to the knee, and it must be mobilized gradually and carefully. (For exercises in the later stages, *see* pp. 81, 82).

2. Dislocated Patella

This, again, is a rare accident without accompanying bony and muscular injury. Knock-knee and weakness or paralysis of the quadriceps are predisposing causes. Certain patients show deficient development of the external condyle of the femur, or of the knee-joint, causing the patella to slip outwards easily. In all these cases the dislocation is liable to recur constantly. The displacement is almost always outward.

SYMPTOMS.—The patella can be felt to be out of place; there is not much swelling as a rule. There may be severe pain at the time of the accident.

Treatment.—

SUPPORT.—The knee is immobilized for 10 to 14 days, with a compression bandage to keep down effusion and hold the bone in place.

PHYSICAL TREATMENT.—This may begin on the 7th day.

MASSAGE AND MOVEMENTS.—Special attention must be paid to the quadriceps. Faradism for these muscles is also indicated. Knock-knee, if present, must be treated.

SURGICAL TREATMENT.—Cases in which there is imperfect development of the external condyle are sometimes dealt with by open operation, the front of the condyle being brought farther forward by the insertion of a bone-graft into a wedge-shaped incision on its outer surface. Various operations are also performed on the quadriceps tendon, in order to give its pull a more inward direction.*

3. Slipped Semilunar Cartilage

ANATOMICAL POINTS.—The position and attachments of the structures which take part in the formation of the knee-joint should always be kept well in mind while treating any injury in that joint or in its neighbourhood; in fact, accurate anatomical knowledge is necessary in order to ensure success. In the case of internal derangements such as slipped or torn cartilages, the following points especially should be remembered:—

THE INTERNAL SEMILUNAR CARTILAGE.—(1) The under surface of the cartilage is not attached to the head of the tibia. (2) Its anterior extremity is attached to the front of the tibia by the coronary ligament; its posterior part is firmly adherent to the deepest fibres of the internal lateral ligament, which is much nearer to the back than to the front of the joint. Between these two points—the anterior extremity and the point corresponding to the anterior margin of the internal lateral ligament—the attachment of the cartilage is much less firm, and consequently the anterior portion is less fixed than the posterior, and hence its greater liability to displacement. A tear of the cartilage may occur at the junction of the anterior and posterior parts. On the other hand, its attachment to the internal lateral ligament may result in its being torn or displaced when violent strain is put on this ligament.

THE EXTERNAL SEMILUNAR CARTILAGE, owing to its greater breadth and firmer attachments, is less subject to injury than that on the inner side. Moreover, the firm pressure between tibia and femur on the outer side of the knee (the weight of the body being transmitted through the external condyle and tuberosity) tends to keep it in place.

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* Jones and Lovett, *Orthopedic Surgery*, iii, p. 34.

THE CRUCIAL LIGAMENTS.—On the crucial ligaments the stability of the knee largely depends. If both are injured, the knee hyperextends, and there is abnormal lateral mobility. If the anterior one alone suffers, the tibia can be moved backwards and forwards on the femur, especially in the flexed position. In either case the knee is rendered weak and independable, and is liable to give way when weight is placed on it.

THE SYNOVIAL MEMBRANE need not be described in detail here. Its great extent and the existence of its many processes should be borne in mind. Some of the latter are liable to injury by being nipped between the bones when the joint is moved. An intense synovitis generally develops with great effusion in the knee when any injury of the joint takes place.

THE POST-PATELLAR PAD OF FAT, which has a process extending over the internal semilunar cartilage, lies behind the patella, between the anterior ligament and the synovial membrane. This also may be nipped or otherwise injured.

MOVEMENTS OF THE KNEE.—These are familiar to us, but a few points need emphasizing.

1. *The 'screw-home' movement* at the end of extension, i.e., the rotation outwards of the tibia on the femur just before extension is complete. If this movement does not take place, and extension is therefore incomplete, the knee is not 'locked', and remains insecure.

2. *The rotatory movement* which takes place when the knee is in semiflexion, and the crucials therefore relaxed. It occurs between the semilunar cartilages and the head of the tibia. Rotation in is limited by the anterior crucial ligament and the crossing of the two crucials; rotation out only by the internal lateral ligament—the crucials being uncrossed in this position. Hence the danger of the outward rotation of the flexed knee; the joint is 'opened' on the inner side, so that the internal semilunar cartilage is held less firmly in position between the femur and the tibia, while movement is taking place between the cartilage and the latter bone, and the drag on the internal lateral ligament further tends to pull the cartilage from its attachment.

CAUSE OF THE INJURY.—The cause of displacement, therefore, is an outward twist of the knee when the latter is in a semiflexed position: that is, a violent outward rotation of the tibia on the femur with the thigh fixed, or a rotation inward of the femur on the tibia with the leg fixed.

NATURE OF THE INJURY.—(1) The cartilage is as a rule not merely displaced, but torn or split, often at the junction between its anterior and its posterior part. It then gets between the bony surfaces in such a way as to prevent complete extension of the joint. (2) The internal lateral ligament and the muscles inserted on the inner side of the knee (semitendinosus, sartorius, gracilis, etc.) are wrenched and sprained. (3) There may be injury to the post-patellar pad or its process, leading later to the formation of adhesions.

HEALING OF THE CARTILAGE.—Repair of cartilage is very slow, because of its poor blood-supply. In serious lesions healing may not take place at all. In these, therefore, as well as in recurrent displacements, it is generally considered better to remove the damaged cartilage rather than trust to the possibility of healing (Timbrell Fisher).

SYMPTOMS.—(1) The patient is unable fully to extend the joint, which is locked in slight flexion. The two knees should be carefully compared. Sometimes the loss of extension is so slight as to be easily missed; it is only the 'screw-home' that is absent. This, however, may interfere gravely with the stability of the knee. (2) Symptoms of traumatic synovitis appear (*see* p. 86). (3) There is pain at the inner side and front of the knee. (4) In neglected

cases arthritic changes are generally found, and the patient suffers from 'giving of the knee', or locking of the joint. The displacement, moreover, is liable to recur.

Treatment.—

A very few cases of injury to the cartilage may recover with physical treatment alone. These are mostly slight injuries where extension of the knee is full, and there is no locking, or mere strains of the internal lateral or other ligaments. Most cases are treated by either manipulation or operation.

MANIPULATION has for its object the reduction of the displacement. It should be followed by physical treatment.

SUPPORT.—After reduction, a crêpe bandage is put on, or an ordinary gauze bandage may be firmly applied over several layers of cotton-wool. This serves the double purpose of affording support and checking effusion. Sometimes a short splint is kept behind the knee for a few days to immobilize it while the injured ligaments and tendons heal.

PHYSICAL TREATMENT.—

MASSAGE.—This may be given from the beginning. At first it will consist principally of effleurage of the thigh, to reduce the swelling ; rhythmic kneading will be added on the second day. Gentle but firm finger kneadings round the joint are given also, to disperse the fluid. The ligaments are treated with frictions, any specially painful points being avoided. The large extent of the internal lateral ligament should be taken into consideration, and frictions carried well down over the shaft of the tibia.

Massage of the lower leg is less important, but should not be omitted, because swelling often appears round the ankle. Effleurage and kneading should be given to the leg, frictions to the ankle and round the tendo Achillis, effleurage and kneading to the foot.

The massage becomes gradually more vigorous as the swelling subsides, and is now directed to strengthening the muscles. The quadriceps are the most important group, and special attention should be paid to the vastus internus. This muscle seems to play the principal part in the last degrees of extension of the knee, and in the 'locking' of the joint. The anterior tibial group and the rest of the leg muscles should not, however, be neglected. A weak tibialis anticus and posticus mean danger of flat-foot later. When all inflammation has disappeared, tapôtement may be added, and the massage should be vigorous and stimulating.

FARADISM is often ordered (graduated contractions of the quadriceps) both to reduce swelling (it is sometimes given with the bandage on), and also to keep up the nutrition of these muscles.

MOVEMENTS.—Active movements are given from the beginning, or at latest after two or three days.

Quadriceps contractions should be taught, and practised by the patient, this being a form of exercise which he can do by himself even if wearing a back splint. Flexion of the knee can also be performed. It is easiest if the patient sits on the edge of his couch or bed, and the knee is gently allowed to flex, the operator meanwhile carefully supporting the knee, and seeing that no rotation of the leg takes place, especially outward rotation. The patient then extends the knee, with the operator's assistance.

The patient is generally allowed to walk in a few days, and then it is most important to see that he does so correctly. If he everts his foot, he may easily 'turn his ankle', and in so doing twist the knee outward, and redisplace the cartilage. He should be put through the *foot-drill* (*see* p. 45, and Exercises 17–20, p. 84), and taught to practise it for himself. At the same time *ordinary*

leg exercises should be given, Knee-bending and -stretching, tip-toe walking with knees braced, Heel-and-toe-raising, Leg-outstretching, Leg-updrawing, Reach-grasp-standing Heel-raising and knee-bending, with feet parallel and knees carried straight forward over the feet—any exercise, in fact, provided it does not produce external rotation of the knee while the patient has his weight on the limb. He may, later, say after three weeks, try inward and outward rotation of the knee while in the sitting position, but outward rotation should never be forced. The exercises must be graduated according to the patient's condition and strength. He should be warned to be careful when walking for the first few weeks, lest there should be a repetition of the original accident.

SURGICAL TREATMENT.—In cases where the injury to the cartilage is very severe, if it has slipped more than once, or if the knee cannot be entirely straightened by manipulation, *an open operation* is performed. The joint is opened with most careful precautions as regards asepsis, the internal lateral ligament being preserved intact. The anterior part—if this only is displaced or injured—or the whole cartilage is removed. The incision is generally a curved one on the inner side of the joint.

The knee is bandaged firmly over a thick dressing of cotton-wool.

PRE-OPERATIVE TREATMENT.—If ordered, this is for the purpose of decreasing the fluid in the joint, and keeping up the strength of the quadriceps. The patient may be kept in bed, or on a couch, for a few days with the knee bandaged. The treatment consists of massage, especially of the thigh, faradism (graduated contractions) and voluntary quadriceps contractions.

POST-OPERATIVE TREATMENT.—The patient is in bed for a few days after the operation, and then probably on a couch.

Massage may be given from the beginning, with *active movements* of the foot, ankle, and toes.

The stitches are removed 7 to 10 days after the operation. *Active movements* to the knee should then be begun. If the stitches are removed at the later date—10 days—quadriceps contractions, and *slight* flexion and extension may be begun on the 7th day, the latter movements in small range and with due precautions with regard to the scar and stitches.

The movements, once the stitches are removed, may progress fairly quickly. *The patient is probably allowed to walk with crutches* in 14 days or less, and then discards one crutch, then both, replacing them by a stick. A week later he should be able to walk *without support*. Meanwhile, *exercises* to restore full flexion of the knee, and to strengthen the quadriceps, are given, e.g., Side-grasp-standing Leg-swinging (bending knee), Sitting Leg-swinging (later with a weight), Heel-raising and knee-bending, Half-kneeling Forward-bending, Backward-pushing on hands and knees, sitting on the heels, use of the rowing machine. (*See* exercises for STIFF KNEE, p. 81.)

Faradism is sometimes ordered after the operation as well as before it.

4. Injury to the Internal Lateral Ligament without Displacement of the Cartilage

ANATOMY.—This ligament consists of superficial and deep fibres. The superficial set are attached above to the internal condyle of the femur, and below to the internal tuberosity of the tibia, and to the surface of the shaft of that bone for about two inches. The deep set connect the lower part of the internal condyle of the femur with the inner margin of the upper extremity of the tibia. It is usually these deep fibres that are injured, most often at their attachment to the tibia.

SYMPTOMS.—(1) There is no locking of the joint. (2) The principal symptom is pain on the inner side of the knee on certain movements: (*a*) when

the foot is everted; (*b*) when the internal lateral ligament is passively stretched, or when pressure is exerted over it.

Treatment.—

These injuries are treated in much the same way as the slipped cartilages which have been replaced for the first time, or which have merely required massage and exercises without manipulation. In severer cases the knee is rested for a time—2 to 3 weeks—and treatment by massage and exercises begins when this period is over.

ANKLE

Very rare without accompanying fracture. It may be treated as a Pott's fracture.

SACRO-ILIAC STRAIN

The sacro-iliac articulation may be attacked by tuberculosis, or some other form of infective arthritis. With these cases we shall have little to do. Those with which we are concerned are strains and subluxations of the joint.

ANATOMY.—The joint is that between the auricular surfaces of the sacrum and ilium. The bones are connected by the anterior sacro-iliac ligament, composed of a number of thin fibrous bands, and the much stronger posterior sacro-iliac ligament. This joint was once classed among the amphiarthroses: most anatomists of the present day describe it as a diarthrosis, maintaining that it has normally far more movement than was previously supposed. In addition to this, during pregnancy the ligaments become much relaxed, and after childbirth they tighten again while the uterus is in process of involution.

CAUSES OF INJURY.—The causes of these 'strains' or subluxations are: (1) Strain, or injury, often when the patient is bending forward. (2) Rising too soon after childbirth, especially after frequent pregnancies. If the patient gets up before the back muscles, and especially the abdominal muscles have had time to regain their strength, she stands in an incorrect attitude, generally in a position of lordosis. In the erect posture the weight of the body falls on the sacro-iliac joints, and if their ligaments are not sufficiently strong, they give way and subluxation occurs. The incorrect posture naturally increases the strain by tipping the pelvis too far back or too far forward.

DISPLACEMENT.—The ilium may be displaced forwards on the sacrum, or the sacrum forward on the ilium. The latter form of displacement is most common after childbirth.

SYMPTOMS.—Pain in the joint, or in the back (lumbar region), with a feeling of instability, the latter often being so marked as to react on the nervous system and to set up neurotic symptoms.

Treatment.—

REDUCTION.—If actually displaced, the articular surfaces are put back into correct position by manipulation under an anæsthetic.

SUPPORT.—The patient wears a belt of some kind, extending from well up the lumbar region to below the great trochanter.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Side-lying, with hip and knee flexed.

MASSAGE.—This is always useful. The joint and all the muscles in its neighbourhood should be treated with vigorous effleurage and kneading—i.e., the glutei, the muscles of the upper part of the thigh, and the lumbar muscles. Deep frictions may be given round the joint. Abdominal massage is also very necessary. For this the patient should be in the usual crook-lying position, the foot of the bed being raised should visceroptosis coexist.

EXERCISES.—These are chosen to strengthen the abdominal and back muscles, mobilize the hip and sacro-iliac joints, and teach correct posture. It is advisable to give the exercises in lying if the patient takes her belt off; exercises in standing are best done with the belt on in the early stages after manipulation.

Such tables as the following might be given. Between exercises may be inserted where required :—

Scheme I

1. Crook-lying Abdominal breathing
2. Half-yard-grasp-standing Leg-swinging forward and backward } with belt on.
3. Arm exercise in crook-lying.
4. Side-crook-lying Abdominal contractions.
5. Lying Alternate hip-updrawing.
*6. Lying Head- and shoulder-raising with trunk-rotation.
7. Tailor-sitting or knee-sitting Back-raising vertebra by vertebra.
8. Crook-lying 2-Knee-extension (three times).
9. Crook-lying Abdominal breathing.

Scheme II

1. Crook-lying Abdominal breathing
2. Half-yard-grasp-standing Leg-swinging } with belt on.
3. Arm exercise.
*4. Crook-lying Trunk-raising with knee-extension and forward-bending (touching toes).
*5. Lying Alternate side-bending with alternate knee-updrawing (grasping ankle).
6. Crook-lying Pelvic-rotation with raised pelvis.
†7. 'Donkey'.
8. Wing-standing Alternate knee-upbending
9. Sitting 2 Arm-rotation-out with diaphragmatic breathing } with belt on.

Most of these exercises are described in Chapter XXIII.

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* *See* Chapter XXIII for illustration.

† *See* Chapter XVIII for illustration; this exercise must not be used for patients with lordosis.

CHAPTER V

SPRAINS: MUSCLE INJURIES: WOUNDS AND SCARS

I. Sprains: Sprained wrist—Sprained ankle—Sprained back—II. Rupture or injury of muscles: Tennis elbow—Tennis leg. III. Wounds and scars: Open wounds—Recently-healed scars—Pain in healed scars.

I. SPRAINS

THE treatment of sprains is not difficult—all are dealt with on the same lines, and it would be superfluous to describe in detail the treatment of every joint which may possibly be sprained. We shall therefore describe that of the three commonest sprains, viz., those of the wrist, ankle, and back.

SYMPTOMS.—(1) There is no deformity. (2) The joint can be moved, though movement causes pain. (3) Other symptoms are similar to those present in dislocations, but less marked. (4) The pain, though severe at the time of injury, later consists of a dull ache, and only becomes sharp on movement, when the injured structures are put on the stretch.

SPRAINED WRIST

This may be caused by violent wrenching of the wrist in any direction, generally forward or backward into forced flexion or extension. Under the term 'sprained wrist' are included all degrees of injuries, from the most trivial to the really serious. Which ligaments and muscles are injured depends, of course, on the direction of the causative force. Violent extension will cause wrenching of the anterior ligament and the flexor muscles, and probably teno-synovitis of their sheaths; violent flexion will produce similar damage to the structures on the posterior aspect. A tender spot will be found over the torn ligament. In a bad sprain there may be a good deal of swelling, extending some way up the forearm.

Treatment.—

SUPPORT.—(1) Generally, a firm bandage over cotton-wool, with the arm in a sling. (2) Occasionally, a splint of some kind, with cotton-wool and bandage.

MEDICAL TREATMENT.—Cold compresses are generally put on at first, or evaporating lotions are applied; later, hot or cold applications, whichever give most relief.

PHYSICAL TREATMENT (severe case).—

MASSAGE AND MOVEMENTS.—

1st Day.—(1) Effleurage above the site of injury, first from elbow to shoulder, then from wrist to elbow; the stroking is then made to include the fingers and hand, passing lightly over the wrist-joint itself, so that there may be no drag on the inflamed tissues. (2) Kneading of the upper arm, and gentle kneading of the forearm if this does not cause pain. The wrist should not be approached too closely. Finger kneading of hand and fingers. (3) Gentle active movements of the fingers.

If there should be muscular spasm, which is unlikely, or a great deal of pain, stroking only is given at first, from hand to shoulder.

2nd Day.—(1) Massage of the upper arm may be fairly firm. (2) Massage of the forearm (as above), gradually approaching nearer to the wrist. (3) Massage of the hand and fingers (as above), and active movements of fingers. (4) Relaxed—or active—movements of the wrist in small range. These movements must be painless.

3rd Day and onwards.—(1) Gentle frictions should be given to the torn ligaments round the wrist, and to the tendon sheaths. (2) The range of the movements should be gradually increased, without pain, i.e., no drag should put upon torn ligaments.

When inflammation has subsided and pain is no longer felt on movement, wrist and hand exercises, carefully graduated, are added to strengthen the muscles. Should any stiffness remain, stretching movements must be given, either in the form of 'forced' movements by the operator, or of free mobility exercises by the patient (*see* pp. 77–80).

SPRAINED ANKLE

This is really a sprain not only of the ankle, but of the mid-tarsal and sub-astragaloid joints as well. It is generally caused by 'turning over the ankle', that is, by a violent inversion of the foot—the same force that sometimes fractures the internal malleolus.

INJURY AND SYMPTOMS.—(1) The external lateral ligament is partially or completely ruptured, and there may be damage to the small ligaments on the outer side of the foot. (2) The peronei and extensor brevis digitorum are wrenched. (3) The swelling may be very considerable over the foot and round the ankle, and may extend some way up the leg. (4) The patient generally falls down when the accident occurs, and in severe sprains is unable to walk without intense pain.

Treatment.

As a result of the large amount of exudation, adhesions are very liable to form, and the patient's foot, unless properly treated, may remain stiff and painful for a long time. Our aims will therefore be to check effusion as soon as possible, and to keep the foot mobile. Should any stiffness remain in the late stages, it must be got rid of by forcible movement.

EARLY STAGE.—Rest on a sofa is prescribed for a few days, the length of time depending on the severity of the accident. It was at one time the custom to keep the patient off his feet for some weeks, but now, the pendulum having swung in the opposite direction, it is the fashion to get him up as soon as possible. The best results are probably obtained by common sense, and careful estimation of the actual damage done to the structures.

Cold compresses are best at first, with a tight bandage applied over cotton-wool, in order to check effusion; later, hot fomentations or cold compresses whichever give most relief.

SUPPORT.—The foot should be bandaged in *eversion*.

PHYSICAL TREATMENT.—

MASSAGE AND MOVEMENTS.—From the beginning in a case of average severity.

1st Day.—Effleurage from above the ankle up to the knee, gradually encroaching on the inflamed area. If the sprain is too severe, manipulations over the injured part should be deferred for a day or two, and effleurage given *above* the injury only. The thigh should be massaged to prevent wasting of the muscles.

2nd Day.—In most cases, kneading of the leg may be added, also the following: Finger kneading to the dorsum of foot and toes. Active movements

of the toes. Active flexion and extension of the ankle. Quadriceps contractions. Movements of hip and knee.

3rd Day and onwards.—Frictions to the front and inner side of the ankle; a little later to the outer side also. The work may be slightly deepened over the leg and dorsum of the foot, special attention being given to the peronei and extensor brevis digitorum. Inversion may be added, carefully at first.

When inflammation has subsided.—Brisk massage to leg and thigh, with hacking and clapping. Active exercises for the knee and ankle (*see* pp. 81–85). Passive stretchings, especially in the direction of inversion, if any stiffness remains. Re-education in correct walking.

SPRAINED BACK

This is really rather a muscle than a joint injury, and consists of stretching or tearing of some part of the erector spinæ, or of some muscle of the fifth layer. It may occur while at play, or may merely be the result of a false step, the patient having contracted his muscles over-strongly in order to avoid a fall.

It is often quite a slight injury, but may cause a good deal of trouble if it does not receive attention from the beginning. It is not uncommon, moreover, for a functional element to become superimposed on the organic trouble.

Treatment.—

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—The treatment may be given in prone-lying, or in lean-sitting. That position is best in which the patient relaxes most completely, and which he finds most comfortable.

MASSAGE.—From the beginning. This should consist of firm kneading and effleurage to check and disperse effusion.

EXERCISES.—

Relaxation exercises should be given next, active Head-rollings and Trunk-rollings*; Stride-standing Alternate trunk-rotation with arms swinging loosely; Back-raisings vertebra by vertebra, etc. Passive Trunk-rolling may be given if the patient can be taught to relax in this exercise.

Definite mobility exercises will be necessary later if there is still any stiffness, e.g., Tailor-sitting Alternate trunk-rotation with Alternate arm-flinging; Lying Alternate side-bending; Standing Alternate side-bending; Sawing, Hewing, etc.

II. RUPTURE OR INJURY OF MUSCLES

Myositis means inflammation of actual muscle tissue. *Fibrositis* means inflammation of connective tissue, whether between muscles or in their substance. Either may be acute or chronic, and may be the result of traumas, such as rupture or overstrain; of fatigue; or of rheumatism.

Fibrositis has been, or will be, considered in various connections, such as rheumatism and sciatica. We need not consider *myositis* as a disease in itself; it will be sufficient here to regard it as a result of injury. We shall take as examples two conditions which are primarily, at least, inflammatory conditions of muscle due to rupture of fibres or to overstrain. Similar injuries happen to many other muscles in the body, the treatment being on similar lines.

GENERAL SYMPTOMS OF MUSCLE INFLAMMATION.—These consist of *pain* in the affected muscles, increased by pressure or on movement, *aching*, *swelling*, and *altered consistency*, the muscles being at first soft and inelastic, later hard and firm, fibrous nodules sometimes forming in their substance. There is *loss of function* in the limb where the inflammation is present, both

* By Mrs. Archer's method, if known.

because of the loss of power in the inflamed muscles, and because the pain inhibits movement. The commonest complication of this condition is pressure on nerves in the vicinity, giving rise to cramp, tremor, or neuralgia.

SUMMARY OF TREATMENT.—

IN EARLY STAGES.—(1) Rest and support. (2) Lotions, compresses, fomentations, or radiant heat. If nerves are involved, anodal galvanism or other appropriate electrical treatment. (3) Massage as for any inflammatory condition; mostly effleurage at first, later kneading, gentle frictions to joints, etc. As soon as possible, relaxed passive or assisted active movements; then gentle free active movements.

IN LATER STAGES, OR IN CHRONIC CASES.—(1) Vigorous massage. (2) Faradism. (3) Exercises.

TENNIS ELBOW

This is primarily a condition of muscular overstrain, due to the playing of tennis or some other game, or to over-indulgence in some strenuous occupation producing strain of the muscles near the elbow, especially of those acting on the superior radio-ulnar joint. The use of too heavy a racket, or of any other tool or implement too large or heavy for the user, may be responsible for the trouble. A faulty technique in tennis or other games may contribute to it.

PATHOLOGY AND SYMPTOMATOLOGY.—Many different accounts have been given of this injury. Romer describes three types or stages:—

1. A *myositis* or *fibrositis* of the muscles round the elbow, the result of the constant jerking of the muscles at their origin on the internal and external condyles, the muscles from the external condyle and supracondylar ridge being most affected, and the supinator longus the chief sufferer, since it is dragged upon when taking 'back-handers' in tennis. The *symptoms* of this form consist of cramp and hardening in the muscles, which are painful on pressure or when the elbow is moved. The onset is gradual in most cases.

2. In addition to the fibrositis, a *periostitis* in the region of the external condyle, probably caused by the actual tearing of some muscle fibre from its periosteal attachment. An additional *symptom* in this form is the presence of a tender spot at the origin of the common extensor tendon. There is a burning pain in the bone at this region. The onset is always gradual.

3. *A synovitis or, later, an arthritis* of the superior radio-ulnar joint, possibly with injury to the orbicular ligament. The *symptoms* are pain and swelling over the head of the radius, pain being especially felt on pronation and supination. The onset is always gradual.

These types are often combined; the first type is, however, often found alone.

Simple Muscular Type

Treatment.*—

MASSAGE AND MOVEMENTS.—

Early Stage.—Rest—especially from the occupation causing the injury. *Massage* to reduce inflammation: effleurage, finger-kneading, hand-kneading. *Gentle movements*, relaxed and active.

In 2 to 3 Weeks.—Exercises. Brisk massage.

The patient now begins to play tennis, etc., generally with the forearm strapped to support the muscles and prevent their dragging on the condyle.

* The opinions of physicians and surgeons upon this matter differ to such an extent that it is impossible to dogmatize on the subject. Some cases have been successfully treated by manipulation, and others by various open operations.

Periostitic or Arthritic Type

Treatment.—

These cases require a much longer period of rest, until pain on movement has disappeared.

MASSAGE AND MOVEMENTS.—Massage is given as above, but the external condyle in the periostitic type, and the region of the radio-ulnar joint in the arthritic, should be avoided.

In 2½ to 3 Weeks.—Very gentle movements.

In 4 to 6 Weeks, or later.—Exercises, gradually increased in strength.

Play may be resumed, with appropriate strapping; but sometimes it is better to give it up for that season.

RADIANT HEAT AND IONIZATION may often be useful in relieving pain in the severer forms.

Neglected cases may have to be manipulated under an anæsthetic to overcome contracture of the flexor muscles, after which massage, with active and passive movements, must be given.

TENNIS LEG

NATURE OF INJURY.—Rupture of the plantaris tendon, or some fibres of the gastrocnemius; occasionally even rupture of the Achilles tendon.

CAUSE.—Sudden strong contraction of the calf muscles, in standing on tip-toe. There is severe pain at the moment of the accident, the patient often thinking he has received a blow on the leg.

Simple Rupture of the Plantaris Tendon

Treatment.—

A good deal of difference of opinion exists with regard to the best way of treating this injury. Probably the best thing is for the patient to use the leg rather than rest it, or to rest it only for about twenty-four hours. A piece of strapping may be applied vertically down the back of the calf, with shorter transverse pieces crossing it. The leg may be massaged and active movements given. Dorsiflexion of the foot must be maintained.

Rupture of Fibres of the Gastrocnemius

Treatment.—

How long the patient is to *rest* depends entirely on the severity of the injury. In slight cases, a few days will probably suffice; in severer cases, the patient may have to keep off his feet for a week or so.

Dr. Mennell points out the importance, in this and in all cases of rupture of muscle fibres, of *checking effusion*, which will otherwise organize and lead to the formation of thickenings and adhesions in the muscle. The limb should therefore daily receive effleurage and careful kneading, and a bandage should be applied over a thick layer of cotton-wool.

Gentle active movements are given in a day or so, or later in cases of very severe injury. Dr. Mennell prefers the use of graduated faradic contractions in the early stages.

At a later stage, when all inflammation has subsided, vigorous massage and exercises are indicated. The operator must see that dorsiflexion of the foot is quite full. If not, *forced passive movements* must be administered.

Rupture of the Achilles Tendon

Treatment.—

This is a much more serious injury. The foot will either be splinted or secured by a bandage in moderate plantar flexion. No movements in the

direction of dorsiflexion are to be given for two or three weeks, and no stretching movements for four or five. Otherwise the treatment is on the same lines as in the slighter injuries. The patient will not be allowed to walk for at least 6 or 7 weeks. When this is permitted, careful re-education in correct walking is essential.

III. WOUNDS AND SCARS

HEALING OF WOUNDS.—A clean wound in which the raw surfaces are in close contact heals by *first intention*—that is, a very thin layer of fibrous tissue forms between the surfaces, uniting them to one another. The skin then grows over the wound, and little or no trace of the injury remains.

If the wound is septic, or if the cut surfaces are not in contact, for example, if an incised wound gapes open, or if in a lacerated wound there has been much destruction of tissue, the healing takes place by *second intention*, or *granulation*. In the early stage of healing of septic wounds or abscess cavities, the dead tissues are thrown off, and the process of repair begins by an increased flow of blood to the part, new vessels growing into the damaged tissues, clotted blood, and exudate. It is these new capillary loops which constitute the granulations, which look like small red bodies. Round them the new fibrous tissue grows, gradually filling up the cavity; and the skin ultimately covers the surface. As soon as this connective tissue is fully formed, the hyperæmia diminishes, leaving the part white in appearance. During this stage the new tissue begins to shrink, sometimes cutting off the blood-supply from parts of the wound which are not yet fully repaired, and so preventing them from healing. In some cases the contraction in the healed wound is so great as to interfere seriously with movement in the nearest joint. The scar may, moreover, adhere to structures around it, such as muscle or bone.

OPEN WOUNDS

Treatment.

Obviously, the essential factor in the process of healing is the increase of blood-flow to the part. Much, therefore, may be done to assist the process, provided that proper precautions are taken with regard to asepsis. If the wound is in the leg or arm, the whole limb should be treated.

PHYSICAL TREATMENT.—

General Massage of the Limb.—If there is danger of great contraction, as in extensive wounds, the limb will probably be splinted in such a way as to prevent it.

The wound should have been dressed before the treatment is begun, and covered with a layer of gauze. The masseuse must be careful not to displace this in the course of her manipulations; it may be lightly strapped on if necessary, or fixed by a turn of two of bandage.

The whole limb should receive a dose of effleurage and pétrissage, and hacking may be performed carefully, but the area of the wound must be given a wide margin.

All joints of the limb may be moved passively and actively provided no strain is put on the healing wound. If there is any doubt about this latter point, it is as well to leave the movements in the joints nearest the wound until we have it exposed, so that we may watch their effect on it.

Local Treatment of the Wound.—The masseuse now scrubs her hands and soaks them in a weak disinfectant solution (e.g., 1 per cent lysol), not drying them unless she has a sterilized towel;* she then removes the dressing from

* Obviously, before attempting to deal with open wounds, the masseuse must have been taught the elementary principles of asepsis.

the wound—if no nurse is in attendance—and replaces it with a small piece of sterile gauze cut to fit exactly the raw surface of the wound. Frictions are then given, firmly but gently, round its edges, the pressure always being *inwards* towards the raw surface, and vibrations, performed with the finger-tips, in the same direction, may be added. If passive and active movement to the nearest joints has not been already administered, it may take place now, or if any drag on the wound results from such movements, the patient can at least be taught to contract the muscles beneath it without moving the joints at all. This will help to prevent the formation of adhesions, as well as to improve the circulation. The masseuse again washes her hands, removes the temporary dressing, applies the ordinary one, and finally washes and disinfects her hands after she has finished with the case. A similar treatment is carried out in the case of burns. *Septic* wounds and ulcers are generally treated by ultra-violet rays, or by various forms of electricity.

RECENTLY-HEALED SCARS

Treatment.—

It is a mistake to suppose that a scar requires no particular care just because the wound is actually closed. No movements which tend to separate the edges are permissible until the healing is quite firm—that is, until three to four weeks after the closing of the wound, in the absence of sepsis. If there has been sepsis, the greatest care is necessary, as injudicious treatment may easily light it up again.

Any ordinary scar, however, can be dealt with quite successfully provided both patient and operator possess the gifts of patience and perseverance. The treatment will have to be long-continued, and it cannot be hurried.

PHYSICAL TREATMENT.—

MASSAGE.—This is on the same lines as for open wounds, though the manipulations may be rather stronger. Very deep work is required for *old adherent scars*. Frictions should be given in such a way as to raise the scar from the underlying tissues. Olive oil is sometimes used to soften the scar.

MOVEMENTS (for firmly-healed scars).—Strong *passive movements* are given to the nearest joints to stretch the contracture, and are followed by *active movements*. The scar should be grasped by the masseuse while the patient contracts his muscles. Vigorous free home exercises should be prescribed.

SPLINTING.—Splints are often applied for the purpose of preventing contracture, or of gradually stretching the tissues if it has already taken place.

OTHER FORMS OF TREATMENT.—Whirlpool baths, if obtainable, help to soften the scar. Failing these, the part may be soaked in hot water before massage. Electrical treatment, as ionization with chlorine or iodine, may be ordered.

PAIN IN HEALED SCARS

CAUSE.—The pain may be due to: (1) Neuralgia or neuritis caused by the involvement of nerves in scar tissue; or (2) Venous congestion in deep scars.

Treatment.—

In the first case, vibrations and frictions may be tried, in order to loosen the nerve from its surroundings. Dr. Mennell recommends the use of the mechanical vibrator.*

In the case of the large deep scar, Sir Robert Jones† says that the pain is due to venous congestion and irregularities of blood-pressure in the tissues

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* *Massage: its Principles and Practice.*
† *Injuries to Bones and Joints.*

below the surface, and that the remedy lies in the promotion of vascular activity. He therefore advises fairly free use of the affected limb, deep massage, hot applications to the part at night (to relieve pain and allow the patient to sleep), and *contrast baths*, which consist of plunging the limb alternately into cold and hot water for about 5 to 10 minutes. (On other parts of the body hot and cold sponges are applied in turn.) This treatment causes successive dilatation and constriction of the blood-vessels, so exercising the muscular fibres of their walls, and thus improves the circulatory condition of the part.

EXERCISES.—These should be of the quick, rhythmic, swinging type, such as Leg-swinging or 2-Arm-swinging, 2-Arm-swinging in circles, 2-Arm-flinging; High-sitting Knee-swinging, etc.

CHAPTER VI

TREATMENT OF THE AFTER-EFFECTS OF INJURY: STIFF JOINTS

Stiff shoulder—Stiff elbow and superior radio-ulnar joint—Stiff wrist, hand, and fingers—Stiff hip—Stiff knee—Stiff ankle, foot, and toes.

In order to avoid constant repetition in previous chapters, the treatment of the *late* effects of fractures and dislocations has been summarized below. It must be clearly understood that most of the exercises suggested are suitable *only* for chronic cases, in which there is no longer any danger of recurrence of the original injury, or recrudescence of inflammation. *All* the exercises given for any particular joint are not appropriate to every individual case. The masseuse must consider her patient's requirements, as well as any complications that have been or are present, before selecting the exercises.

STIFF SHOULDER

Massage.—Vigorous massage of all the muscles acting on the joints of the shoulder-girdle, that is, of the shoulder, arm, neck, chest, and back, should be administered; deep frictions are applied to the ligaments to stretch adhesions; beating or pounding at the front and back of the shoulder-joint are sometimes added.

Passive (Forced) Movements of all joints of the shoulder-girdle, in all directions, are given to restore mobility, special attention being paid to any particularly limited movement.

Active Movements.—These form the most valuable part of the treatment. Quick, swinging movements are the best, since not only do they strengthen the working muscles, but they also increase the mobility of the joint itself, the momentum acquired by the swinging limb carrying it slightly beyond the existing range of movement. Moreover, they have this advantage over forced movements, that the patient does not contract the antagonists of the acting muscles as he would do, voluntarily or involuntarily, to resist a painful stretching carried out by another person. Nervous patients and children do much better when treated by this method. In some cases the weight of the patient's whole body may be made to act as the stretching force, as in hanging or travelling on the boom.

In the case of the shoulder-girdle, it is essential that exercises should be chosen which will restore every movement of each of the three joints which it comprises; no movement must be omitted from the table. The movements are as follows:—

Humero-scapular (*Shoulder*) *Joint.*—(1) Flexion and extension. (2) Abduction and adduction. (3) Internal and external rotation.

Sterno-clavicular Articulation.—(1) Elevation (of the clavicle and with it of the scapula). (2) Depression of these bones. (3) Forward movement, the scapula being drawn forward (abducted), on the chest wall when the clavicle

moves forward. (4) Backward movement of both bones, the scapula being adducted, or carried back towards the vertebral column.

Acromio-clavicular Articulation.—A movement of rotation of the scapula takes place in conjunction with abduction of the humerus and elevation of the clavicle. When the arm is lifted from the side, the inferior angle of the scapula is rotated outward, so that the acromion process is raised, allowing the deltoid to complete the abduction of the humerus. When the arm is lowered, the inferior angle is rotated inward towards the vertebral column.

All the above movements must find a place in the patient's table; elevation should be taken through flexion (Arm-raising forward and upward) and through abduction (Arm-raising sideways and upwards).

FREE EXERCISES.—

1. Standing 2-Arm-swinging forward and upward, backward and downward.
2. Standing Alternate arm-swinging, as above.
3. Standing 2-Arm-swinging in circles.
4. Standing- or (long-) sitting, 2-Arm-raising sideways and upward (quickly), clapping the hands over the head.
5. As 4, but bringing the backs of the hands together over the head instead of the palms.
6. Lying, or crook-lying, Alternate arm-swinging forward and upward over head.
7. As 6, but with the two arms together.
8. Standing (or sitting) Alternate arm-swinging forward and backward with elbow-flexion and -extension. This consists of loose alternate swinging of the arms, shoulder and elbow flexed together in the forward swing, and extended together in the backward swing. The arm is not raised above shoulder level. (*Fig.* 26.)
9. Standing 'Crawling up the wall' (with one arm).
10. As 9, but with both arms together.
11. Forward-bending over plinth or table, Chest-downpressing. Exercise for elevation through flexion. The patient, with arms raised forward and upward as far as he can, bends forward over a high plinth or table, until his body lies as flat as the stiffness of his shoulder will allow. He then tries to press his chest down on the plinth, thus forcing the arms upward and backward.

Fig. 26.—Standing Alternate arm-swinging forward and backward with elbow-flexion and -extension.

12. Long-sitting 2-Arm-rotation-outward and -circling, with forward-bending.* The patient rotates the arms outward as far as possible at the shoulder-joint, and then carries them sideways and upward, the palms facing upward. He then turns the palms forward, and continues the circle, carrying the arms forward and downward till they rest on the front of the tibiæ about half-way down, or on the front of the ankle-joints. (If placed in the latter position, there will be a good deal of flexion in the spine; and in any case, there is strong work for the abdominal muscles throughout the exercise.) A similar exercise may be done in knee-sitting. (*Figs.* 27–29.)
13. Standing, stride-sitting, or tailor-sitting 'Cabman's exercise'. This is well known to most people. The patient crosses his arms over his chest, and

* Suggested by an exercise devised by Madame Agnete Bertram.

then swings them outward into talk position. It should be done vigorously and in quick time.

14. Standing, or sitting, 2-Shoulder-shrugging.

15. Standing, or sitting, 2-Arm-bending and -stretching in all directions.

16. Forward-bend- (or neck-rest-) standing, or sitting, 2-Elbow-circling. The patient carries the elbows round in small circles, taking them back sharply and relaxing slightly as he brings them forward again.

17. Forward-bend-standing, or (ride-) sitting, 2-Elbow-backward-carrying. Performed much as 16, but the elbows are carried backwards in a series of jerks. Both these exercises are for the back shoulder muscles, and may be repeated about ten times; after a short rest a second series of ten may be given.

18. Reach-standing 2-Arm-parting (quick or slow).

19. Bend-standing or (ride-) sitting 2-Arm-flinging.

20. Forward-bend-stride- or tailor-sitting Alternate arm-flinging.

21. As 20, with Alternate (head- and) trunk-rotation.

22. Standing, or sitting, 2-Arm-swimming.

Fig. 27.

Fig. 28.

Fig. 29.

Figs. 27–29.—Knee-sitting 2-Arm-rotation-outward and -circling, with forward-bending.

23. Standing, or sitting, free (single) Arm-rotation with rod, poker, etc. The patient grasps the rod or poker near the centre. The elbow should be straight and the shoulder slightly flexed, abducted, or between flexion and abduction. He rotates the shoulder in and out. A dumb-bell may also be used. To make the exercise more difficult, the poker may be held progressively nearer and nearer the end, so lengthening the weight arm of the lever, and increasing the resistance (Dr. Mennell).

24. Standing, or sitting, Hand-placing behind neck (neck-rest position) and behind lumbar region. An exercise for inward and outward rotation of the shoulder. It should be done as quickly as possible. (*Figs.* 30–32.)

25. Hand placed against wall, Trunk-rotation. The patient places his hand flat on the wall in front of him, and rotates the trunk to right or left.

26. Grasping partner's hand (elbow extended), Rotation in and out.

27. Standing Sawing.

28. Prone-falling position and its variants. The patient stands with hands against the wall or some high piece of furniture, with arms only just below shoulder level. In this position he performs 2-Arm-bending and -stretching allowing himself to fall close to the wall and pushing himself away. The

support for the hands is gradually lowered, e.g., the patient will place his hands on (1) a table, (2) a high chair, (3) a low chair or stool, (4) the floor. Arm-bending and -stretching in the last position will only be possible for patients with very strong muscles, and forms a final strengthening exercise on recovery. For many patients it is never possible with the hands lower than (2), either because the arms are not strong enough, or because of the strenuous work for abdominal muscles and quadriceps.

Fig. 30.

Fig. 31.

Fig. 32.

Figs. 30-32.—Standing Hand-placing behind neck (neck-rest position) and behind lumbar region. *Fig.* 30, Rotation out (neck-rest position); *Fig.* 31, Rotation in (hands behind lumbar region); *Fig.* 32, Further rotation in, with extension of shoulder.

29. For children; 'Cat washing its face' forms a variant of Arm-circling. (*Figs.* 33–37.)

EXERCISES REQUIRING APPARATUS OR SKILLED RESISTANCE.—

1. Pulley exercises, double or single pulley.
2. Stretch-half-lying 2-Arm-rolling + 2-Arm-bending and -stretching. A final exercise, for circulation and strengthening, since mobility must be nearly complete if the arm can be brought up to stretch position.
3. Half-yard- half-wing-sitting 2-Arm-rotation with rod.
4. Standing Shoulder-lifting.
5. Turning nautical wheel (elbow straight).
6. Turning handle of wrist machine with elbow straight.
7. Use of screw-driver.
8. Exercises with Indian clubs, dumb-bells, etc.
9. Hanging by the hands from the boom.
10. Swinging on the boom.
11. Travelling on the boom.
12. Hanging (grasp with hands supinated) Heaving and sinking. Only possible for strong patients. A final exercise.

Pulleys may often be extemporized in private houses. An ordinary roller towel on its rail is quite useful, the patient grasping both sides of it and pulling one side down, thus drawing up his other arm. Or he may put a piece of cord or rope over a beam, hook on a door, etc., and holding the two ends use it as a pulley.

It will be noticed that some of the exercises given are directed especially towards the improvement of mobility, others towards the strengthening of muscles. Others, again, aim at attaining both these results at the same time.

Fig. 33.

Fig. 34.

Fig. 35.

Fig. 36.

Fig. 37.

Figs. 33-37.—'Cat washing its face. The movement shown in *Figs.* 33 and 34 is performed twice before continuing the exercise.

Specimen Table for a Class, showing how each Movement may be included

Exercise	Movement
1. Standing Deep breathing	
2. Standing 2-Arm-swinging forward and upwards, backward and downward	Elevation through flexion; depression and extension

3. Forward-bend-standing 2-Elbow-backward-carrying	Extension of shoulder: adduction of scapulæ
4. Long-sitting 2-Hand-clapping over head	Elevation through abduction
5. Hanging and swinging	Passive stretching in all joints
6. Sawing	Forward and backward movement of scapulæ, flexion and extension of shoulder, etc.
7. Standing 2-Shoulder-shrugging	Elevation
8. Tailor-sitting 'Cabman's exercise'	Flexion and extension in shoulder-joint
9. Standing 2-Hand-placing alternately behind neck and behind lumbar region	Rotation in and out in humero-scapular joint
10. Standing 2-Arm-swinging in circles	Circumduction
11. Standing (or crook-lying) Deep breathing	

STIFF ELBOW AND SUPERIOR RADIO-ULNAR JOINT

Massage.—Of the usual type.

Passive (Forced) Movements.—

1. Flexion and extension of the elbow-joint. The operator must allow for the 'carrying angle', and not try to force the forearm into line with the upper arm.

2. Pronation and supination of the radio-ulnar joints. The elbow must be kept in semi-flexion during the administration of these movements, so as to eliminate rotation in the shoulder-joint.

In some cases, supination may be combined with flexion of the elbow, and pronation with extension. For mobilization of the inferior radio-ulnar articulation, *see* STIFF WRIST (p. 77).

Active Movements.—

FREE EXERCISES.—

1. Standing Alternate arm-swinging forward and backward with elbow-flexion and -extension (*see* No. 8, shoulder exercises, and *Fig.* 26).

2. Standing 2-Arm-bending and -stretching in all directions (quickly).

3. Standing Alternate forearm-bending and -stretching. The forearm is held between pronation and supination, and one elbow is flexed as the other is extended. Should be done quickly.

4. No. 3, combined with marching

5. Standing (or sitting) 2-Forearm-bending, touching shoulders. Both elbows are bent at the same time; the forearm is in supination. The movement may be quick or slow.

6. Standing 'Crawling up the wall'.

7. Standing with forearms resting on high plinth, Forward-bending. The exercises should be done with the forearms in supination and in pronation. (*Figs.* 38, 39.) The same exercise may be done sitting at a low table.

8. Climbing wall-bars, stretching elbows. The patient keeps hands and feet close together and stretches backward between each step.

9. Tug-of-war. The patient grasps his partner's or the operator's hand, and they pull against each other.

10. Forward-bend-standing (or tailor-sitting) 2-Arm-flinging.

11. Forward-bend-tailor-sitting Alternate arm-flinging with trunk-rotation.

12. (Stoop-) stride-standing Alternate arm-flinging with head-turning to same side ('sign-post').

13. Standing Sawing.

14. Weight lifting and carrying.

15. Arm-swinging with weight.

16. Prone-falling position, with or without 2-Arm-bending and -stretching (*see* No. 28, shoulder exercises).

17. Standing 2-Arm-swimming.

18. Standing (or sitting) Elbow-grasp Pronation and supination. The patient grasps his own elbow from behind with his other hand, to prevent rotation in the shoulder-joint. He quickly turns the palm of his hand upward and downward. (*Fig.* 40.)

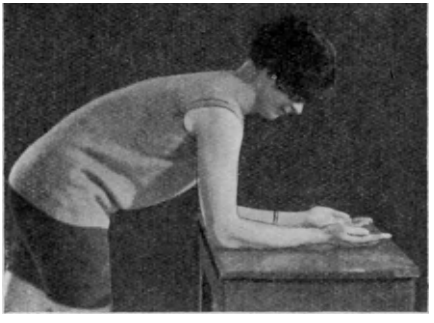

Fig. 38.

Fig. 39.

Figs. 38, 39.—Standing with forearms resting on a high plinth, Forward-bending. (A table is used in this case.)

Fig. 40.—Standing Elbow-grasp position; used for most pronation and supination exercises.

19. As 18, but grasping partner's hand; each resisting the other.

20. Elbow-grasp Pronation and supination with rod or poker. The grasp of the rod is as in No. 23, shoulder exercises. The position of the arm is as in *Fig.* 40.

21. Wringing a cloth.

22. Twisting a rod. The patient holds a short rod in front of him, hands pronated and about 3 inches apart. He twists the rod towards him (pronation) and away from him (supination) with his injured hand, resisting with his sound hand. (*Figs.* 41, 42.)

23. Turning door handle.

24. Use of small screw-driver, elbow kept flexed.

25. Hands palm to palm or clasped, finger-tips away from body. Turn finger-tips towards body, keeping palms together. This, of course, must include shoulder movement (flexion and rotation).

26. Hand-clapping (alternate pronation and supination). The elbows are kept close to the sides. The hands are clapped, each hand being placed alternately on top of the other.

APPARATUS AND RESISTANCE EXERCISES.—

1. Pulley exercises, or those with home-made substitutes.
2. Hitting the punch-ball, or a large ball suspended in the air.
3. Wrist machine (Pronation and supination—elbow-grasp).
4. Stretch-half-lying 2-Arm-bending and -stretching.
5, 6, 7. Hanging, swinging, or travelling on the boom.
8. Hanging, with hands supinated, Heaving and sinking (*see* No. 12, shoulder apparatus exercises).

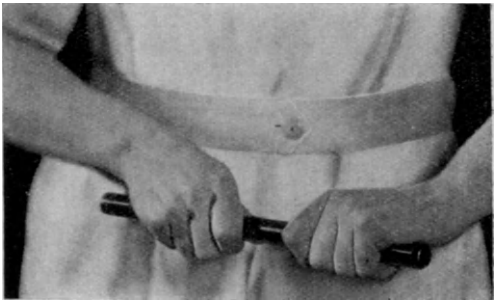

Fig. 41.—Twisting a rod. Complete pronation.

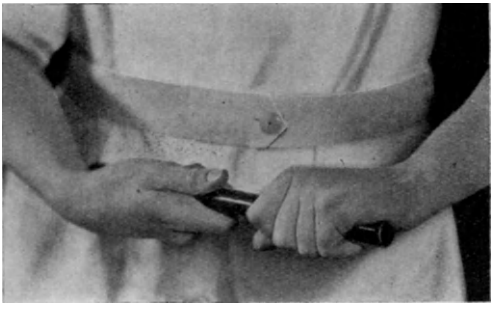

Fig. 42.—Twisting a rod. Complete supination. The patient is moving the right hand from one position to the other.

STIFF WRIST, HAND, AND FINGERS

Massage.—Of the usual type; the whole arm should be treated.

Passive (Forced) Movements.—The following are necessary :—

WRIST JOINT.—Flexion, extension, abduction, and adduction.

INFERIOR RADIO-ULNAR JOINT.—

1. The radius should be grasped between the thumb and index finger of one of the operator's hands, the ulna in a similar manner with her other hand, and the radius moved backwards and forwards on the ulna (Mennell).
2. Ordinary pronation and supination.

CARPAL JOINTS.—Slight movements of flexion, extension, and rotation between the carpal bones will take place in conjunction with those of the wrist and inferior radio-ulnar joints.

METACARPO-PHALANGEAL JOINTS.—These are enarthrodial (ball-and-socket) joints and therefore are capable of: (1) Flexion and extension; (2) Abduction and adduction; (3) A very slight movement of rotation.

1. Flexion and extension. Dr. Mennell has pointed out that there is a marked gliding element in the movements of this joint, as well as in that of the interphalangeal joints,* and that if the first phalanx is grasped well above the joint and forced forward, the posterior ligaments will be torn. Instead of this, the *head* of the metacarpal should be pressed back while the *base* of the

* *Massage: its Principles and Practice*, chapter xvii.

first phalanx is moved forward over it, the pressure in both cases being exerted as close to the joint as possible.

2. Abduction and adduction. The first phalanx should be grasped firmly, and drawn out longitudinally, and the finger should then be moved from side to side.

3. Rotation. The grasp is as above, but the joint is slightly flexed. Only very slight movement is possible.

INTERPHALANGEAL JOINTS.—These are flexed and extended in a similar manner.

The chapter in Dr. Mennell's book, referred to on p. 77, is most valuable, and should be read by all who wish to make a success of this kind of work. It is written for surgeons, but many useful suggestions may be gathered by the experienced masseuse which should be of considerable assistance to her in her work. It is not, of course, intended for beginners.

Active Movements.—Cases to be treated in a *class* for hand injuries should be very carefully selected. Over-strenuous treatment may in many cases do irreparable damage; and we have to remember how very serious for many patients is hand disablement. Cases in which sepsis has been present should be

Fig. 43.

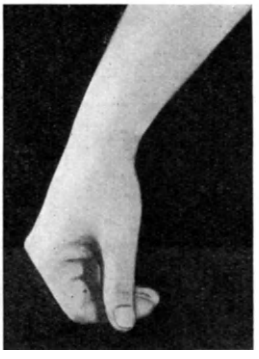

Fig. 44.

Fig. 45.

Figs. 43–45.—Standing, hand on table, Wrist- and finger-flexion. *Fig.* 43, Starting position. *Fig.* 44, Flexion of metacarpo-phalangeal and first interphalangeal joints. *Fig.* 45, Flexion of wrist.

most carefully watched. Patients recovering from paralysis are not suitable for inclusion in classes until recovery is practically complete.

FREE EXERCISES.-

1. Wrist-shaking, forward and backward.

2. Wrist-shaking, laterally. This combines abduction and adduction of the wrist with pronation and supination.

3. Standing, hand pronated on table, Trunk-falling-forward. For extension of the wrist.

4. Crawling on all fours (for children). For extension of the wrist.

5. For pronation and supination, Exercises 18–26, in the list of elbow exercises (*see* p. 76).

6. Standing, hand on table, Wrist- and finger-flexion. (*Figs.* 43–45.)

7. Hand-opening and -closing, with abduction and adduction of fingers.

8. As No. 7 + flexion and extension of wrist. Closing of the hand accompanies extension of the wrist, opening accompanies flexion.

9. Hand-opening and closing + 2-Arm-bending and -stretching.
10. Squeezing a rubber ball.
11. Grasping rods of different sizes.
12. Palms together, arms stretched in front of body; draw hands in towards body, carrying elbows outwards, the palms being kept together. For extension of the wrist. (*Figs.* 46, 47.)

Fig. 46.

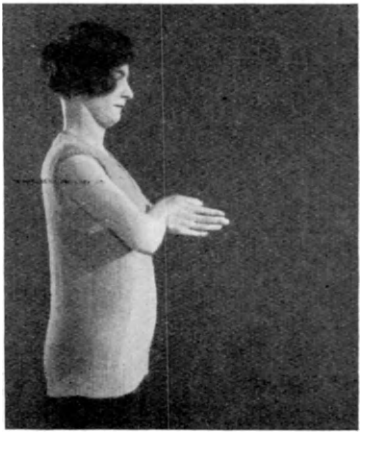

Fig. 47.

Figs. 46, 47.—Exercise No. 12, for extension of wrist.

Fig. 48.

Fig. 49.

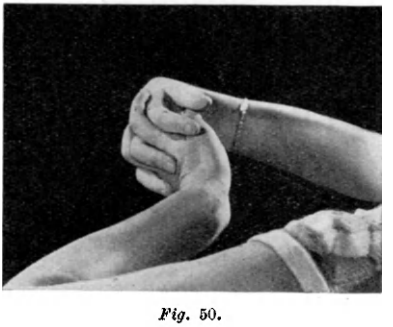

Fig. 50.

Figs. 48–50.—Exercise No. 13, for flexion and extension of wrist. For the purpose of showing the wrist movement, the model's arms are raised to shoulder level and carried to the left. In the exercise as described, the hands are placed in front of the thorax just above the waist level.

13. Hands clasped in front of thorax, elbows at side. Each forearm is brought alternately against the thorax, producing flexion of one wrist and extension of the other. A strong exercise if done quickly and vigorously. (*Figs.* 48–50.)

14. Finger-tips together, finger-tips pointing away from body, elbows at sides. Bring elbows out from sides, pressing palmar aspects of all fingers together, keeping palms of hands apart. For extension of fingers and thumb.

15. Touch each finger-tip in turn with the tip of the thumb. For opposition of the thumb.

See also exercises for MEDIAN and ULNAR PARALYSIS (Chapter XII). These are useful for strengthening the small muscles of the hand.

APPARATUS EXERCISES.—

Wrist Machine.—Begin by grasping the smallest bar. Turn: (1) Away from self for wrist flexion; (2) Towards self for extension. Progress to larger bars, and add resistance gradually. For pronation and supination, use as for elbow exercises.

Failing a wrist machine, a rolling-pin held by an assistant answers quite well.

Fig. 51.—Standing Alternate knee-raising, with knee-clasping.

STIFF HIP

Massage.—Of the usual type: special attention to the glutei and thigh muscles; the lumbar muscles should also be treated.

POSITION OF PATIENT.—

For thigh massage: half-lying, with a pillow under the lower leg and knee.

For hip massage: side-lying, with hip and knee slightly flexed (if possible). A pillow should be placed between the knees.

Passive Movements.—(Patient in lying). The following should be given:—

1. Rotation of the hip with the legs extended.
2. Flexion and extension of the hip and knee together.
3. Rotation with flexed hip and knee.
4. Abduction and adduction with flexed hip and knee.
5. Abduction and adduction with the hips and knees extended.
6. Hip-rolling, in lying or half-lying ("little circles in big circle").

Special attention must be paid to abduction and inward rotation after all old injuries to the femoral neck, and indeed in most cases of 'stiff hip' from whatever cause.

Active Movements.—

FREE EXERCISES.—

1. Half-yard-standing (or free standing) Leg-swinging forward and backward. The patient stands first on the injured leg and swings the sound one; later on the sound leg, swinging the injured one.
2. Cock-step marching, or marching with knee-raising.
3. Standing Alternate knee-raising, with knee-clasping. The patient raises each knee alternately, clasping it with both hands and drawing it into as full flexion as possible. (*Fig.* 51.)

4. Knee-sitting position, or the endeavour to assume it.
5. Going up and down steps.
6. Sitting, or loin-support-standing, Trunk-rolling. Movement in the hip-joint should be encouraged in these cases, instead of trying to localize it in the joints of the spine.
7. Reach-grasp-standing Leg-side-swinging.
8. Crook-lying 2-Knee-abduction and -adduction (free).
9. Reach-grasp-standing Leg-carrying (or -swinging) in circles.
10. Long-sitting (if possible) Forward-bending.
11. Stride-sitting Forward-bending.
12. Sitting Forward-bending and backward-falling to half-lying position. If in a gymnasium, the patient sits on the short end of a low plinth, the long end being raised. He alternately bends forward and falls back into half-lying position.
13. Stretch-standing Forward- and downward-bending and raising.
14. Standing Hewing.
15. Wing- or reach-grasp-standing Heel-raising and knee-bending.
16. Heave-grasp-close-standing (in doorway) Alternate pelvic-rotation (free).
17. Crook-lying Pelvic-raising and -rotation.
18. Yard-close-standing Alternate trunk-rotation; or any trunk-rotation in which the pelvis is not fixed.
19. Crook-lying Pelvic-rotation. The patient swings both knees together, first to one side then to the other.
20. Any exercise in the list of knee exercises which involves movement in the hip also.

APPARATUS OR RESISTANCE EXERCISES.

1. Pulley exercises (single pulley).
2. Leg-forward-lying Trunk-forward-bending. The patient is in leg-forward-lying on a low plinth, or a high plinth with a stool in front. The feet are strapped, or supported by the operator. He places his hands on the floor, or stool, and gradually lowers his body over the end of the plinth by bending his arms.
3. Heave-grasp-lying, 2-Knee-updrawing and -down-pressing.
4. Crook-half-lying 2-Knee- (or leg-) abduction and -adduction (resisted
5. Resisted Trunk- and Pelvic-rotations.
6. Stationary bicycle.
7. Rowing machine.

STIFF KNEE

Massage.—Vigorous massage to the whole thigh and leg, with special attention to the quadriceps.

Passive Movements.—

1. Lateral movement of the patella.
2. Flexion and extension of the knee.
3. Rotation in and out with the knee in semi-flexion (this is often forgotten).

Outward rotation should not be given to knock-kneed patients.

Active Movements.—

FREE EXERCISES.—

1. High-sitting free Leg-swinging. Later, a weight may be attached to the foot—first 1 lb., then 2 lb.
2. Sitting Knee-bending and stretching.

3. Wing-standing, or half-yard-grasp-standing Leg-swinging (knee swinging loosely).

4. Reach-grasp-standing Heel-raising and knee-bending (quickly and slowly).

5. As No. 4, for one leg only. The other knee may be held flexed, or instep-support position may be taken. The patient should not go down too far.

6. Crook-sitting position, the patient drawing up the stiff knee towards his body with his own hands.

7. Wing-knee-standing, trying to assume knee-sitting position.—This can only be given if the knee can already be flexed to a little beyond a right angle. Otherwise the patient assumes a position of lordosis, hollowing his back in order to keep the line of gravity within the base.

8. Half-kneeling Forward-bending.—The patient kneels on the sound knee (*Fig.* 52). He then bends forward over the front knee (*Fig.* 53), so forcing it into flexion; a series of small movements backward and forward may be made when the limit of movement is reached. In order to obtain a further stretching he may bend the trunk as far forward as possible, stretching out the arm on the side of the injured knee and trying to touch the ground as far in front of him as possible (*Fig.* 54).

9. Patient on hands and knees Backward-pushing. The patient pushes his body backward with his hands till knees and hips are fully flexed, or as much flexed as possible. (*Figs.* 55, 56.)

10. Running on the spot with knee-raising.

11. Lunge position.

12. 'Frog-march.'

13. 'Bunny-jumping' for children.

14. Lying, half-lying, or standing Quadriceps contractions.

15. Nos. 2, 3, and 5, in list of hip exercises.

16. Stride-sitting Knee-rotation in and out.

APPARATUS OR RESISTANCE EXERCISES.

1. All resisted Knee-bendings and -stretchings.

2. Rowing machine (or rowing in boat with sliding seat).

3. Pulley exercises.

4. Kicking a football.

STIFF ANKLE, FOOT, AND TOES

Massage.—Of the thigh, leg and foot, special attention being given to :—

1. The *quadriceps*, since if a correct standing position is to be maintained, it is essential that the knees should be firmly braced back.

2. The *anterior tibial group*, since gravity pulls against these muscles, which have also to act in antagonism to the powerful calf muscles. In addition to this, the tibialis anticus is one of the principal supports of the inner arch of the foot.

3. The *small muscles of the sole*, the supports of both longitudinal and transverse arches.

If the arch is dropped or in danger of dropping, massage is given as for flat-foot (Chapter XVI).

Passive Movements.—

1. Flexion and extension of the ankle.

2. Inversion and adduction, eversion and abduction, in the sub-astragaloid and mid-tarsal joints.

3. Foot-rolling.

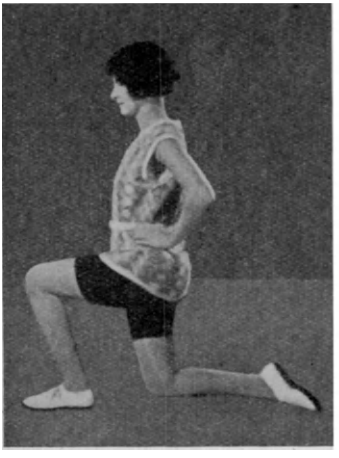

Fig. 52.

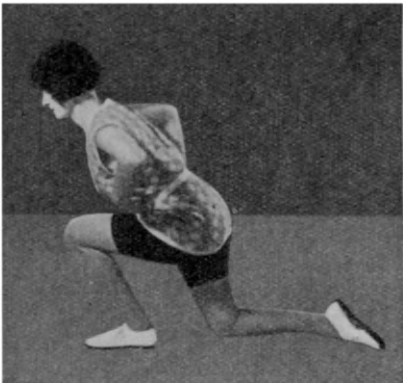

Fig. 53.

Fig. 54.

Figs. 52–54.—Half-kneeling Forward-bending. The knee can be still further flexed if the heel is raised from the ground; but this must not be allowed if the purpose of the exercise is to to obtain full dorsiflexion of the ankle.

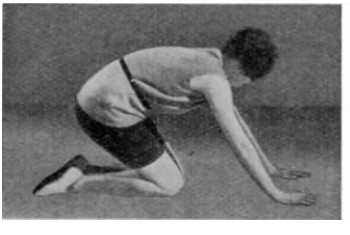

Fig. 55.

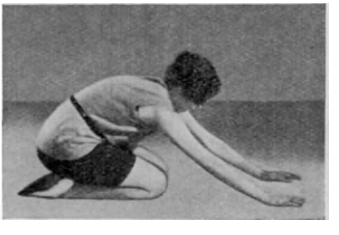

Fig. 56.

Figs. 55, 56.—On hands and knees Backward-pushing.

4. Flexion and extension of the toes.
5. Toe-rolling.

It must be remembered that movements of the toe-joints should be given on the same principles as those of the finger-joints (*see* p. 77).

Active Movements.—

FREE EXERCISES.—

1. (Wing) standing Single heel-raising and -lowering. (*Fig.* 57.)
2. Standing 2-Heel-raising and -lowering.
3. Standing 2-Knee-bending (to curtsey-standing position).
4. Wing-standing Heel-raising and knee-bending.
5. Walking on the toes, and running.
6. Knee-sitting Trunk-raising and -lowering. Given for plantar-flexion of the ankle.
7. Stamp-and-toe-marching. Four steps on tip-toe, then four steps stamped.
8. Other fancy marches, in which the patient uses the feet quickly and actively.
9. Reach-grasp- (or wing-) standing Alternate heel- and toe-raising.

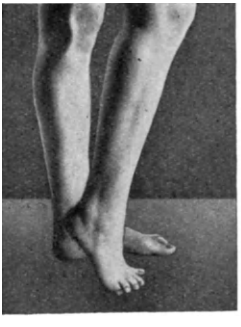

Fig. 57.

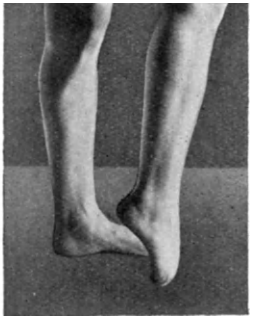

Fig. 58

Figs 57, 58.—Standing Toe-flexion and -extension, *Fig.* 57 also represents the position taken in *heel-raising* in Exercise 1, Wing-standing Single heel-raising and -lowering.

10. Half-kneeling Forward-bending. No. 8, knee exercises (*see also Figs.* 52–54). The exercise produces strong dorsiflexion of the foot of the leg in front.
11. Heel-support-standing Forward-bending.
12. Heel-support-standing Heel-raising and knee-bending. Both these exercises stretch the calf muscles as well as the hamstrings.
13. Standing Toe-flexion and extension. (*Figs.* 57, 58.)
14. Standing at edge of plinth, toes over the edge, Flexion and extension of toes of both feet.
15. Picking up objects with the toes—pencil, marble, golf-ball, etc.
16. Sitting (or half-lying) Toe-separating (if possible).
17. Standing Foot-shortening, reforming arch (*see* Exercises for FLAT-FOOT, Chapter XVI).
18. Sitting 2-Foot-inversion ('clawing').
19. Standing 2-Foot-inversion.
20. Standing on outer borders of feet. This exercise is much recommended by some. It produces a great strain on the outer side of the foot and should

not be given to heavy patients, nor if there has been any damage to or weakness of the external lateral ligament of the ankle.

21. Exercises for eversion (rarely necessary). (*a*) Walking with feet turned out. (*b*) Sitting foot eversion.

22. Tailor-sitting, or sitting with leg crossed over knee, Passive foot-rolling by patient. This should be carefully taught before the patient is allowed to use it as a home exercise. As a rule, it should be done as for flat-foot.

23. Sitting (on stool) with knees crossed, Active foot-rolling.

24. All dancing steps; jumping and skipping exercises.

25. Exercises for re-education in walking (p. 44).

26. Walking and running with short steps.

27. 'Frog-march' and 'Snake-hop' for children. The latter is simply 'frog-march' in line, each child placing his hands on the shoulders of the one in front of him.

N.B.—If the Achilles tendon is shortened, no tip-toe exercises should be given.

APPARATUS AND RESISTANCE EXERCISES.—

1. Pulley exercises.

2. Half-lying Foot-bending and stretching, Inversion and eversion, Toe-bending and -stretching (resisted).

3. Foot-stretching in apparatus.

> An apparatus has been invented by Mrs. Guthrie-Smith to stretch the tendo Achillis and produce full dorsiflexion of the ankle.
>
> The patient's foot is fixed to the foot-piece by straps; it may also be inverted if desired by means of a wedge under the inner border. The end of the foot-piece is fastened by straps to a broad piece of webbing which passes behind the patient's body, so that by leaning back he puts tension on the calf muscles and tendo Achillis. This is a useful and easily constructed apparatus.

4. Rowing machine.

5. Stationary bicycle.

6. Walking on inclined board. The board is so constructed that it is highest in the centre and slopes down on both sides towards the edge, which is guarded by a rim. The patient's feet are thus kept in inversion as he walks.

CHAPTER VII

DISEASES OF JOINTS, SYNOVIAL MEMBRANES, AND BONES

I. Diseases of joints: Traumatic synovitis or arthritis—Bacterial synovitis or arthritis—Infective arthritis—'Rheumatoid' arthritis—Osteo-arthritis—Still's disease—'Dry' arthritis—Tuberculous joints. II. Diseases of synovial sheaths, bursæ, etc.: Tenosynovitis—Bursitis—Ganglion. III. Diseases of bone: Osteomyelitis, Periostitis.

I. DISEASES OF JOINTS: SYNOVITIS AND ARTHRITIS

Synovitis means inflammation of the lining membrane of a joint; if the inflammation spreads to, or begins in, other structures of the joint, the condition is known as *arthritis*. The synovial membrane is a delicate structure, which is easily injured, and it also falls an easy victim to bacteria; hence disease often starts here, and may, or may not, spread further.* Certain infections, however, may begin in the cartilage, as does osteo-arthritis, or in the bone-ends, as does tuberculosis.

Synovitis and arthritis may be divided into two definite varieties, *traumatic* and *bacterial*. Certain forms—osteo-arthritis, 'dry' arthritis, gout, and chronic rheumatism—come into neither class, but appear to be due to defective circulation or metabolism. The last two will be dealt with among constitutional diseases.

TRAUMATIC SYNOVITIS OR ARTHRITIS

This condition arises as the result of injuries to joints, dislocations, sprains, fractures into or near joints, blows, and bruises; of continual overstrain; or of the habitual holding of a joint of the lower limb in a position incorrect for weight-bearing, as in the case of genu valgum or flat-foot, so that it is subjected to undue stress. We may probably also include in the same class certain conditions of varied and uncertain origin, such as 'water on the knee' occurring from no ascertainable cause. This type of synovitis may be *acute* or *chronic*.

Acute Synovitis

PATHOLOGY.—The changes in the *synovial membrane* are those of acute inflammation. There is a greatly increased exudation of clear serous synovial fluid, and the joint cavity becomes much distended. In severe injuries, blood may escape from torn vessels into the joint. The inflammation may, as mentioned above, spread to other structures, and constitute an *arthritis*.

SYMPTOMS.—These, again, are the general symptoms of joint inflammation.

The joint may feel hot, and the skin is sometimes *reddened*. This is not always so, as the inflammation, if deeply seated, may not extend to the skin.

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* The distinction between the two conditions is largely theoretical. Few infections or traumas would involve nothing but the synovial membrane.

Swelling is marked, owing to the exudation into the joint. *Fluctuation* may generally be detected, by placing the fingers of one hand on one side of the affected joint, when by gently pressing and relaxing the pressure on the other side, the movements of the fluid may be felt against the fingers of the stationary hand.

Pain is a marked feature, dull and aching in character when the joint is at rest, but increased on movement, whether active or passive.

The patient holds the joint in such a position as to relax the ligaments.—This is generally a position midway between two extremes of movement, e.g., semi-flexion at elbow or knee.

Atrophy of the muscles working on the joint occurs very quickly. In addition to these general symptoms there will probably, in the traumatic variety, be a tender spot at the site of the actual injury, and there may be signs of fracture, dislocation, or other derangement of the joint.

Treatment.

This is on the same principles, whichever be the injured joint. We will take the knee, so frequently the seat of synovitis, as a type.

SURGICAL TREATMENT.—This consists of treatment of the cause, if necessary; e.g., reduction of the dislocation or fracture; replacement of a slipped cartilage.

SUPPORT.—The limb is raised, and placed on a splint in a semi-flexed position. Sometimes it is supported by pillows and sandbags, but in bad cases the splint is more comfortable, since it procures complete immobilization, and in these cases the least movement is intensely painful. If cold applications or evaporating lotions are to be used, the leg should be fixed by two bandages, one including the foot and leg to just below the knee, and the other loosely applied above the knee.

IN THE EARLY STAGES.—During the first 24 hours or so, *ice-bags or cold applications* give most relief. For the latter, a piece of lint or flannel, or a small towel, may be wrung out in cold water and applied to the part. It should not be covered by a bandage or other dressings, since these would prevent evaporation. It should be replaced as soon as it gets warm.

Evaporating lotions (lead lotion, lead and opium lotion) are also used, and are applied on lint and left uncovered in the same way. The heat, in the case of these lotions and in that of the cold dressing, is carried off by evaporation, the blood-vessels are constricted, and the inflammation is reduced.

LATER.—If absorption of the fluid is slow, a *compression bandage* may be put on—that is, the joint is bandaged firmly over several thicknesses of wool. The latter, being elastic, prevents the exertion of too much pressure on the blood-vessels or nerves in the vicinity.

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—Half-lying. The leg may be unbandaged from the beginning, but should be left resting on the splint for a few days, until it can be moved without pain.

FIRST FEW DAYS.—

Massage.—Effleurage only should be given for 10 or 15 minutes, at first above the knee, gradually coming closer to the joint. If the synovitis is too acute for the patient to bear even this manipulation, gentle squeezing movements, given with one hand each side of the limb in an upward direction may be substituted, and the effleurage added later. The effleurage is gradually brought lower, and carried over the knee itself, and finally the whole leg is treated, but a return should constantly be made to the thigh, so as to keep the lymphatic vessels clear in that region.

Gentle finger kneadings are next given round the knee, to reduce the swelling within the synovial cavity, and prevent the formation of adhesions. Kneadings with the palm of the hand on either side of the joint are added a little later.

Meanwhile, kneading should be begun on the thigh to prevent wasting of the quadriceps, special attention being paid to the vastus internus. Any parts of the thigh that can be reached without moving the knee should be treated. The lower leg and foot should also be massaged.

Faradism is sometimes given as soon as it can be borne, for the purpose of reducing œdema, the contracting muscles exerting pressure on the lymphatics, and so hastening the flow in these vessels. It also most effectually maintains the strength and nutrition of the quadriceps during their period of inactivity. The patient should be taught to contract these muscles voluntarily as soon as he can do so without pain.

Movements.—These should be given as soon as possible—either by the relaxed method first, and then actively, or as assisted active movements from the beginning. They should be painless, the movement stopping before the point where pain begins.

LATER.

The treatment, both as regards massage and movements, is increased gradually in strength.

When the inflammation has subsided and pain is gone, vigorous massage is given, including tapôtement of the thigh muscles, and deep frictions round the knee.

Exercises should now be begun, at first without the patient bearing weight on the leg, e.g., Sitting Alternate leg-swinging, and Knee-bending and stretching with resistance. Then the patient may practise on the rowing machine and stationary bicycle, if these are available; finally, he is allowed to walk. He should then perform general leg exercises, and any mobility lost may be restored by strong passive movements or active mobility exercises (*see* pp. 81, 82 for exercises).

Chronic Synovitis

CAUSES.—Chronic synovitis may be the result of: (1) One or more acute attacks; (2) Repeated injuries or strains; (3) Loose bodies in the joint, or internal derangement of any kind.

PATHOLOGY.—The synovial membrane, from long-standing inflammation, becomes *thickened, vascular, and roughened* by organized fibrinous deposits. It also becomes *fringed*, and portions of these fringes may break off, and form loose bodies in the joint. The exudation in the joint may continue indefinitely.

SYMPTOMS.—*Chronic swelling* may persist. The *ligaments become lax and the muscles atrophy*, hence the joint becomes unstable, and tends to 'give way'. The *pain is of a dull aching kind.* There may be some *stiffness* in the joint.

Treatment, e.g., of the knee.—

SURGICAL TREATMENT is sometimes required for the removal of loose bodies in the joint, or to remedy other derangements.

SUPPORT.—A compression bandage is sometimes applied.

PHYSICAL TREATMENT.—Our aims will be: (1) To assist the circulation in the joint, and so improve the nutrition of all structures in connection with it. (2) To strengthen the atrophied muscles and thus restore the stability of the joint. (3) To break down any adhesions and thickenings which may have formed in or around it.

The following treatment should be given :–

VIGOROUS MASSAGE, especially of the thigh muscles.

MASSAGE OF THE JOINT, with kneading and deep frictions.

PASSIVE MOVEMENTS.—'Knee-pumping' may be used for the sake of its circulatory effects ; slow movements in full range are more effective in producing mobility.

ACTIVE EXERCISES : both for the restoration of mobility, and for the purpose of strengthening the muscles ; for example :

1. High-sitting Leg-swinging ; free, then with a weight.
2. Heel-raising and knee-bending (quickly). (In reach-grasp or wing-standing).
3. Half-yard-grasp-high-standing Leg-swinging (the knee being allowed to swing loosely).
4. Running on the spot, with knee-raising.
5. Quadriceps contractions.
6. Practice on the rowing machine or stationary bicycle, etc.. (*See also* Exercises for STIFF KNEE, pp. 81, 82.)

BACTERIAL SYNOVITIS OR ARTHRITIS

A large variety of types of joint trouble is included under the above heading, from those due to the introduction of organisms by way of open wounds, or direct infection from other local lesions in the vicinity, such as the bursting of a bone abscess into a joint, to such general conditions as rheumatoid arthritis, or the arthritis arising in connection with scarlet fever, enteric, or other diseases.

We have thus to consider various types of arthritis, some of them bacterial, others of doubtful origin ; others again apparently due to defects of circulation or metabolism. We shall therefore, in this chapter, proceed to deal with : (1) Infective arthritis, (2) 'Rheumatoid' arthritis, (3) Osteo-arthritis, (4) Still's disease, (5) 'Dry' arthritis of the knee, (6) Tuberculosis of joints.

INFECTIVE ARTHRITIS

Under this heading we include arthritis due to scarlet fever, enteric fever, or other general diseases ; or to infection with various bacteria whether from without, or from a focus elsewhere within, the body.

PATHOLOGICAL CHANGES.—These vary in severity from those of a slight synovitis to those of an intense arthritis which destroys the whole joint, with purulent exudation filling the synovial cavity, caries (wasting or necrosis) of bone, and involvement of all structures round or near the joint.

ACUTE FORM. The changes are at first similar to those of the acute traumatic variety, but in some cases of virulent infection may be of a much graver nature. The serous exudate may become *sero-fibrinous* or *fibrinous* (i.e., containing little or much fibrin), *sero-purulent* or *purulent* (i.e., containing more or less pus).

CHRONIC FORM.—This may be the final stage of the acute form, or the infection may be chronic from the beginning. The fibrin exuded becomes organized, i.e., turned into connective tissue in and around the joint. Blood-vessels grow into this newly-formed tissue, bringing increased nutrition to it. White corpuscles pass out and lay down interstitial substance. This leads to *fibrous ankylosis*, that is, *fixation* of the joint by fibrous tissue. If other parts of the joint—bone, cartilage or ligaments—are involved, the damage is still greater. The bones may become necrosed at the ends, and knit together, producing a *true*, or *bony ankylosis*.

SYMPTOMS.—These vary correspondingly in severity. They may resemble those of traumatic arthritis, or may be those of intense inflammation, with *agonizing pain*, *muscle spasm*, and *loss of mobility*, ending in complete *ankylosis*, fibrous or bony. *Dislocations* may occur. In severe purulent cases, *constitutional symptoms* arise—rigors, fever, etc.

Treatment.—

SUPPORT.—The limb is kept at rest on a splint; if there is a tendency to deformity or the muscles are in spasm, traction is applied as for a tuberculous joint (*see* p. 96).

MEDICAL TREATMENT.—Hot or cold applications or anodynes are used to reduce the pain and swelling. If the exudation is only serous, Bier's treatment is sometimes tried (*see* p. 16).

SURGICAL TREATMENT.—The fluid is sometimes drawn off with a syringe. If the exudate is purulent, the joint is opened, and the pus evacuated. Rubber tubes are inserted for a time to secure free drainage. If the disease is of such a serious nature that ankylosis is inevitable, the joint is put up in the position in which it will later be most useful to the patient

PHYSICAL TREATMENT.—The acute stage must be passed before this is begun. After the pus has been evacuated, and when the wounds are healing well, careful massage, and gentle relaxed or active movements may be started.

EARLY STAGE.—

Massage should be very gentle at first, and the area of the joint should be given a wide berth until healing is complete.

No movement should be forced at an early stage.

LATER STAGE.

When the wounds are firmly healed, and the infective process is over, the *massage* may be given more deeply, to restore the nutrition of the muscles.

Radiant heat and whirlpool baths, if obtainable, give good results.

Active movements and strong passive stretchings will have to be continued for weeks or months. The latter are necessary in these later stages, but should be given with discretion.

In the slighter types of infective arthritis, in which pus has not been formed, the progression in treatment may be more rapid, but even in these cases, caution is imperative. Sometimes, if stiffness in the joint remains after recovery, and this stiffness will not yield to passive movement and active exercises, the joint is *manipulated under an anæsthetic*. This is only done when all symptoms of infection have disappeared. The treatment will then be similar to that carried out after the manipulation of joints for adhesions after fracture—massage, passive movements, and free active exercises.

'RHEUMATOID' ARTHRITIS

'Rheumatoid' arthritis and osteo-arthritis (considered below) are frequently confused with each other. The so-called '*rheumatoid*' *arthritis* is a toxic or bacterial condition generally occurring in young people, though a chronic and less severe form of it appears also in middle age (Tubby). Broadly speaking, *osteo-arthritis* is a disease of old age, or later middle life, probably due to some metabolic defect.

ETIOLOGY.—

SEX.—'Rheumatoid' arthritis, which has no connection with rheumatism, is more common in women than in men.

TYPES.—There seem to be two distinct types: *an acute form*, involving many joints, which usually affects young women between the ages of 15 and

30, though it may occur also in men or in children ; and *a chronic form* from which middle-aged women, at or after the menopause, are the most frequent sufferers.

CAUSES.—*Predisposing causes* are debility, overstrain, worry, or exhausting diseases. Dyspepsia and constipation are frequent in these patients. The poor are more often affected than the rich ; and exposure, damp, or cold may favour the development of the disease. There may be a hereditary factor. The *actual cause* is not known ; the disease is probably toxic in origin, and may arise from some focus of infection in the body, e.g., in the intestinal tract, mouth or throat.* Both the joints and the nervous system are affected.

PATHOLOGY.—The disease begins in the *synovial membrane*, which becomes hyperæmic and thickened, bone or cartilage forming in its substance. The *ligaments* are involved next. The *cartilage* becomes soft, degenerates, ulcerates, and is ultimately absorbed. Finally, the *bone* atrophies and softens, the compact tissue being worn away by friction. Later, the cancellous tissue of the adjoining bone-ends knits together, and a true bony ankylosis occurs.

The *structures round the joint* all become fibrous and thickened. The muscles become markedly atrophied, much more so than in osteo-arthritis, and they often degenerate, forming contractures. These very pronounced changes point to involvement of the central nervous system.

SYMPTOMS.—The *onset* may be *sudden* or *insidious* ; or the disease may run a chronic course with intermittent acute attacks. The *acute polyarticular form* which attacks young people is far the most serious, and the patient may in a very short time be entirely crippled, with joints stiff and deformed. If the disease does not appear till the patient is middle-aged, it is not of such a virulent character, and is much more amenable to treatment. The attacks are intermittent, and generally take place when the patient is out of health.

In the acute forms, the patient manifests *general symptoms*. She is thin, weak, and anæmic, and suffers from loss of appetite, languor, a feeling of cold, and functional nervous symptoms (Tubby). Pulse and temperature are raised in the early stages.

LOCAL SYMPTOMS.—*Many joints are attacked, usually symmetrically* on both sides of the body ; the smaller joints suffer first, usually the *interphalangeal articulations* of the hands. The deformity of the latter is typical, the enlargement of the joints being *fusiform*. As a rule, the metacarpophalangeal joints are flexed, the first interphalangeal hyperextended, and the second interphalangeal flexed. The fingers are drawn over to the ulnar side of the hand. During the acute phase, the joints are often *hot*, and the skin over them may be *red*. There is *neuralgic pain* in the joints, often worst while in bed at night. *The muscles* become very much wasted ; *trophic changes* are most marked in the skin, which becomes pink and glossy. The sweat glands do not function normally. *Creaking* in the joints is also a feature.

Treatment.—

The treatment here described is that for the 'rheumatoid' type of arthritis. The osteo-arthritic form will be noticed later. The latter is the easier of the two to treat, because: (1) The patient's general health is better ; and (2) Since it is not a toxic or bacterial condition, there is less danger of lighting up inflammation in the affected parts.

GENERAL AND MEDICAL TREATMENT.—This consists of a search for any focus of infection that may be present in the body, and its elimination by

* Some authors, however, are of opinion that the majority of cases are due to a defect of metabolism. *See* A. H. Douthwaite, *The Treatment of Rheumatoid Arthritis.*

medical or surgical means. The patient may be treated by appropriate drugs or vaccines, and her diet is prescribed by the doctor. If she is thin and anæmic, as in the acute type described above, the diet is full and nourishing, rich in fats; if she is over-weight, as sometimes happens when the attack occurs in connection with the menopause, the diet aims at reduction.

Warm clothing should be worn, and sufficient, but not excessive, exercise taken. If possible, the patient should live in a warm climate.

PHYSICAL TREATMENT.—

EARLY AND ACUTE STAGES.—

Hot baths of various kinds are of great value in the treatment. They may be taken at suitable spas—Buxton, Droitwich, Aix-les-Bains, or Pistany. Failing this, ordinary local or general baths, hot packs, or the whirlpool bath if obtainable, are useful for relieving pain, stimulating the circulation so that the products of inflammation in the affected parts are carried away, and increasing the action of skin and kidneys, thus promoting the elimination of toxins, whether produced by the action of bacteria, or by some defect of metabolism.

Radiant heat, *diathermy*, and *ionization* are also of benefit.

LATER STAGES.—

Massage and Movements.

Our aims are: (1) To relieve pain, and to prevent extreme atrophy of muscles. (2) To maintain, as far as possible, the mobility of the joints, but not to attempt to restore lost mobility by violent stretching of the tissues, unless expressly ordered to do so. (3) To assist in the elimination of toxins from the system.

No treatment should, of course, be given in the *acute stage* when fever is present; nor should any acutely inflamed part ever be touched.* It is often, however, possible to treat some joints even though others may still be in too acute a stage for massage or movement.

When the acute inflammation has subsided, the following treatment may be carried out:—

Massage.—General massage to improve the condition of the patient's body as a whole, to raise her power of resistance to infection, and to assist excretion. *Abdominal massage* is especially important because of its influence on the portal circulation. For the same reason light abdominal exercises, e.g., abdominal contractions and easy trunk-rotations may be given. These will also be valuable in combating constipation.

Limb massage consists of brisk but gentle effleurage and kneading of the wasted muscles; careful effleurage and frictions may be given round the joints to reduce the thickening in the periarticular tissues. These manipulations must never be painful, and their effect must be carefully watched. The treatment should not be too long.

Movements.—Passive (*relaxed*) movements may be administered to the joints to preserve mobility. *Forced* movements would only increase pain and inflammation, and should never be used. *Assisted or free active movements* are given to strengthen the muscles, and may slightly decrease the stiffness.

SURGICAL TREATMENT.—

When the active stage of the disease is past, the surgeon sometimes decides to mobilize the joints by manipulation or by open operation. This is only done if he is satisfied that (1) the focal sepsis has been eliminated, or (2) the metabolic defect has ceased to exist.

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* Some physicians consider that even at this stage the joints should be moved gently once a day. This, however, will as a rule be done by the doctor himself. In any case, it ought not to be attempted except by his instructions.

POST-OPERATIVE TREATMENT consists of adequate support for the joint (splints, calipers, etc.), massage, relaxed and active movements, continued over a long period.

Finally, everything possible should be done to encourage and cheer these patients, many of whom really come as much for psychical as for physical help. Any slight improvement should be pointed out, and the operator must never lose patience, or let the patient see that she has given up hope. The increasing knowledge of the causes of rheumatoid arthritis, and the possibility of arresting the disease by the discovery and elimination of some septic focus, or of some metabolic defect, has made the outlook far more hopeful than it was.

OSTEO-ARTHRITIS

ETIOLOGY.—There are two types: (1) A form which attacks one joint, generally a large joint such as the hip or shoulder. This is a disease of old age, and may follow repeated attacks of rheumatism, or other forms of arthritis. The exciting cause is probably an injury; and (2) A form beginning in late middle age in the hands, and spreading to other joints. It probably attacks the hands because these joints have been so much used in the course of life. (Tubby). Both forms are probably due to some fault of metabolism, and not to bacterial infection.

PATHOLOGY.—In this type of arthritis, unlike the 'rheumatoid' form, the *cartilage* is first attacked; it becomes fibrous, is worn away at the points of greatest pressure, allowing the bones to rub together, and lies in irregular masses round the edges of the articular surfaces. The *bone*, owing to the continuous friction, becomes polished and very hard, like ivory. This process is known as 'eburnation'. Moreover, at the articular margins, where the friction does not take place, osteophytes are thrown out, and new processes of bone are formed, interfering with the movements of the joint.

The *soft structures round the joint* become involved, degeneration taking place in the ligaments. The action of the muscle tendons inserted in the neighbourhood is hampered, and the muscles atrophy to some extent, though not so markedly as in the 'rheumatoid' form. Later, the *synovial membrane* is inflamed and thickened. It becomes fringed, and sometimes parts of these fringes break off, forming loose bodies in the joint.

SYMPTOMS.—The disease comes on gradually, one of the large joints, hip, knee or shoulder being generally the first to suffer, though other joints may be implicated later. The local symptoms are those of a *chronic inflammation*, the skin over the joint not being red or hot, or very painful when touched. *Swelling* appears, and later the joint may become much enlarged owing to the formation of osteophytes. *Pain and aching* are felt in the affected joint, worse when the limb is kept constantly at rest. *Stiffness* is present from the early stages, and later there is *ankylosis* of the joint—not a true ankylosis, but one caused by the blocking of the movements by the bony outgrowths. *Creaking* in the joint is always present. *The muscles* waste, and deformity may develop owing to contractures.

In the polyarticular form, the small joints of the hands are attacked, beginning with the second interphalangeal joints, which become enlarged (Heberden's nodes). The other phalanges are implicated later, and the hands become quite stiff and distorted. Later, the disease may spread to other joints. It is not acutely painful.

Treatment.—

This is similar to that of rheumatoid arthritis, but in these cases it is sometimes possible to attempt to restore mobility by strong passive movement.

The doctor's advice should, however, be sought before doing so. Pulley exercises can generally be given, and the active exercises may be stronger and more vigorous. The muscles, less wasted than in the 'rheumatoid' type, can bear somewhat deeper massage.

SUPPORT.—The joints of the lower extremity, especially the hip-joint, may need support, or some form of apparatus to relieve the strain upon them (bandages, calipers, plaster, etc.).

SURGICAL TREATMENT.—When the quiescent stage of the disease is reached, these cases are sometimes treated by manipulation or open operations.

MANIPULATION is undertaken to stretch the shortened ligaments, and to break down adhesions.

Post-operative treatment consists of massage and active exercises. The joint may, in fact, be treated in much the same way as any stiff joint after manipulation. In the case of joints of the lower extremity, the exercises are, of course, first given in lying or sitting.

OPEN OPERATION.—The osteophytes round the joint, or loose bodies within it, are sometimes removed. The whole of the synovial membrane may be removed in some cases, as well as other soft structures within the joint, or the joint surfaces are remodelled. These operations are performed in order to make the joint more movable. If it is desired to fix it, thus relieving pain, the operation is that of *arthrodesis*.

Post-operative treatment after any operation designed to secure a *movable joint* is the same as that after manipulation, the interval which must elapse between the operation and the beginning of treatment depending on the nature of the operation and on which joint is involved. After *arthrodesis*, massage, movements of *other* joints, and re-education in walking, or in the use of the arm, are required. The affected joint, of course, must be kept rigid.

STILL'S DISEASE

This is a form of arthritis occurring in children under eight years of age. It is so similar in its general symptoms to the rheumatoid arthritis of adults that it need not be described in detail here. In addition to the joint changes, the spleen and lymphatic glands are enlarged. The disease has probably a toxic origin. It is not fatal, but the child may be badly crippled, and his development arrested.

Treatment.

In the chronic stage, treatment is similar to that for rheumatoid arthritis.

'DRY' ARTHRITIS

(*Arthritis Sicca. Gonitis Crepitans*)

An arthritis of the knee-joints, due not to an infection, but to a defect of circulation.

ETIOLOGY.—This affection is usually found in elderly or middle-aged women, often sufferers from obesity, who in many cases show other signs of defective circulation, such as varicose veins. It is due, therefore, to insufficient nutrition of the joints. It has no connection with rheumatism, nor with rheumatoid arthritis.

PATHOLOGICAL CHANGES.—These are typical of chronic inflammation. The *ligaments* become thickened and the *synovial membrane* roughened and fringed, small parts of the fringes sometimes breaking off. There is *no exudation of fluid* into the joint, hence the name 'dry arthritis'. The bony changes are very slight.

SYMPTOMS.—The *knees alone* are affected. The chief features of this form of arthritis are *pain* and *aching* in the knees, often at their worst after long-continued exercise, and *stiffness*, worse after rest. Mobility is not much interfered with, but the joint is markedly weakened. *Sudden locking* of the joint may take place while walking, with pain and inability to straighten the knee. This is due to a detached fragment of synovial membrane getting between the joint surfaces and blocking movement. *Enlargement of the joint* is often apparent, owing to thickening of the ligaments and soft tissues round the joint. There is marked *creaking* in the joints.

Treatment.—No treatment can permanently cure this condition. The symptoms, however, can be alleviated, and about two months' work generally produces a great improvement, though the patient will probably need further periods of treatment at intervals.

PHYSICAL TREATMENT.—

MASSAGE.—The chief aim is to improve the circulation, and to this end we shall make use of vigorous massage of the thigh muscles and of the joint itself. Massage is also given to the lower leg.

MOVEMENTS.—

Passive movements will be used to overcome stiffness and to improve the circulation. Knee-pumping and High-sitting Leg-swinging are most effective exercises for this condition.

Active movements are used to bring more blood to the part. They should be done quickly and energetically.

For suitable exercises, *see* those for RHEUMATISM (Chapter XVIII) and for STIFF KNEE (pp. 81, 82). The patient should, if necessary, receive treatment for obesity. Varicose veins may also have to be considered (*see* Chapter XX).

TUBERCULOUS JOINTS

Patients with tuberculous joints do not require physical treatment till the infective process has subsided. Too much time need not be spent, therefore, in considering the symptoms, etc., of the *acute* stage in detail. Phthisis is dealt with in the chapter on lung disease.

CAUSES.—

PREDISPOSING.—General weakness and debility; unhygienic surroundings.

EXCITING.—Injury to a joint, which is then invaded by the tubercle bacillus.

AGE.—Children and adolescents are most often attacked, then old people.

ENVIRONMENT.—The poor are more often affected than the rich.

PATHOLOGY.—The bone ends or the synovial membrane are affected first. The membrane becomes thickened, soft, and spongy. Tuberculous foci form in it, some of them becoming *caseated* (*see* TUBERCULOSIS, Chapter XXII), and breaking into the joint. Sometimes there is pus formation. Caries occurs in the bones close to the cartilage, which at a later stage becomes eroded; the ligaments may ultimately be destroyed.

RESULTS.—The disease may terminate in recovery, fibrous ankylosis, bony ankylosis, or dislocation.

RECOVERY.—This may take place in slight cases, where no structure other than bone is attacked, or the infection of the synovial membrane is checked at a very early stage.

FIBROUS ANKYLOSIS.—The synovial membrane and cartilage are replaced by fibrous tissue. The bacilli, if still living, are shut in and encapsulated by adhesions.

BONY ANKYLOSIS.—The cartilage being destroyed, the bone-ends knit, forming a true ankylosis; or the fibrous tissue surrounding the joint may become ossified.

DISLOCATION.—This is due partly to destruction of the ligaments and partly to neglect. The parts are fixed in the incorrect position by fibrous tissue (Tubby).

SYMPTOMS.—Generally *only one joint* is involved, but this is not invariably so. *Order of frequency:* The spine is most often attacked; then the hip; then the knee and ankle; then the elbow. Finger-joints may also be affected.

In the early stages is found the well-known '*tumor albus*' or 'white swelling', the skin over the joint being white, and the swelling hard; *movement, active or passive, is painful,* and *the muscles waste rapidly.* These symptoms are due to disease of the synovial membrane. If the bone-ends are affected, any movement which tends to rub the joint surfaces together, or jar them, is intensely painful. Later, *pain increases* (ligaments and cartilages being involved) and *all voluntary movement ceases.* The muscles go into spasm, and ultimately produce *fixed deformity.*

Finally, to the above symptoms may be added *shortening of the limb, dislocation of the joint,* and *suppuration.*

Treatment.—

REST AND PREVENTION OF DEFORMITY.—The patient remains in bed for a time, wearing proper supports for the limb, which immobilize it during the period of inflammation. The splints are retained for some time after the infective process is apparently quiescent. The limb is put up in the best possible position, muscle spasm being overcome by traction in some cases. If the joint is bound to become ankylosed, it is maintained in the most favourable position (*see* p. 97).

MEDICAL TREATMENT.—Local applications, injections or counter-irritation are used for the joint condition. A Bier's bandage is sometimes applied. The patient often receives vaccine treatment.

SURGICAL TREATMENT.—This may consist of:—

1. OPENING OF ABSCESSES, when necessary.

2. EXCISION OF THE JOINT.—Only undertaken nowadays when general treatment has been of no avail, in very serious cases, or sometimes to remedy fixation or deformity.

3. AMPUTATION.—Only performed when all else (including excision) has failed, if the affected limb will be otherwise useless, or in patients with bad health, etc.

PHYSICAL TREATMENT (in the later stages) when the disease is quiescent.—

MASSAGE of the whole limb, especially of the muscles that work on the affected joint, e.g., the thigh muscles in a tubercular knee, the leg muscles for an ankle, etc. Brisk, light work is indicated to counteract atrophy. The joint itself should not be touched, or only light effleurage carried over it.

ACTIVE MOVEMENTS may be given to the joint affected, but no attempt should ever be made to mobilize it, or to break down adhesions, lest bacteria encapsulated by fibrous tissue should be set free, and the disease light up again. If the surgeon believes the lesion to be entirely healed, decides to mobilize the joint, and wishes such movements to be given, he will issue orders to that effect. Unless he does so, neither 'forced' movements given by the operator, nor active movements in which the weight of the patient's body or limb is used to produce a similar effect of mobilization, are permissible.

The other joints of the limb should be kept mobile by passive (relaxed) and active movements.

BEST POSITIONS FOR ANKYLOSIS.—The ankle is fixed in dorsiflexion to a right angle; the knee in extension; the hip in abduction to 20° or 30°; the wrist in dorsiflexion; the elbow in flexion at or near a right angle, so that the hand can be carried to the mouth (if both elbows are affected, one is rather more flexed than the other); the shoulder in abduction to 45°, and in inward rotation.

(For TUBERCULOSIS OF THE SPINE (Pott's disease), *see* Chapter XVII.)

II. DISEASES OF SYNOVIAL SHEATHS, BURSÆ, ETC.

TENOSYNOVITIS

Inflammation in the synovial sheath of a muscle, generally at the wrist or ankle. The condition may, like synovitis of a joint, be traumatic or bacterial.

Traumatic Tenosynovitis

CAUSES.—(1) Overwork of a muscle. (2) Stretching or wrenching of the tendon; e.g., in sprained or dislocated ankle or wrist. (3) Spread of inflammation from surrounding tissues—skin, fascia, muscles, etc.

PATHOLOGICAL CHANGES.—The changes are those typical of inflammation. The fluid exuded by the membrane is *serous* or *sero-fibrinous*. When the inflammation subsides and the exudate is absorbed, *adhesions* are liable to form between the tendon and its sheath, hindering the movements of the joint on which the muscle works.

SYMPTOMS.—There is *swelling in the line of the affected sheath or sheaths*, with *tenderness* and *pain* on either active or passive movement. Sometimes a *creaking* or *grating* can be detected, due to the friction between the roughened walls of the sheath and the tendon.

Treatment.—

EARLY STAGE.—

REST AND SUPPORT.—The limb is supported on a splint, in the most comfortable position; in the case of the wrist, sometimes by a bandage and sling only.

COLD APPLICATIONS are often used at first; later, a compression bandage is put on to reduce swelling.

GALVANISM is sometimes employed for the relief of pain.

MASSAGE.—The limb is unbandaged, and left lying on its support. Effleurage only, above the affected part, should be given at first, any drag on the inflamed structures being carefully avoided. A few days later, as inflammation subsides, the effleurage is carried over the affected area, and the parts below this may be treated with effleurage, and kneading or frictions. In another day or so, very careful frictions round the affected tendon are added. The treatment must not cause pain, and its effects should be carefully watched. At the same time, gentle (relaxed) passive, or assisted active movements in very small range are allowed. It is advisable to add these as soon as they can be done without pain, as otherwise adhesions may be a source of great trouble afterwards. This treatment is continued until the inflammation has subsided, the range of movement being gradually increased.

LATE STAGE.—When the inflammation has disappeared, we have to restore full mobility to the joint, and strengthen the muscles. Deep frictions and stretching passive movements are required, as well as active exercises. Stimulating massage of the whole limb should take place daily.

(For EXERCISES FOR A STIFF WRIST OR ANKLE, *see* pp. 77–80, and 82–85.)

Bacterial (Suppurative) Tenosynovitis

CAUSES.—The causes of this type of tenosynovitis are injuries which break the skin, through which bacteria gain an entrance to the tissues. The infection may spread up the synovial sheaths of the flexor tendons from fingers to wrist if the initial sepsis is in the thumb or little finger, since the flexor longus pollicis tendon has one continuous sheath from two inches above the wrist to its insertion, while the flexor sheath of the little finger is continuous with the common synovial sheath of the flexores profundus and sublimis digitorum. This does not occur in the three middle fingers, which have distal sheaths unconnected with the common sheath.

PATHOLOGICAL CHANGES.—The changes are those of typical bacterial inflammation, with pus formation. The pus may break through the sheath, spreading infection in the surrounding tissues, or the tendon itself may be attacked and destroyed.

The late results are *dense adhesions*, *extensive scarring*, and *limitation of movements* of the neighbouring joint or joints.

SYMPTOMS.—Marked *pain*, *œdema*, and all the typical symptoms of bacterial inflammation. The toxins formed locally enter the blood-stream and produce *general symptoms*, the patient's temperature rising to a variable extent.

Late symptoms, after the infection is overcome, may consist of *scarring*, *contractures*, or *deformity* of the limb; or, if the process is confined to the tendon-sheaths, loss or limitation of mobility in the joints.

Treatment.—

EARLY STAGES.—As long as the infective process is active, the treatment is medical and surgical only. Incisions are made to liberate the pus, and drainage is maintained by means of rubber tubes or of gauze packing. Appropriate dressings or baths are used.

Nothing can be done in the way of physical treatment until the general and local infection is overcome.

LATER STAGES.—

MASSAGE.—When the wounds are *clean and almost closed*, massage may be begun. Often, however, treatment is not ordered until they are firmly healed. In the former case, the massage must be very gentle. It will be similar to that given for infective arthritis (*see* p. 90).

When the wounds are *firmly healed and all inflammation has passed away*, more vigorous treatment may be applied. This also is similar to the late treatment for infective arthritis. The adhesions and contractures are in this case in the tendon-sheaths and in the soft tissues over them, and not in the joint itself, unless the infection has spread thither, although the joint may well be stiff from 'passive inflammation'—stagnation of blood in the part—or from long immobilization. There may be stiffness not only in the joint nearest to the inflamed sheaths, but in others higher up the limb, especially if the case has received no physical treatment before this period. All the muscles of the limb should be massaged; strong frictions should be given to loosen adhesions and adherent scars; passive (forced) movements are required to mobilize joints and stretch adhesions, and active exercises to restore the strength of the limb. Olive oil is sometimes used to soften the superficial tissues, but it should not be applied until after the frictions and kneadings have been given, as it renders deep massage impossible.

RADIANT HEAT, WHIRLPOOL BATHS, AND IONIZATION are often useful.

Much the same treatment is required for the *after-results of an acute cellulitis*

or other septic conditions of the soft tissues. Great patience and perseverance are required on the part of both patient and masseuse. The progress is very slow, and the result often disappointing, though in some cases a very marked improvement takes place, and an almost crippled hand or foot again becomes useful. If a nerve is involved, the outlook is of course much less hopeful.

BURSITIS

Inflammation of a bursa, generally of a superficial one.

ANATOMY.—Bursæ are small membranous sacs, lined with endothelial cells, which may or may not be in communication with joints. Their purpose is to prevent friction between any two structures, as tendon and tendon, or tendon and bone, or to protect prominent bony points—the patella or olecranon process, for example. A *true bursa* is one normally present at some particular point ; a *false bursa* one which is not normally present, but which has formed over some bony point that has become unduly prominent through disease. Such is the bursa found over the metatarso-phalangeal joint in hallux valgus (*see* Chapter XVI).

Examples of inflammation of a true bursa are prepatellar bursitis, subdeltoid bursitis, 'miner's elbow' (inflammation of the olecranon bursa), and achillodynia (inflammation of one of the bursæ situated round the tendo Achillis).

Bursitis may be acute, subacute, or chronic.

CAUSES.—(1) *Trauma.* A severe injury causes acute bursitis, repeated lesser injuries cause the subacute or chronic variety. (2) *Rheumatism, gout,* or other metabolic diseases or infections.

PATHOLOGICAL CHANGES.—These are similar to those of synovitis.

SYMPTOMS.—In the acute form there is *pain, stiffness* of the joint near which the bursa is situated, with *swelling and fluctuation limited to the bursa itself,* and most noticeable therefore when it is a superficial one. The pain, also, is limited to the bursa, and increased in those positions of the joint which cause pressure to be exerted on it. There is no pain in the joint itself.

We shall here consider two typical examples of bursitis—the prepatellar and subdeltoid varieties.

Prepatellar Bursitis

('*Housemaid's Knee*')

'Housemaid's knee' may be a true prepatellar bursitis—that is, an inflammation of the bursa situated over the patella and beneath the skin ; or it may be an affection of that placed between the ligamentum patellæ and the upper part of the tubercle of the tibia.

CAUSES.—(1) A blow, or fall, on the knee. (2) Much kneeling, hence the frequency of its incidence in housemaids, charwomen, etc.

SYMPTOMS.—(1) *Pain* in the region of the bursa. (2) *Swelling.* If the prepatellar bursa itself is the seat of the trouble, the swelling is a large rounded one over the knee-cap ; if that under the ligament is the one affected, the swelling is seen on either side of that structure. (3) *Stiffness* of the knee, but *no pain in the joint itself.* (4) In the chronic form there is little pain, though the swelling may be marked.

Treatment.—

If causing no inconvenience, the bursa is sometimes left alone. Otherwise operative treatment is the rule.

SURGICAL TREATMENT.—This consists in removal of the bursa, of crushing it, or some similar procedure.

PHYSICAL TREATMENT.—

POST-OPERATIVE.—*Radiant heat* may be used if there is pain.

WHEN THE WOUND IS HEALED.—(1) *Massage* of all the muscles of the thigh; *frictions* to the knee-joint and round the patella; lateral movement of the patella. (2) *Active movements* to the knee, gradually increasing in range; quadriceps contractions.

LATER.—Active knee exercises.

If the bursa has been merely crushed without open operation, massage may be begun at once to hasten the process of absorption. Occasionally, in slight cases, massage and movements are given without operation.

Subdeltoid Bursitis

The subdeltoid bursa is a large sac situated, as its name implies, between the deltoid and the capsule of the shoulder. It does not communicate with the joint.

CAUSES.—(1) Trauma—a fall or blow on the shoulder; or injury to the muscles in that region. It may complicate a fracture of the great tuberosity. (2) Rheumatism or infection.

A condition similar to a true bursitis may arise through the tearing of the subscapularis from its insertion.

SYMPTOMS.—(1) These are similar to those of an acute synovitis, but are *localized*, there being one particular painful spot. (2) The pain is worst *if the arm be abducted*, the acromion process then pressing on the inflamed bursa. (3) The patient sometimes has *fever* and *general symptoms*.

Treatment.—

ACUTE STAGE.—Massage is not advisable for the first few days. The condition is treated by: (1) *Rest*; the arm being supported in a sling. (2) *Cold or hot applications*. Any other injury, such as fracture or dislocation, will receive appropriate treatment.

IN A FEW DAYS: PHYSICAL TREATMENT.—After a few days, massage may be begun.

POSITION OF PATIENT.—The patient should sit with the arm supported close to the side on a table.

MASSAGE.—The chest, the upper part of the back, and the forearm should first be treated with effleurage and kneading; then the shoulder and upper arm should be carefully approached. Gentle effleurage should be given, and then kneading, at first avoiding the painful area, but encroaching gradually on it as the pain subsides. Frictions, not too deep to begin with, are added later. This treatment needs great care and skill.

MOVEMENTS which are painless may be administered, but *not* abduction.

LATER.—

MOVEMENTS.—Careful re-education of the deltoid and supraspinatus must be undertaken as soon as this can be done without pain. The patient should begin in the lying position, and the movements are practised in the same way as for paralysed muscles (*see* p. 168), that is, the back of the plinth may be raised day by day till the patient sits upright. When he no longer feels any pain in the shoulder, the course of treatment will conclude with general arm exercises, e.g. Arm-swinging, Arm-circling, 2-Arm-bending and -stretching in all directions; Sawing; 2-Arm-swimming, etc.

Inflammation in other bursæ is treated on the same lines.

GANGLION

A ganglion is a cyst of synovial membrane generally found on the dorsal surface of the wrist.

PATHOLOGY.—Ganglia are fibrous sacs containing a viscid material. Their origin is uncertain. They may be small pouches which have become separated from tendon-sheaths or the synovial membranes of joints during fœtal life, and which for some reason—irritation or strain of the parts—become distended with fluid and form swellings (Tubby).

SITUATION.—A ganglion most commonly develops on the outer side of the dorsum of the wrist; but it may appear in other places also—in the palm of the hand, on the dorsum of the foot, or on the outer side of the knee.

SYMPTOMS.—Unless it is in some part which is subject to pressure, it may give no trouble. In appearance, the ganglion is a rounded swelling, which develops gradually. It may be quite small, or as large as a walnut.

GANGLION OF THE WRIST.—In this condition there is weakness of that joint, and sometimes pain when doing laborious work—for instance, in lifting heavy weights. The symptoms may, however, be very slight.

Treatment.—

SURGICAL TREATMENT.—An operation is performed if the ganglion is giving trouble. It is either opened, and its contents evacuated, or removed altogether. Unfortunately, recurrence is common.

PHYSICAL TREATMENT (ganglion of wrist or hand).—Post-operative treatment consists of massage of arm and hand, with proper precautions as regards the scar; and, after a few days, careful movements of wrist and fingers to regain mobility.

III. DISEASES OF BONE: OSTEOMYELITIS, PERIOSTITIS

As a type of bone infections we may take *osteomyelitis*, the late results of which we so often encounter in the course of our work. All infective processes in joints and bones need somewhat similar treatment. It is, however, advisable to have some understanding of the nature of these serious conditions, in order to appreciate the dangers which confront us when dealing with them.

ETIOLOGY.—

AGE.—The disease is commonest in children and in young people at puberty (10–14 years). This is because of the active bone growth taking place at this time of life, as well as the frequency of injuries at this age.

SEX.—Males are much more often affected than females.

CAUSE.—Infection, direct or indirect, of the bone-tissue by micro-organisms.

PATHOLOGICAL CHANGES.—The bones most often affected are, in order of frequency: (1) The lower end of the femur; (2) The upper end of the tibia (hence the frequent involvement of the knee-joint); (3) The upper end of the humerus; (4) The ulna; (5) The fibula; (6) The radius; (7) The metacarpals and metatarsals. (Tubby).

The inflammation generally begins close to the epiphysial cartilage where growth is proceeding, the soft new tissue being a favourable situation for the growth of the bacteria. Thence it spreads to the medullary cavity of the diaphysis, or shaft. The inflammation is intense, pus forms, and parts of the bone die. The pus, unless evacuated by surgical means, ultimately forces its way to the surface of the body, and escapes. Surrounding tissues—muscles, ligaments, or fascia—may become involved, and infection may also be carried by the blood to other parts of the body.

REPAIR.—Bone has a wonderful capacity for recovery. As soon as the pus is evacuated, it begins to grow again, the periosteum and bone-marrow laying down new bone round the dead parts. The latter ultimately come loose from the new tissue, and have to be removed by operation. It is rare for the bone not to be reproduced.

SYMPTOMS.—

GENERAL SYMPTOMS.—Fever and other general symptoms arise in most cases. These may be serious, or even fatal.

LOCAL SYMPTOMS.—*Great pain* in the affected bone. *Swelling*, appearing as a marked and early symptom if a superficial bone is affected, but at a later stage in the case of a deep bone. *Fluctuation* may be apparent. *Changes in the skin over the affected bone*; it is first white, then red and angry-looking. If the pus is not surgically liberated, the abscess bursts.

COMPLICATIONS.—Involvement of joints; spontaneous fractures; displacement of epiphyses. Involvement of organs: the liver, spleen, kidneys, or heart may become diseased.

LATE RESULTS.—(1) *Shortening* of the limb, as the result of a displaced epiphysis; or *lengthening*, due to overgrowth caused by hyperæmia. In either case *deformity* results, especially where one of two parallel bones is affected; such as talipes valgus or varus, or club-hand (*see* Chapter XVI). (2) *Ankylosis*, *deformity*, or *dislocation* of joints.

PROGNOSIS.—The prognosis is bad, except in slight cases, the disease being often fatal.

Treatment.—

ACUTE STAGE.—

SURGICAL TREATMENT.—Incisions are made to evacuate the pus, with removal of as much dead bone as is necessary.

LATER STAGES.—

SURGICAL TREATMENT.—Operations of various kinds are required, for example:—

Sequestrotomy, or removal of the dead pieces of bone (these are known as *sequestra*).

Bone-grafting.—If the bone has been extensively destroyed, bone-grafts are inserted into the gap; e.g., the patient's own fibula may be used to replace parts of the tibia, humerus, or femur.

Amputation.—Performed only if the patient is in danger of death from sepsis, or where the limb is bound to be useless.

PHYSICAL TREATMENT.—In practice, we generally meet these cases at one of two periods: (1) When the wounds are just healed, or almost healed; and (2) When the wounds are firmly healed. These are old cases. The nearest joint may be partially or completely fixed by a bony or fibrous ankylosis. The muscles are probably much wasted.

1. *Cases with Unhealed or Recently Healed Wounds.*—It is essential to begin treatment very gently and carefully. The patient is weak, nervous, and apprehensive, and the masseuse must re-assure him, making it quite clear that he is not going to be hurt. If the wounds are not quite healed, the bandages should be left in position for a day or so. Then they may be removed with the dressings, and a clean (i.e., sterile) piece of gauze put over the wound. It is safer in these cases not to give frictions, etc., round it until healing is complete.

If the masseuse touches the dressings or the skin near the wound, she must take proper precautions with regard to asepsis. In any case, she should be very careful as to the cleansing and disinfection of her hands. Any skin lesion should be protected by a gauze and collodion dressing.

Massage.—This is much the same as for infective arthritis. Effleurage and kneading are given to all parts of the limb, especially those above the affected area. The masseuse should begin by treating a part well away from any of the wounds, and she should not approach them closely for some days.

Active Movements.—These should be encouraged after a few days' treatment. They should be assisted by the operator. No force must ever be used until all risk of lighting up the infection is at an end.

2. *Old Cases, with Wounds Long Healed.*—In these cases we shall need stimulating massage to restore the power of the muscles. With regard to movements, we must be guided by the condition of the nearest joint. It may or may not be ankylosed; if it is, the ankylosis may be bony or fibrous. The masseuse should have seen an X-ray of this joint, or should have been informed by the surgeon of its actual condition.

If there is bony ankylosis, it is obviously useless to attempt movement. All that can be done is to massage the muscles, and teach the patient to contract them actively, although he cannot produce any movement by doing so. A patient with an ankylosed knee, for instance, can be taught to contract both the quadriceps and the hamstrings. Later, he will have to be taught to walk as correctly as possible with a stiff knee; or if, unfortunately, the knee is fixed in a more or less flexed position, with whatever apparatus is prescribed for him. If the ankylosis is fibrous—that is, due to adhesions within the joint and to contractures in the soft tissues surrounding it—an attempt may be made to mobilize it; forced movements may be given in cases where all infection is over and no danger of its recurrence exists.

In either case, we may endeavour to loosen adherent scars by frictions and vibrations, though if soft tissues have become adherent to *bone*, it is improbable that our efforts will be attended with much success. Olive oil may be tried. The whirlpool bath is useful in these late cases. Chlorine ionization is sometimes given.

Precaution.—A watch must always be kept for signs of inflammation in or near the wounds or scars. A recrudescence of inflammation with a small amount of discharge in a previously healed area probably means that another small fragment of dead bone has come loose and is setting up irritation. Anything of this kind should be reported at once.

Acute Traumatic Periostitis

This is a condition which arises as the result of a blow on the bone—generally on the shin bone, which is subcutaneous and therefore especially exposed to injury.

PATHOLOGICAL CHANGES.—The changes are those of simple inflammation. Suppuration rarely occurs. The bone does not die, but is merely a little thickened at the site of the injury.

SYMPTOMS.—These consist of *swelling*—not excessive—*pain*, and *tenderness*.

Treatment.—

MEDICAL AND SURGICAL TREATMENT.—The condition is treated by rest, suitable lotions, and sometimes counter-irritants (iodine, etc.). Occasionally the fluid is drawn off with a syringe.

PHYSICAL TREATMENT.—As for acute traumatic synovitis, but as the condition does not affect a joint, and therefore movement is less painful, progression may be quicker.

CHAPTER VIII

DISEASES OF THE NERVOUS SYSTEM: GENERAL CONSIDERATIONS

Etiology of nervous diseases—Pathology—General symptoms—Classification.

ETIOLOGY OF NERVOUS DISEASES

LESIONS of the nervous system, whether of the brain, of the spinal cord, or of the peripheral nerves, may be due to *injury* or to *disease*. The principal causes are as follows :—

INJURIES.—Such as fractures of the skull, vertebral column, or limbs ; dislocations ; or any application of force to the tissues sufficiently strong to sever, lacerate, bruise, or otherwise injure a nerve. In the case of fractures, the nerve may be damaged at the time of the accident, or may be compressed afterwards by displaced bone or by forming callus.

DISEASE.—Under this heading we may include : (1) *Infection by micro-organisms* as in 'infantile' paralysis, tabes dorsalis, or post-diphtheritic neuritis. The bacteria have generally a *selective affinity* for some particular part of the nervous system—that is, they attack that part and no other, e.g., the bacteria of acute anterior poliomyelitis attack only the anterior horn cells of the cord, or the corresponding cells of the cranial nerves. Bacterial inflammation may also, of course, spread to nervous structures from the surrounding tissues. (2) *Poisoning*, e.g., by lead, arsenic, alcohol, etc. This generally affects the peripheral nerves. (3) *Tumours or congenital malformations*, producing pressure on some part of the nervous system. (4) *Vascular lesions*, as hæmorrhage, thrombosis, embolism, etc. (5) *Rheumatism*, the products of which produce compression of nerves, as in some forms of facial paralysis, or irritation of nervous structures, as in chorea. (6) *Any other conditions causing compression* of these structures, e.g., spinal caries. (7) The origin of certain nervous diseases is at present unknown or uncertain, e.g., progressive muscular atrophy and disseminated sclerosis.

The symptoms vary according to the cause and site of the lesion.

PATHOLOGY

A nervous disease may consist of (1) acute inflammation, or (2) chronic degeneration, of some part of the nervous system.

ACUTE INFLAMMATION.—The usual changes are present. The blood-vessels are distended, and there is swelling and destruction of cells, as well as pain, due to pressure on sensory neurons if such are in the neighbourhood. The inflammation may clear up, often leaving behind it more or less permanent damage ; it may progress to a fatal issue ; or it may be succeeded by a chronic process of degeneration.

DEGENERATION means the transformation of a highly specialized tissue into one of a lower order—for example, of nervous or muscular structures into fibrous connective tissue. In the case of nerves, the cells or fibres are destroyed, and their place is taken by neuroglia.

DEGENERATION OF FIBRES.—If a nerve-fibre is cut off from its trophic centre, that is, from its cell of origin, it dies. In the case of the motor neurons, the cells of origin of which are situated in the cerebral cortex (upper motor neuron) or in the anterior horns of the spinal cord (lower motor neuron), their axons passing downwards—that part of the fibre *below* the lesion degenerates; or if the cell itself is destroyed, the whole axon dies: this is known as *descending degeneration* (*Fig.* 59). The cells of origin of the sensory neurons are situated peripherally. Those of the lowest neurons are in the ganglia on the posterior

Fig. 59.—Descending degeneration of efferent (motor) neurons. A, Upper motor neuron; B, Anterior horn cells; C, Lower motor neuron; D, Cerebral cortex. In *Figs.* 59 and 60 the site of the lesion is shown by two parallel cross lines, the degenerated part by a solid black line.

Fig. 60.—Ascending degeneration of afferent (sensory) neurons. A, Optic thalamus; B, Nucleus cuneatus; C, Lowest sensory neuron; D, Posterior root ganglion cells; E, Cerebral cortex.

roots of the spinal nerves, and their axons pass upwards in the cord. Therefore, if the cell or fibre is injured, the part *above* the lesion dies, that is, there is an *ascending degeneration* (*Fig.* 60). (The fibre passing into the ganglion from the skin or other part is, physiologically, a dendron, and will die, too, if separated from its cell.) The same rule applies to the higher sensory neurons, which have their trophic centres in the medulla, optic thalamus, etc.

Changes of Degeneration in Fibres.—(1) The medullary sheath degenerates first, breaking up into fatty globules, which are ultimately absorbed. (2) The axon is later broken up and disappears. (3) The neurilemma sheath remains, and its nuclei increase in number. It is filled at first by a soft protoplasmic substance; later, this becomes fibrous tissue.

Regeneration of Fibres.—Peripheral nerve-fibres *outside* the cord are capable of regeneration in favourable circumstances, but not fibres *within* the brain or cord. The process begins in the central end. The new axis cylinders are laid down by the cells of the neurilemma, and grow down into the peripheral

portion, into the sheaths of the dead axons, or the spaces between them. It is essential that the ends of the severed nerve should not be too widely separated, and that its outer sheath should be intact. The medullary sheath is reproduced later. The new nerve grows downwards at the rate of about 1 millimetre a day. At the point where the axons have been newly laid down, a gentle tapping over the nerve will produce a tingling sensation in the limb. This is known as *Tinel's test*, and by it we can discover exactly how far the regeneration of the nerve has proceeded. The sign may be elicited before there is any indication of returning sensation or motor power.

DEGENERATION OF CELLS.—A cell may be destroyed by injury, compression, the action of bacteria, etc. It atrophies and dies, and its place is taken by the neuroglia, which increases in quantity. The death of the cell involv erating with f them disap *leros* = hard) l, after birth, or their speci

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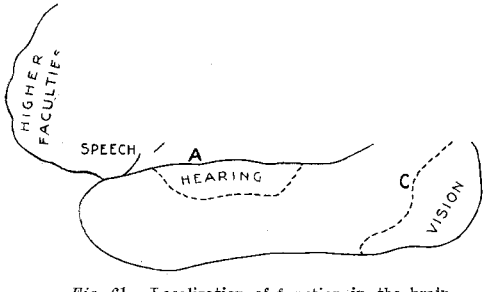

Fig. 61.—Localization of function in the brain. A, Fissure of Sylvius; B, Fissure of Rolando; C, Parieto-occipital fissure.

)MS.—

These occur when there is injury or disease of the frontal lobes of the brain (*Fig.* 61), or sometimes when some important 'association area' is affected, that is, when the communication between the various parts of the brain is cut off or disorganized.

MOTOR SYMPTOMS, EFFECTS ON MUSCLES AND MOVEMENTS.—The patient may suffer from: (1) Flaccidity of muscles, with complete loss of power, and atrophy. (2) Spasticity of muscles. (3) Involuntary movements of various kinds. (4) Atonia (loss of tone) or hypotonia (decrease of tone) of muscles, without loss of *power*. (*Fig.* 62.)

1. FLACCID PARALYSIS WITH ATROPHY.—

This condition is characteristic of the *lower motor neuron lesion*, i.e., injury of the anterior horn cells of the spinal cord, or of their axons. The muscles are at first pale and flabby; later, they become much wasted, and the limb is cold and blue. This is because the motor nerve-supply to the muscles is entirely cut off. No messages come through to them, therefore all power of contraction is lost, no movement at all can take place, and even the normal

tone of muscles at rest cannot be maintained. Moreover, the anterior horn cells, in some way that is not well understood, control the nutrition of the muscles, which, if these cells are destroyed, atrophy for some other reason than mere disuse. The circulation of the whole limb is disorganized, and if bone growth is not complete, it may be gravely impaired.

If a nerve is severed, or its cells of origin destroyed by an accident, the resulting paralysis appears immediately; if an acute inflammation arises in the neurons, it comes on in a few days or hours; if a degenerative process sets in, the development of the paralysis may extend over months or years.

2. Spasticity of Muscles.—This is characteristic of the *upper motor neuron lesion*. The inhibiting power of the cortical (pyramidal) cells of the cerebrum is lost, so that the lower motor neuron is uncontrolled, all sensory stimuli producing exaggerated responses. Moreover, impulses coming down from the cerebellum and the semicircular canals of the inner ear *increase* the tone of the muscles; and since these are no longer balanced by the inhibiting impulses from the cerebral cortex, the muscle tone becomes abnormally great in the affected parts of the body, and we have the development of the *spastic state*. This results in the peculiarities of gait and posture which are to be seen in upper motor neuron lesions. These are described in detail later (*see* Hemiplegia, pp. 116, 117).

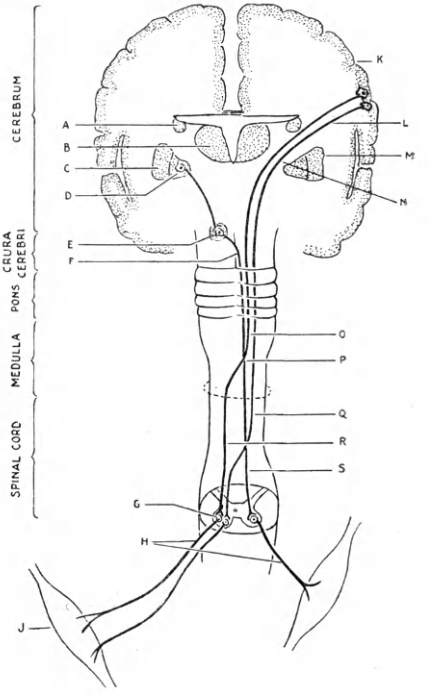

Fig. 62.—The motor path (descending tract). A, Caudate nucleus; B, Optic thalamus; C, Putamen; D, Globus pallidus; E, Red nucleus; F, Decussation of Forel; G, Anterior horn; H, Final common pathway (motor nerve); J, Muscle; K, Motor cortex; L, Corona radiata; M, Lenticular nucleus; N, Internal capsule; O, Pyramid; P, Decussation of pyramids; Q, Direct pyramidal tract; R, Crossed pyramidal tract; S, Rubrospinal tract.

3. Involuntary Movements.—These are of many different kinds, and may be due to:—

Injury of the Basal Ganglia, i.e., the caudate and lenticular nuclei. This may produce: (1) *Athetosis*, a strange twisting, squirming movement, generally of the fingers or toes, but sometimes seen also in wrist, elbow, or shoulder; it occasionally accompanies hemiplegia or diplegia in children; or (2) *Tremors*, of the kind seen in paralysis agitans (*see* p. 143), consisting of fine shaking movements, continuing when the limb is at rest, and less evident when the patient performs purposive, i.e., *willed*, movements. Both athetosis and tremors of this kind are due to the loss of the controlling action of the above-mentioned ganglia over various other groups of cells in the brain, (e.g., the red nucleus in the mid-brain), which produce these disordered movements. Purposive movements are less affected, because the cerebral cortex is more active

in that case. The *diffuse rigidity* of paralysis agitans (*see* p. 143) is also due to the failure of this inhibition, since those parts of the brain which produce overtone of muscle are not sufficiently balanced.

Injury to the Cerebellum.—This produces tremor during the performance of purposive movements, i.e., *intention tremor*, *nystagmus*, etc. (*see* p. 148). The cerebellum controls—or partly controls—co-ordination during movement, and hence injury to this part of the brain, or to the tracts passing to or from it, brings about a kind of jerky inco-ordination.

Irritation of Motor Nerves in any Part of the Nervous System.—This is the result of pressure of inflammatory products on the nerves. The upper neurons may be affected, as in chorea, or the lower neurons as in various cramp conditions, and possibly sometimes in spasmodic torticollis. The spasm in such cases may be *tonic* or *clonic*. In the tonic variety, the muscles go into a condition of fixed over-contraction or tetanus, as in the well-known cramp of the calf-muscles. Clonic spasm consists of a series of twitches or jerks, as in chorea or spasmodic torticollis.

4. ATONIA OR HYPOTONIA.—

This would really be more correctly classed as a sensory symptom, because it is generally due to a lesion of the afferent tracts, as the columns of Goll and Burdach in tabes dorsalis. It must not be confused with loss of power of contraction—the muscles of the tabetic are not deficient in *power* (*see* p. 135).

DISTRIBUTION OF PARALYSIS.—

This is according to the site of the lesion. It may be unilateral or bilateral, according to whether one or both sides of the brain or cord are involved. It may be on the opposite side of the body from the lesion, or on the same side according to whether the lesion occurs above or below the crossing of the fibres of the neurons concerned. It may effect many or few movements or muscles. Broadly speaking, a lower motor neuron lesion produces a paralysis of *muscles*—a group or part of a group, one single muscle, or even only part of that muscle; because the cells for each muscle lie together in the anterior horns. In upper motor neuron lesions, we have a paralysis of *movements* rather than of *muscles*, e.g., loss of extension of the wrist, with spastic flexion of the wrist, etc. This is because the cells in the motor area of the cerebral cortex are arranged according to movements, not according to muscles.

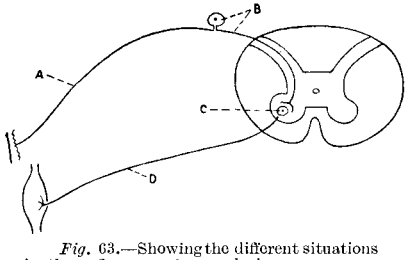

Fig. 63.—Showing the different situations in the reflex arc where a lesion may occur, resulting in loss of the reflex. A, Sensory nerve—e.g., by severance; B, Posterior nerve root and ganglion—e.g., in tabes dorsalis; C, Anterior horn—e.g., in anterior poliomyelitis; D, Motor nerve—e.g., by severance, neuritis.

REFLEXES.—

The nature of a reflex is well known to all students. It depends on the integrity of the reflex arc; and if this is broken in any part, the reflex is lost. For instance, in tabes dorsalis, the *afferent* (*sensory*) *impulse* is prevented from reaching the cord by the destruction of the posterior nerve-roots and ganglia; in 'infantile' paralysis, the *motor response* to the stimulus cannot take place, because the anterior horn cell—*the discharging station*—is lost; in peripheral nerve lesions, the *efferent fibre* is out of action. Therefore, in diseases or injuries of the lower motor neuron, or of the lowest sensory neuron, the reflex is *lost* (*Fig.* 63). In upper motor neuron lesions—for example, in hemiplegia or primary spastic paraplegia—

the reflex response is *increased*, because the arc is intact, but the controlling power of the cortical cells is lost.

If a lesion involves both grey and white matter in the cord at some particular level, the reflexes are *lost* in the parts of the body supplied by the cells in that area; they are *increased below* the site of the lesion because the upper motor neuron fibres of the pyramidal tracts are interrupted on their way to the anterior horn cells lower down in the cord; and they are, of course, normal *above* it. There is often a hypersensitive area corresponding to the upper edge of the lesion, the degenerate or inflamed part acting as a foreign body and irritating the living tissues above (*see* TRANSVERSE MYELITIS, p. 152, and TABES DORSALIS, p. 135). The reflexes are little affected in extrapyramidal or cerebellar lesions.

The reflexes which are best known and most easily obtainable in healthy persons, and therefore most valuable as a diagnostic test in disease are, among deep reflexes, the knee- and ankle-jerks, and among superficial or skin reflexes, the abdominal and plantar.

THE KNEE-JERK (patellar reflex) is obtained by means of a sharp tap on the common tendon of the quadriceps, the patient sitting on a chair with one leg crossed over the other, or on a bed with the legs hanging over the side. It consists of a single sharp contraction of the quadriceps. It is a test of the integrity of the reflex arc at the level of the second, third, and fourth lumbar nerves (that is, roughly, of the lumbar plexus).

THE ANKLE-JERK (Achilles tendon reflex) is elicited by tapping that tendon, with the foot hanging free in dorsiflexion, i.e., the patient kneels on a chair with his foot over the edge. It consists of a contraction of the calf-muscles, and corresponds to the fifth lumbar, and the first and second sacral segments (that is, roughly, to the sacral plexus).

The reflexes in the arm, e.g., the biceps, triceps and supinator jerks, are more difficult to elicit, and are often absent in healthy people.

THE ABDOMINAL REFLEXES are three in number. The upper one, corresponding to the sixth and seventh thoracic segments, is obtained by tickling the skin over the epigastric region; the middle one (Thoracic 8 and 9) by stimulation of the skin above the umbilicus, and the lower (Thoracic 10, 11, 12) by stimulation of the skin below it. They all result in contractions of various parts of the abdominal muscles.

THE PLANTAR REFLEX (Lumbar 5, Sacral 1 and 2) is produced by drawing some sharp object along the inner side of the sole of the foot. It normally causes *flexion* of the big toe—except in infants who have not yet begun to walk, in whom *extension* takes place.

Abnormal responses to stimuli, known as *pathological reflexes*, occur in upper motor neuron lesions. These are ankle clonus, knee clonus, and Babinski's sign.

ANKLE CLONUS.—To elicit this, with the patient in the lying or half-lying position, the knee should be flexed and the ankle dorsiflexed, by putting pressure on the ball of the foot. A series of quick contractions of the calf muscles takes place. The normal reflex response to pressure on the ball of the foot in walking is extension of the ankle. It here takes place in an uncontrolled and inco-ordinate manner, owing to lack of cerebral inhibition.

KNEE CLONUS.—This is less often seen. The patella is drawn down, and a tap given to its upper margin. A similar tremor results.

BABINSKI'S SIGN, is, in adults, the pathological form of the plantar reflex. Extension of the big toe, instead of flexion, follows the stimulus. It is a return to the infantile type, the acquired reflex, brought about by the necessity of pressing the toes on the ground when walking, being lost.

TROPHIC CHANGES.—

Muscle Atrophy has already been discussed; it is characteristic of lower motor neuron lesions only, and does not appear in other types of nervous disease except as the result of disuse of the part.

Changes in the Skin, Nails, Bones, or Joints may also take place in lower motor neuron lesions, or in those of the sensory nerves. The skin becomes glossy and sometimes thickened and hard, the nails longitudinally streaked, and abnormally curved from side to side. The sweat glands may over-secrete or under-secrete in the affected area. Ulcers may appear, and any injury to the skin heals slowly and with difficulty. The bones may become brittle, and fractures occur as the result of trivial violence; in children, bone growth is arrested. Arthritic changes may take place in the joints, or they may become the seat of intense effusion (Charcot's joints).

SENSORY SYMPTOMS.—

The most important of these are pain, anæsthesia or paræsthesia, and hyperæsthesia.

Pain.—This is due to pressure on sensory nerve fibres, exerted by inflammatory products within or without their sheath; by displaced bone, by formation of callus, scar tissue, etc.

Anæsthesia (Greek, *an* = not, *aisthesis* = sensation).—This means loss of sensation, due to interruption of sensory nerves or tracts.

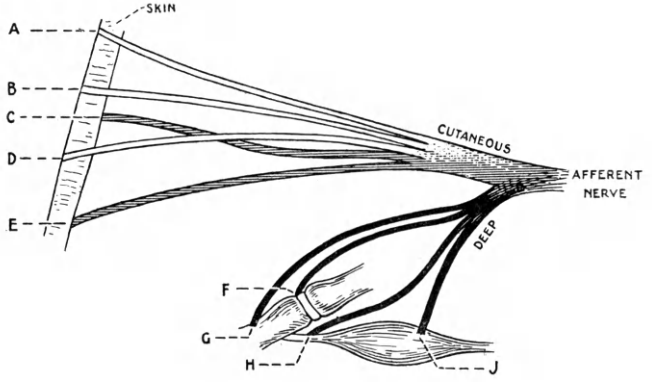

Fig. 64,—Types of sensation and their distribution. **A**, Light touch (discriminative sensibility); **B**, Localization; **C**, Pain; **D**, Finer differences of temperature; **E**, Extremes of temperature; **F**, Joint sense; **G**, Bone sense; **H**, Tendon (muscle sense); **J**, Muscle (deep sensation).

Anæsthesia due to Injury of Peripheral Nerves.—The student will remember that there are two kinds of sensibility, superficial and deep. *Superficial*, or *cutaneous*, *sensibility* may be divided into *protopathic* and *epicritic*, each type of sensation being carried by special fibres. The protopathic type of sensation includes the perception of painful stimuli, of pressure, and of extremes of temperature; the epicritic type, the perception of light touches, of finer shades of temperature, and of cutaneous localization (i.e., of knowledge of what area of skin is touched, whether it is touched in one or two places at the same time, etc.). *Deep sensibility* is that of the muscles, tendons, joints, and bones, and the impulses arising in these organs are those of 'muscle sense' and 'joint sense'. Put shortly, *muscle sense* keeps our brain informed as to the state of contraction or relaxation of our muscles, *joint sense*

as to the position of our joints. Both are necessary if we are to co-ordinate our movements correctly. Pain and a sensation of pressure may also be felt in these deep structures. (*Fig.* 64).

If a single peripheral nerve is injured, there may be little or no impairment of deep sensation, and the loss of epicritic sensation is always more extensive than that of protopathic. Epicritic sensation is tested by touching the part supplied by the nerve with cotton-wool; protopathic sensation by means of

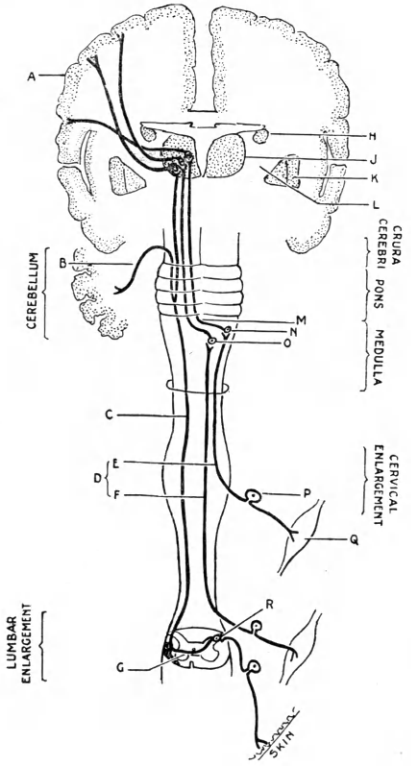

Fig. 65.—The sensory path—the columns of Goll and Burdach and the antero-lateral (Gower's) tract. **A**, Sensory cortex; **B**, Superior peduncle; **C**, Antero-lateral tract; **D**, Posterior columns; **E**, Column of Burdach; **F**, Column of Goll; **G**, Grey commissure; **H**, Caudate nucleus; **J**, Optic thalamus; **K**, Lenticular nucleus; **L**, Internal capsule; **M**, Sensory decussation; **N**, Nucleus cuneatus; **O**, Nucleus gracilis; **P**, Posterior root ganglion cell; **Q**, Muscle; **R**, Cell of posterior horn.

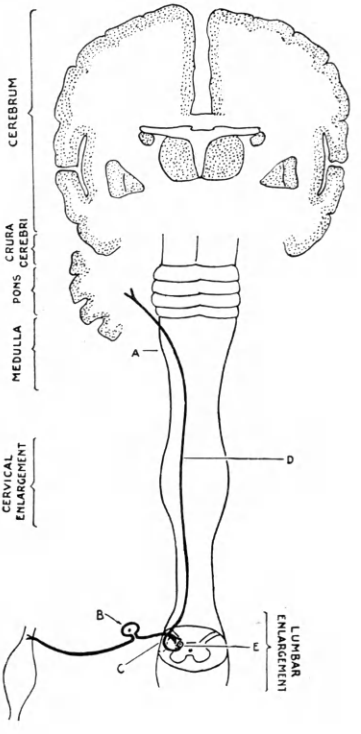

Fig. 66.—The direct cerebellar tract. **A**, Restiform body; **B**, Posterior root ganglion cell; **C**, Posterior horn; **D**, Direct cerebellar tract; **E**, Cell of Clarke's column. The direct cerebellar tract ends by passing through the inferior peduncle into the cerebellum.

pinpricks, or the application of the faradic current. Deep sensation may be tested by strong pressure on the part, muscle sense by active movements, and joint sense by passive movements. All these tests should be carried out with the patient's eyes shut.

Anæsthesia due to Injury of Tracts in the Cord.—The fibres carrying

all the above types of sensation enter the spinal cord by way of the posterior nerve-roots, and are then distributed to the various ascending tracts. Roughly speaking, there are three main tracts going upwards to the brain: (1) *The columns of Goll and Burdach* (posterior columns). These carry impulses of muscle and joint sense and tactile discrimination (i.e., the finer shades of touch). (2) *The antero-lateral (Gower's) tract*, carrying sensations of pain and temperature, and of crude touch and pressure. (3) *The direct cerebellar (Flechsig's) tract*, carrying impulses connected with the maintenance of co-ordination and equilibrium (e.g., certain types of muscle sense). (*Figs.* 65, 66).

If all these tracts are destroyed, there is complete anæsthesia below the level of the lesion. *Dissociated anæsthesia* means loss of some particular form of sensation, while other kinds remain intact—for example, in syringomyelia (*see* p. 142) there is loss of the pain and temperature sense, but not of that of touch, muscle contraction, etc., this being because the antero-lateral tract only is affected.

PARÆSTHESIA (Greek, *para* = beyond).—This means abnormal or perverted sensation, the afferent nerves carrying up false impressions, such as the feeling of walking on cotton-wool in tabes, 'pins and needles', etc. It is due to *partial* lesions of the nerves or tracts. The latter may also cause *diminished or delayed sensation*—the patient may not feel the touch until several seconds after it has actually taken place.

HYPERÆSTHESIA.—This is a condition of too acute sensibility to stimuli, due to irritation of nerves.

ATAXIA.—This has been defined as '*pathological inco-ordination*'. Although it is manifested by disordered *movements*, it is a defect of the *afferent* tracts. It is mainly the result of loss of muscle and joint sense through lesions of the posterior columns, or cerebellar tracts, the cerebrum or cerebellum not being kept informed of the state of contraction of the muscles or of the position of the joints, so that they are unable to co-ordinate the movements of the body. For a description of the two types of ataxic gait, *see* TABES DORSALIS and CEREBELLAR ATAXIA (pp. 135, 145).

ELECTRICAL CHANGES.—

In *upper motor neuron disease* the electrical reactions are normal. In *lower motor neuron affections* we find the condition known as *reaction of degeneration* (R.D.). The characteristics of this reaction are, in the first place, increased excitability to both galvanism and faradism; after a short time, decreased response to the faradic current (because the dying nerve is less and less able to carry the stimulus to the muscle), but increased response to the galvanic (which stimulates the muscle tissue directly); and, finally, entire loss of reaction to faradism, the galvanic response persisting for a time, but gradually weakening and dying away, as the muscle itself degenerates.

The reaction of degeneration is accompanied by polar changes. Normally, the kathodal closing contraction (K.C.C.) is the strongest; the anodal closing and opening contractions (A.C.C. and A.O.C.) are equal to each other, and weaker than the kathodal closing contraction. The kathodal opening contraction (K.O.C.) is weakest of all. But in lower neuron diseases the A.C.C. may be stronger than the K.C.C.

DEFORMITIES.—

These may follow nervous diseases and are due to contractures. In lower motor neuron lesions, they are caused by the unopposed pull of healthy antagonists, sometimes assisted by the action of gravity; in upper motor neuron disease, by the action of spastic muscles which maintain the limbs in abnormal positions.

CLASSIFICATION

Nervous diseases may be divided into diseases of the brain; diseases of the spinal cord; and diseases of the peripheral nerves. It will, however, be more convenient here to take together those which have similar groups of symptoms according to which neuron, or neurons, are affected. We shall therefore consider in order :—

I. Lesions of Brain and Cord.—

(1) The upper motor neuron. (2) The lower motor neuron. (3) The sensory tracts. (4) Other lesions.

II. Lesions of Peripheral Nerves.—

Injury or disease of individual nerve-roots or-trunks. Neuritis, neuralgia, and cramp.

III. 'Functional' Conditions.—

Those in which there is no *known* pathological change.

CHAPTER IX

DISEASES OF THE MOTOR NEURONS

I. Lesions of the upper motor neuron: Hemiplegia—Cerebral paralyses of infancy—Primary spastic paraplegia. II. Lesions of the lower motor neuron: Acute anterior poliomyelitis—Progressive muscular atrophy—Amyotrophic lateral sclerosis.

I. LESIONS OF THE UPPER MOTOR NEURON

HEMIPLEGIA

By this is meant a spastic paralysis of the arm, the leg, and sometimes of the face on the opposite side to that of the lesion. The trunk muscles and the diaphragm are not as a rule affected, since these are bilaterally innervated—that is, they receive nerve impulses from both sides of the brain; so that, if one side is injured, the centre on the other side supplies the deficiency.

ETIOLOGY.—The principal *causes* of hemiplegia are: (1) *Hæmorrhage* into the brain substance; *embolism*; or *thrombosis* of one of the arteries in the brain. (2) *Tumours* of various kinds, or *inflammatory conditions* of the brain. (3) *Traumas*, such as fractures of the skull.

CEREBRAL HÆMORRHAGE.—

Predisposing Causes.—(1) Cases are often found among men engaged in occupations entailing *continual hard physical work* (dock-labourers, etc.), because the constant exertion keeps the blood-pressure high, and so irritates the artery walls, bringing about degenerative changes; or among butchers and publicans, because the large intake of nitrogenous food or alcohol produces similar effects. (2) Hæmorrhage tends to occur in men of a *certain physical type*—plethoric individuals of heavy build with short thick necks. (3) *Arteriosclerosis* is the commonest predisposing cause. It is a condition in which the arterial walls become hard and brittle. It is either a physiological change of old age—hence the greater frequency of 'apoplexy' in old people—or the result of various diseases—heart or kidney disease, syphilis, lead-poisoning, etc. (4) *Blood-diseases*, e.g., pernicious anæmia. (5) *Aneurysm.*

Exciting Causes.—Anything which causes a sudden rise of blood-pressure may bring about a hæmorrhage in one predisposed—sudden violent exertion, e.g., running to catch a train, lifting a heavy weight, an attack of coughing, or even violent emotion.

Pathological Changes.—It is always an *artery* that is ruptured, never a vein, since the pressure in the veins is low. The hæmorrhage lacerates the brain tissue in the area where it occurs. The blood then clots, the serum being gradually absorbed. The clot itself may in some cases be absorbed also, leaving only a small scar. This happens most often in young people, and the result is recovery. Or it may become organized, inflammation having been produced in the surrounding tissues by the irritation caused by the clot, leading to increase of connective tissue, which forms a fibrous capsule round it. This is more common in elderly people, and in this case recovery does not take place, though there may be slight improvement as the inflammation subsides.

Symptoms.—The occurrence of a large hæmorrhage is manifested by a sudden loss of consciousness known as an *apoplectic fit.* The outflow of blood raises the pressure within the cranium, disorganizing the whole brain, not only that part in which the bleeding takes place. The attack may be ushered in by headache or dizziness, or it may occur without warning. The patient's face becomes flushed—in contradistinction to the pallor of syncope; the breathing is stertorous, because impeded by the paralysed tongue and palate; the pupils of the eyes are dilated, sometimes one more than the other, from paralysis of the iris, and turned towards the side of the lesion in the brain, because of paralysis of the external rectus on the contralateral side; the head is turned towards the same side. The pulse is strong, full, and slow.

The limbs are completely paralysed and flaccid, and all reflexes are lost; the latter return gradually, those on the sound side first. Those on the affected side are exaggerated later. For the time, the whole nervous system is out of

ore tone in the muscles of the sound side, so
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e cases they may begin with convulsions;
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or days. When *reaction* sets in the pulse
id the patient becomes restless, excited, or
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ly rigidity, and this may pass off or last till
weeks afterwards. For later symptoms, *see*

n the wall of a blood-vessel. An *embolus* is
elsewhere in the body, which has been broken
blood-stream, until finally it lodges in some
ry, since these vessels are of smaller calibre
ched from vegetations on the valves of the heart may also form emboli. Thrombosis in the brain is usually due to arteriosclerosis or syphilitic disease of the artery walls; embolism is often a complication of disease of the mitral valve.

Pathological Changes.—The result of either embolism or thrombosis is softening and degeneration of the brain in the area thus deprived of its blood-supply. If, for instance, the branches of the middle cerebral artery which supply the internal capsule are blocked, the fibres in that part degenerate, and the ultimate result is much the same as would have taken place had there been a hæmorrhage (*see* p. 116).

TUMOURS.—

In the case of tumours, the progress of the disease is very slow—spread over many months. Headache, giddiness, or coma appear gradually, as do the 'localizing symptoms', the nature of which depend on the situation of the new growth. Hemiplegia occurs if the tumour is in the motor (Rolandic) area.

. It must be remembered that there is such a thing as 'functional hemiplegia', appearing in hysterical patients.

SYMPTOMS ARISING AS THE RESULT OF THE ABOVE-MENTIONED LESIONS.—We have not space here to consider the characteristic symptoms of lesions at all the various levels of the upper motor neuron. The student who knows her anatomy can easily work them out for herself. We must confine ourselves to enumerating those found as the result of the commonest type

of lesion—a hæmorrhage from a branch of the middle cerebral artery into the internal capsule. A brief note is added later as to two other types of lesion.

SYMPTOMS OF A TYPICAL CASE OF HEMIPLEGIA DUE TO A LESION IN THE INTERNAL CAPSULE (*Fig.* 67, B).—

THE MUSCLES AND REFLEXES.—During the initial attack or fit, the muscles are completely paralysed and flaccid. During the stage of reaction or a little later, appears the *early rigidity*, which may pass off or merge into the *late rigidity* (spasticity), which comes on after an interval of weeks, or even months. (In a few rare cases rigidity never appears at all.)

The reflexes are exaggerated; ankle clonus and Babinski's sign (*see* p. 109) are both present.

CONDITION OF LIMBS AND FACE.—(1) *The arm* is more seriously affected than the leg or face. It is held close to the side in a position of adduction; the elbow is semiflexed, the forearm pronated, the wrist and fingers flexed. If

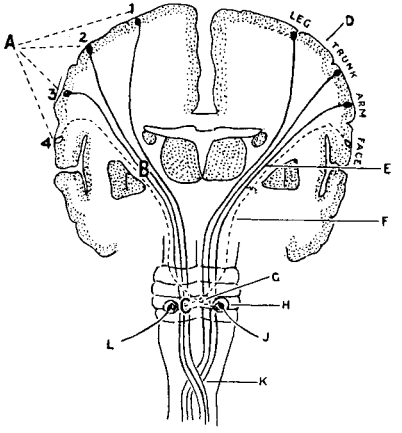

Fig. 67.—Positions of lesions of upper motor neuron (hemiplegia). A, Motor cortex; B, Internal capsule; C, Pons. The remaining letters indicate structures. D, Cerebral cortex; E, Internal capsule; F, Upper neuron fibres for face; G, Decussation of facial fibres; H, Facial nucleus; J, L, Facial nerves; K, Decussation of pyramids (fibres for limbs).

Fig. 68.—Connections of facial nucleus with cerebrum. A, Facial nucleus; B, Pyramidal cells; C, Upper part of nucleus; D, Lower part of nucleus.

recovery takes place, the arm is always the last to become normal, and since in both limbs the coarse movements return before the fine ones, the small movements of hand and fingers are the last to be re-established. (2) *The leg* is held stiffly with the knee in extension, and the foot strongly plantar-flexed.

> *All* the muscles in the affected limb are spastic, and not merely those producing the abnormal position. The stronger groups, however, take command of the situation, and overcome the resistance of the others. In the arm, the adductors of the shoulder, pronators of the forearm, and flexors of the elbow, wrist, and fingers prevail; in the legs the extensor groups are the stronger. (But *see* DISSEMINATED SCLEROSIS, pp. 147, 148.)

(3) *The face* is the least affected, and recovers first. The paralysis is most marked in the lower part. This is because the upper part of the facial nucleus receives fibres from both sides of the cortex, the lower part from the opposite side alone (*Fig.* 68). *The tongue*, when put out, inclines towards the paralysed side, being drawn across by the spasm of its intrinsic muscles supplied

by the hypoglossal nerve. *The muscles of mastication* are unaffected, since the fibres for these, and for the extrinsic muscles of the eyes, are the farthest forward in the internal capsule, and so escape. The patient, however, finds that though he has no difficulty in chewing his food, it collects between his teeth and his cheek on the affected side. This is due to paralysis of the buccinator, which maintains the tone of the cheek. For the same reason he is unable to whistle.

GAIT.—The patient leans towards the sound side, and swings the paralysed leg forward in a half-circle. Both these movements are for the purpose of bringing his dropped foot clear of the ground.

THE SPHINCTERS, as is usual in unilateral lesions, are unaffected.

SENSATION is generally normal.

THE HIGHER FAÇULTIES are rarely impaired.

APHASIA, or loss of the power of speech—not due to paralysis of the muscles of articulation, but to inability to co-ordinate and combine the various nervous impulses by which speech is produced, the patient having, as it were, lost his formula for speech—is generally found if the lesion is on the *left* side of the brain—that is, in a *right-sided* hemiplegia—the fibres from the speech centre being cut off in the internal capsule. Later, the patient may be able to say a few simple words, such as 'Yes', and 'No'. We do not know whether this is done by means of a few remaining fibres from the centre on the left, or by means of the rudimentary centre on the right. In *left-sided hemiplegia*, which is rare, there is no interference with speech, except in left-handed persons, whose speech centre is in the *right* hemisphere.

LATE SYMPTOMS.—These consist of involuntary movements and trophic changes.

Tremors are often seen in old cases, in the paralysed limbs (damage to the lenticular nucleus ?); also *athetosis* (*see* p. 107) due to involvement of the caudate and lenticular nuclei; or a kind of *chorea*; the last two symptoms being more common in children.

Trophic Changes are sometimes seen in the skin; muscular atrophy may occur in the hand; and arthritis may develop, also in the hand, making movement painful. In these cases, similar to those of lower motor neuron disease, the anterior horn cells must have become affected.

SYMPTOMS IN ATYPICAL CASES.—

LESION IN THE MOTOR CORTEX (*Fig.* 67, A).—This produces a *monoplegia* (paralysis of a single limb), in whatever part of the body is controlled by the injured area, i.e., in arm or leg on the opposite side to that of the lesion. The extent of the paralysis varies according to the size of the lesion; for instance, an injury at A.1. in the diagram may cause a spastic paralysis of the whole leg, or may affect one movement only, e.g., extension of the ankle. A *hemiplegia* in a cortical case could only arise from a lesion so extensive as to make it very improbable that the patient would survive.*

LESION IN THE PONS (*Fig.* 67, C).—This produces, as a rule, a *hemiplegia* of the arm and leg on the *opposite* side to that of the lesion, and of the face on the *same* side, the fibres for the face being injured *after* they have crossed the middle line, the pyramidal fibres *before* their decussation. This constitutes what is known as *crossed paralysis*. If the facial nucleus itself is injured, the paralysis in the face is of the lower motor neuron type. Sometimes the fibres which have crossed over to go to the nucleus of the sixth cranial nerve (abducens oculi) are also involved.

* But as regards *infantile* hemiplegia, *see* p. 121.

Treatment of the Apoplectic Fit.—

FIRST AID.—The patient should not be moved more than is absolutely necessary. If the fit occurs indoors, he should not be taken from the room where he fell, but should be placed on a couch, or even left on the floor until the doctor arrives. If the fit comes on out-of-doors, an ambulance should be summoned, and the patient should not be moved until it arrives, unless he is in a position of danger, e.g., in the road amongst the traffic. All tight clothing should be loosened, the patient's head should be raised, and he should be placed in a position which facilitates breathing, and a free circulation of air allowed in the room. Hot-water bags or bottles—with a cover, or wrapped in a blanket—may be placed at the feet, and ice, if obtainable, applied to the head. Nothing should be given by the mouth, and no further steps should be taken until the doctor arrives.

Treatment of the Resulting Condition.—

AIMS OF TREATMENT.—The two great aims are to keep all the structures in the affected limbs in good order pending the absorption of the clot; and, if and when this happens, to re-educate the patient in the use of these limbs, by obtaining relaxation and restoring co-ordination.

In these cases, we have to realize that the patient's recovery is not in our hands. It depends on the severity of the initial damage and the patient's recuperative power. It is our business to assist nature by preventing the joints from becoming stiff, and the muscles from becoming permanently shortened; so that if recovery takes place, nothing may present an obstacle to the return of function to the limb. The nerve cells or fibres once destroyed are destroyed for ever. There can be no regeneration or reproduction of either within the brain or cord, although cells not *fatally* injured may gradually return to normal. If the clot is absorbed, and little damage has been done to the surrounding structures, the patient will recover; if it is not absorbed, he will remain paralysed, though some improvement may take place as the surrounding tissues heal. The prognosis is best in young people.

First Month

The patient will be in bed. The masseuse must take care not to disturb him more than is absolutely necessary. He should not be moved in bed, still less asked to move himself; nor should he be excited or stimulated in any way by the operator's manipulations, manner, or conversation.

SUPPORT.—Splints are not often used. The hand may be left free, provided suitable movements are given frequently; but the foot should be kept in position by a splint or by sand-bags, and a cradle placed over both feet to keep off the pressure of the bedclothes.

PHYSICAL TREATMENT may begin a day or so after the attack, provided that it is of a suitable kind.

Massage.—This should be of a soothing and rhythmic character, slow and fairly deep, whether the patient's limbs are spastic or not. It should consist of effleurage, kneading, and stroking. No stimulating movements must be used, even if the early rigidity has passed off and the late rigidity not yet appeared. As a rule, only the affected limbs are treated.

Passive Movements.—The purpose of these is to prevent the formation of adhesions in the joints, or contractures in the muscles. They should be given smoothly and slowly, but strongly enough to ensure the stretching of the spastic muscles to their full extent. When spasticity has set in, the beginning of the passive movement is difficult. For instance, in extending the elbow, the spastic flexors resist strongly at first, but as the stretching continues, their

resistance weakens, and the end of the movement is easy. Care must be taken not to jerk the limb at this stage, or spasm will again be excited.

The beginner is often worried by the occurrence of ankle clonus when she attempts to dorsiflex the ankle. This generally happens when the patient is no longer in bed, and is being treated in half-lying on a plinth with a foot-rest, or in an arm-chair with his feet raised. It is also a disturbing feature in a monoplegia affecting the lower leg only, the thigh muscles being normal, so that the knee is not held rigid. To avoid the ankle clonus, the masseuse must keep the knee straight—if she wished to obtain this reflex, she would flex the knee—and must grasp the patient's foot as near the ankle as possible. Pressure under the balls of the toes sets up a reflex producing plantar-flexion of the ankle—this happens normally in walking—and in the hemiplegic the reflex cannot be inhibited, but takes the pathological form of the clonus.

The entire treatment should not occupy more than 15 to 20 minutes during this early period.

After a Month or Later

Massage is continued in the same manner as in the early stages. The back may be treated if desired, the patient being gently turned on to the sound side. Abdominal massage, dangerous up till now because it raises the blood-pressure, may be added if the patient is suffering from constipation or flatulence, but the doctor should first be consulted. Rhythmic stroking and kneading are the best movements.

Passive Movements should be continued as before.

Active Movements may now be given as power returns, assisted at first, then free, to one joint at a time. We have to teach the weaker muscles to work again, and the stronger spastic groups to relax. The patient must not, however, be over-tired, mentally or physically, at any stage.

Progression

Each case must be judged on its own merits, and treated accordingly. Neither in hemiplegia nor in any other kind of nervous disease, is it of the least use to attempt to hurry progress, or push the patient on too quickly. To do so is to defeat one's own object, and no worker who is not prepared to have patience should undertake the treatment of a nerve case. If, in an excess of zeal, or an outburst of exasperation, we give the patient too long a treatment, or ask him to do more than at that time he can or ought to do, we shall find, then or later, that not only have we done him no good, but that we have actually done him harm.

Massage becomes less, and exercises more, important as the patient progresses. Some workers gradually leave it off except in cases where atrophy occurs; others prefer to continue it, because it certainly soothes the patient and relieves the spasm, even though this relief may be merely temporary.

Passive Movements should be continued as long as spasm is present.

Exercises.—

Re-education Exercises.—The early active movements should be as simple as possible, and should take place in only one joint at a time, so that the patient may give all his attention to the control of that joint. For instance, he may be told to extend the elbow, and allowed meanwhile to hold the wrist flexed and the forearm pronated; then he attempts supination, the elbow and wrist being kept flexed. The same plan is followed with regard to the movements of the other joints. Later on, he should be taught to hold one joint corrected while exercising another; e.g., he may extend the elbow while holding the forearm supinated, or extend the wrist with the elbow straight.

He thus learns to control two joints at a time. Gradually, he is taught to control the whole limb. For instance, Arm-raising-sideways to the vertical will involve control of all the joints of the arm and shoulder, if correctly performed. Later still, more elaborate movements, such as 2-Arm-bending and -stretching forward, upward, outward, and downward, may be added.

The small fine movements of the hand and fingers are the last to return. The patient should be made to pick up and put down (the latter is the more difficult) balls or other small objects. Many kinds of games are useful at this stage—throwing of balls, rings, or quoits. These teach co-ordination of movement. Finally, the patient should practise the ordinary occupations of his or her life—writing, sewing, and so forth. It is needless to say that many patients never recover sufficiently to be able to do such things.

The lower extremity is easier to deal with, but treatment should be on the same lines. *Re-education in walking* is the main problem here. We have to teach the patient to flex his hip and knee, and dorsiflex his foot, in order to avoid the abduction of the hip, and the exaggerated tipping of the pelvis as the leg is carried forward. He has also to be taught to walk up and down stairs, to sit down and get up. All these complex movements may at first be broken up into their component parts, as in the case of a tabetic patient (*see* pp. 139–141).

Exercises to Produce Relaxation and Rhythmic Movement (*see* pp. 195, 200, 201). These are most valuable, and should always find a place in the scheme. Head-rolling and trunk-rolling, done actively by the patient, and rhythmic swinging of arm and leg are useful; any exercise or position that decreases the overtone of the muscles should be noted, and employed frequently. We must not forget that deep breathing promotes relaxation.

Pulley Exercises.—The pulley is a most valuable piece of apparatus in the treatment of late cases of hemiplegia. If the 'double pulley' is used, these exercises constitute a form of strong passive movement combined with assisted active movement, since the sound arm is in a position to help the paralysed one. A pulley with a weight at one end of the cord may also be used, in which case the weight may be arranged to contribute either assistance or resistance to the movement. (Resistance, however, is rarely required.) Dr. Mennell's well-known apparatus is excellent for this purpose, or some simpler form of pulley can easily be extemporized in the patient's own home.

Exercises for Co-ordination and General Exercises.—Those patients who are fortunate enough to have completely, or almost completely, recovered the normal use of their limbs, may conclude their treatment by a short course of general exercises of average strength, in which movements for co-ordination should have a large place.

This does not, of course, apply to elderly patients, or to those who are in any danger of another hæmorrhage, such as sufferers from arteriosclerosis. People with heart disease should be appropriately treated according to the kind of lesion present.

CEREBRAL PARALYSES OF INFANCY

CAUSES.—These affections are due to disease or injury of the brain before birth, during birth, or in infancy or early childhood. (1) *Before birth*, the trouble is due to injury or disease of the mother affecting the fœtus. (2) *During birth*, injuries may occur in the course of a difficult labour, and are sometimes due to the pressure of instruments on the child's head. (3) *After birth*, the chief causes of trouble are the infectious diseases of childhood, which may lead to meningitis or encephalitis.

TYPES OF PARALYSIS.—These consist of: (1) *Hemiplegia*, affecting the upper and lower extremities on one side of the body only. (2) *Paraplegia*,

paralysis of both lower, or both upper, extremities. The legs are much more often affected than the arms. (3) *Diplegia*, a paralysis of all four limbs, though sometimes in varying degrees.

Hemiplegia usually arises in infancy as the result of some infectious disease. Paraplegia and diplegia are more often caused by an injury at birth or by a pre-natal infection. They are sometimes known as 'Little's disease'.

SYMPTOMS.—

INFANTILE HEMIPLEGIA.—The symptoms are the same as those present in adults. But *tremor* or *athetosis* is more common, and the affected side of the body does not develop normally.

DIPLEGIA AND PARAPLEGIA.—The '*scissor-gait*' is generally the most marked symptom, being due to spasm of the adductors, which causes the child to cross his legs as he walks (*Fig.* 69). Moreover, he cannot bring his heels to the ground, because of the rigidity of the gastrocnemius. The face may be affected. The child is slow in developing, and does not sit up until long after the usual time, nor does he attempt to walk until very late—the above-mentioned spasm making it almost, or quite, impossible for him to maintain his balance. *Aphasia* (*see* p. 117) may be present, or the speech may be very indistinct from spasticity of the muscles of articulation. *Deformities* are liable to occur as a result of the spasticity, especially talipes equinus.

Fig. 69.—Congenital cerebral diplegia. Cross-legged progression.

In any of these cases, there may be *mental deficiency*. It is most common in *diplegic* children.

THE OUTLOOK.—In most of these tragic cases, we have to recognize the fact that the patient will never be as other children. The damage is done and cannot be undone. All we can do is to try and make the child as happy, as useful, and as efficient as is possible in the circumstances. There are, of course, many different degrees of disability.

1. THERE IS THE MENTALLY DEFICIENT CHILD WITH DIPLEGIA OR PARAPLEGIA.—Here we can do little. Mercifully, this child will not realize what he has lost. He should be placed in an institution, where he will generally be happier than he would be at home. We have to remember, however, that

many of these children are not really mentally deficient, but merely backward because they are deprived of the normal child's opportunities of acquiring information, especially if their speech be affected. This type of child needs training by those skilled in this kind of work, but something may be done by the medical gymnast by care and sympathy.

2. THERE IS THE DIPLEGIC, HEMIPLEGIC, OR PARAPLEGIC TYPE WHOSE SPEECH IS UNAFFECTED AND WHOSE MIND IS NORMAL.—If the arms are not involved, this child has a future before him, since he may undertake, and excel in, any sedentary occupation. If the arms are seriously affected, the handicap is much greater; fortunately, this is rarely the case. The victim of a right-sided hemiplegia is also at a greater disadvantage than the paraplegic child. But in all these cases much improvement can often be produced.

3. THE CHILD WHOSE ARMS, LEGS, AND SPEECH HAVE ALL SUFFERED, BUT WHOSE MIND IS NORMAL.—This is the most pathetic case of all. The aphasic child often suffers from some degree of mental impairment, but it is quite possible for the speech to be extremely indistinct, from spasticity or incoordination of the muscles of articulation, and yet for the patient to have a normal or even supernormal mentality. He will sooner or later realize the extent of his deprivation, and very sympathetic treatment is necessary in the training of such a child. Yet even in such circumstances it is possible for him —like the even more tragically handicapped blind deaf-mute—to 'make good'.

Inexhaustible patience is required in treating these cases. Sympathy, tact, love of children, the spirit of play, the power of stimulation and encouragement, are all needed. But it is infinitely worth while.

Treatment.—

PHYSICAL TREATMENT.—*Splints* are used as required. An attempt must be made to obtain *relaxation* even if it be only temporary. Hot baths—whirlpool baths if obtainable—and suitable electrical treatment, may be tried, and soothing massage—effleurage, rhythmic kneading and stroking—with passive movements, should be given, the patient being kept warm and comfortable during treatment.

EXERCISES.—If the child, at the age of 18 months or 2 years, cannot sit up, efforts must be made to teach him to do so. Then *walking* must be taught, on the same lines as in adult cases. We shall try to get the child to keep his legs apart. He may be encouraged to ride astride rocking horses, or hobby-horses, and to play at ball games, ninepins, etc. We need not be too particular as to *how* movements are performed so long as we can teach the child to get about and help himself. As he grows older, he may do the same exercises as adult patients with spastic paralysis—rhythmic and pulley exercises, etc. (*see* p. 120). The less severe cases may attempt ordinary free exercises, or play carefully chosen games. Some patients with very slight hemiplegia or monoplegia (*see above*) may sometimes even join with other children in an exercise class, provided the teacher keeps an eye on them and allows for their disabilities. It is far better for them not to regard themselves as quite different from other children, and joining with others in class may obviate this. Such treatment is, of course, only suitable for those with very slight disability.

MENTAL TRAINING of dull or backward children who are also paralysed in this way is a matter for experts. Nevertheless, while treating the physical condition, we shall do well to try and arouse the child's interest in his surroundings—to make him notice the objects with which he plays; to count his ninepins, balls, or beads, or to tell us the colour of them. We may show him pictures in books and ask him what they represent. If the speech is affected, we may

try and get him to say first single words, and then short sentences. For instance, he may be taken to the window, and asked what he sees, as well as other simple questions, requiring at first only one word as an answer. Some of these children are best treated away from other patients for a time, in a room alone, or in a corner screened off, in order to secure their attention—a difficult matter among many distracting influences.

OPERATIVE TREATMENT.—Operations are sometimes performed for relief of spasm of the calf muscles, adductors, etc. These consist of severance* or crushing of the nerves, or parts of the nerves, to these muscles (e.g., the obturator nerve or the branches from the internal popliteal nerve to the gastrocnemius). The tendo Achillis is sometimes divided or lengthened. Special apparatus is used afterwards to retain the limbs in correct position, and as soon as walking is allowed, re-education is continued. Careful after-treatment is essential.

N.B.—The child's spine must be carefully watched for signs of scoliosis.

PRIMARY SPASTIC PARAPLEGIA

(*Primary Lateral Sclerosis*)

A spastic paralysis of both legs, due to disease of the pyramidal tracts.

ETIOLOGY.—This disease generally begins under the age of 40. Its *cause* is unknown. Injury, exposure, and toxins predispose to it.

PATHOLOGY.—The disease consists of a degeneration of the direct and crossed pyramidal tracts, generally in the cervical region (*Fig.* 70). The sclerotic process may extend later to other tracts in the cord.

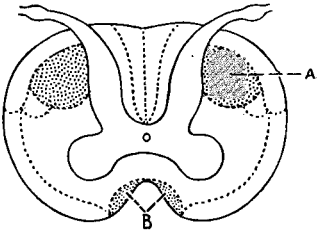

Fig. 70.—Primary spastic paraplegia. A, Crossed pyramidal tract; B, Direct pyramidal tract.

SYMPTOMS.—The *onset* is gradual, and the course long and slow. The *legs* show signs of a typical upper motor neuron paralysis. There is marked *spasticity*, the hip and knee being extended, the foot plantar-flexed, and the thighs strongly adducted. *The gait*, therefore, is characteristic. The patient walks on his toes, and the spasm of the powerful adductors causes him to cross his legs, producing the 'scissor-gait'. *The reflexes* are increased, and the pathological reflexes present (*see* p. 109) There is no *atrophy*, nor other trophic change, nor any *sensory loss*. *The sphincters* are normal till late in the disease. Later, the degeneration may extend to other regions of the cord, causing additional symptoms or a fatal issue.

Tumours of the cord often produce a similar result as regards paralysis, but in many cases *pain* is a prominent symptom.

Treatment.—

These cases are treated on the same lines as hemiplegia (*see* pp. 119, 120), though, of course, the prognosis is not so good. *Re-education in walking* must be attempted.

In secondary paraplegia tumours are sometimes removed by operation. If this is successful, there may be considerable improvement, but in many cases the most that can be done is to relieve pressure. After the wound is healed, and the patient has recovered from the shock of the operation, he may begin, or resume, treatment for the spastic condition in the same way as the hemiplegic or paraplegic patient. The surgeon will decide when he is to get up.

* Stoffel's operation. *See* Jones and Lovett, *Orthopedic Surgery*, Chapter xx, p. 422.

II. LESIONS OF THE LOWER MOTOR NEURON

ACUTE ANTERIOR POLIOMYELITIS

(Infantile Paralysis)

An acute inflammation of the anterior horns of the spinal grey matter (*Fig.* 71).

ETIOLOGY.—The disease is due to a *bacillus* which has not yet been definitely identified. Apart from human beings, no animals except monkeys are capable of contracting it.

It may be *epidemic* or *sporadic*, both forms generally appearing in hot weather. The epidemic form attacks both children and adults, and is often fatal. Serious outbreaks occur from time to time in America, Norway, Sweden, etc., but are rare, and not so widespread, in this country. The sporadic form, though its after-results are often lamentable, is never fatal. It generally attacks children between the ages of 1 and 4 years, though no age is immune.

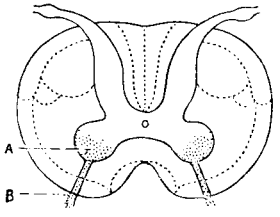

Fig. 71. — Acute anterior poliomyelitis. A, Anterior horn; B, Anterior nerve-root.

The disease is *infectious* during the acute stage, the nasal secretions being the vehicle of infection, the bacteria entering by way of the mucous membranes of nose and throat. It can probably be spread by carriers who do not themselves contract the disease. The incubation period is 6 to 8 days.

From the nasal mucous membrane the bacteria are carried by the lymphatics to the spinal cord, where they attack the anterior horns of the grey matter.

PATHOLOGICAL CHANGES.—The virus attacks first the blood-vessels of the anterior horns, which become engorged and inflamed. The membranes round the affected part become hyperæmic. The large motor cells of the anterior horns swell up and degenerate, and the degeneration spreads to the anterior nerve-roots, and later to the nerve-trunks. The nervous elements in the part are thus destroyed, and the neuroglia, which is increased in amount, takes their place.

As a result of the destruction of these cells, the muscles, cut off from their trophic centres, also show signs of degeneration; they become flaccid, and atrophy sets in early; if a whole muscle is thus destroyed, it ends by becoming merely a fibrous or fatty mass.

Polio-encephalitis is the result of the same virus, but in this case it is the grey matter of the higher centres that is attacked. The nuclei of the cranial nerves are generally involved, and there may be at the same time a lesion in the cord. The vital centres in the pons and medulla are not implicated.

SYMPTOMS.—

THE ACUTE STAGE.—

The onset is acute, and usually febrile, the fever reaching its height at about the third day. In two or three days the paralysis appears, but even before this there may be signs of irritation of the meninges—cervical rigidity, hyperæsthesia and tenderness of the limbs, with vomiting or even convulsions. The pain in the limbs persists for some weeks, and is increased by movement.

The paralysis is often very extensive at first, sometimes affecting all four limbs. It soon clears up, except in certain limbs or groups of muscles, which remain powerless. This is because, during the acute stage, many cells

not actually destroyed are compressed by the products of the inflammation, and thus temporarily put out of action. As the inflammation subsides, these cells gradually resume their activities. *The residual paralysis* varies greatly in extent; all four limbs may be involved in different degrees, or only one muscle group, or even a single muscle. The lower limbs are more frequently affected than the upper, the anterior tibial group and peronei being most often paralysed, and, next to these in frequency, the quadriceps and glutei. In the arm, the deltoid is the chief sufferer. The paralysis may be symmetrical or asymmetrical. It is more often the latter, e.g., the anterior tibial group may be affected in one leg and the quadriceps in the other. Complete recovery is very rare. As a rule, one attack confers immunity.

LATER STAGE.—

The flaccid muscles soon atrophy. The limb looks fairly normal at first, but soon the wasting becomes apparent. Later, the defective circulation causes it to look cold and blue. *The reflexes* are lost in the affected parts. *Trophic changes* take place in the skin and nails; the growth of bone is arrested, causing shortening of the limb. *Reaction of degeneration* is present. *Deformities* tend to develop in the later stages: they are due to shortening of the healthy antagonists of the paralysed groups, generally assisted by the pull of gravity. For example, talipes equinus results from paralysis of the anterior tibial group alone, while the calf muscles are intact, or flexion deformity of the knee from paralysis of the quadriceps, while the hamstrings are healthy. Scoliosis appears either because one leg is shortened, or one arm powerless, or else because of unilateral paralysis of abdominal or back muscles, or of the psoas.

Treatment

For the purpose of describing the treatment, the course of the disease may be divided into three stages—the acute, the convalescent, and the chronic.

THE ACUTE STAGE

This includes the initial attack, and the period immediately succeeding it, and lasts from four to six weeks. The most important part of the treatment at this time is *rest*, with appropriate medical measures and nursing. Proper precautions have to be taken against infection. As long as the limbs are tender and painful no physical treatment can be given, but appropriate splints should be applied if necessary. These should be as light and simple as possible. At the *end* of this period, however, *massage* should be begun—that is, as soon as the tenderness of the limbs has disappeared.

PHYSICAL TREATMENT.—

MASSAGE should be of the lightest description, and should consist of *effleurage*, very gentle *kneading*, and *frictions* round the joints. It is most important to maintain the circulation in the paralysed muscles, which, cut off from their trophic centres, are unable to obtain a proper blood-supply, and are therefore wasting. If nothing is done to remedy this, they will receive little or no nourishment, waste products will accumulate, and degeneration will be hastened. It cannot be too much emphasized, however, that in any case of flaccid paralysis, especially in the early stages, the massage should be of the gentlest kind, great care being taken not to exert too much pressure on the delicate muscles, which might so easily be bruised or injured. We have also to remember, as Dr. Mennell points out, "how simple it is to overdo massage treatment in these cases. Any excess leads to paralytic dilatation (of vessels), which means that the stagnation of the circulation—already present to some extent as the result of the paralysis—is increased by our manipulations, and thus the very

evil which we are attempting to remedy is actually enhanced."* For the same reason, the treatment should be very short, though, if possible, the patient may be treated twice or even thrice a day.

The Convalescent Stage

This follows on the acute stage, and lasts for about two years. This is the most important time from the point of view of the masseuse. It is the period of recovery, and this can be hastened and made more complete by careful and efficient physical treatment. Our aims, briefly stated, are to prevent the development of contractures and deformity, to check atrophy, and as far as possible to re-educate the patient in the use of the injured muscles, or, in cases where these are damaged beyond recovery, to teach him how best to use his other muscles to make up for their loss.

GENERAL TREATMENT AND SUPPORT OF THE LIMBS.—

Appropriate Splinting is most important for two reasons: firstly, to prevent the shortening of the healthy antagonists of the paralysed muscles, and, secondly, to avoid any stretching of the paralysed muscles themselves—which stretching, if allowed even for a short time, will inevitably retard their recovery, even if it does not injure them permanently. If, for instance, the quadriceps are paralysed, the knee should be kept in extension (not hyper-extension); if the anterior tibial group, the foot should be dorsiflexed to a right angle and inverted. If the extensors of the wrist are affected, a *cock-up splint* is used; if the deltoid, an *abduction splint*. If there is paralysis of back muscles, a *spinal jacket* should be worn. When the child is allowed to walk, and for this purpose wears iron supports or special boots during the day, his splints should be replaced at night.

Splints should be made as light as possible. The heavy wooden back-splints still often used for the legs of infants and little children are quite unsuitable, not only because they hamper the movements of other parts of the body but also because when the child is carried about, it is impossible to prevent the weight from dragging on the muscles of the hip, so that, if paralysed, they are further injured, and if healthy, they are weakened by the stretching. Aluminium splints with appropriate straps are excellent, but expensive. Cheaper splints are made of alloys of aluminium or other metals; these are not much heavier, and are certainly a great improvement on the wooden variety. All splints should be well padded and special care taken to protect bony points. Splint-sores develop very easily on these patients, and, once developed, may be difficult to heal. If a leg splint includes the knee, a small pad should be placed beneath the joint to prevent hyperextension.

Instructions to Parents of Paralysed Children.—When the patient is wearing splints all the time, it is as a rule inadvisable that the parents should take them off between treatments, as splints are so often incorrectly re-applied. If the child is being treated every day, there will probably be no need for removal. It is as well, however, in the case of babies and very young children wearing long leg-splints, that the mother should be taught how to remove and re-apply them in case of need, as should they become damp or soiled, they may cause much discomfort to the child and irritation to his skin, and such accidents may occur at week-ends when the child does not attend the hospital for treatment, or during any temporary absence due to childish ailments. The masseuse in charge of the case should not merely *show* the mother how to put on the splint, but see that she is able to do it, making her apply it several times under supervision. The splints themselves, when

* *Massage: its Principles and Practice.*

used for little children, should be covered with some waterproof material which can be sponged if it becomes soiled, a thick layer of wool being placed between this and the patient's leg, which should be wrapped up warmly. Some extra wool and a spare bandage should be given to the mother. She should also have explained to her how she may assist the treatment by keeping the paralysed limb warm, a long straight knitted stocking, made like a bed-sock, large enough to go over the splint, being the best covering for arm or leg. Cleanliness is also most important; the skin should be washed with warm water, and carefully dried, a good powder being used, especially on the flexor aspects of joints. It should also be impressed upon the mother how much her child's recovery depends upon keeping the limb supported in the correct position when off the splint, and in never allowing the muscles to be stretched for a moment.

Personally, I am convinced that no attempt should be made to teach the mother to massage the limb herself, nor should she be advised to try and do so. I believe this to be most important; massage by the unskilled is not only ineffectual, but may be dangerous. The giving of movements, active or passive, is still more so, save in a few exceptional cases. I have known a case where an enthusiastic father, advised to give 'forced' movements to a case of talipes equino-varus, actually succeeded in producing a fracture; and another where the pain and swelling of a several weeks' old fracture were considerably increased by the 'massage' of the patient's daughter, who had been 'shown how to do it' by the doctor! The danger in cases of flaccid paralysis in its early stages is even greater. It is easy for the trained worker to overdo things—how much more so for the willing but unskilled relative! If she does make a mistake, the trained worker is able to recognize it, and modify or correct her treatment, whereas if the mother is at fault, neither she nor the masseuse may realize what has happened, and the latter will inevitably get the blame if the case does not make satisfactory progress.

PHYSICAL TREATMENT.—

Position of Patient.—The limb may rest on the splint for part of the treatment if convenient. If it is removed from the splint, it must be supported with the paralysed muscles kept short; e.g., the dropped foot must be kept at a right angle.

Massage.—As time passes, the massage may be made more stimulating—that is, the rhythm may be quickened—but it should never at any stage be heavy or forcible. Effleurage and kneading are used for the affected muscles; more stretching manipulations—picking up or frictions—for their antagonists. General nerve vibrations may be given with one or both hands down the course of the limb; hacking should only be given in very slight cases where there is but little atrophy. The treatment must not be too long, especially in small children. Fifteen minutes for massage and movements are enough for them.

Passive Movements.—These may be given from the first, i.e., as soon as they are not painful, in order to prevent contractures and preserve the mobility of the joints. There is no need to move the joint more than once provided the full range of movement in the required direction has been attained. They must be given so as not to stretch the paralysed muscles; e.g., in dropped foot, the ankle must be fully dorsiflexed, but only plantar-flexed to a right angle. If two antagonistic groups are affected, the movement must not be extreme in either direction, e.g., if the anterior tibial group and the peronei are both out of action, the foot should not be carried either into extreme inversion or extreme eversion. In this case, there will be no contracture of muscles, and any ligamentous shortening that may occur must be remedied later if recovery takes place.

In untreated cases, where contractures have already become established, recourse must be had to forced m.vements.

ACTIVE MOVEMENTS: RE-EDUCATION.—This is the most important part of the treatment.

Our *aims* are to induce the partly paralysed muscles to resume work, so that any healthy fibres in them may hypertrophy and in some measure compensate for those whose nerve-supply is lost; and also to strengthen the unaffected muscles, especially those of the same group as the damaged ones, or those which have a similar action. Failing this, we have, as we said above, to teach the patient to do the best he can in the circumstances. It is in cases like this that any 'trick movements which are useful should be deliberately encouraged.

We have to watch carefully for the least sign of returning power, and as soon as a flicker of movement can be discerned in a paralysed muscle, re-education should begin. This is, of course, easier in children who are old enough to understand what is required of them, but even in babies some progress can be made by one who can understand and amuse them.

In the re-education of muscles in poliomyelitis, or indeed in any form of flaccid paralysis, certain *rules* must be observed.

1. *Make sure that the patient knows what is required of him.*—Show him what movement you wish him to try to make by means of a passive movement. If there is a corresponding sound limb, let him make the movement with that first; if there is not, demonstrate on your own limb, or on that of some other person. In babies, the exercises must take the form of play—e.g., the child may be persuaded to try and touch toys or brightly coloured objects, or the operator's finger, with his toes.

2. *The paralysed muscles must never be stretched.*—Movements are therefore given *in the inner range only*. If two opposing groups are paralysed, both sets of movements are given *in middle range*; sometimes it is permissible to indulge in a small degree of favouritism towards the more useful group; e.g., in paralysis of the evertors and invertors of the foot, it is as well to allow inversion to be carried a little further than eversion.

3. *The muscles should be placed in the most favourable position for working.*—In the earliest stages the patient's position should be chosen so that the pull of gravity *assists* the movement. A little later he is so placed that the pull of gravity is *eliminated*. Friction is reduced as much as possible by using a piece of smooth cardboard powdered with French chalk, on which the limb moves easily. Mrs. Guthrie-Smith advocates the use of slings suspended from a beam over the patient's bed for the same purpose.* Later still, gravity is made to act as a *resistance*. (For application of these principles, *see* Chapter XII.)

4. *The movements themselves should be first assisted, then free* (first given as *holdings*, then as ordinary free movements, both with gravity eliminated). Later still, *resisted* movements are added, first given eccentrically against either gravity or the resistance of the operator, and then concentrically as well as eccentrically. Very young children, of course, cannot grasp the idea of eccentric movement.

5. *The patient should never be over-tired.*—He must not be asked to make a movement too many times without resting; massage and movement may be given alternately, or short rests taken between the attempts at movement. A perceptible improvement cannot be expected every day: if on any day there is *less* movement than there was the day before, the patient has probably been overworked, and should have a day or two's rest. When any definite

* Shires and Wood, *Advanced Methods of Massage and Medical Gymnastics*.

improvement does take place, the fact should be pointed out to the patient, if he is old enough to appreciate its significance.

6. *Finally, we must not neglect the healthy muscles of the limb.*—If the anterior tibial group is paralysed, and the patient is splinted, we must remember that other groups, especially the quadriceps, will undergo a certain amount of atrophy from disuse. Massage and movement should also be administered to these. Even the *antagonists* of the paralysed groups need exercise, though they must only be allowed to work *in the outer range.* If the patient has one quite sound leg, it is as well not to neglect this either.

It depends on the individual case how long it is before the child is allowed to walk. Some doctors prefer to keep a child off its feet for eighteen months, some less. In any case, when walking is allowed, if any muscles remain paralysed the patient must be supported by proper apparatus to prevent stretching of these muscles, and should never be allowed to walk without it. The child with paralysed anterior tibial muscles will have the foot so fixed that it cannot be extended beyond a right angle; the one with powerless hip muscles will have a walking caliper. A careful watch should be kept for scoliosis during this stage and the next.

The Whirlpool Bath, when it can be obtained, is excellent for improving the circulation. Ordinary warm baths are also useful, and movements can sometimes be obtained with less effort while the child is in the bath, because of the support afforded by the water to the limb.*

Electrical Treatment may be useful with the older patients, interrupted galvanism or faradism being used according to the needs of the case. We do not personally consider that either form is at all suitable for small children. They are generally frightened and upset by them, and cannot bear enough current to do them any good. In any case, it causes them to associate pain and fear with their treatment, and this, it seems to us, is a fatal thing. The child should *enjoy* his visit to the hospital, or the visit of his masseuse, and only if he does shall we be able to get the maximum of effort from him.

Radiant Heat is useful before massage if the child's limbs are very cold.

Ultra-violet Rays and Artificial Sunlight are sometimes tried.

Much patience and conscientiousness are needed during the long course of this treatment, but we have to remember that the patient's fate is more or less decided during these two years, and on the completeness and care with which the treatment is carried out that fate largely depends. A medical man, lecturing to the Chartered Society once said that the hopeless cripples seen as the result of infantile paralysis are a reproach to our treatment. This seems a harsh judgement, but nevertheless there is some truth in it. We have to see that the defective circulation is maintained as far as possible, so that growth of bone may continue, and the structures of the limb be kept in good condition; and that no preventable deformities occur. We have to develop to the utmost any power of movement that may be left. If, through weariness or lack of interest, we neglect to do any of these things to the utmost of our power, we certainly assume a grave responsibility.

The Chronic Stage

This may be said to begin after two years, or even longer in cases that have received no physical treatment. Any recovery that is possible may now be presumed to have taken place. Muscles which are completely paralysed have become mere fibrous bands, with no response to any form of electric current.

* It must not be forgotten, however, that even while in the bath, the paralysed muscles must not be stretched. Precautions with regard to this are too often neglected.

The principal methods of treatment at this stage include the provision of suitable apparatus for support; operations of various kinds; post-operative physical treatment, re-education in walking, etc.

APPARATUS.—The forms of apparatus worn cannot be described in detail here. In serious cases, where many muscles round the hip are paralysed, the child wears a kind of caliper with a special boot. With this he at first uses crutches, then sticks, and, finally, dispenses with the latter if possible. Meanwhile, he generally continues to receive massage, and is taught the best way to walk; for example, if the abductors of the hip are quite powerless, he is made to use the lateral flexors of the spine to tip the pelvis. Each case has to be carefully studied and treated on its own merits.

SURGICAL TREATMENT.—The operations performed are of many different kinds. They may be briefly summarized: (1) *Operations on tendons*: tenotomy and tendon transference (muscle transplantation). (2) *Operations on bones and joints*: osteotomy and arthrodesis. (3) *Operations on nerves*: nerve anastomosis.

OPERATIONS ON TENDONS.—

Tenotomy is the severing of a tendon, generally by passing a knife beneath the skin, in order to overcome a contracture of the muscle attached to it or of the tendon itself; e.g., tenotomy of the Achilles tendon in talipes equinus. The tendon heals, but the joint having been meanwhile held in the correct position, the contracture is abolished. *Myotomy* means division of a muscle for the same purpose; *fasciotomy* that of deep fascia.

Tendon transference consists of either cutting the tendon of a healthy muscle and attaching it to that of a paralysed one, or of removing a tendon from its attachment to the periosteum of a bone, and inserting it into bone elsewhere. An example of the first method is one of the operations for dropped wrist, when the flexores carpi radialis and ulnaris are transplanted into the tendons of the extensores communis digitorum, indicis, and minimi digiti and the extensors of the thumb. The second method is used when, in the case of paralysed peronei, the tibialis anticus is transferred to the outer border of the foot to act as an evertor. Similarly, the peroneus brevis may be used to replace a lost tibialis anticus; or the biceps and semitendinosus may be inserted into the patella or tibial tubercle to act as extensors of the knee when the quadriceps are paralysed.

OPERATIONS ON BONES AND JOINTS.—

Osteotomy means cutting a wedge from a bone and then closing the incision, so as to alter the line of the bone (*see* p. 224).

Arthrodesis means fixation of a joint. It is used most often for joints of the lower extremity which have become unstable so that the limb will not support the patient, e.g., in cases of flail knee or ankle, talipes valgus, etc. The stabilization of the joint allows the patient to dispense with apparatus. It is brought about by removing the articular cartilage, cutting thin slices from the bones, and fixing them in apposition, so that they knit together. Examples of this operation are Whitman's operation and Robert Jones's operation (*see* pp. 243, 244).

OPERATIONS ON NERVES.—

Nerve anastomosis is a much less common operation than the above. It consists of joining the central end of a severed healthy nerve to the distal end of a cut nerve, the cells of origin of which have been destroyed and which is therefore degenerate; e.g., the spinal accessory nerve, or part of it, is sometimes grafted into the facial nerve in facial paralysis, causing regeneration of the latter. The cerebral cortex appears to adapt itself to the change.

[A most interesting account of all these operations will be found in Tubby's *Deformities*, vol. 2, section 10, chapter ii, p. 626, 2nd edition; and in Jones and Lovett's *Orthopædic Surgery*, chapter xxi, p. 466.]

PRE-OPERATIVE AND POST-OPERATIVE TREATMENT.—This is described in Chapter XVI (TREATMENT OF PARALYTIC FORMS OF TALIPES).

PROGRESSIVE MUSCULAR ATROPHY

(Chronic Anterior Poliomyelitis)

This disease is due to chronic degeneration of the anterior horns of the spinal cord, and is therefore a typical lower motor neuron lesion.

ETIOLOGY.—Men are more frequently attacked than women. The disease is one of middle life. Very little is known of the causes; but cold, damp, chill or mental worry have been suggested as predisposing factors; the actual cause is as yet undiscovered.

PATHOLOGY.—The changes are those of sclerosis (*see* p. 106). The *cells of the anterior horns* degenerate one by one. The degenerative process may spread upwards into the pyramidal tracts (*Fig.* 72). The *muscles*, cut off little by little from their nerve-supply, atrophy, become flaccid, and finally degenerate.

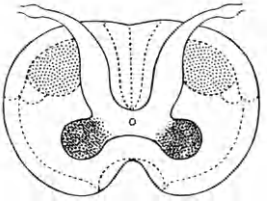

Fig. 72.—Progressive muscular atrophy. The darker shading indicates the parts affected first, the lighter shading those affected later.

SYMPTOMS.—The disease is *progressive and incurable*, though it occasionally becomes arrested at a late stage. It may end by extension of the degenerative process to the medulla, involving the vital centres (bulbar paralysis), or the patient may die of some intercurrent disease.

The first symptom to appear is *atrophy of the small muscles of the hands*, the lumbricales, interossei, and those of the thenar and hypothenar eminences. The patient's hand assumes the claw-like appearance. The atrophy spreads gradually to the forearm and shoulder muscles, and then to those of the back, missing out the upper part of the trapezius. Then, after an interval, often quite a long one, the legs become similarly affected, symptoms arising first in the muscles of the feet, the anterior tibial group, and the peronei. Occasionally the legs suffer first and the arms later. *Interference with respiration* owing to paralysis of the diaphragm and intercostal muscles may lead to a fatal issue. The degenerating muscles exhibit peculiar twitching movements—*'fibrillary twitchings'*. *The reflexes* are gradually lost. There is *partial reaction of degeneration.*

Besides the above, there is another variety of progressive muscular atrophy known as the *peroneal type.* This begins in childhood, in the peronei and foot muscles, and extends from the lower leg to the thigh, of which it generally affects the lower third. Later, it attacks the arms, the muscles becoming involved in the same order as in the adult type. The child may develop talipes equino-varus. This form is hereditary, or at least a family type of affection.

Treatment.—

No cure is to be expected in progressive muscular atrophy, and though a slight improvement may take place in a hitherto untreated case, the patient is bound to go steadily downhill. Very rarely, indeed, the disease does become arrested, but not before much irreparable damage has been done. But undoubtedly its progress is considerably *retarded* by means of physical treatment, and the patient remains much happier if he feels something is being done for him. We cannot work for long among cases of progressive paralysis without realizing that any form of treatment that helps the patient to keep up his courage in the face of so terrible and incurable an illness is abundantly worth while. We have to inspire him to fight every inch of the

ground, even though he knows the battle to be a losing one. From a professional point of view we sometimes feel inclined to be bored with old cases of hemiplegia, or advanced cases of progressive paralysis ; but even if this is so, such an attitude of mind must never be allowed to become apparent to the patient. He needs all the encouragement and sympathy we can give him, and though we should never hold out false hopes impossible of fulfilment, we should be quick to point out any favourable sign. Often the visit of the masseuse is a welcome break in the monotony of a bedridden patient's day, and we should endeavour to make that visit as helpful and inspiriting as possible.

SUPPORT.—The hands are not splinted as a rule, even at night. Provided the joints are kept supple by passive movements, the tendency to contracture of the muscles will disappear as the latter gradually become paralysed. The feet, however, should be supported in dorsiflexion by splints or bed-boots when the patient is in bed, since the calf-muscles retain some power long after the paralysis has spread to the muscles of the thigh, and a talipes equinus will prevent the patient from walking much earlier than would otherwise be the case.

PHYSICAL TREATMENT.—

MASSAGE.—This will be of the type required for all flaccid paralyses—brisk but light effleurage, and kneading. Hacking, useful at the beginning, will have to be discontinued as the atrophy increases. Nerve frictions and pressure vibrations may be tried over the chief nerve-trunks, in which some fibres still survive, and general vibrations given to the whole limb. Spinal nerve pressures and back hacking are recommended by some.

PASSIVE MOVEMENTS.—These are given in the usual way to prevent contractures.

ACTIVE MOVEMENTS.—In the early stages, general exercises, resisted and free, may be given ; leg exercises should not be neglected even when the arms only are affected, or arm movements when the legs are the first to be attacked.

As regards the affected limbs, movements are to be given according to the usual rules (*see* p. 128), except that instead of being made stronger they will have to be modified as time goes on. They may be given free at first, or with slight resistance. *Free* movements, combined with *eccentric* movements, are often best for the patient ; later, his work has to be *assisted.* We have to be careful not to produce fatigue. Hip movements, for instance, when the muscles in this area are seriously weakened, are a terrible effort to the patient, even with gravity eliminated and with assistance from the operator, and he should not be required to do them more than twice each.

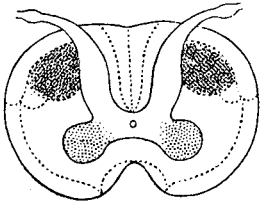

Fig. 73.—Amyotrophic lateral sclerosis. The darker shading indicates the parts affected first, the lighter shading those affected later.

As long as possible the patient should be kept on his feet, and not allowed to become bedridden.

AMYOTROPHIC LATERAL SCLEROSIS

This is really a variety of progressive muscular atrophy, but in this case the degeneration begins in the pyramidal tracts and spreads downwards to the anterior horns and nerve-roots. It begins, therefore, as an *upper motor neuron* disease, and ends as one of the *lower motor neuron.* (*Fig.* 73).

ETIOLOGY.—The cause, like that of progressive muscular atrophy, is unknown. Both men and women are attacked, generally between the ages of 25 and 50. It is neither hereditary nor the result of syphilis.

PATHOLOGICAL CHANGES.—The same as in progressive muscular atrophy.

SYMPTOMS.—The disease begins as a *spastic paralysis* in the fingers and hands and spreads up the arms, the upper extremity assuming an appearance like that seen in hemiplegia. At the same time the muscles of the limb *atrophy* very slowly, as the cells of the anterior horns degenerate one by one. *The reflexes* are, at first, increased, but are gradually lessened, and finally lost. Ultimately, therefore, the *spasticity* disappears, and its place is taken by *flaccidity*, the symptoms due to the lesion of the lower motor neuron masking those caused by that of the upper motor neuron. *Sensory symptoms* are not marked; there may be tingling or numbness of the hands (paræsthesia) but not anæsthesia.

Later, the *legs* are attacked, spastic symptoms appearing first, as the whole of the crossed pyramidal tract becomes involved. The disease spreads into the anterior horn cells of the lumbar enlargement, and atrophy and paralysis follow in the same way as in the arms. The legs, therefore, may be in the spastic stage when weakness and atrophy are well advanced in the arms. *The reflexes* in the legs, as in the arms, are first exaggerated, ankle clonus and Babinski's sign (*see* p. 109) being present, but are finally lost. *The sphincters* are unaffected.

COURSE OF THE DISEASE. — This is shorter than that of progressive muscular atrophy, generally 1 to 3 years.

FINAL SYMPTOMS.—Death is due to *intercurrent disease*, often pneumonia, or *bulbar paralysis*, the disease spreading up into the medulla. The respiratory or cardiac centres may be involved, or swallowing becomes difficult and the patient may choke, this being due to paralysis of the tongue and soft palate. *Speech* becomes indistinct or impossible.

Treatment.—

Little can be done in these cases. *During the spastic stage* massage should be of the same type as that used in hemiplegia, but somewhat more vigorous. Passive and active movements in all directions should be given from the beginning: they entail no risk in this condition and are most necessary in order to counteract as far as possible the advancing atrophy. *When the spastic phase is past*, the treatment is the same as that for progressive muscular atrophy. The onset of bulbar paralysis makes further treatment useless, unless massage increases the comfort of the patient.

CHAPTER X

DISEASES OF THE SENSORY NEURONS

Tabes dorsalis—Syringomyelia.

TABES DORSALIS

(Locomotor Ataxy)

A SLOWLY progressive degeneration of the posterior nerve-roots and ganglia, and the columns of Goll and Burdach (*Fig.* 74).

ETIOLOGY.—The disease is much commoner in men than in women, and generally begins between the ages of 20 and 50. In the vast majority of cases, the disease is a late result of syphilis ; in a few, possibly some other toxin may be at the root of the trouble ; the *exciting cause* may be injury, illness, or exposure to damp or cold.

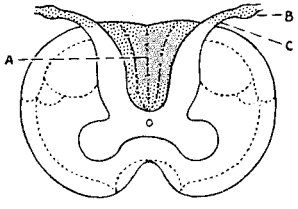

Fig. 74.—Tabes dorsalis. A, Posterior columns (Goll and Burdach) ; B, Ganglion ; C, Posterior nerve-root.

PATHOLOGICAL CHANGES.—The lesion consists of a chronic degeneration of the posterior nerve-roots and ganglia, spreading up the posterior columns. The nerve-fibres are destroyed, and the neuroglia increases. In some cases, the sclerosis may extend to other afferent columns, as the antero-lateral or direct cerebellar tracts. The optic nerve may be involved, and the motor nerves of the eyes also suffer, though it is not clear whether it is their nuclei or motor fibres which are involved, or the *afferent* fibres which are connected with these nuclei, and form the sensory part of the reflex arcs in these regions.

COURSE OF THE DISEASE.—The onset is insidious, and the course very slowly progressive. It may be divided into three periods, each lasting roughly ten years. These merge into each other, and the progress of the disease varies in different patients. Certain special symptoms occur sometimes in one stage, sometimes in another. There is also a more acute form, coming on suddenly. This has the best prognosis. In the usual form, the disease sometimes becomes arrested, but this does not generally occur until a fairly advanced stage. The three stages are known as the *pre-ataxic*, the *ataxic*, and the *paralytic*.

SYMPTOMS.—

PRE-ATAXIC STAGE

As a rule, we shall find the following symptoms :—

LIGHTNING PAINS.—These are often mistaken by the patient for rheumatism. They are felt most in the legs, on one or both sides of the body, and consist of sharp, shooting pains like a knife-stab, at right angles to the axis of the limb. They are due to the irritation of sensory fibres in the posterior roots and ganglia.

GIRDLE SENSATION.—A feeling as of a cord drawn tightly round the body. It may even be so widespread as to feel like a cuirass. It is due to the irritation of sensory fibres in the intercostal nerves at the upper border of the lesion (*see* p. 109).

PARÆSTHESIA (perverted sensation), generally numbness of the soles of the feet.

EYE SYMPTOMS.—The chief of these are :—

Argyll-Robertson Pupil.—This consists of the loss of the pupillary reflex response to *light*, while *accommodation* is not affected. Normally, the iris contracts when light falls on the retina—hence, the pupil grows smaller, and thus the eye is protected against too strong a light. In a dim light the pupil grows larger. (A homely example of this may be obtained by observing the eyes of a cat during the daytime and in the evening.) In accommodation, in looking at a near object the pupil contracts, and in looking at one far off it dilates. The reflex arc controlling these movements consists of cells in the retina, the optic nerve, and the motor oculi. In tabes there is some damage to the arc, probably on its sensory side.

Ptosis, or dropping of the upper eyelid.

Double vision (diplopia) or squint, due to paralysis (or ataxia) of some of the extrinsic eye muscles.

Miosis, or abnormal contraction of the pupils, due to inaction of the dilator muscles of the pupil.

Blindness, from atrophy of the optic nerve.

Both the paræsthesiæ and the eye symptoms may appear either in this stage or the next. If the patient becomes blind, the *ataxia* develops slowly and is rarely complete. Many of the eye symptoms may pass off later on.

ATAXIC STAGE

ATAXIA, or 'pathological inco-ordination', is due in this case to the degeneration of the posterior columns, causing loss of conscious muscle and joint sense, the patient being unable to tell the position of his joints, or to judge of the direction and extent of his movements, without watching them. Loss of *joint sense* is tested by *passive movements*, loss of *muscle sense* by *active movements*, with the eyes open, and with the eyes shut. The ataxia is specially manifested by two signs :—

Romberg's Sign.—The patient cannot stand with his eyes closed and his feet together, but becomes unsteady and falls, since he can control his movements neither by muscle and joint sense, nor by sight.

Ataxic Gait.—The patient lifts the feet too high, throwing them forward with too much force, and stamps them down heavily, heels first. He keeps his feet far apart to widen his base, and tends to fall if he places them too close together. He watches them all the time—often he cannot walk at all in the dark. There is great difficulty in turning round, or in avoiding obstacles. This is, of course, a picture of the typical gait in a *late* stage. If the ataxia is worse in one leg than in the other, if the muscular hypotonia is extreme, or if there is ataxia of the *trunk* muscles as well as of those of the legs, the gait becomes even worse.

HYPOTONIA, OR ATONIA.—There is diminution of the *tone* of the muscles, but not of their *power of contraction*. This may be very marked. The limbs can be placed in all sorts of extraordinary positions. Their increased range of movement exposes the joints to the danger of strains, or even of dislocation. The atonia may also cause the patient to fall suddenly. It is probably due to destruction of fibres destined for the cerebellum in the posterior columns, or to partial involvement of the direct cerebellar tract.

REFLEXES.—These are lost in the affected parts, the afferent part of the arc being broken in the posterior roots and ganglia.

SENSORY CHANGES.—If the *paræsthesia* in the soles has already appeared, it now grows worse, the patient feeling as if he were walking on cotton-wool; finally, it may deepen into *anæsthesia*. The cutaneous anæsthesia, however, is not so marked as the loss of muscle and joint sense. Sometimes the sensation in the legs is *delayed* rather than *lost* (*see* p. 112). Other forms of sensation may be affected at a later stage.

TROPHIC CHANGES are present in skin, nails, bones, and joints. *Perforating ulcer of the foot* is common, and, since it causes little pain, is liable to be neglected by the patient. The bones become brittle, and fractures occur as the result of trivial violence.

Charcot's joints are a common complication. This disease consists of a painless swelling in one or more joints, which become distended with fluid. The articular surfaces are destroyed, new bony tissue forming in the structures round the joints. The ligaments become stretched and lax; hence abnormal mobility develops, and the joint may become completely flail-like.

VISCERAL CRISES.—These are attacks of pain occurring in various organs. They may be *gastric*, with pain and vomiting, *laryngeal*, with paroxysmal cough and dyspnœa, *renal*, *vesical*, etc.

BLADDER DISORDER.—Besides the visceral crises, there is bladder trouble —retention of urine, and imperfect control of the sphincter of the organ.

PARALYTIC STAGE

The patient's symptoms increase to such an extent that he is unable to walk at all, and becomes completely bedridden. The bladder trouble increases, and may result in *cystitis* (inflammation of the bladder), or *kidney disease*. The patient usually dies of this or of some intercurrent disease, often pneumonia.

Treatment

GENERAL AND MEDICAL.—The patient must take gentle exercise with sufficient rest, all strain or over-exertion being carefully avoided. His food should be nutritious. Beyond this, he is given appropriate tonics, and if the Wassermann reaction (the blood test for syphilis) is still positive, suitable treatment for the causative condition. Various drugs are also used for the purpose of arresting sclerosis.

PHYSICAL TREATMENT.—Our primary object is to treat the main symptom—ataxia. We endeavour to re-educate what remains of the patient's muscle sense, or if this has almost ceased to exist, we train him to use the *sense of sight* as in some measure a substitute for it. At the same time, we aim at a general improvement of the patient's health and bodily condition. He must not be allowed to take to his bed, but should be encouraged to continue his ordinary work as long as possible.

METHOD.—It is important that these patients should not be fatigued. It does not do to rely on their *sensations* of fatigue, because these are not normal; they do not know when they are tired. Consequently, frequent rests must be allowed between exercises. If there is any doubt about whether the patient has done as much as he ought, the pulse should be taken; it rises with fatigue.

MASSAGE.—Less valuable than exercises, this is nevertheless useful in improving the general condition of the patient's body, and in minimizing the trophic changes in skin or muscles. It should be of the light stimulating variety. General massage may be given, or at all events legs and back should be treated. Effleurage, kneading, hacking, and clapping may be used for the *limbs*—the clapping should improve the condition of the skin by stimulating

capillary circulation. For the *back* the usual manipulations, effleurage, kneading, and picking up are suitable. Nerve frictions, vibrations, and hacking are recommended by some. If used at all, they should be given gently. For the *abdomen* all movements to help portal circulation and increase peristalsis are useful, especially if the muscles in this region are atonic. Bladder-shaking is said by Arvedson to be beneficial.

If lightning pains or girdle sensation are troublesome, only light stroking and kneading should be administered to the affected parts.

As a rule, the massage is best fitted into the intervals between the exercises, as it affords a rest to the patient.

EXERCISES.—

The patient may be treated simply by Frenkel's exercises, or by a combination of these with Swedish remedial movements. Of the latter, it is best to use mostly free exercises, though, if desired, concentric and eccentric movements may be given, provided that no strong overstretch is ever permitted which, in the atonic condition of the muscles, might injure the joints. *Strong exercises* are not required, since there is no loss of muscle power. The exercises should be done slowly and rhythmically, on the Frenkel plan. In cases where the arms are unaffected, while the legs are ataxic, the Swedish movements may be used for the former, the Frenkel's exercises for the latter. Breathing and trunk exercises may be given in the usual way. (N.B.—Trunk ataxia is uncommon.)

Frenkel's Exercises

These consist of a carefully planned series of exercises which aim at making the patient employ what is left to him of muscle sense. It is hoped in this way to prevent its further decrease, or even effect an improvement. Just as the normal individual may by practice acquire the correct co-ordination for some complex movement, so, Frenkel considered, may the tabetic, in spite of his damaged sensory path, be enabled by constant exercise to use what is left to him in the way of muscular sensation to the fullest advantage in performing the ordinary movements of life. And, in fact, we see this principle illustrated in cases where optic atrophy has supervened early, for in these the ataxia develops slowly and incompletely, since the blind man is *obliged* to depend on his muscle and joint sense, and so uses it to the utmost of his capacity. If, however, the muscle sense is practically non-existent in a patient by the time he comes for treatment, the object of the exercises is to teach him to replace his lost sense by the sense of sight—and this may in some cases be done most successfully, though he will never be able to walk in the dark or stand with his eyes closed. If the cerebellar tract is affected, the result will be far less satisfactory, but fortunately this is rarely the case.

Treatment should be begun as soon as possible, preferably in the pre-ataxic stage, when the patient should perform the most complex movements possible. In the later stages the exercises begin with very simple movements and gradually advance to more complicated ones. Certain rules should be observed in giving these, at whatever stage the patient may be.

RULES FOR GIVING FRENKEL'S EXERCISES.—

1. *Commands* should be given in an even, monotonous, singing voice; the exercises should be done to counting.

2. Each exercise or set of exercises should have been mastered by the patient —that is, he should be able to do it accurately and smoothly—before he is allowed to proceed to a more difficult one. *Precision of performance* must be attained, but at the same time the exercises must be sufficiently varied to prevent boredom.

3. Exercises with strong muscle work should not be given; in progression, the *strength* of the movement should not be increased, but only its *complexity*.

4. Movements in *complete range* are easier than those in *small range*, therefore the former should be given before the latter. But no movement is to be taken beyond its normal limit, because of the hypertonus of muscles and laxity of ligaments; the result of doing so might be a dislocation or the onset of Charcot's disease.

5. The movements should be given first rather *quickly*, then *slower*.

6. The patient should practise movements first with his eyes open, and then with them shut.

7. Each patient should have individual attention, and never be left unattended. If he should fall, besides the danger of fracture, the mental (or psychical) effect may be most serious, the patient's self-confidence being gravely impaired. This may throw him back considerably, and the final result of his treatment may not be as good as it should have been.

8. *Rests* must be given between the exercises; after so many minutes' work, an equal number of minutes' rest should be taken. Half an hour's treatment twice a day is best if exercises alone are used; three-quarters of an hour, or an hour, if massage is interposed between the periods of exercise.

9. It is necessary to take into consideration the patient's general health and mental attitude, the state of his muscles, and any complications such as Charcot's joints.

The exercises themselves are given in *lying*, in *sitting*, or in *standing*.

Exercises in Lying.—The patient lies on a bed, plinth, or couch with a smooth surface along which the feet may move easily. His head is sufficiently raised for him to be able to watch his feet. The exercises in this group are very numerous, beginning with simple movements, and gradually becoming more difficult and complicated.

The first set are as follows: (One leg moved at a time; legs moved alternately):—

1. Flexion of one leg, at hip and knee, foot kept on plinth; extension.
2. Flexion as above; abduction; adduction; extension.
3. Flexion as above, but only half-way; extension.
4. Flexion as above (half-way); abduction; adduction; extension.
5. Flexion (voluntary halt made by patient during flexion); extension.
6. As 5, but halt at operator's command.

The exercises are to be done slowly, three or four times each, and each leg in turn. The foot should be kept dorsiflexed, so as not to stretch the hypotonic anterior tibial group. The operator should count four during each movement.

At a later stage both legs are moved together.

Examples of more difficult exercises in the lying series.—

1. Flexion of one leg in hip and knee, heel raised some inches from the plinth; extension.
2. Heel of one leg placed on patella of other leg; return.
3. As above, with voluntary halt.
4. As above, with halt to command.
5. Heel is placed on the middle of the other tibia, lifted off, and put by side of leg; extension.
6. Heel put on other knee; down on bed at side; leg extended till heel reaches middle of tibia; placed on tibia, then again on bed at side; extended to level of ankle; placed on ankle, then on bed at side; complete extension.
7. Heel placed on knee; heel slides along tibia to ankle-joint; extension.
8. Same as above, but heel carried from ankle back to knee; extension.

9. Flexion and extension of both legs, with heels off bed.

10. As above, with halts.

11. One leg (e.g., left) flexed ; left leg abducted and right leg flexed, simultaneously ; left leg adducted and right leg extended ; left leg extended. (Repeat with legs reversed.)

12. Left leg flexed, right leg abducted and flexed (all at same time) ; right leg adducted ; both legs extended, without heels touching bed till end of movement.

N.B.—These asymmetrical exercises are very difficult to the tabetic.

13. The operator places her finger on various places on the leg ; the patient places his other heel on her finger.

14. As above ; but as the patient reaches the finger, the operator moves it, and the patient tries to follow its course.

15. Right heel is placed on the knee of the other limb, which is in extension ; with right heel in this position, the left leg is flexed and extended.

16. Right heel is placed on left knee, and slides down the tibia to the ankle ; as it slides down, the left leg is flexed ; as it is brought back to the knee, the left leg is extended.

These are only a few examples of the whole series of nearly 100 exercises. Anyone who has to treat cases of tabes should make a point of studying the lists in Frenkel's book,* and indeed the whole book is well worth study. A careful record should be kept of exactly what work the patient is doing from day to day. It is, of course, quite possible to invent other similar exercises if desired.

Exercises in Sitting.—These must not be understood to be necessarily *progressions* on those in lying ; they are considerably easier than some of the more advanced exercises in that series. Those given by Frenkel consist of rising from a stool or chair, and sitting down again. The patient has literally forgotten how to perform these 'stock' movements—he has lost his 'formula' for them. The rising movement, therefore, is divided into its component parts, the operator counting three. At *one*, the patient draws his knees under the stool. At *two*, he bends his trunk forward. At *three*, he rises, extending hips and knees. He then sits down again, reversing the above process.

These movements may be done at first in the reach-grasp position, the patient sitting close to the wall-bars. Later, he rises unsupported. Later still, he attempts to do so with his eyes closed.

Other exercises may be given in sitting.—

1. The patient may be directed to raise his knee and place his foot on, say, the second rail from the bottom. This is done in three movements : (1) Flexion of hip ; (2) Extension of knee ; (3) Lowering of foot on to bar. He then replaces the foot on the ground.

2. He may be made to touch marked points on the floor with his foot. (Frenkel gives this type of exercise in lying ; but it necessitates apparatus in that position.)

Exercises in Standing.—These are the *walking exercises*, and are most valuable. To give them effectively, a large room or gymnasium is necessary ; failing this, a corridor may form a substitute, or a garden path or lawn.

On a mat, or on the floor, lines should be marked out as seen in *Fig. 75*.

1. *Walking sideways.*—The patient, accompanied by the gymnast—who must be prepared to support him if necessary—begins by walking sideways.

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* *Tabetic Ataxia*, trans. Freyberger : Heinemann.

Balance is easier in this way, because, except in the long step, he does not have to rise on the toes of one foot, thus decreasing his base.

He should begin by taking *half-steps*, which are easiest, alternately to left and to right, the operator counting three for each step ; e.g., for half-step to right : (1) *One*, he places the right foot on the ground half a step away. (2) *Two*, he transfers his weight from the left to the right foot. (3) *Three*, he brings the left foot up beside the right one.

He then practises *quarter-steps*, then *long steps*, and finally combines all three lengths in one exercise, e.g. : (*a*) Three-quarter-step to right—one—two—three. (*b*) Quarter-step to left—one—two—three. (*c*) Half-step to right—one—two—three. (*d*) Whole step to left—one—two— three.

The long steps are more difficult because the toes have to be put on the ground first, the heel being raised, and the patient's base therefore smaller.

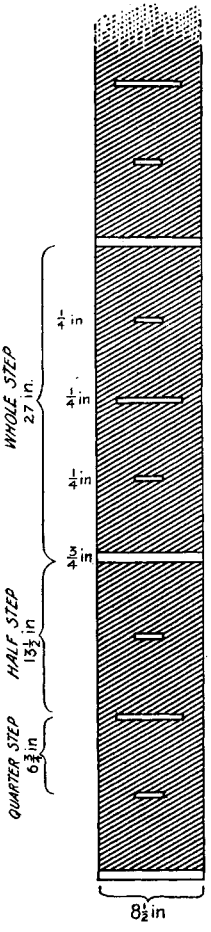

Fig. 75. — Diagram of 'steps' used in treating tabes. (*After Frenkel.*)

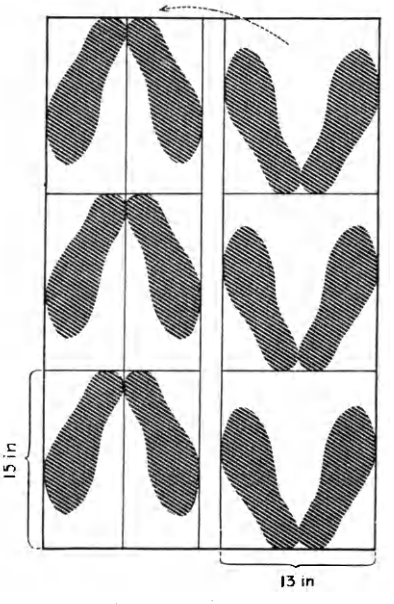

Fig. 76.—'Footsteps' for tabes treatment. (*After Frenkel.*)

2. *Walking forwards.*—Whole, half- and quarter-steps forwards, beginning with each foot alternately, counting three as before ; thus, in beginning with the right foot : (*a*) Place right foot forward, heel on the ground. (*b*) Transfer weight to this foot, raising heel of left foot. (*c*) Bring left foot up beside right foot.

3. *Walking backwards*, in a similar manner.

4. *Walking heel to toe.*

5. *Walking in footsteps* painted on the floor (*Fig.* 76).

6. *Turning round*, also in footmarks on the floor (*Fig.* 77). Practised in three movements ; e.g., turning to right : (*a*) The patient turns on the right heel ; (*b*) He raises the left heel and turns on the toes of this foot ; (*c*) He brings the left foot up beside the right. This may be done four times, completing the full turn, and then repeated to the left.

7. *Walking up and down stairs or steps.*—(*a*) The patient first goes up one step at a time, that is, he places, e.g., his right foot on one step and brings his left up beside it, then places his left foot on the next step and brings his right up to it ; later, he practises walking up the steps as a normal person would. (*b*) He walks up and down, at first holding the rail at the side of the steps ; later, he dispenses with this support.

8. Finally, he is taught to walk while at the same time using his arms, carrying parcels, getting out of the way of obstacles, etc.

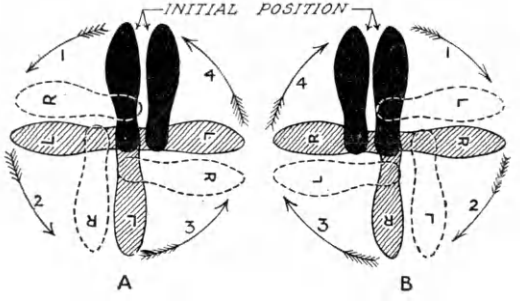

Fig. 77.—'Footmarks' for turning round, in treatment of tabes. **A**, Turning to the left; **B**, Turning to the right. (*After Frenkel.*)

When the Arms are Affected, which is much more rarely the case, exercises of a similar nature are given, special attention being paid to the fine movements of hands and fingers. The patient may be told to place his fingers in holes in a board ; or to insert pegs or matches in such holes ; to pick up small objects like marbles, chessmen, draughts, counters or coins, and arrange them or pile them up on one another ; to stick pins into indicated points on a pincushion. Frenkel describes a piece of apparatus in which a number of balls of different sizes and colour are hung from a bar. The patient swings them and catches them, first the larger, then the smaller ; then two together ; first in the hands, then with the finger tips ; first in his own time, then to command. He may also practise going over diagrams with a pencil, writing, drawing, etc.

The tabetic is generally willing to work hard at his exercises. With patience and perseverance, both on his part and on that of the gymnast, an excellent result can often be obtained. The cases in which the onset was sudden sometimes appear to be completely cured. Even very serious cases can be considerably improved, and patients who have become bedridden can often be got on to their feet again.

In the paralytic stage, only very simple movements, such as Foot-bending and -stretching, can be given, or in some cases the simpler and easier exercises of the series in lying. General massage may be continued if it appears to make the patient more comfortable. Breathing exercises are still valuable.

In the absence of a nurse, the care of the patient's skin becomes in part the responsibility of the masseur or masseuse. It is his or her duty to see that bed-sores are avoided, or properly treated, and to inform the doctor if this matter is not receiving proper care and attention.

SYRINGOMYELIA

This is a rare condition, cases of which occasionally appear in our hospital departments ; it consists of dissociated anæsthesia (*see* p. 112) and paralysis.

ETIOLOGY.—The cause is unknown. It is said to be sometimes due to a congenital defect of development in the spinal cord. Men are more often attacked than women. It generally appears in young people under 30.

PATHOLOGY.—The disease starts as a new growth of connective tissue round the central canal of the cord. This tissue afterwards breaks down, and forms cavities, destroying the structures in the immediate neighbourhood of the canal, and exerting pressure on the regions beyond. The anterior grey commissure is first affected, and this entails destruction of some of the *pain and temperature fibres of the antero-lateral (Gower's) tract* as they cross over to the opposite side soon after entering the cord. Next, the pressure falls on the anterior horns. Later, the sensory and motor tracts are affected, and their fibres degenerate. (*Fig.* 78.)

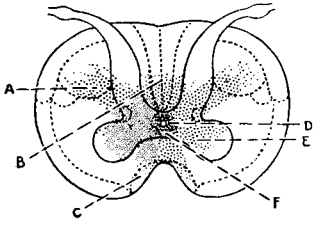

Fig. 78.—Syringomyelia. **A**, Crossed pyramidal tract; **B**, Posterior columns; **C**, Direct pyramidal tract; **D**, Central canal; **E**, Anterior horn; **F**, Anterior grey commissure. The darker shading in the centre indicates the initial lesion, the lighter shading the parts affected later. The former should include a little more of the anterior grey commissure.

The disease generally starts in the cervical or thoracic regions, and spreads upwards or downwards.

SYMPTOMS.—The earliest and most characteristic symptom is *dissociated anæsthesia*, i.e., loss of sensations of *pain and temperature*, but not of the sense of touch or muscle sense in the same areas. The latter sensations are unimpaired because the posterior columns (of Goll and Burdach) are not involved until much later. These patients tend to burn or otherwise injure their hands, where the loss of pain and temperature sense first occurs. Later, it spreads up the arms and to the trunk.

Muscular atrophy and paralysis appear as soon as the anterior horns are subjected to pressure. As in progressive muscular atrophy, they begin in the hands, and spread up the arm and then to the trunk, in the same order as does the anæsthesia. Later, the feet may be similarly affected.

At a still more advanced stage, there may be *loss of sensation to touch*, with *ataxia* (posterior columns), or *spastic paraplegia* of the legs (crossed pyramidal tract), or the disease may spread up to the medulla, producing bulbar paralysis.

Trophic changes—bone or joint changes, similar to those of tabes dorsalis—may appear, and the patients often get whitlows on the fingers—painless, since the sense of pain is lost.

COMPLICATIONS.—Scoliosis or kypho-scoliosis.

Treatment.—

The general health will need attention. Apart from this, treatment is similar to that for progressive muscular atrophy. Later, if ataxia develops, exercises of the Frenkel type may be tried. It is, in fact, as well to begin these before ataxia actually appears, starting with the more complex movements. If spastic paraplegia is the more marked, this must be appropriately treated (*see* HEMIPLEGIA, pp. 118–120 ; and PRIMARY SPASTIC PARAPLEGIA, p. 123).

PRECAUTIONS similar to those required in tabes are necessary when giving movements to joints, great care being taken not to strain any joint or carry any movement beyond its normal limits.

CHAPTER XI

OTHER DISEASES OF THE BRAIN AND SPINAL CORD

Paralysis agitans—Encephalitis lethargica—Cerebellar ataxia—Disseminated sclerosis—Combined sclerosis—Friedreich's disease—Transverse myelitis—Chorea.

PARALYSIS AGITANS

(*Parkinson's Disease—'Shaking Palsy'*)

ETIOLOGY.—This disease is commonest in advanced life, generally appearing after the age of 50 or 60. It attacks men more often than women. The *cause* is unknown; shock, worry, or an accident seem to excite it. It is not hereditary, nor due to syphilis or any other infection.

PATHOLOGICAL CHANGES.—Paralysis agitans is due to a degeneration of the globus pallidus (part of the lenticular nucleus) and of other cells scattered throughout the lenticular and caudate nuclei, the fibres from which descend in the rubrospinal tract (*see Fig.* 62). This part of the nervous system presides over *automatic movements*, as the swing of the arms in walking, and such movements are lost in paralysis agitans. Also, it inhibits the action of certain lower centres in the brain which increase muscle tone, and the loss of this inhibition 'releases' these centres, so that they produce over-tone of muscle, and uncontrolled movements (tremor).

SYMPTOMS.—

TREMOR.—This begins in one hand, and is very characteristic. The fingers are flexed and extended, especially at the metacarpo-phalangeal joints, while the thumb rests against the index finger. This produces the so-called 'pill-rolling' movement. The tremor generally spreads to the leg of the same side, and then to the other arm and leg. The head and trunk are rarely affected. This is not an 'intention' tremor; it is often absent during voluntary movement, but continues when the limb is at rest, especially if unsupported. It ceases during sleep.

WEAKNESS OF MUSCLES AND DIFFUSE RIGIDITY, that is, overtone of all the striated muscles in the body, not only of certain groups as in hemiplegia. This produces a peculiar posture and gait, as well as a characteristic facial expression.

Posture.—The patient bends his body forward from the hips, and stands with hips and knees flexed. The head is also carried forward. The arms are slightly abducted, the elbows standing out from the sides and flexed to a right angle. The wrists are slightly extended, while the fingers are flexed at the metacarpo-phalangeal joints and extended at the interphalangeal.

Gait.—This is what is known as 'festinant' (hurrying). The patient walks with short steps, which tend to get faster and faster. If pushed forward, he will run in that direction; if pulled backward, he will run backward. The automatic swing of the arms is lost.

Facial Expression.—This consists of the 'Parkinsonian mask', the face becoming immobile and expressionless. The blinking reflex occurs less often than usual, hence the patient appears to have a fixed stare.

REFLEXES.—Normal or sometimes increased (*see* pp. 108, 109).

Treatment.—

Although the disease is slowly progressive and incurable, yet physical treatment may retard its course and relieve the symptoms, as well as having a psychical effect. Our *aims* will be to lessen the stiffness of the muscles, and to obtain relaxation as far as possible; to encourage active movement, and to keep the patient on his feet as long as we can.

PHYSICAL TREATMENT.—In order to reduce the rigidity, we shall resort to massage, passive movements, and relaxation exercises. Radiant heat and galvanism may also be tried.

MASSAGE.—General massage should be given if possible, to improve the circulation, as well as to obtain relaxation. It is important that these patients, who are often very sensitive to cold, should be kept warm during treatment, as well as at other times. Cold not only slows the surface circulation but produces contraction of muscle. The massage should, of course, be of the soothing type—effleurage, kneading, and stroking. Deep slow frictions may be given to the joints. *Abdominal massage* is important, since the rigid condition of the abdominal muscles tends to cause constipation (though the intestinal muscles are normal, the sympathetic nervous system not being involved).

PASSIVE MOVEMENTS to all joints induce relaxation, if skilfully performed.

RELAXATION EXERCISES (*see* pp. 195, 200, 201) may also be tried.

ACTIVE EXERCISES.—These may be assisted, free, or resisted, according to the patient's capabilities. Voluntary, controlled movement should be encouraged, because the patient has now to carry out movements which would normally be automatic and controlled by the basal ganglia by means of his cerebral cortex. Success has been claimed by some workers for *Frenkel's exercises*. At all events, the patient should try to practise correct walking and ordinary occupations. The exercises may be arranged in the form of a 'general strengthening' scheme, but frequent rests should be given. Deep breathing should not be neglected.

ENCEPHALITIS LETHARGICA

This terrible disease, so much in evidence of late years, and popularly known as 'sleepy sickness', occurs both in an epidemic and in a sporadic form.

PATHOLOGY.—It consists of an acute inflammation of the connective tissue of the brain, and of degeneration of the nerve cells, especially those of the basal ganglia, and of the cells of origin of the motor nerves of the eyes, which lie in the floor of the aqueduct of Sylvius.

SYMPTOMS.—The illness begins with an acute attack, the first symptoms of which are *fever*, and *paralysis of eye muscles*. Then appear the *lethargy* and drowsiness which have given the disease its name. The patient often remains lethargic all day, but at night becomes restless, or even delirious. At no stage of the disease, however, is there any form of *motor* paralysis, other than that of the ocular muscles, nor is there anæsthesia, nor are the reflexes affected.

In fatal cases, the patient dies from respiratory failure, due to involvement of the vital centres in the medulla oblongata. In a few slight cases he may recover completely, or almost completely: in these cases there has been, of course, little or no destruction of nerve-cells. In most cases *a syndrome develops*

resembling that of paralysis agitans with tremor, athetosis, and the 'Parkinsonian mask' (*see* p. 144), due to injury of the caudate and lenticular nuclei; more rarely *spastic paralysis* or *cerebellar ataxia* (Purves-Stewart), if the cerebrum or cerebellum is injured.

LATE SYMPTOMS.—The after-results of this disease are often tragic. Many patients remain mentally dull, and those who before their illness were quick, clever and efficient are often quite unable to resume their former work, being no longer either physically or mentally equal to it. The patients are slow in all their movements, and react slowly to commands, holding their limbs stiffly. Improvement may follow, but more often the reverse is the case, and even in the event of an apparently complete recovery, a relapse is liable to take place during the two or three years after the illness.

In children, symptoms such as *hemiplegia* or *diplegia*, *tremor*, *athetosis*, etc., may persist, and respiration may be affected, the child breathing through his mouth, which remains open, giving him an imbecile expression. Worst of all, there may be a *complete alteration in the child's character*, the truthful, obedient and well-behaved child becoming insubordinate, untruthful, quarrelsome, lazy, and dishonest. He is not, of course, responsible for his actions, any more than are some of the unfortunate adult victims of the disease, who afterwards fall into crime.

Treatment.—

With the treatment of mental cases we have no concern. Experiments have been made lately with certain drugs, the administration of which seems to produce an improvement in the behaviour of children thus afflicted, at all events for as long as they remain under this treatment. It is with the physical condition of the patients that we are called upon to deal; and we can hardly say that the proper treatment has yet been discovered. Our *aims* are to obtain relaxation, since the patient suffers from a diffuse rigidity like that of paralysis agitans; and later to quicken his response to stimulus.

PHYSICAL TREATMENT.—As far as our present experience goes, *soothing massage*, especially kneading, and *slow rhythmic passive movements* constantly repeated seem to have the best result. These are followed by *breathing exercises*, and *active exercises*, easy at first, and gradually increased in strength if the patient improves. *Relaxation exercises* have also been tried with a certain measure of success, and *rhythmic exercises* with pendulum movement should be useful.

CEREBELLAR ATAXIA

A congenital or acquired deficiency or disease of the cerebellum, causing defective synergic control of the muscles. This is a rare disease, and a medical gymnast may easily pass her career without coming across a case of it—though, of course, the cerebellum or its afferent or efferent tracts may be involved in multiple lesions such as disseminated sclerosis, or in extensive degenerations, such as Friedreich's disease.

SYMPTOMS.—The effects of a cerebellar lesion are *loss of the postural tone of muscles* (*see* p. 263), the patient being unable to stand steadily, and *asynergia* —lack of co-ordination and harmonious action of muscles in complex movements. These two defects of control are manifested by the following symptoms.

THE CEREBELLAR GAIT.—A reeling, lurching mode of progression. This varies according to the actual site of the lesion in the cerebellum, but in any case it consists of a lack of co-ordination of the movements of the limbs and trunk. Most often the trunk is held rigidly, while the legs appear to run away from it, this being because the trunk muscles cannot adapt themselves quickly

enough to the changes of position of the body brought about by the movements of the limbs. Therefore the patient staggers and sometimes falls to one side or the other, or even backwards. In other cases, the trunk may be the first part to move, and the legs be unable to respond in time, so that the trunk falls forwards, backwards, or to the side whenever the patient attempts to walk. So marked is the reeling and staggering that the unfortunate sufferer is not infrequently thought to be in a state of intoxication, which impression is confirmed by his indistinct or incoherent speech. He finds great difficulty in turning round.

DISSOCIATION OF NORMALLY COMBINED MOVEMENTS.—He breaks up movements into their component parts, instead of performing these simultaneously; for instance, if told to raise his leg (in the lying or standing position) he will first flex the hip and then extend the knee, instead of holding the knee in extension while the hip is being flexed.

DYSMETRIA.—An incorrect estimation of how much a muscle should be contracted in order to perform any particular movement; for instance, if asked to drink a glass of water, the patient will probably over-contract the arm muscles and throw the water over his shoulder or into his own face.

The 'heel-to-knee' test may be used in this condition as well as in lesions of the posterior columns. The patient is asked to put the heel of one foot on the patella of the other leg. He is as unsuccessful in doing so as is the tabetic, though for a different reason. Symptoms of inco-ordination may appear in various special groups of muscles.

INTENTION TREMOR of head, neck, and limbs; NYSTAGMUS (*see* p. 148); SCANNING (*staccato*), EXPLOSIVE, OR SLURRING SPEECH.—These three, which form the 'diagnostic symptoms' of disseminated sclerosis, are also present in cerebellar ataxia. In the former case they are probably due to some of the multiple lesions being situated in the cerebellum (*see* p. 108).

THE REFLEXES are normal, the reflex arc and the pyramidal pathway being intact; but the *knee-jerk* is peculiar, a swinging movement being produced in response to the stimulus instead of a single twitch ('pendular knee-jerk').

THE MENTAL CONDITION is normal.

Similar symptoms would be produced by the destruction of *tracts* to and from the cerebellum.

Treatment.—

All we are able to do is to try and teach the patient to co-ordinate his movements, replacing as far as is possible the lost involuntary control by voluntary control, brought about by means of the higher centres in the cerebrum. For this purpose we may make use of Frenkel's exercises, though we shall not find such a valuable auxiliary in the sense of sight as we do in the tabetic, since cerebellar ataxia is as bad with the eyes open as when they are shut. However, the same type of exercises is suitable, and the same rules should be observed. The patient should also be given exercises in which first two, and then more, joints have to be moved simultaneously, or one has to be moved and another held in some particular position—e.g., Lying or standing Leg-lifting (flexion of hip with static extension of knee); Reach-grasp-standing placing the knee on a stool in front (flexion of hip and knee); Bend-sitting (or half-lying) Arm-stretching upward (abduction of shoulder, extension of elbow, elevation of shoulder girdle, etc.—an advanced exercise).

The condition is a discouraging one to treat, but occasionally a marked improvement can be noted, and the lesion is at least not progressive. (*See also* treatment of TABES DORSALIS, pp. 136–141.)

DISSEMINATED SCLEROSIS

The bacteria or toxins which cause this disease are unlike those of most other nervous maladies, in that they are not *selective* in their action ; that is, they do not attack some one definite part of the nervous system, e.g., the anterior horns of the spinal cord, as do those of acute anterior poliomyelitis, or the posterior nerve-roots, ganglia, and columns as does the *Spirochæta pallida* in tabes. In disseminated sclerosis, as the name implies, the lesions are *multiple* ; there are scattered patches of sclerosis found throughout the nervous system—in the spinal cord, in the brain, or in both. Grey and white matter may both be involved, though the latter is generally affected first.

ETIOLOGY.—The disease generally begins in young adults. Both sexes are affected, but women much more often than men, in the proportion of 5 to 3. The patients are otherwise healthy.

CAUSE.—This is unknown. It is most probably due to a toxin circulating in the blood, but the germ producing this toxin has not yet been identified. An attack may follow an injury, a period of mental worry, one of the specific fevers—measles, typhoid, or scarlet fever—or a severe shock, such as a railway accident. Many cases were reported after air raids during the war. These occurrences were not the cause of the disease, but only precipitated an attack in a patient already having the poison latent within his or her system. Syphilis is not a factor.

PATHOLOGICAL CHANGES.—The condition begins with small patches of inflammation scattered about in various parts of the nervous system, generally appearing first in the spinal cord. Later, these inflamed patches degenerate and become hardened. Almost any part of the nervous system may be affected—cerebrum, cerebellum, medulla, cord, etc., but the vital centres are not attacked.

THE COURSE OF THE DISEASE is long and slow, spread over many years. In most cases there are a series of attacks, slight at first, with fairly long intervals between. Each attack is a little worse than the one before, and the intervals or 'remissions' grow gradually shorter. Diagnosis is difficult at the beginning, because the symptoms are so transient. The earlier attacks often seem to clear up completely, though there are often some slight after-effects unnoticed even by the patient. Only a very small percentage of patients grow steadily worse, without these remissions.

SYMPTOMS.—

EARLY STAGE.—

Spinal symptoms usually occur first, the lower extremities being affected. The patient suffers from slight spasticity and weakness of the legs ; she feels fatigue when walking, and perhaps begins to drag one leg a little.

Eye symptoms often appear. These are due to the disease having affected the nuclei of the optic nerve or of the motor nerves of the eyes. There is blurred vision, which later clears up completely or almost completely. There may also be diplopia (double vision).

Sphincter trouble may cause a temporary loss of control of the bladder or rectum.

One or both arms may also give trouble. They become clumsy and of little use, the finer movements of the fingers and hand being most affected.

All these symptoms tend to pass off.

LATER SYMPTOMS.—

Definite spasticity develops, generally worse in one leg than in the other. The leg is held stiffly in *extension* as in a case of hemiplegia or paraplegia. In the later stages of the disease, when the brain is practically cut off from the

spinal cord, the reflex arc takes command entirely. The strongest reflex in the leg is that of the *flexors*, because this is the protective reflex by which the limb would be withdrawn from anything painful or dangerous; therefore in the later stage there is *paraplegia in flexion*, the patient having both legs drawn up, flexed at hips and knees. Owing to this position, *contractures* form, the muscles degenerate, and the position becomes fixed.

Ataxia is sometimes combined with spasticity, or it may be the more marked symptom of the two.

The gait may be spastic, i.e., like that of hemiplegia, or that of paraplegia (scissor gait); or ataxic, i.e., unsteady and reeling, like that of tabes or cerebellar ataxia; or it may be a combination of both.

The reflexes are generally exaggerated, ankle clonus and Babinski's sign being present (*see* p. 109).

At this stage appear what are known as the three diagnostic symptoms: (1) *Nystagmus*, which consists of an oscillation of the eyeballs when the patient looks sideways. It may be seen if she is asked to follow with her eyes the operator's finger, which is carried slowly to the right or to the left. (2) *Intention tremor*. When the limb is kept at rest, no tremor occurs, but if the patient starts to perform a definite movement, the tremor begins, getting worse as the movement continues. It is tested by asking the patient to touch her nose with her finger ('finger-to-nose test'). Similar tests have been devised for the lower extremity. It may be worse in one leg or arm than in the other. (3) *Scanning or staccato speech.* The patient pronounces every syllable of every word separately. These three symptoms are all probably due to lesions in the cerebellum, or in the tracts leading to or from it. They are manifestations of loss of co-ordination and control in the eye muscles, limb muscles, or muscles of articulation.

Sensory changes are slight or absent.

Mental or temperamental changes occur. There is no question of insanity, but in the later stages the patient becomes emotional. She is rarely depressed, but is prone to laugh and giggle, and is amused at trifles, or at things that are not really amusing.

Trophic changes are not marked. The skin sometimes becomes dry. Bed-sores, or the tendency to them, may form a complication in the later stages.

Treatment.—

These patients need gentle exercise, *which should, on no account, be carried to the point of fatigue* It is most necessary that they should continue to walk and get about as long as possible, so as to prolong their active life to its fullest extent, but the exercise should be in proportion to their strength.

PHYSICAL TREATMENT.—

MASSAGE.—*General massage* should be given, if possible. If there is much spasticity, it should be of the same type as that used for hemiplegia, slow, rhythmic, and fairly deep; if the ataxia predominates, it may be somewhat brisker in character.

Abdominal massage is important, as a patient unable to take proper exercise always tends to suffer from constipation.

PASSIVE MOVEMENTS should be given for the spastic type of case. They are always necessary, but are specially indicated in the late stages where paraplegia in flexion tends to occur, appropriate splints being also used to prevent contractures. (But *see* p. 149.)

EXERCISES.—In cases where the ataxia is marked, nothing can be better than *exercises of the Frenkel type* (*see* pp. 137–141).

Breathing exercises may be given, and light trunk exercises, such as back-raisings, trunk-rotations (free), and abdominal contractions ; also arm exercises, either ordinary free exercises (not too hard) if the patient has no arm symptoms, or Frenkel's exercises for the upper extremity if such symptoms have appeared.

When treating definitely spastic cases, we should, though not omitting the co-ordination exercises, since some degree of ataxia is always present, add such as would be suitable for hemiplegia or paraplegia (*see* pp. 119, 120). Arm exercises (including pulley exercises) may be given, and trunk and breathing exercises as above.

In cases at a late stage, which have become bedridden, only very simple movements should be given, e.g., Foot-bending and -stretching, and Forearm-flexion and -extension. Later still, leg movements may have to be discontinued altogether, as the least touch or attempt at movement brings on the flexion spasm. Massage should be continued and breathing exercises given as long as the patient derives any benefit from them, i.e., until increasing weakness makes further treatment useless. If no nurse is in attendance, the masseuse is responsible for the care of the patient's skin, and must do all in her power to prevent the occurrence of bed-sores.

COMBINED SCLEROSIS

(*Postero-lateral Sclerosis. Ataxic Paraplegia*)

An affection of the posterior and lateral columns of the white matter of the spinal cord.

ETIOLOGY.—The disease is one of middle age, and more common in men than in women. *The cause* is unknown : it sometimes occurs in connection with pernicious anæmia.

PATHOLOGY.—There is degeneration of the lateral columns, including the crossed pyramidal tract, the direct cerebellar and antero-lateral tracts. Symptoms due to the lesion of the pyramidal tract predominate. There is also sclerosis of the columns of Goll and Burdach, but the posterior nerve-roots are not affected, so that the reflex arc is not broken (*Fig.* 79).

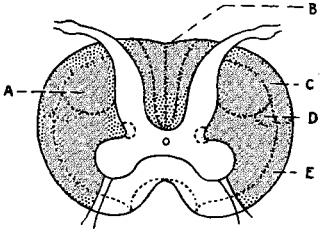

Fig. 79.—Combined sclerosis. **A**, Crossed pyramidal tract ; **B**, Posterior columns (Goll and Burdach) ; **C**, Direct cerebellar tract ; **D**, Rubrospinal tract ; **E**, Antero-lateral tract.

SYMPTOMS.—These resemble the early symptoms of disseminated sclerosis. The *onset* is insidious. There are *weakness and spasticity* of the legs (due to the pyramidal lesion). There is also *ataxia*, from the involvement of the posterior columns and cerebellar tract. *Gait* is unsteady. *Reflexes* are exaggerated ; ankle clonus and Babinski's sign are present (lesion of pyramidal tract). As in disseminated sclerosis, in the later stages the spasticity becomes much more marked than the ataxia. There is *no anæsthesia*.

Treatment.—

Combined sclerosis is so similar in its main symptoms to some cases of disseminated sclerosis that a similar form of treatment may be given (*see* pp. 136–141 and 146, for treatment of ataxia, and pp. 119, 120 for treatment of spastic paralysis).

FRIEDREICH'S DISEASE

ETIOLOGY.—A *family* disease, affecting both males and females of the same family. The *cause* is unknown; it is uncertain whether or not the malady is hereditary. It generally begins in childhood, but may appear later, in early or late adolescence.

PATHOLOGY.—The changes are those of chronic degeneration, or sclerosis, involving both posterior and lateral columns of the cord. The columns of Goll and Burdach, the direct cerebellar tract, the antero-lateral (Gower's) tract, and part of the crossed pyramidal tract are implicated. Of the grey matter, Clarke's column and some of the cranial nuclei suffer. The posterior nerve-roots are also affected, though, as a rule, some of their fibres escape. (*Fig.* 80.)

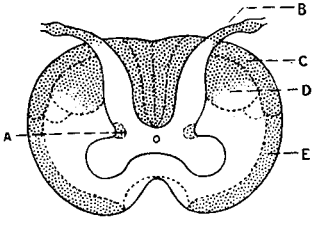

Fig. 80.—Friedreich's disease. A, Clarke's column; B, Posterior nerve-root; C, Direct cerebellar tract; D, Crossed pyramidal tract; E, Antero-lateral tract.

SYMPTOMS.—It is difficult, in so extensive a lesion as this, to work out the exact symptoms likely to be present. As a matter of fact, those produced by the destruction of the pathways to the cerebellum seem to predominate. We therefore find an ataxia of more or less cerebellar type. The principal symptoms are :—

ATAXIA.—In an advanced case, there is a *jerky kind of inco-ordination*, with a *reeling, staggering gait*, resembling that of cerebellar ataxia. The inco-ordination spreads to the arms at a later stage.

NYSTAGMUS, and tremor of the head and neck.

SPEECH is *hesitant* or *staccato*. It has been described as being of the 'hot-potato type'.

The above three symptoms are all probably due, in the main, to cerebellar defect (*see* pp. 108, 148).

REFLEXES.—The knee-jerk is lost. The extensor form of the plantar reflex (Babinski's sign) is, however, sometimes found.

SENSORY CHANGES are slight as a rule. There is sometimes paræsthesia, but rarely anæsthesia.

COMPLICATIONS.—Various deformities are liable to develop, especially scoliosis or kypho-scoliosis, talipes equinus or equino-varus, pes cavus, or a combination of the two last.

COURSE AND PROGNOSIS.—The malady is progressive and incurable, and runs a long, slow course. It is not fatal, and the patient dies of some intercurrent disease.

Treatment.—

Treatment is unfortunately not very effective, since the disease is bound to advance. A certain temporary improvement seems sometimes to take place in these patients, especially when they first start treatment. It may be due to physical or to psychical causes, but in any case it is worth having.

As in all incurable progressive nervous diseases, we are really only concerned with treating the symptoms, and with the improvement of the patient's general health. Our chief aims, therefore, are : (1) To deal with the ataxia as far as is possible by co-ordination exercises. (2) In case of any spasticity or stiffness, to obtain relaxation of the muscles. (3) To take all possible precautions against the development of spinal or foot deformities. (4) To increase the patient's comfort, and keep his general health at as high a level as possible.

PHYSICAL TREATMENT.—

MASSAGE of the limbs, of the rhythmic type, should be given throughout. As in all paralytic cases, the patient should be made comfortable and kept warm.

FRENKEL'S EXERCISES, or movements of a similar nature, may be tried for the sake of improving co-ordination, and maintaining—or regaining—some measure of control of muscle (*see* pp. 137–141). Movements of the head and neck must not be forgotten.

PASSIVE MOVEMENTS, taken to the normal limit, but not beyond, may be given to prevent contractures, especially in the feet.

RHYTHMIC MOVEMENTS AND RELAXATION EXERCISES for trunk and limbs should be included, to counteract any rigidity of muscle that may be present, as well as to prevent loss of mobility, and fixation in a position of deformity. Free rhythmic trunk-rotations, trunk-rollings, head-rollings and -rotations, alternate side-bendings of head and trunk are all suitable, with swinging arm movements, leg-swinging, etc. All these exercises may be done in sitting, except the last, for which the patient may stand between and grasp two chair-backs. The true relaxation exercises, head- and trunk-rollings, etc., should not be omitted.

BREATHING EXERCISES should also be included—to obtain relaxation, preserve the mobility of the thorax, and promote metabolism by increasing the interchange of gases in the lungs.

All possible care should be taken to prevent the development of deformities, which unfortunately tend to occur in spite of all precautions against them. The talipes is not as a rule treated by surgical methods, since the progressive nature of the disease renders any improvement so attained merely temporary.

TRANSVERSE MYELITIS

This disease consists of an acute inflammation of the spinal cord, involving either the grey matter alone, or both grey and white matter.

ETIOLOGY.—It is commoner in men than in women. People of any age may be attacked. *Causes* are many and varied. It is a bacterial or toxic condition, following various acute infections. Injury of the spine, or severe chill, may be the exciting cause. Syphilis is sometimes a factor.

PATHOLOGY.—The changes in the cord are those of acute inflammation.

SYMPTOMS.—*The onset is generally sudden*, the patient's temperature rising very high. This is soon followed by the development of *paralysis and anæsthesia.* The exact symptoms depend on the level of the lesion of the cord. The lower part of the thoracic region is generally the seat of the trouble.

The table on p. 152 shows the chief typical symptoms due to lesions in the cervical, lower thoracic, or lumbar regions, if the whole cord has been involved at one of these levels (*see also* Chapter VIII). We have to realize that if the lesion involves both grey and white matter in the cervical enlargement, the paralysis of the arms will be *flaccid*, that is, of the lower motor neuron type, because the anterior horn cells, the fibres of which are destined for the brachial plexus, have been destroyed; while that of the legs will be *spastic*, because the pyramidal tracts are interrupted, though the anterior horn cells of the lumbar and sacral plexuses are intact.

PROGNOSIS.—Lesions in the cervical region generally prove fatal, because the involvement of the phrenic nerves causes paralysis of the diaphragm. Cystitis (inflammation of the bladder) and nephritis may complicate the case, and ultimately cause death. Recovery, if it occurs, is seldom complete. The anæsthesia clears up first, and the paralysis after a time, to a greater or less degree.

TABLE TO SHOW THE CHIEF TYPICAL SYMPTOMS IN TRANSVERSE MYELITIS.

	CERVICAL ENLARGEMENT	LOWER THORACIC REGION	LUMBAR ENLARGEMENT
ARMS	1. Flaccid paralysis of arms 2. Atrophy and other trophic changes 3. Reflexes lost 4. Complete anæsthesia	Normal	Normal
TRUNK	Possible involvement of phrenic nerve; if so, fatal result	1. Probably girdle sensation corresponding to upper limit of lesion 2. Otherwise normal, or little affected	Normal
LEGS	1. Spastic paraplegia, with contractures 2. Trophic changes due to sensory loss. Bed-sores 3. Reflexes exaggerated; clonus and Babinski's sign 4. Complete anæsthesia	As in cervical lesion	1. Flaccid paralysis 2. Atrophy of muscles, and other trophic changes. Bed-sores 3. Reflexes lost 4. Complete anæsthesia
SPHINCTERS	1. Bladder. Retention, due to spasticity; later incontinence 2. Rectum. Constipation, later incontinence	As in cervical lesion	Bladder and rectum: Complete incontinence due to involvement of their centres in cord

Treatment.—

PHYSICAL TREATMENT.—No physical treatment can, of course, be undertaken until the acute stage is past. In the convalescent stage :—

MASSAGE AND MOVEMENTS.—These will be according to the kind of paralysis present.

Flaccid cases need the light brisk type suitable for all paralyses of this class. The re-education will also proceed on a similar plan (*see* p. 128). Passive movements will be required for all joints of the affected limbs, and splints or other suitable supports must be used to prevent contractures due to the pull of gravity, e.g., foot-drop. Other muscular contractures are unlikely to occur in complete lesions, as there are no healthy muscles in these cases.

Spastic cases, commoner than the flaccid ones because the disease so often attacks the cord in the lower thoracic region, are more difficult to treat because of the intense spasm which is sometimes brought on by the merest touch. They are dealt with in the same way as the cases of primary spastic paraplegia (*see* p. 123, and also pp. 119–120, HEMIPLEGIA).

Incomplete lesions have to be treated according to the symptoms they produce.

CHOREA

(St. Vitus's Dance)

A disease generally occurring in children, the most characteristic symptom being that of involuntary spasmodic movements.

ETIOLOGY.—Chorea occurs most often in children between the ages of five and ten, though occasionally cases are seen among adolescents. It is much

commoner in girls than in boys, and the children are generally of an excitable or nervous temperament. The disease also occurs in young girls during pregnancy, but most often where a state of emotional instability exists.

CAUSES.—Chorea is no longer regarded as a *pure neurosis*, though there may be a family or personal history of neurosis of some kind, and a 'nervous' cause seems to predispose to the affection. There is almost invariably some connection with *acute rheumatism*, either in the child herself or in her family. So constant is this factor in the history of the disease that it is now generally considered that the actual cause of chorea is a toxin of rheumatic origin, though in a few cases other toxins may lead to it. *The exciting cause* may be shock, fright, overstrain, or overwork.

PATHOLOGICAL CHANGES.—There is undoubtedly an irritation or diffuse inflammation of the cerebral cortex due to inflammatory changes in the meninges. The basal ganglia are also affected. Endocarditis (*see* Chapter XIX), due to the rheumatic toxin, is sometimes present; this may lead to valvular disease of the heart, generally of the mitral valve.

SYMPTOMS.—

INABILITY TO CONCENTRATE.—An attack often begins by the child's showing an inability to concentrate on her school work. She is fidgety, irritable, and difficult. Possibly she becomes 'nervy' and emotional, and a sudden outburst of tears in class for little or no reason sometimes leads to her first visit to the doctor. She is quite unfit for school work for the time being, but no permanent mental trouble need be feared.

LOSS OF CO-ORDINATION.—The patient becomes awkward in performing fine movements. The gait may be unsteady, if the inco-ordination extends to the trunk or leg muscles. The respiration may be affected, through failure of co-ordination among the respiratory muscles; the articulation may become jerky. The swing of the arms in walking is lost, as in paralysis agitans.

INVOLUNTARY MOVEMENTS.—These are jerky, purposeless, and irregular, affecting one or both sides of the body, or being more marked on one side than on the other. Most frequent in the arms and the face, they may also appear in the legs and trunk, and sometimes affect the tongue and soft palate as well. They increase when the child is excited or nervous, as when she is conscious of being watched, or when she attempts to perform specialized movements. They cease during sleep. They do not cause fatigue.

MUSCULAR PAINS, probably of rheumatic origin, may be present before the attack. *Muscular weakness*, with hypotonia, occurs later.

HEART SYMPTOMS.—The pulse is quick and irregular, and there may be other symptoms of valvular disease.

There are no *sensory changes*. *Reflexes* are normal.

COURSE AND PROGNOSIS.—The patient recovers gradually in a few weeks or two or three months. The prognosis is good, but other attacks may occur later.

Treatment.—

GENERAL TREATMENT.—The patient must be kept in bed in the early stages, away from other patients or children. Good food, avoidance of all excitement, and prevention of constipation are all important.

PHYSICAL TREATMENT.—

EARLY STAGE: PATIENT IN BED

MASSAGE.—Soothing stroking and rhythmic kneading may be tried in order to reduce the spasm. Treatment may be given twice a day, but each séance should not last more than a few minutes.

EXERCISES.—As the patient improves, exercises for (*a*) control of movement and (*b*) co-ordination of movement are added.

Breathing Exercises.—The child should be taught to breathe slowly and deeply, in order to regain control of the intercostals and diaphragm. Both the diaphragmatic and costal types of breathing should be practised.

Extremity Exercises.—The child should practise keeping still—for a short time at first—that is, a few seconds only. Later, the length of time may be increased; but it must be borne in mind that it is not natural for any small child to remain motionless for long!

Arm Exercises.—The larger movements should be attempted before the finer ones, as requiring less co-ordination. Movements of the shoulder and elbow come first, e.g., Forearm-bending and -stretching and Arm-raising sideways to the horizontal; pronation and supination and wrist movements are next added; finger movements last of all. The patient should try to make them slowly and rhythmically, without jerking.

If a jerk occurs during a movement, the movement must be begun again, but no exercise should be given more than three to four times running in the early stage, or more than six to eight times in any case. It is most important that these patients should not be overtired.

Exercises should be given first *for one arm at a time*, e.g., Half-lying Forearm-bending and -stretching; then for *both arms together*; then the movement may be made *asymmetrical*, one forearm being flexed while the other is extended. The patient should not at first be required to fix her attention on more than one simple movement at a time. Later she may attempt more complicated exercises, as 2-Arm-bending and -stretching upward (or outward), where movement takes place in elbow and radio-ulnar joints, as well as in those of the shoulder girdle.

The exercises should be done *slowly, to counting*; generally four may be counted for the larger movements, three or even two for the smaller ones (such as wrist movements, pronation and supination, etc.).

While the patient is learning to perform the easier exercises with increased steadiness, the *finger movements* may be added, first simply in the form of Finger-bending and -stretching. Later hand and finger exercises may be given on Frenkel's system (*see* p. 141). She should also be encouraged (between treatments) to play games which need a steady hand, such as building houses with bricks, draughts, etc. These should not be indulged in for too long a time, however, nor should they entail too difficult work. The erection of 'card houses' is best deferred till recovery is complete!

Leg Exercises.—These should be given in the same way, if there is spasm of the lower extremities. Frenkel's exercises, first for one leg, then both, first symmetrically, then asymmetrically, may be used.

Head Exercises.—Head-rotation, -side-bending, and -extension should all be practised in the same way.

LATER STAGE: PATIENT UP

MASSAGE is now omitted from the patient's table.

EXERCISES.—The exercises are continued, and *balance exercises* added, progressively more and more difficult, in order still further to improve co-ordination. Such movements as the following are examples:—

Leg Exercises.—

1. Wing-stride-standing Heel-raising and -lowering.
2. As No. 1, successively in standing and close-standing.
3. Heel-raising and knee-bending, successively in reach-grasp-standing, back-lean-standing, wing-, neck-rest-, and stretch-standing.

4. Wing-standing Foot-placing forwards, sideways, and backwards. The patient's foot is placed on the toe in front of her, being moved to this position slowly while the operator counts three. It is then brought back beside the other foot in the same manner. It is then similarly placed sideways, and backwards.

5. Wing-toe-support-standing-forwards Leg-raising and -lowering. The foot is placed forward on the toe ; then raised with straight knee, and again lowered.

6. Wing-standing Leg-raising backwards and -lowering. The patient may bend the trunk forward from the hips when the leg is raised backward, raising the trunk when the leg is lowered.

7. Wing-standing Alternate knee-upbending (slowly).

8. Cock-step.

9. Wing-stride-toe-standing Alternate knee-bending (to the side). The patient carries her body to the left, bending the left knee ; then to the right, bending the right knee (*Fig.* 81). She must straighten both knees as she changes from left to right.

10. Free-standing Leg-carrying in circles.

11. Balance-walking along a line on the ground.

12. Balance-walking on the boom. The boom must never be placed high for these patients.

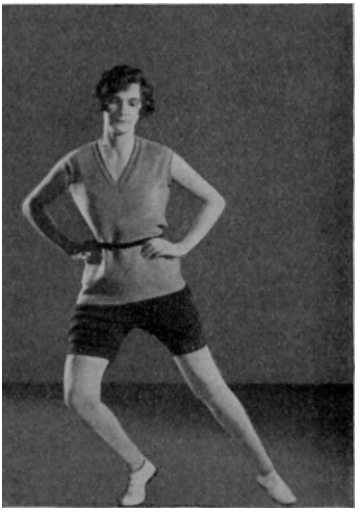

Fig. 81. — Wing-stride-toe-standing Alternate knee-bending (to the side).

Arm Exercises.—

1. Standing 2-Arm-bending and -stretching + Hand-opening and -closing.

2. 2-Arm-circling, successively in stride-standing, standing, close-standing, toe-standing.

3. Standing, or sitting, 2-Arm-bending and -stretching in all directions.

4. As 3, but with asymmetrical work for arms, e.g., Left arm forward, right arm outward stretching, etc.

Arm and Leg Exercises.—

1. Standing 2-Arm-raising outward and upward + Heel-raising and -lowering.

2. Standing 2-Arm-raising outward and upward + Heel-raising and knee-bending.

3. Standing 2-Arm-bending and -stretching + Heel-raising and knee-bending, e.g., the patient raises the heels and brings the arms to bend position ; bends the knees and stretches the arms upwards (or forwards ; or sideways), straightens the knees and brings the arms to bend position again ; lowers the heels and stretches the arms downward.

4. As No. 3, but with asymmetrical work for arms, e.g., right arm stretched upward, left arm forward as knees are bent.

5. Any exercises in *deep* knee-bend position.

6. Balance positions (*a*) stretching one leg backward and opposite arm forward, (*b*) As (*a*) with forward-bending, (*c*) raising left leg and right arm upward and

sideways and *vice versa*. (*Figs.* 82–84). The patient must not be required to *maintain* these positions for more than a few seconds at a time.

Fig. 82.—Balance position. Stretching one leg backward and opposite arm forward.

Arm and Head Exercises.—

1. Forward-bend-stoop-standing Alternate head-rotation + Arm-flinging ('Signpost').

2. Standing 2-Arm-raising and -rotation out + Head-extension. The patient, while extending the head, brings the arms up to yard position, and turns the palms upwards; then lowers the arms, while bringing the head to the vertical position. The patient should breathe in during the raising and out during the lowering.

The patient's progress must be gradual; difficult balance positions and exercises with elaborate co-ordination must on no account be given too soon. The above exercises must be used along with easier movements.

The patient's age must also be taken into consideration. Many of the above exercises are unsuitable for children under 8. Only quite simple movements should be given to little children of 5 to 7.

Easy trunk exercises should also be included in the scheme. Most of the exercises—limbs or trunk—should be *free*, though occasional concentric and eccentric movements may be given.

Mirror exercises are strongly recommended by many workers, for the purpose of obtaining control of the face muscles. The great objection to them seems to be that they tend in many cases to increase self-consciousness.

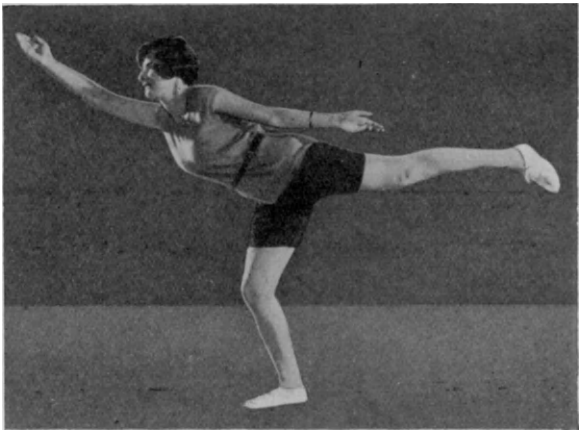

Fig. 83.—Balance position. As above, with forward-bending.

If given at all, they should not be required of the child in a room with other patients.

PRECAUTION.—The operator must ascertain from the physician *the condition of the patient's heart*, and if it is affected, must modify the treatment accordingly. In any case, children's tables should be short, varied, and interesting,

Fig. 84.—Balance position. Raising left leg and right arm upward and sideways.

containing an element of play. Long, monotonous schemes are the worst possible treatment for any small child. Games should be introduced among the exercises. Catching a ball, for instance, requires a large amount of co-ordination.

CHAPTER XII

LESIONS OF THE PERIPHERAL NERVES

I. Nerve lesions of the upper extremity: Ulnar paralysis—Median paralysis—Musculospiral paralysis—Paralysis due to injury of the circumflex nerve—Erb's paralysis—Klumpke's paralysis—II. Nerve lesions of the lower extremity: Anterior crural paralysis—External popliteal paralysis. III. Winged scapula. IV. Facial paralysis. V. Operations on nerves.

AN accurate knowledge of anatomy and the principles of treatment of lower motor neuron lesions should suffice to guide the masseuse in these cases (*see* pp. 127–129). The great majority of nerves are of the *mixed* variety (that is, they have both motor and sensory fibres), so that as a rule there is some degree of *anæsthesia* as well as of *paralysis*. *Trophic changes* are generally present, though more marked in some lesions than in others. In examining these cases, we have to remember that the muscular or cutaneous supply is not always exactly that described in the text-books—for instance, sometimes the ulnar nerve supplies three of the lumbricales, or even four, instead of only two; and the author has known one case of complete severance of the ulnar nerve just above the wrist, with no loss of sensation in the hand. Moreover, some nerves communicate so freely with others that loss of sensation is often slight or incomplete if one of them is injured. Generally speaking, however, the nervous distribution is remarkably true to type.

Paralysis may be caused by a lesion of the *nerve-roots*, or of the *nerve-trunks*; or a *whole plexus* may be involved.

We will consider first the lesions of the main nerves in the upper extremity, viz., the ulnar, median, musculospiral, and circumflex; then the two 'root-paralyses', those of the Erb's (Cervical 5 and 6) and Klumpke's (Cervical 8 and Dorsal 1) type. In the lower extremity, we shall describe the paralyses occasioned by lesions of the anterior crural and external popliteal nerves. Next we shall deal with the treatment of winged scapula, and of facial paralysis. Finally, we shall discuss the operations on nerves. Neuritis, neuralgia, and cramp are dealt with in the following chapter.

I. NERVE LESIONS OF THE UPPER EXTREMITY

ULNAR PARALYSIS

The ulnar nerve may be injured: (1) *In the axilla* (rarely); by a wound, by pressure (as of a crutch), or by the presence of a cervical rib (*see* p. 167). (2) *At the elbow*, where it may be torn or lacerated when a fracture or dislocation takes place, or afterwards compressed by callus or scar-tissue. (3) *At the wrist*, generally by direct injuries, such as cuts, wounds, etc. It may be injured in any part of its course by wounds or tumours.

SYMPTOMS.—

PARALYSIS IF THE INJURY IS AT OR ABOVE THE ELBOW.—

1. *In the forearm*, paralysis of the flexor carpi ulnaris and the inner half of the flexor profundus digitorum, resulting in weakening of adduction

of the wrist, and loss of flexion of the terminal phalanges of the fourth and fifth fingers.

2. *In the hand*, paralysis of the interossei, the two inner lumbricales, the adductores pollicis, and the abductor and flexor brevis minimi digiti, producing loss of abduction and adduction of the fingers; and inability to flex the metacarpo-phalangeal joints and at the same time extend the interphalangeal joints of the two inner fingers (sometimes of three or even four).

PARALYSIS IF THE INJURY IS AT THE WRIST.—The flexor carpi ulnaris, and flexor profundus digitorum are uninjured. The changes mentioned above under (2) are the only ones present.

ATROPHY of all these muscles, most evident on the inner side of the palm (hypothenar eminence), and in the hollows between the metacarpals on the dorsum of the hand.

POSITION OF THE HAND.—This is the well-known *main-en-griffe*, or claw-hand; it is due to paralysis of the interossei and two or more lumbricales, the unopposed action of the extensor communis digitorum producing hyper-extension of the metacarpo-phalangeal joints, and the long flexors producing flexion of the interphalangeal joints. As a rule, only the ring and little fingers are affected (*Fig.* 85). If the lesion is at or above the elbow, and the flexor profundus is paralysed, the last phalanges are not flexed.

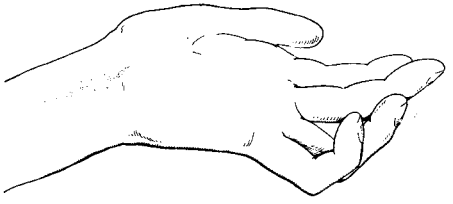

Fig. 85.—*Main-en-griffe* in ulnar nerve paralysis.

The tendons of the flexores sublimis and profundus become visible, and stand out in the palm, owing to the wasting of the lumbricales and hypothenar muscles.

In *incomplete lesions*, fibrous changes often take place in the palmar fascia, and the tendons become adherent to their sheaths. This produces an entirely fixed 'claw' position of at least the two inner fingers (Purves-Stewart*).

ANÆSTHESIA of the parts supplied by the nerve, viz., the inner half of the palm and dorsum of the hand, and one and a half inner fingers. If the lesion is at or only just above the wrist, the dorsal cutaneous branch escapes, and sensation at the back of the hand and fingers is unaffected.

PAIN is not present as a rule, except at the moment of injury.

TROPHIC CHANGES, other than in muscles, are not marked. This is a disabling form of paralysis, impairing the fine movements of hands and fingers.

Treatment.—

We have to distinguish between cases in which the nerve is bruised, lacerated, or injured by compression, and those in which it has been actually severed, and the two ends united by suture. In the latter cases, treatment must be modified. (For treatment of nerves after suture, *see* p. 177.)

CASES OF INJURY WITHOUT ACTUAL SEVERANCE

These cases are treated by: (1) Support; (2) Massage and passive movements; (3) Re-education.

SUPPORT.—A special splint, made of metal and fitted with straps for each

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* *Peripheral Nerve Injuries.*

finger, is preferable in these cases; if such is not provided, an ordinary straight splint, appropriately padded, may be used.

POSITION OF THE HAND.—If the nerve is injured just above the wrist, the hand should be placed on the splint with the metacarpo-phalangeal joints flexed, and the fingers straight, and the thumb in adduction close to the hand (*Fig.* 86). If it is injured above the point where its branches to the two forearm muscles are given off, in addition to this the wrist should be slightly flexed and the hand adducted. This position must be maintained throughout treatment.

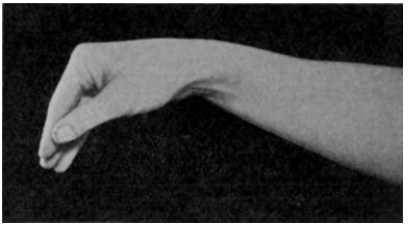

Fig. 86.—Position in which the hand should be splinted in ulnar paralysis. (The thumb should be more adducted than is shown in the figure.)

PHYSICAL TREATMENT.—

MASSAGE.—The type used is similar to that for infantile paralysis (*see* p. 127). The whole arm, from shoulder to hand, should be treated in order to promote good circulation. Special attention should be paid to the inner side of the front of the forearm in lesions above this part.

Hand Massage.—This is specially important. Effleurage is given to the whole hand, and finger kneading to all the muscles affected—that is, to the whole of the palm and hypothenar eminence. and the interosseous spaces at the back of the hand; also careful frictions to all the fingers, especially the fourth and fifth.

Nerve Massage.—This consists of quick frictions down the course of the nerve, and pressure or running vibrations. It may be performed from the beginning if the nerve is merely suffering from the effects of compression, and no pain is felt. If the nerve is lacerated, or badly contused, or if there is neuritis, it must be deferred till all pain has ceased.

PASSIVE MOVEMENTS should be given to shoulder, elbow, and radio-ulnar joints. The nerve must not be unduly stretched if the injury is in the forearm.

The Wrist-joint.—Flexion and adduction may always be given. The wrist must not be abducted if the flexor carpi ulnaris is paralysed. Extension should not be carried beyond the mid-line if the flexor profundus is affected. Otherwise all movements may be given—with due regard to any wound or bruise present.

The Hand and Fingers.—(*See* notes on giving passive movements to stiff joints, p. 77.) (1) Flexion of the metacarpo-phalangeal joints as far as possible. (2) Gentle extension of the interphalangeal joints. (3) Flexion, adduction, and opposition of the thumb; abduction and extension only to mid-position. (4) Adduction and abduction of the four inner fingers.

ACTIVE MOVEMENTS.—The above movements should be performed actively, as soon as possible. The rules given for re-education in flaccid paralysis all apply to these cases (*see* pp. 128, 129), and should be carefully observed. The length of time elapsing before movement begins to be possible depends on the severity of the injury; it may be weeks, or it may be months. In some cases the power may never have been completely lost.

'Trick' Movements.—It is necessary here to warn the masseuse against two 'trick' movements, which may lead her to suppose that power is returning before this is actually the case: (1) It is possible to produce a small amount of *abduction* of the fingers—plus hyperextension at the metacarpo-phalangeal joint—by using the extensor communis digitorum, and of *adduction*—plus

flexion—by using the long flexors of the fingers. (2) She may find that there appears to be no loss of *adduction of the thumb*, because the flexor longus pollicis and opponens pollicis perform this action. If there is no chance of the nerve recovering, trick movements may be encouraged, but if return of function is probable, they should not be allowed.

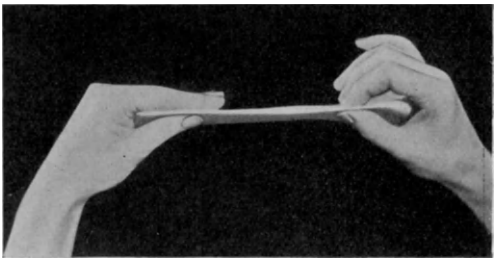

Fig. 87.—Grasping a sheet of paper with both hands. The left hand shows the position to be aimed at, the right hand that generally assumed by the patient in ulnar paralysis.

For instance, to prevent the patient from abducting and adducting his fingers by means of the long flexors and extensor, the hand should be so placed that hyperextension is impossible during abduction, and flexion during adduction; i.e., during abduction the metacarpo-phalangeal joints should be kept slightly flexed, and during adduction, at least in the later stages, in almost complete extension, though not of course in hyper extension.

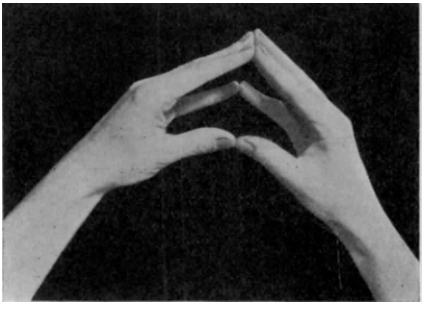

Fig. 88.

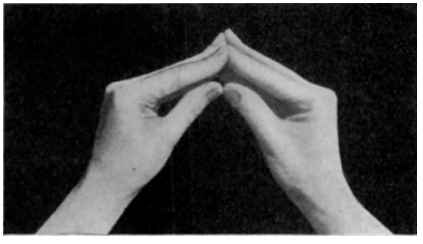

Fig. 89.

Figs. 88, 89.—'Old Gentleman,'. In an early case, the thumbs should not be so far abducted as in *Fig.* 88.

Later, the patient may perform *resisted exercises*. Finally, he must be taught to use the hand normally, obtaining a correct co-ordination; that is, he—or she—must practise the ordinary movements of life—writing, sewing, tying knots, fastening buttons, etc. Free exercises for all joints of both arms may be given with advantage. A list of exercises suitable for ulnar paralysis is given below.

EXERCISES.—

1. *Finger parting and closing* (hand in supination on table). (1) Free, moving each finger separately. (2) Free, moving all fingers together. (3) Resisted, each finger separately; patient may push away weights with his fingers.

2. *Grasping a sheet of paper with both hands*; between thumb and first finger, keeping metacarpo-phalangeal joints flexed and interphalangeal joints extended (*Fig.* 87).

3. '*Old Gentleman*'.—Finger-tips and thumb of both hands placed together (hands in front of thorax) fingers slightly abducted, thumb between abduction and adduction (*Fig.* 88). Bring the four finger-tips

close together, flexing the metacarpo-phalangeal joint, and bring thumb-tips into contact with index fingers (*Fig.* 89).

4. *Finger-stretching.*—Hands pronated on table, fingers flexed; stretch each finger forward in turn (*Fig.* 90). (Be careful while doing so not to hyperextend the metacarpo-phalangeal joints of the other fingers.) (*Fig.* 91.)

5. *Hands side by side on table*, supinated. Approximate in succession, tips of two little fingers, two ring, two middle, and two index fingers.

6. *Place index and little fingers* in front of middle and ring fingers (*Fig.* 92).

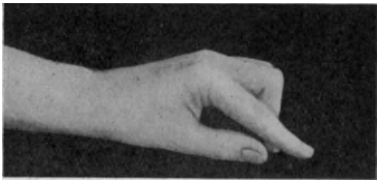

Fig 90.

Fig. 91.

Figs. 90, 91.—Finger-stretching. *Fig.* 90, the exercise done correctly. *Fig.* 91, the exercise done incorrectly, with hyperextension of the metacarpo-phalangeal joints of the three inner fingers.

Fig. 92.—Exercise 6, ulnar paralysis. The index and little fingers placed in front of the middle and ring fingers.

MEDIAN PARALYSIS

The median nerve may be injured: (1) *In the axilla*, or above the elbow (rarely). (2) *At the elbow*, where it may be involved in a fracture, though far less frequently than is the ulnar nerve. (3) *Low in the forearm, or at the wrist*, the most common site of injury, due to wounds, etc.

SYMPTOMS.—

Paralysis if Injured At or Above the Elbow.—

Pronators.—The forearm can only be pronated weakly to mid-position by the supinator longus.

Wrist Flexors, except Flexor Carpi Ulnaris.—The wrist can only be flexed very weakly, and is at the same time drawn to the ulnar side.

Long Flexors of Fingers and Thumb.—The last phalanx of the thumb cannot be flexed. The index and middle fingers can only be flexed at the metacarpo-phalangeal joint (by the interossei), but not at either interphalangeal joint. The ring and little fingers can be flexed at all joints by the inner half of the flexor profundus, though less strongly because of the loss of the flexor sublimis. (Sometimes the ulnar nerve supplies rather more than half of the flexor profundus, and the middle finger can also be flexed.)

Intrinsic Muscles of Hand.—Paralysis of the abductor, opponens, and outer half of flexor brevis pollicis. The loss of the power of opposing the thumb to the fingers is the most serious feature of the injury, since the patient

cannot use his hand for any fine movements, unless he can do this. Abduction, however, may be brought about by the extensor ossis metacarpi pollicis. The loss of the two outer lumbricales weakens flexion of the metacarpo-phalangeal joint of the index and middle fingers, and extension of their interphalangeal joints.

PARALYSIS IF INJURED AT THE WRIST, or below the point where the muscular branches are given off in the forearm.—The only loss is that of the intrinsic muscles of the hand—the thenar muscles and lumbricales.

ATROPHY of the front of the forearm and thenar eminence.

POSITION OF THE HAND.—The deformity is not obvious when the hand is at rest, except that the thumb lies back on the same plane as the fingers, producing the characteristic *main-de-singe* (monkey hand, *Fig.* 93), and that the atrophy of its muscles is marked. The hand is supinated, and the wrist in slight extension.

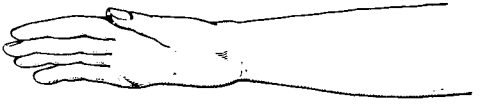

Fig. 93.—*Main-de-singe* in median nerve paralysis.

SENSORY CHANGES.—

Anæsthesia in the part supplied by the nerve—often incomplete.

Loss of Joint Sense in the affected fingers.

Hyperæsthesia to deep pressure in some cases.

Pain is specially common in lesions of this nerve. It may be spontaneous, or produced by pressure, and is known as *causalgia* or *thermalgia*. It is generally at the tips of the fingers, at the inner side of the thenar eminence, or at the junction of the palm with the index and middle fingers. It comes on suddenly and increases in intensity till it becomes almost unbearable. The patient may suffer from these pains for months, and so severe are they that he may become morbid and neurotic.

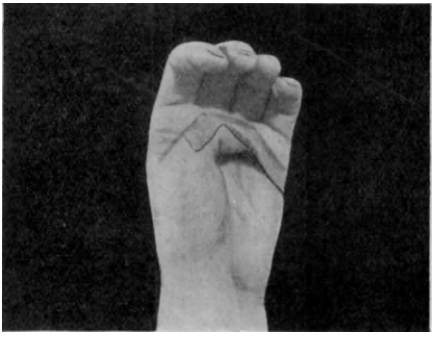

Fig. 94.—Method of keeping the thumb in opposition in median paralysis.

TROPHIC CHANGES are well marked, possibly because a large number of vasomotor fibres run in this nerve. The sweat-glands of the part may become more or less active than normal, the skin may be reddened, and characteristic changes appear in the nails.

Treatment.—

SUPPORT: POSITION OF THE HAND.—A special splint may be provided. The thumb is abducted and opposed to the fingers, and the fingers semiflexed at all joints. Failing this, the thumb may be fastened across the palm of the hand by zinc oxide strapping, its terminal phalanx being flexed, and the fingers bandaged lightly over it in flexion (*Fig.* 94). A small pad of wool should be placed in the palm. The wrist is also flexed, and the hand supported in pronation in a sling. If the nerve is injured low down in the forearm, the wrist and radio-ulnar joints may be left free, unless a wound has to be considered. Another method is to bandage the hand over a tennis ball (*Fig.* 95).

PHYSICAL TREATMENT.—

MASSAGE.—On the same principle as for the ulnar nerve, with special attention to all atrophied muscles; later, nerve massage. If there has been any sign of causalgia, the parts where it has been felt must be avoided. In some cases, it may contra-indicate massage of the hand altogether.

PASSIVE MOVEMENTS.—On the same principle: (1) *To the shoulder and elbow.* (2) *To the wrist and radio-ulnar joints*: pronation should be given, and flexion and abduction of the wrist. (3) *To the hand*: flexion, abduction, and opposition of the thumb, and flexion of the fingers should be given.

ACTIVE MOVEMENTS.—As above, on the usual principles (*see* p. 128). Later, exercises for co-ordination, as for ulnar paralysis (*see* above).

Trick Movements.—In order to bring about pronation of the hand, the patient slightly abducts the shoulder, so that the hand falls into pronation by gravity. This may be mistaken for a true active movement. Also, he may produce a similar movement by straightening the elbow and inwardly rotating the shoulder. Sometimes all the fingers may be flexed at all joints

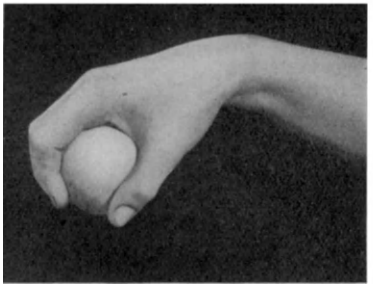

Fig. 95.—Hand bandaged over a tennis ball in median paralysis.

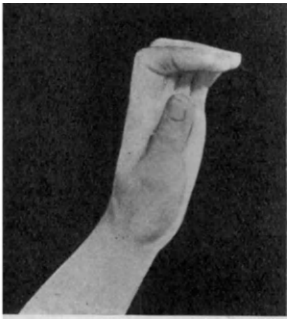

Fig. 96.—Flexion of first interphalangeal joints alone.

by the pull of the part of the flexor profundus which is supplied by the ulnar nerve, this part pulling up the paralysed outer half with it. Flexion of each finger separately should be practised.

All joints of the two inner fingers can be flexed by the deep flexor, which having flexed the second interphalangeal joints, afterwards flexes the first. To work the flexor sublimis, the patient should practise flexing the first interphalangeal joints without having flexed the second (*Fig.* 96).

EXERCISES.—

1. *Grasping and squeezing a rubber ball*, not larger than a tennis ball. (*a*) Soft, (*b*) Hard.

2. *Grasping* and holding a walking-stick, then a penholder; all gripping movements.

3. *Closing the hand; then opening gently*, not fully extending fingers or wrist when opening.

4. *Touching the tip of each finger in turn with tip of thumb*, 'making O's'.

5. *Touching the second phalanx of each finger with tip of thumb* (flexion of all joints of fingers).

6. *Piano-playing movements* of fingers with hand half-way between pronation and supination. The wrist must not be hyperextended if the nerve

is injured high up—that is, if the long flexors of wrist and fingers are paralysed. The metacarpo-phalangeal joints must not be hyperextended in any case.

7. *Abduction of wrist.*—Hand on block or box, fingers flexed over edge; push away weight by abducting hand.

8. *Wrist-machine* for flexion and pronation when strong enough.

9. *Picking up and putting down* small objects—balls, dice, marbles, coins held by edges between fingers, etc.

CAUSALGIA is treated by cold wet applications. In bad cases, injections of alcohol into the nerve are sometimes tried.

MUSCULOSPIRAL PARALYSIS

(*Wrist-drop*)

The musculospiral, or its motor branch, the *posterior interosseous nerve*, may be injured: (1) *In the axilla*, generally by pressure, as of crutches; (2) *In the musculospiral groove*, injury of the nerve complicating fracture of the humerus (*see* p. 15); (3) *Near or below the elbow*, in injuries to that joint.

SYMPTOMS.—

PARALYSIS IF INJURED IN THE AXILLA.—

Triceps and Anconeus.—Loss of extension of the elbow.

Supinator Longus and part of Brachialis Anticus.—Weakening of flexion of the elbow.

Supinator Longus and Brevis.—Loss of supination, except with the elbow flexed, when the movement is performed by the biceps.

All Extensors of Wrist, and Long Extensors of Fingers and Thumb.—Loss of extension of the wrist, metacarpo-phalangeal joints of the fingers, and all joints of the thumb.

PARALYSIS IF INJURED AT OR BELOW THE ELBOW (posterior interosseous nerve).—

All Extensors of Wrist, except Extensor Carpi Radialis Longior, which can only produce very weak extension of the wrist, if any.

Extensors of Fingers and Thumb.—As above.

Supinator Brevis.—Weakening of supination.

ATROPHY of these muscles; especially evident at the back of the arm and forearm. The wasting is, however, generally less marked than in median and ulnar lesions.

POSITION OF THE HAND.—*Dropped wrist*: the wrist hangs loosely in flexion, and the metacarpo-phalangeal joints are also flexed. Contracture of the flexors, however, is rare. The patient generally keeps the elbow semiflexed. The hand is pronated. When the patient attempts to extend the fingers, the wrist is flexed by the synergists.

ANÆSTHESIA is rare, because of the numerous communications between the musculospiral and other nerves. If it is present, it is in the area supplied by the radial nerve.

TROPHIC CHANGES are not marked. There is no pain.

Treatment (say, of posterior interosseous paralysis—pure 'wrist-drop').—

SUPPORT.—The hand is flexed on a *short* cock-up splint, with the wrist in full, or almost full, extension. The metacarpo-phalangeal joints also are supported in extension, but the other finger-joints should be left free; the thumb is in abduction and extension. (*Fig.* 97.)

PHYSICAL TREATMENT.—

MASSAGE.—Of the usual type. Special attention is to be paid to the posterior aspect of the forearm. Hacking is generally possible in these cases.

PASSIVE MOVEMENTS.—Full extension of the wrist and fingers together should be given to prevent any tendency to flexor contraction; extension of the thumb is also necessary.

ACTIVE MOVEMENTS.—These consist of extension of the wrist, metacarpo-phalangeal joints, and all joints of the thumb. The usual rules must be observed.

The extension of the wrist is given successively: (1) With the hand in supination, over the edge of the table or cushion (gravity assisting). (2) With the hand between pronation and supination (gravity eliminated). (3) With the hand pronated (gravity resisting).

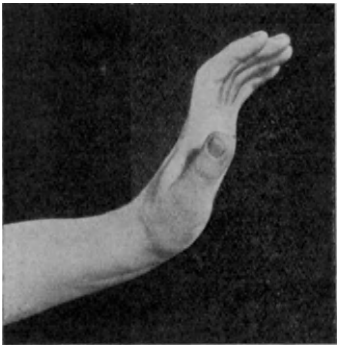

Fig. 97.—Position in which the hand should be splinted in musculospiral paralysis.

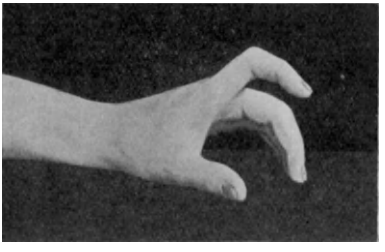

Fig. 98.—Five-finger exercise for musculospiral paralysis.

EXERCISES for later stages.—

1. For stretching movements, *see* free exercises for stiff wrist (p. 78).
2. *Five-finger Exercises.*—Hand pronated on table, fingers flexed; raise each finger separately; later, all together. (*Fig.* 98).
3. '*Piano-playing*'.—Position as No. 2. Same exercise, but done quickly, each finger in succession.
4. Hand pronated on table; raise each finger separately; later, all together.
5. *Finger-parting.*—Starting position as in Exercise 3 for ULNAR PARALYSIS ('Old Gentleman'). Separate each pair of finger-tips in succession as far as possible from each other, keeping the others in contact (*Fig.* 99).
6. Push away objects on the table by extending wrist and finger-joints.
7. Wrist machine, the bar being turned *towards* the patient's body.

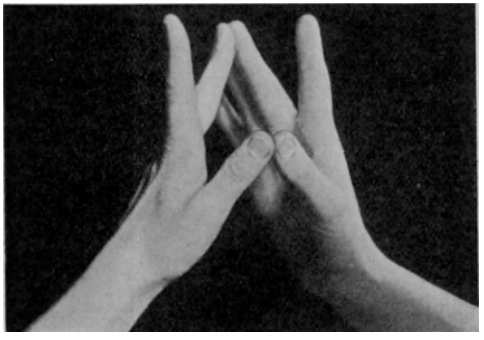

Fig. 99.—Finger-parting for musculospiral paralysis.

The prognosis in musculospiral injuries is much better than in those of the median and ulnar nerves, even after severance.

PARALYSIS DUE TO INJURY OF THE CIRCUMFLEX NERVE

A lesion of the circumflex nerve *alone* is rare, though it may occur as a complication of a dislocated shoulder, or of fractures in the region of that joint. Paralysis of the deltoid is more often due to a lesion of the *fifth cervical root*, when it is paralysed in conjunction with the other muscles having the same nerve-supply, the syndrome produced being then known as *Erb's paralysis* (*see below*).

SYMPTOMS.—Injury of the circumflex nerve alone results in :—

PARALYSIS AND ATROPHY of the deltoid and teres minor. The power of abducting the arm is almost lost, for the supraspinatus, though capable of lifting the arm, is unable to maintain it in the abducted position without the assistance of the powerful deltoid. Outward rotation of the shoulder is weakened.

ANÆSTHESIA over the deltoid area.

Treatment.—

SUPPORT.—*Fairbank's* abduction splint (*see* ERB'S PARALYSIS, p. 168, *also Fig.* 100), or some similar abduction splint, is used. The shoulder is put up in abduction and rotation out.

PHYSICAL TREATMENT.—

MASSAGE is on the usual lines.

MOVEMENTS.—The re-education of the abductors and outward rotators is described under Erb's paralysis, and this is so similar to that of the deltoid and teres minor alone that it need not be described in detail here. The only difference is that in circumflex paralysis the elbow may be extended as well as flexed ; and the forearm pronated, provided the shoulder is not inwardly rotated at the same time.

ERB'S PARALYSIS

This is due to a lesion of the fifth cervical root, and sometimes of part of the sixth. It generally occurs as the result of an injury at birth through traction between the child's head and shoulder. The strain falls first on the upper roots of the brachial plexus, the fifth cervical root yielding first, and then the roots below it, in succession. It is rare for more than Cervical 5 and 6 to be injured.

A similar condition may be produced in later life by means of violence. The whole plexus may be torn or severed in these cases. A *cervical rib* (i.e., an extra rib attached to the last cervical vertebra, or an elongation of its transverse process) may cause much the same kind of trouble.

SYMPTOMS.—

PARALYSIS AND ATROPHY.—

In the case of an injury to the *fifth cervical root alone*, there is paralysis and atrophy of the rhomboids, deltoid, supra- and infraspinatus, teres minor, biceps, brachialis anticus, and the supinators. The result is loss of power to abduct or outwardly rotate the shoulder, to flex the elbow, or to supinate the forearm.

If the *sixth cervical root* is involved, some of the extensors of the wrist (those on the radial side) may be affected.

POSITION OF THE ARM.—The arm hangs at the side with the forearm extended, while owing to the extreme pronation and inward rotation, the palm of the hand faces outwards. The arm may be held in this position by contraction of the subscapularis and the coraco-humeral ligament.

ANÆSTHESIA is rare. If present, it is found on the outer side of the arm and forearm, back and front, the area supplied by fibres from Cervical 5 (*see Fig.* 101).

TROPHIC CHANGES are absent or slight.

Treatment.—

SUPPORT.—*Fairbank's or some other form of abduction splint.* The arm is abducted to shoulder level and rotated out; the elbow is semiflexed; the forearm is supinated (*Fig.* 100). If any of the extensors of the wrist are affected, this joint will be placed in extension. In bandaging the arm of an infant to a splint of this kind, it is important to see that the hand is in a correct position, not in a twisted or unnatural one.

Fig. 100.—Position for splinting in Erb's paralysis.

PHYSICAL TREATMENT.—

POSITION OF THE PATIENT.—The patient must lie quite flat on a plinth or couch, a low pillow being placed below the head if required. The arm should be supported on a cushion in the abducted position, fully rotated out, and with the elbow semiflexed, in the same position as it was when on the splint.

MASSAGE.—Given in the usual way.

PASSIVE MOVEMENTS.—Full movements are given to fingers and wrist, and to the other joints in such a way as not to stretch paralysed muscles.

RE-EDUCATION EXERCISES.—Each muscle group must be re-educated separately in the early stages, on the usual principles (*see* p. 128).

The Abductors.—In the early stages, the patient is placed in the lying position on a plinth, which should be smooth and polished, or a specially prepared piece of cardboard may be used. An adult may be required to perform successively static, assisted, free, eccentric, and concentric abduction in the usual way, the arm never being brought below shoulder level, or only a few degrees below. An infant must be persuaded to try and move his arm upwards as soon as possible.

When a slight amount of power has returned to the muscles, the back of the plinth is raised an inch or so; static holdings are practised, and other active movements in the same order as above. The back of the plinth is gradually raised more and more, so increasing the angle of the pull of gravity, until finally the patient can do his exercises sitting upright. In the later stages, the muscles are worked in their full range, the arm being brought down to the side.

The Outward Rotators.—The position of the patient is successively: (1) Lying (gravity assisting). (2) Side-lying on the sound side (gravity eliminated). (3) As (2) with resistance by the operator.*

The Supinators.—Positions: (1) Lying (gravity assisting). (2) Sitting, with the arm supported in abduction and the forearm semiflexed and held vertical (gravity eliminated). (3) As (2), resisted by the operator.*

The Flexors of the Elbow.—Positions: (1) Sitting, the arm supported in abduction, the shoulder being outwardly rotated (gravity assisting). (2) Lying (gravity eliminated). (3) As (2) with slight resistance by operator.*

* Where a position in which gravity can be used as an assistance or resistance proves to be very awkward or inconvenient, it is better to regulate the amount of work done by means of assistance or resistance given by the operator, rather than by change of position.

At a Later Stage.—Pulley exercises to assist abduction may be added in older patients, the double pulley being used so that the stronger arm may assist the weaker. In pure deltoid paralysis, they may be used at quite an early stage, provided that either the splint is left in place so that the arm after its upward movement comes to rest on it, or that the gymnast herself is careful to prevent the arm from being brought below shoulder level at any time. In Erb's paralysis, these exercises should be deferred until much later, because they would stretch the flexors of the elbow.

Later still, free and resisted shoulder and elbow exercises are added. Many of the exercises described in Chapter VI are suitable.

SURGICAL TREATMENT.—Treatment by physical means alone is rarely entirely successful, except in the slighter cases among infants, or in adults where the severance of the nerve-root or roots is not complete. The more serious cases, where the injury is extensive, or where the muscles and ligaments on the inner side of the joint have been allowed to shorten, are treated by operation.

One of the following may be performed: (1) *Fairbank's operation*: division of the subscapularis and the coraco-humeral ligament (the commonest operation). (2) Opening of the capsule, and correction of the position of the head of the humerus. (3) Suture of the divided nerves. The arm is afterwards put up on the abduction splint in the usual way. Cases are often sent for treatment after one of these operations.

POST-OPERATIVE TREATMENT is on the same lines as that described above. Due attention must be paid to the scar. For treatment after nerve suture, *see* p. 177.

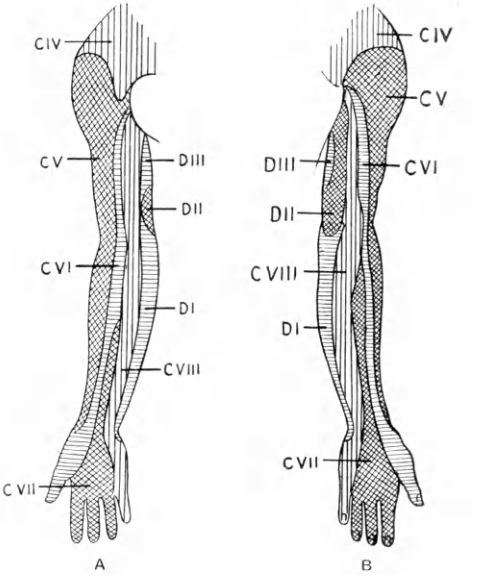

Fig. 101.—Cutaneous supply of nerve-roots in arm. A, Anterior; B, Posterior.

KLUMPKE'S PARALYSIS

This type of paralysis is due to a lesion of the *eighth cervical* and *first thoracic roots*, produced by traction between the arm and the trunk. It occurs in adults, as when a man in falling from a scaffolding grasps at some support, such as a pole or beam, and the whole weight of his body falls suddenly on his arm; or as a complication of other shoulder injuries. It also arises as the result of a birth injury, though less commonly than the Erb's type.

ANATOMY.—The *first thoracic root* supplies the intrinsic muscles of the hand, its fibres passing down in the median and ulnar nerves; the *eighth cervical root* the long flexors of wrist and fingers.

The cutaneous supply of the first thoracic consists of an area on the inner side of the forearm, back and front. (This area is supplied through the internal cutaneous nerve). The supply of the eighth cervical consists of two narrow strips down the middle of the upper extremity, one at the

back and one at the front, of the inner side of the hand, and of one, or one and a half, inner fingers. (*Fig.* 101.)

SYMPTOMS.—

PARALYSIS.—If both these roots are injured, there is complete paralysis and atrophy of *all the intrinsic muscles of the hand*, and of the *long flexors of the wrist and fingers*. This produces a condition similar to that caused by a lesion of both the median and ulnar nerves at the elbow, except that pronation is still possible. No movement at all is left in the hand, except extension of the metacarpo-phalangeal joints by the extensor communis digitorum and its accessory muscles, and extension of all joints of the thumb. Flexion of the wrist is also lost.

POSITION OF THE HAND.—This is a combination of *main-de-singe* and *main-en-griffe* (*see Figs.* 85, 93). The fingers are clawed—though the *flexion* of the last two phalanges is not so marked as in ulnar paralysis—and the thumb lies on the same plane as the fingers. The whole hand is flaccid and wasted.

ANÆSTHESIA is generally present in the area supplied by these roots, as shown above.

Treatment.—

SUPPORT. A specially-made splint is necessary to maintain the hand in the correct position. The metacarpo-phalangeal joints of the fingers are flexed, the interphalangeal joints extended or slightly flexed, the thumb in flexion and opposition, half-way between abduction and adduction; the wrist is flexed.

PHYSICAL TREATMENT.—

MASSAGE.—Massage of the whole arm, especially of the hand, and of the flexor aspect of the forearm, as for median and ulnar paralysis.

PASSIVE MOVEMENTS.—Movements are given to all joints of the hand. (1) All flexion movements of thumb and fingers should be given to the limit, the wrist being kept in flexion meanwhile, though not in such complete flexion as to prevent the hand from being completely closed. (2) Opposition of the thumb is most important; neither abduction nor adduction should be carried to the extreme limit. (3) The fingers should be gently parted from each other, and each finger abducted and adducted, the metacarpo-phalangeal joint being kept slightly flexed so as not to overstretch the interossei. (4) The wrist should be fully flexed. (5) The interphalangeal joints should be extended, the metacarpo-phalangeal joints being flexed meanwhile. All other extension movements of wrist, fingers, and thumb are given in the *outer range only*.

ACTIVE MOVEMENTS.—These are given in the inner range, on the same principle as the passive movements. Many of the exercises for ulnar and median paralysis are suitable for this condition (*see* pp. 161 164). The operator must see that no paralysed muscle is stretched during the early stages. It is not easy to avoid doing so, and much care and attention are necessary. The extreme importance of the opponens pollicis must never be forgotten.

II. NERVE LESIONS OF THE LOWER EXTREMITY

Injuries to the nerves of the leg are less common than to those of the arm, and we are rarely called upon to treat them except as part of some nervous disease such as infantile paralysis or multiple neuritis. We will take as examples lesions of: (1) The anterior crural nerve; and (2) The external popliteal nerve.

ANTERIOR CRURAL PARALYSIS

This is very rare as an isolated lesion, though the quadriceps often suffers in poliomyelitis or multiple neuritis.

SYMPTOMS.—

PARALYSIS of the quadriceps extensors and the sartorius. The loss of the latter muscle is not serious, but that of the quadriceps does away with all extension of the knee. The atrophy is often extreme, especially that of the vastus internus. Flexor contraction may develop at the knee. Only an injury very near the beginning of the nerve in the pelvis would affect the branches to the iliacus. In this case, flexion of the hip would be weakened by paralysis of this muscle, as well as that of the rectus femoris, sartorius, and half of the pectineus.

ANÆSTHESIA is present in the area of distribution of the nerve—the inner side and front of the thigh (middle and internal cutaneous branches); and the inner side and front of the leg, inner ankle and inner border of the foot (long saphenous nerve).

REFLEXES.—The knee-jerk is lost.

Treatment.—

SUPPORT.—The knee is supported in full extension by some form of apparatus. A *back splint, with a foot-piece*, is generally worn at night. This should be as light as possible. During the day, the patient often wears a *walking caliper* (*see* p. 30), so that the knee is kept straight, and no weight placed on the leg. Two points should receive attention when applying either splint or caliper :—

1. The *knee must be kept in full extension, but not in hyperextension.* If a hyperextended position becomes established, it is most difficult to correct later. Therefore a *thin* pad of wool should be placed under the knee when on the splint. When the caliper is in use, the leather support behind the knee should be so arranged as to support both femur and tibia, and should not be too low down, so that it pushes the latter bone too far forward.

2. Great care should be taken to *avoid pressure on the paralysed quadriceps* by bandaging or supports. When the leg is on a splint, the foot and lower leg may be bandaged to it, and the bandaging should cease immediately above the knee. A strap or a few turns of bandage should be applied over a layer of wool at the upper end of the splint.

PHYSICAL TREATMENT (for paralysed quadriceps only).—

MASSAGE of the thigh, especially in front and at the inner side, is carried out as for flaccid paralysis in general. The lower leg should also be treated.

PASSIVE MOVEMENTS are given to all joints of the leg and foot. The knee must not be flexed beyond a right angle in the early stages.

RE-EDUCATION EXERCISES. — Exercises are given successively in the followng positions :—

Prone-lying on a Plinth, with a thin but soft cushion placed beneath the patient's knee and shin. The foot should hang over the end of the plinth. The operator should flex the knee about 10°, and let it drop on the cushion (to relax the antagonists) and then tell the patient to try and "hold the knee stiff" in this position (gravity assisting).

Side-lying on the Sound Side. — The powdered cardboard is placed between the legs, the knee is flexed to a right angle, and the patient tries to extend it. The cardboard may be so tilted that gravity is made slightly to assist or resist the movement. If held quite level, gravity is eliminated. The cardboard is then removed, and the patient abducts the leg, keeping

the knee stiff. This gives him the *sense* of holding his knee straight, although no actual muscle work is required in this position. As strength returns, he turns his body more and more backwards towards the supine position, so that the pull of gravity on the knee is gradually increased. Finally, he is able to raise his leg from the plinth with straight knee in the *lying* or *half-lying position.*

Sitting Position.—Work is now done statically, eccentrically, and concentrically against gravity. The patient will next go on to resisted work.

Re-education in Walking.—When the muscles have sufficiently recovered the patient will gradually discard the caliper and begin to walk without it. Correct walking must be insisted upon, especially the bracing of the quadriceps when the weight is taken upon the leg. During the period of recovery, the other leg muscles should have been assiduously exercised, and foot drill practised; otherwise the patient may be in danger of flat-foot from inefficiency of the invertors. Weakness of the calf-muscles is also a serious handicap in walking.

EXTERNAL POPLITEAL PARALYSIS

This nerve, or its *anterior tibial* branch, may be injured in fractures of the upper extremity of the fibula. Occasionally, also, lesions occur before or during childbirth from pressure in the pelvis on that part of the great sciatic nerve which contains the fibres destined for its external popliteal division (obstetrical paralysis).

SYMPTOMS.—

Paralysis and Atrophy in Injury of the External Popliteal Nerve.—*Paralysis and atrophy* of the anterior tibial group, extensor brevis digitorum, and the peronei; *loss* of dorsiflexion of the ankle, extension of the toes, and eversion of the foot; *weakening* of inversion, which is possible in plantar-flexion only.

Paralysis in Injury of the Anterior Tibial Nerve only.—As above, except that the peronei are normal, and eversion is possible.

Anæsthesia, found on the lower two-thirds of the outer side of the leg, and on the dorsum of the foot and toes, except the last phalanges. If the anterior tibial nerve alone is injured, the only sensory loss is at the cleft between the first and second toes.

Joint Sense is lost in the joints of the foot and toes; if the whole nerve is injured, sometimes in the ankle as well.

Trophic Changes.—There are characteristic changes in skin and nails. Trophic ulcers may occur.

The Reflexes are unaffected, since the calf and sole muscles are sound.

Treatment.—

SUPPORT.—

For External Popliteal Paralysis.—A *back splint* should be used, if possible of the 'tin-shoe' type, made of aluminium or duralumin (an alloy of aluminium), and extending up the leg to just below the knee. The foot is put up in dorsiflexion to a right angle, and the splint fixed in position by straps or a bandage. If the calf muscles tend to contract and the foot is difficult to keep in position, strips of adhesive plaster may be used for this purpose and a bandage applied over them.

For Anterior Tibial Paralysis only.—A similar splint is used, but is so shaped that the foot is kept in inversion, as well as in dorsiflexion. In either case, when the patient has sufficiently recovered to be able to walk, a 'valgus wedge' should be placed in the boot—that is, it should be raised about a

quarter of an inch by means of a leather wedge inserted into the sole on the inner side, so as to prevent the foot from being everted.

PHYSICAL TREATMENT, e.g., of anterior tibial paralysis.—

MASSAGE.—This is carried out on the usual lines. Care must be taken, when hacking the anterior tibial group, not to touch and stimulate the peronei also, and it is best to protect these muscles by keeping one hand over them during the performance of this manipulation.

Pressure vibrations to this deep-lying nerve should, if the muscles covering it are much atrophied, be postponed until they are sufficiently recovered not to be bruised by such deep manipulations.

PASSIVE MOVEMENTS.—Dorsiflexion and inversion of the foot are given to their full limit, eversion and plantar-flexion only to the mid-position. Extension of the toes is important, and they may be flexed a little beyond the straight, if the ankle is kept fully dorsiflexed.

EXERCISES.—Unfortunately, we cannot invent such a variety of exercises for the foot as for the hand. *Extension of the toes and dorsiflexion of the ankle* may be given successively in :—

1. Forward-lying or kneeling with the feet over the end of the plinth (gravity assisting) ; or side-lying with assistance from the operator.
2. Side-lying (gravity eliminated).
3. Half-lying (gravity opposing).

For *inversion*, the patient may be in half-lying throughout. Gravity is eliminated in this position, and assistance or resistance may be given.

Later, exercises are given in *sitting*, as for flat-foot. When the patient begins to take weight on his foot, similar exercises are given in *standing* (p. 232).

For re-education in walking, *see* p. 44.

III. WINGED SCAPULA

A deformity due to paralysis or weakness of the serratus magnus, often combined with similar weakness of the middle and lower trapezius.

ETIOLOGY.—This type of deformity may be part of some general condition such as infantile paralysis or the juvenile or infantile type of muscular dystrophy. More commonly, it is due to pressure on, or injury to, the posterior (long) thoracic nerve. Some slight cases are merely due to poor muscular development and general weakness.

SYMPTOMS.—The patient is *unable to raise the arm above shoulder level*, having lost the power of outwardly rotating the inferior angle of the scapula ; nor can he perform any *forward pushing movements*. On raising the arms forward to shoulder level, *the vertebral border of the scapula stands away from the ribs*, projecting backwards.

Treatment.—

PHYSICAL TREATMENT.—

POSITION OF THE PATIENT.—First prone-lying, arms raised to shoulder level, forehead resting on hands ; then side-lying or half-lying.

MASSAGE.—The muscle is difficult to reach, since a great part of it lies beneath the scapula, and most of the rest beneath other large muscles—the pectoralis major in front, and the posterior scapular muscles behind. However, an attempt must be made to knead it through the overlying layers. Hacking may always be given.

PASSIVE MOVEMENTS.—Full elevation of the arm is most important.

ACTIVE EXERCISES.—The usual rules must be observed in a case of paralysis ; but, if the muscles are merely weak, it is not necessary to adhere to them quite so rigidly.

In the Early Stage: *Lying or Prone-lying Position.*—The foot of the plinth may be slightly raised, so that the patient's head is a little lower than his feet. The powdered cardboard may be used if desired. The patient begins with his arms at shoulder level, or a little above, and practises raising them above his head (inner range). The elbow may at first be held in flexion, afterwards in extension.

Later, the foot of the plinth is lowered, and then, the patient being in *lying*, the head of the plinth is raised till he is in the *half-lying*, and finally in the *sitting* position. The movement should, of course, be successively static, assisted, free, resisted, etc.

Later Exercises.—

1. Reach-grasp-sitting or -standing; trying to keep scapula in position against chest wall.
2. Sitting 2-Arm-raising forward to shoulder level. This presents considerable difficulty. It may be tried first in side-lying for each arm separately.
3. Fall-out-standing Forward pushing. The patient, in lunge position, say with right knee forward, places his right hand against a wall and pushes strongly forward. He then changes to left fall-out-standing, and pushes with his left hand.
4. Prone-falling position, with 2-Arm-bending and -stretching (modified) The patient places his hands against a wall or on a high table. (*See* Exercise No. 28, p. 72.)
5. Standing 2-Arm-raising outward and upward, and -sinking.
6. Standing 2-Arm-circling.
7. Standing 2-Arm-raising forward; parting; raising upward to vertical; sinking forward and downward.

Resisted Exercises.—

1. Yard-stride-sitting 2-Arm-lifting and -downpressing.
2. 2-Plane-arm-carrying (in various positions).

Many exercises in the list for stiff shoulders (*see* pp. 71–75) may be used in the later stages.

IV. FACIAL PARALYSIS

ANATOMY.—The seventh cranial, or facial nerve supplies all the face muscles except the levator palpebræ, supplied by the motor oculi, and the muscles of mastication, supplied by the trigeminal. It is, therefore, *the nerve of facial expression.* Its functions are not quite like those of other nerves, since the movements of the face muscles, although they may be voluntary, take place largely in response to *emotional stimuli*, and in such cases are purely reflex. The nerve has only one sensory branch, the chorda tympani, which supplies sensation to the anterior two-thirds of the tongue. Its nucleus—that is, the group of cells of origin of its lower motor neuron—is in the pons Varolii. It is connected with the cells of the cerebral cortex by fibres which form its upper motor neuron.

The facial nerve may be injured in various parts of its course:—

1. THE UPPER NEURON.—This may suffer in cases of hæmorrhage, thrombosis, tumour, etc. It then generally forms part of a hemiplegia (*see* p. 116).
2. THE LOWER NEURON.—*The nucleus*—or its fibres within the pons—is occasionally attacked in acute anterior poliomyelitis, or injured by hæmorrhage, tumours, etc. There may or may not be injury to other nerves.

The peripheral fibres, after they have left the pons, may be injured or compressed either in their bony canal, or after they have emerged on the face. These are the cases with which we are most often concerned. They may be the result of otitis media (inflammation of the middle ear), accidental severance

at operations on the ear, wounds, or fractures of the skull; or, most promising from our point of view, they may be due to rheumatism, the inflammatory products of which compress the nerve in the narrow stylomastoid foramen, causing a *neuritis*.

We shall here consider the symptoms and treatment of the *peripheral* form of facial paralysis only—the form commonly known as 'Bell's palsy'. (For the upper neuron type, *see* HEMIPLEGIA.)

SYMPTOMS.—

IF THE NERVE IS INJURED AT THE STYLOMASTOID FORAMEN.—

Flaccid paralysis and atrophy of all the face muscles on one side, except the levator palpebræ (which raises the upper eyelid) and the muscles of mastication; loss of all movement on that side, voluntary or emotional. Results:—

The eye can be opened, but not completely closed (paralysis of orbicularis palpebrarum). Hence the blinking reflex is lost, the eye is not efficiently protected from dust or other injurious substances, and therefore tends to water, or even becomes inflamed (conjunctivitis).

The corner of the mouth drops, and the patient cannot raise it on this side in smiling.

The food collects between the teeth and the cheek when eating, because the tone of the latter cannot be maintained (paralysis of buccinator); and whistling becomes impossible.

As regards *articulation*, the pronunciation of the labial consonants (*l*, *m*, *n*) is affected.

The power of wrinkling the forehead either vertically or horizontally is lost on the affected side. If the patient had wrinkles, they disappear.

The nasal fold is obliterated, and the nostrils cannot be voluntarily dilated, though they move passively during breathing.

IF THE NERVE IS INJURED ABOVE THIS POINT.—

In addition to the above symptoms, there is loss of taste sensation in the anterior part of the tongue, or hypersensitiveness to certain sounds, according to the level of the injury. The auditory or other nerves may be involved also.

Treatment.—

MEDICAL AND SURGICAL TREATMENT.—The treatment will be that of the cause—ear disease, rheumatism, etc.

SUPPORT.—A hook attached to a piece of narrow rubber tubing is sometimes used to hold up the corner of the mouth. Its other end is hooked round the ear.

PHYSICAL TREATMENT (for example, of the rheumatic type).—The prognosis of this type is good. In lesions of the nucleus or fibres within the pons, it is bad; and in the cases of severance during operation it is not very favourable. The treatment in these cases is similar to that given below.

POSITION OF PATIENT.—The most convenient arrangement is for the patient to sit on a chair, with the operator standing behind him, the patient's head being supported on a small cushion between himself and the operator, while the latter's hand is placed beneath his chin; or he may lie supine on a couch, the operator standing behind his head.

MASSAGE.—This should be begun at once in rheumatic cases. The following manipulations are given:—

Stroking, firm and stimulating, to remould the face. It should be given from the chin upwards to the temple, and from the middle of the forehead downwards towards the ear.

Finger kneadings, small and circular, all over the affected side of the face, care being taken not to stretch the muscles. Picking-up, which is sometimes used, is really only suitable in the upper neuron type of paralysis.

Tapôtement.—This is best administered in the form of 'tapping' with the finger-tips, quickly and lightly. It must be done very gently over the forehead and superciliary ridges, where only a thin layer of muscle covers the bone.

Frictions at the point where the nerve enters the face, to break up rheumatic deposits in this situation. This point may be found just below and in front of the lobule of the ear, over the neck of the condyle of the lower jaw.

Vibrations are also given with the tips of one or two fingers on the nerve-trunk at this point in order to stimulate it. Vibrations may also be administered to all the terminal branches by placing the whole hand flat on the affected side of the face.

Stretching manipulations may be given to the muscles of the sound side of the face, if they show any signs of contracture.

EXERCISES.—The patient should be in a room alone, or screened off from other patients, otherwise he will be self-conscious and unable to concentrate. He should try to perform the following movements :—

1. Closing the eyes.
2. Smiling.
3. Whistling, and blowing.
4. Closing the mouth tightly.
5. Smiling, showing the teeth, and raising the upper lip.
6. Wrinkling the forehead, vertically and horizontally.
7. Dilating the nostrils.
8. Screwing up the whole face.
9. Pronunciation of words containing labials.

This part of the treatment may easily be made into a game in dealing with children. Later it is possible to give gentle resistance to some of those movements.

ELECTRICAL TREATMENT.—Faradism or interrupted galvanism is used, according to whether there is, or is not, reaction of degeneration.

SURGICAL TREATMENT.—In obstinate cases, an operation is sometimes performed, consisting of *nerve anastomosis*, part of the spinal accessory, or hypoglossal nerve—generally the former—being joined to the distal end of the facial.

POST-OPERATIVE TREATMENT is as described above. (*See also* p. 177, NERVE SUTURE.)

V. OPERATIONS ON NERVES

Operations are performed on nerves for the following purposes :—

1. *To re-unite two ends of a severed nerve*, so that it may regenerate, the axons from the central end growing down into the sheath of the peripheral end (nerve suture).

2. *To free a nerve* that has been caught in forming callus, or is being compressed by displaced bone, scar tissue, or any other structure.

3. *To relieve pain in a nerve*, when this persists and cannot be got rid of by other means. This operation consists of injections into the nerve, or even severance, or removal of some part of it ; e.g., the Gasserian ganglion is sometimes removed in cases of trigeminal neuritis (tic douloureux).

4. *To join the central end of a healthy nerve to the peripheral end of a degenerate one.* This is known as nerve anastomosis (*see* p. 130).

Nerve Suture

It often happens that we are asked to treat lesions of peripheral nerves after this operation. At the operation, the two ends of the nerve are located. There may be a considerable gap between them, or they may be deeply embedded in scar tissue, from which they have to be freed. The central end is cut back for a short distance in order to remove the degenerate part. The sheaths of the two ends are sewn up all round with small stitches, and sometimes one large stitch is taken through the whole nerve. In some cases the nerve is wrapped in a piece of fascia to prevent adhesions from forming round it.

These operations are undertaken if the nerve is known to have been severed in an accident, paralysis having appeared immediately afterwards, or if a paralysis shows no sign of improvement about three months after its onset. If the operation is performed at once, it is known as *primary suture* ; if after an interval, as *secondary suture.*

PROGNOSIS AND COURSE OF RECOVERY.—Some nerves regenerate more readily than others ; the musculospiral nerve recovers more satisfactorily than the median or the ulnar. Primary suture is more successful than secondary ; the longer a nerve is left ununited, the worse are its chances of full recovery. The rate of recovery varies according to the site of the lesion ; a nerve severed near its termination will recover much sooner than if it were severed high up. If sepsis be present, regeneration is delayed (Purves-Stewart).

As the nerve recovers, protopathic sensation returns first ; then epicritic sensation and motor power, almost simultaneously ; or the epicritic sensation slightly in advance of the power of movement (*see* pp. 110, 111).

After a primary suture, protopathic sensation may begin to return in about six weeks, epicritic sensation and motor power in about six months (Purves-Stewart).* If there is no return of power by the eighth month, there is not likely to be any later, and the nerve is sometimes re-sutured.

After secondary suture, the prospects are not nearly so good. Epicritic sense and motor power do not return for nine months or a year, and their restoration is rarely perfect.

Treatment of a Case after Nerve Suture.—

SUPPORT.—The limb must be splinted in the correct position, with no drag on the nerve ; for an ulnar nerve sutured at the wrist the metacarpo-phalangeal joint would be flexed, the inter-phalangeal joints extended, the thumb adducted, and the wrist slightly flexed.

PHYSICAL TREATMENT.—

MASSAGE.—This may be given from the beginning to the muscles supplied by the sutured nerve, but the area of the wound must be given a wide berth, and any movements that could possibly drag on it are to be avoided. Nerve massage—frictions or vibrations—is of no use until the nerve is regenerated, and should not be begun until signs of motor power appear.

PASSIVE MOVEMENTS.—Any movements that do not stretch the nerve may be given from the beginning, but *no strong movements are permissible for from 6 weeks to 2 months.* For example, in the case of suture of the ulnar nerve cited above, the fingers may be moved, and the wrist may be further flexed, but *not* extended. The elbow may be gently extended with the wrist in *full* flexion, but the movement must be *relaxed,* and not *forced.* Pronation and supination may be given *gently,* after the wound is healed (10 to 12 days). The shoulder-joint may be moved actively with the elbow flexed. Most of

* *Peripheral Nerve Injuries.*

the above movements should be done actively rather than passively as soon as possible. Really strong passive movements are only given after 2 months or more, when the union of the two ends of the nerve should be firm, if the operation has been successful.

ACTIVE MOVEMENTS.—The masseuse must watch for the first signs of returning movement, and as soon as these appear, re-education will begin. Anyone who specializes in these cases will find them most interesting. She will watch for the appearance of the protopathic sensation, map out its extent, and note its gradual spread; she will notice likewise the appearance and increase of the epicritic sense; and from that moment will begin to expect the return of the power of movement. She will re-educate the patient in the use of each affected muscle, and will finally restore the function of the limb by co-ordination exercises.

CHAPTER XIII

NEURITIS AND NEURALGIA. CRAMP

I. Neuritis and neuralgia: Brachial neuritis—Intercostal neuralgia or neuritis—Sciatica—Multiple neuritis. II. Cramp.

I. NEURITIS AND NEURALGIA

TRUE neuritis (inflammation of a nerve), as distinguished from neuralgia, is of two kinds: (1) *Interstitial neuritis*, that is, inflammation of the sheath and connective tissue of a nerve, the axis cylinders not being inflamed, but only compressed. (2) *Parenchymatous neuritis*, or inflammation of the axis cylinders themselves.

STRUCTURE OF A PERIPHERAL NERVE.—A peripheral mixed nerve is composed of: (1) The axons of cells in the anterior horns of the spinal cord, i.e., *motor fibres*. (2) Fibres taking their origin in the ganglia on the posterior nerve-roots, i.e., *sensory fibres*.

Each of these fibres has its own medullary sheath and neurilemma. Between the fibres lies connective tissue called the *endoneurium* (Greek, *endon* = within); a delicate sheath binds the axons into bundles, and is known as the *perineurium* (Greek, *peri* = around); while another variety of connective tissue occupies the space between the bundles, and also forms the outer sheath of the whole nerve—this is the *epineurium* (Greek, *epi* = upon). (*Fig.* 102.)

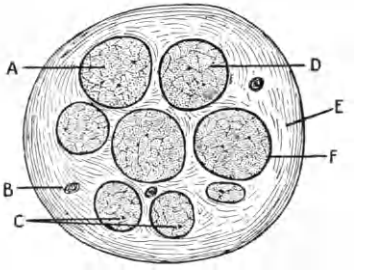

Fig. 102.—Diagram of a cross-section of a nerve, showing its sheaths. A, Axons; B, Artery; C, Arterioles; D, Endoneurium; E, Epineurium; F, Perineurium.

The two outer sheaths—perineurium and epineurium—are sometimes both included under the term 'perineurium'.

Interstitial Neuritis.—

In *interstitial* neuritis, the inflammation affects the epineurium, perineurium, and sometimes the endoneurium; only in very severe cases are the axons or their immediate sheaths involved. This form is therefore sometimes—more correctly—known as *perineuritis*.

The *parenchymatous* type attacks primarily the axons, though the interstitial tissue generally shares in the inflammation.

CAUSES.—

PREDISPOSING CAUSES.—Neurasthenia, debility, or any weakening or exhausting diseases; or metabolic diseases, such as diabetes.

EXCITING CAUSES.—(1) *Trauma*, causing bruising or laceration of the nerve; e.g., fractures, dislocations, strains. (2) *Continued pressure* on the

nerve, due to its involvement in callus after a fracture; to pressure by displaced bone; to a cervical rib; to tumours; or to the pressure of crutches in the axilla. (The last, however, generally produces parenchymatous neuritis.) (3) *Poisons* from septic foci in the body, e.g., in the teeth, tonsils, or intestinal tract.

GENERAL SYMPTOMS.—The predominant feature of neuritis is *pain*, more or less intense according to the severity of the inflammation. It is due to pressure exerted on the sensory fibres by the congested tissues of the sheath. It may be acute, or dull and aching in character. There are usually tender points on the trunk of the affected nerve, and swelling of the nerve itself, if superficial, can sometimes be felt. The pain may be worst in the final distribution of the nerve, or all along its course. *Other disturbances of sensation*, such as paræsthesiæ (p. 112) arise in serious cases. If motor fibres are irritated, there may be *twitchings* of muscles. Atrophy and paralysis do not occur unless the inflammatory process has spread to the axons, and the neuritis has thus become a parenchymatous one. *Reflexes* are normal in a simple interstitial neuritis. *Trophic changes* may occur in skin and nails.

VARIETIES.—The forms of interstitial neuritis we are most often called upon to treat are the *brachial*, *intercostal*, and *sciatic* varieties. Neuritis of a purely motor nerve is generally of the parenchymatous type (*see* FACIAL PARALYSIS, p. 174).

Neuralgia.—

Since many of these patients are sufferers rather from neuralgia than from neuritis, it will be well at this point to consider the difference between the two conditions. Neuralgia ('pain in a nerve'—Greek, *neuron* = nerve, *algos* = pain) is not due to inflammation of the nerve itself, but either to pressure upon it, or to unhealthy conditions of the blood on which it depends for its nourishment, such as are found in anæmia, constitutional diseases, debility, malaria, or influenza. The pressure may be produced by scar tissue, tumours, rheumatic products (fibrositis), or muscle inflammation. (Any of these forms of pressure may, if long-continued, end by setting up a neuritis.) Neuralgia may also be a *reflex pain*, due to disease elsewhere in the body than at the part where the pain is felt. Such is the pain in the back in heart affections.

GENERAL SYMPTOMS.—The *pain* is of a shooting, throbbing variety, more intermittent than that of neuritis. There is *tenderness* in the affected part, but the nerves are not thickened or swollen. There may be *muscular twitching or tremor*, due to irritation of motor fibres, but never paralysis. *Trophic changes* are sometimes seen—excessive perspiration in the affected part; redness or pallor (due to irritation of the vasomotor nerves).

BRACHIAL NEURITIS

This is an intensely painful form of neuritis, and needs great care in treatment. One or more nerves in the arm may be affected, and tender spots are found at various points on their course—over the brachial plexus in the posterior neck triangle; in the ulnar nerve as it passes between the internal condyle and the olecranon process; in the median nerve in the antecubital fossa; or in the musculospiral nerve as it leaves the musculospiral groove. The patient is often neurotic, but it is often difficult to say whether the neurosis is partly the cause, or wholly the result, of the neuritis.

Treatment.—

MEDICAL OR SURGICAL TREATMENT.—This consists of search for, and treatment of, the cause.

PHYSICAL TREATMENT.—

THE ACUTE STAGE

REST AND SUPPORT.—The patient may be in bed for a time ; in any case the arm will be supported in a large sling.

WARMTH.—All sufferers from neuritis are intensely sensitive to cold. The arm and shoulder must be kept warmly wrapped up in cotton-wool.

WHIRLPOOL BATHS.—These will both improve the circulation and lessen the pain.

ELECTRICAL TREATMENT.—The most usual form is *anodal galvanism*. The forearm may be placed in a bath, and a large pad applied over the brachial plexus, the anode being connected with this pad, and the kathode placed in the bath.

THE SUBACUTE STAGE

When the inflammation has subsided sufficiently for the patient to be able to bear it, massage may be tried.

POSITION OF PATIENT.—He should be in bed, or on a chair, the arm being supported close to the side by pillows, or on a table with cushions. Warmth during treatment is essential. No part of the limb must be unnecessarily exposed ; except for the performance of effleurage or stroking, the massage may well be carried out under a light shawl, and the arm thus kept covered during almost the whole of the treatment. The room should be warm and without draughts.

MASSAGE.—At first, vibrations only should be given, with the flat hand, all down the arm, beginning in the neck over the brachial plexus. Reflex stroking, from shoulder to hand, may next be added, if the patient finds it soothing. Many, however, are unable to tolerate any form of stroking at this stage, and if this is the case, it should be omitted, and careful kneading tried instead ; but the latter must be a very gentle movement, light and slow, and not of a stretching type. In cases of brachial neuritis due to injury or rheumatism, the muscles also may be inflamed, and therefore any drag on them would be intensely painful.

THE CHRONIC OR CONVALESCENT STAGE

MASSAGE.—As improvement takes place, possibly about two months after the onset, nerve massage may be added, very cautiously at first, beginning over the plexus in the posterior neck triangle, and being continued down the whole course of the affected nerve or nerves. The manipulations used should be gentle finger-kneadings. By these, it is hoped both to break up any inflammatory products which may be compressing the nerve, and also to produce a condition of 'internal massage'—that is, one in which the muscle is made to massage the nerve beneath it, and, by this means, to help in the elimination of inflammatory products in the nerve-sheath itself.

PASSIVE MOVEMENTS.—As a case of neuritis improves, passive movements are required to prevent stiffness in the joints or contraction of the nerve-sheath. These should at first be given gently and by the *relaxed* method. In the final stages only may *stretching* movements be given, if necessary, and then only with great care.

ACTIVE MOVEMENTS.—Light active assisted movements should be begun as soon as possible. No date can be given for their commencement. The operator must use her own judgement, or consult the doctor. Small movements that cause no pain will be given first, and they should be very gradually increased in range, and others added in due course. Later, the movements may be free,

and exercises of the 'pendulum' type may be added. Finally, if all goes well, the patient proceeds to general arm exercises, free and resisted, to strengthen the muscles, and get rid of any stiffness due to immobilization of the limb.

Treatment of brachial neuritis is, unfortunately, not always successful. If the pain increases instead of diminishing, treatment should cease, possibly to be resumed at a later stage. Careful inquiries should be made as to the patient's sensations, say half an hour after the end of the treatment. In the later stages, some pain on active movement may be inevitable, though even then nothing should be done which could cause the inflammation to flare up again ; but the massage during the early stages is meant to soothe, and no painful manipulations are justified. To take any risks with an inflamed nerve is to court disaster.

Brachial Neuralgia

Brachial neuralgia is treated on the same lines, but progress is much quicker. Pressure, painful in neuritis, often relieves neuralgia ; effleurage and kneading may be possible from the beginning.

INTERCOSTAL NEURALGIA OR NEURITIS

This is encountered generally in the form of neuralgia, due to rheumatism, fibrositis, or trauma of the deeper layers of the back or intercostal muscles. Rheumatism in either of these groups may, of course, exist without producing a neuritis or neuralgia, tenderness with sharp pain on movement, or aching during rest, being present throughout the affected muscles.

SYMPTOMS.—The principal symptom is a *sharp neuralgic pain*, especially noticeable when the patient takes a deep breath, since the act of inspiration stretches the intercostal nerves. The pain is generally unilateral, or worse on one side of the body than on the other : in severe cases, backache may be troublesome. There are *tender thickenings in the muscles* in fibrositic cases, or a definite area of tenderness in the traumatic variety. *Tender points are also to be found on the nerves*, especially at the places where their cutaneous branches emerge : (1) Near the spinous process (posterior primary divisions). (2) In the mid-axillary line (lateral cutaneous branches of intercostal nerves). (3) Near the sternum (anterior cutaneous branches of intercostal nerves).

Treatment.—

PHYSICAL TREATMENT.—

POSITION OF PATIENT.—The patient should lie on his sound side, in a comfortable position, supported by pillows. If both sides are affected, he may lie first on one side and then on the other. Warmth is important.

MASSAGE.—This should begin with *soothing strokings* over the painful area. It is most convenient to begin the strokings from the region of the sternum, carrying them as far as the mid-axillary line—the mammary gland in women being, of course, avoided—after which the back of the thorax is similarly treated, the stroking being carried from the vertebral column to the mid-axillary line. This should be followed by careful *kneadings* over the whole region. Since the condition is generally of rheumatic origin, these should be as deep as the patient can bear them—though their strength may have to be modified in some cases.

Next, *frictions* should be given, to break up rheumatic products. These should be taken from end to end of each intercostal space—except, of course, where this is impossible because of the overlying scapula—and also on the deep muscles on either side of the thoracic spine, as well as on any others in the neighbourhood in which fibrositic nodes can be detected. Special attention

should be given to the points of exit of the nerve branches. After the frictions, the kneading is repeated, to assist elimination of these products; *effleurage* towards the axillary glands follows, and the séance ends with stroking, or *fine vibrations*.

EXERCISES.—A few days later, if all has gone well, *gentle active trunk exercises* may be begun. Free side-bendings—to both sides—trunk-rotations and back-raisings should be employed. *Deep breathing* will be added as the pain decreases, but should not be required of the patient in the early stages. When the pain has gone, *mobility* exercises for the thorax, and breathing exercises of all kinds should be given before the patient ceases treatment.

TRIGEMINAL NEURALGIA

For a description of this condition *see* RHEUMATISM, Chapter XVIII.

SCIATICA

A name usually given to any painful condition of the great sciatic nerve. It may, in fact, be a *neuralgia* or a *neuritis*, the former due to pressure on the nerve from whatever cause, the latter consisting of an inflammation of the sheaths or connective tissue surrounding the axons themselves. In some very severe cases the inflammation may spread to the axons, and set up a parenchymatous neuritis.

ETIOLOGY.—The causes of sciatica are many and various, and it is often very difficult to find any cause at all. The following are some of the best known :—

POISONING.—A *neuritis* may arise as the result of poisoning, bacterial, chemical, or metabolic. Gout, diabetes, or alcoholic poisoning may be responsible.

FIBROSITIS in the gluteal or lumbar muscles is certainly one of the commonest causes (*see* Chapter XVIII), and may arise from chill, overstrain, or a focus of infection somewhere in the body. The thickenings in the muscles press on the sciatic nerve—in the case of a *lumbar* fibrositis, the pressure may fall first on the emerging lumbar nerves—and the inflammation may later spread into the nerve-sheath, setting up a true perineuritis.

ARTHRITIS of the lumbar spine, sacro-iliac joint, or hip-joint; a most troublesome form.

BONE DISEASE in the same regions (tuberculosis, etc.).

STRAIN, CHILL, OR OVER-EXERTION, especially sacro-iliac strain.

TUMOURS IN THE PELVIS, PREGNANCY, SEVERE AND CHRONIC CONSTIPATION—all of them conditions which tend to cause pressure. Constipation generally sets up left-sided sciatica, the contents of the pelvic colon pressing on the left sciatic nerve.

PATHOLOGICAL CHANGES.—In a sciatic *neuralgia* pure and simple, there are no changes in the nerve, only in some other neighbouring structures, e.g., muscles. In a *neuritis*, the typical changes of interstitial neuritis occur (*see* p. 179).

SYMPTOMS.—

PAIN.—The chief symptom is pain, coming on suddenly or gradually. It is described as a 'gnawing' or 'burning' pain, and may be continually present, or may occur in paroxysms. It is often extremely severe, especially at night. It is worse in any position that causes *pressure* on the nerve (e.g., in sitting), or *stretching* of it. The patient, if in bed, lies on his side, with hip and knee bent, and ankle plantar-flexed.

Distribution of Pain.—The pain often begins in the lumbar region or in the hip-joint, and tends to spread downwards. It may never reach below the knee, and is generally worse at the back of the hip and thigh; but it may involve any, or all, branches of the nerve in its whole course.

TENDERNESS.—Specially tender points are: (1) The point where the nerve emerges through the great sacro-sciatic notch (at the junction of the lower and middle thirds of a line from the posterior superior iliac spine to the outer part of the tuberosity of the ischium—this point can generally be found by looking for the highest point of the gluteal mass as the patient lies prone). (2) Half way between the ischial tuberosity and the great trochanter where the nerve emerges from beneath the gluteus maximus, lying over the neck of the femur. (3) Sometimes all down the back of the thigh, as far as the popliteal space. (4) There may, in cases of very extensive inflammation, be tender points on the external popliteal nerve (at the head of the fibula); the internal popliteal nerve (in the popliteal space), the posterior tibial (below the internal malleolus), the external saphenous (alongside the tendo Achillis), or the plantar nerves (in the sole of the foot). There may also be paræsthesia.

LASÈGUE'S SIGN.—If the knee is kept in full extension and the foot dorsi-flexed, the hip cannot be flexed to any extent without causing great pain, this being brought about by the direct stretching of the nerve. It is the same if the trunk is the part moved—the patient cannot bend forward from the hips when standing, or assume the long-sitting position.

GAIT.—To avoid stretching the nerve, the patient, in a severe case, walks on the toes of the foot of the affected side, with plantar-flexed ankle, the hip and knee being kept bent. This produces a limp. He may suffer great pain while walking. Often the only positions in which the patient is at all comfortable are kneeling, and lying on his side with hip and knee bent and foot plantar-flexed.

In chronic cases there may be considerable *wasting of muscles*, and weakness of the leg. Occasionally there may be *cramp* and *fibrillary tremors*. *The ankle-jerk may be lost.* (The knee-jerk may be increased or normal, but is rarely lost.) In rare cases there is *reaction of degeneration*. All these symptoms denote an extension of the trouble to the axons. A definite paralysis or anæsthesia is very unusual.

COURSE OF THE DISEASE.—This varies according to the cause. An attack due to acute myositis or fibrositis which has extended to the nerve may clear up completely in a few weeks. The majority of cases are far more troublesome, and the trouble persists for months or years, or becomes chronic, with occasional acute attacks. The severest cases of all, fortunately not very common, in which the patient becomes bed-ridden, are most distressing. These are mostly cases where the cause for some reason cannot be located or removed.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—In severe cases, the patient should rest in bed for a time in the most comfortable position possible, should be kept warm, and have good and nourishing food. Some doctors keep the limb fixed in plaster for some time, and this sometimes has excellent results.

COUNTER-IRRITATION.—Blisters over the nerve are sometimes tried.

INJECTIONS of various substances into the nerve may be given.

SEDATIVES are administered if necessary.

PHYSICAL TREATMENT.—Much difference of opinion has arisen in regard to these cases. The author is personally of the opinion that for the purpose of physical treatment they should be divided into two classes: CLASS 1, consisting

of all the *neuritic* or *perineuritic* conditions, due to whatever cause; and CLASS 2, comprising the *neuralgic* conditions due to fibrositis or myositis.

CLASS 1—NEURITIS

These cases should not, in the early stages, or indeed as long as there is pain, be treated by massage or exercises at all. Radiant heat, galvanism, or other forms of electrical treatment may be possible, but the nerve should have complete rest, and to touch it or stretch it is to 'ask for trouble'.

When all inflammation is gone from the tissues, pain has ceased, and all that is left is stiffness and weakness of the limb, exercises may be given to mobilize and strengthen. A medical man, in a lecture to the Chartered Society, once suggested that any masseuse, asked to treat a case of true perineuritis, should immediately take influenza, and hand the case over to her dearest enemy! There is much wisdom in this advice. These cases should undoubtedly be treated with the greatest caution.

CLASS 2—NEURALGIA

These cases, due to chill, rheumatism or overstrain, etc., which have set up an inflammation in the muscle fibres or connective tissue, are in a different category altogether. That is not to say that they are to be approached light-heartedly—no case of sciatica, or indeed any disease involving a nerve, should be so treated. Nevertheless, it is possible to begin massage and exercises at a much earlier date, provided the masseuse is prepared to exercise due care and watchfulness. The *chronic* cases will derive very much benefit from proper treatment by physical methods. The following outline, therefore, applies to these fibrositic cases, though similar exercises may be given to the patients of CLASS 1, at the late stage mentioned above.

Acute Stage

No massage or movements should be given.

HEAT.—Dry heat is best, produced by hot-water bottles, or radiant heat. The effect of the latter should be carefully observed. The patient must be covered up at once when the bath is removed, and all risk of chill avoided.

ELECTRICAL TREATMENT.—*Galvanism*, or other forms of electrical treatment, may be given.

Subacute Stage

MASSAGE.—If begun now, this should consist only of vibrations, and very light kneadings. The patient should lie on his sound side, in a comfortable position, with hip and knee flexed. He should be kept warm, the leg being covered by a light blanket or shawl, and the operator working with her hands under it. *No pain should be caused.* The vibrations are given along the course of the nerve as far as the popliteal space, or as far down as the pain extends. The kneadings are given very gently on both sides of the lumbar spine, a little more firmly over the gluteal muscles, and very gently on the thigh. It is advisable to begin by treating the front and sides of the thigh before touching its posterior aspect.

ELECTRICAL TREATMENT may be continued during this period, generally in the form of *diathermy*.

Late and Chronic Stages

POSITION OF PATIENT.—As soon as he can do so without discomfort, the patient should lie prone, a fair-sized pillow being placed beneath the foot to keep the knee flexed and so relax the tension on the nerve. As he improves,

smaller and smaller pillows may be used. If, however, this position is painful, he may lie on his side as in the earlier stages, and progress to prone-lying later on.

POSITION OF OPERATOR.—If the patient lies on his side, the operator may stand either on the side to which he faces, or behind him. With a low bed or plinth, it is easier to work in the former position.

MASSAGE.—

Lumbar Region.—Both sides of the back should be treated. Some degree of fibrositis may be present on both sides. Light kneadings may be given, using one hand only at a time to avoid any drag; then frictions on either side of the vertebral column and, finally, light effleurage.

Gluteal Region.—Effleurage may be firm in this area, since here the nerve lies deep beneath the muscles; it is followed by kneading and picking up of the glutei, raising them well up off the nerve, and not pressing them down heavily on to it. All kneadings in sciatica should be of this kind.

Any tender thickenings in the muscles should now be sought. They are often found round the iliac crest or near the spines of the ilium where so many muscles have their origin, or near and over the sacrum, but they may be anywhere. Deep frictions should be given to the thickenings with finger or thumb, working carefully round each one from circumference towards centre. These frictions should be firm, but not jerky or over-forcible. Frictions over the nerve as it leaves the notch, and as it emerges from under the gluteal fold are given in a similar manner; and, finally, kneading and effleurage, to disperse and carry away the broken-down products. Students should make sure of the position and surface marking of the nerve.

Back of Thigh.—Similar treatment is carried out, frictions being given down the course of the nerve as it lies beneath the biceps femoris. We have to remember that after the nerve has divided at the upper angle of the popliteal space, the two branches lie on bone beneath skin and fascia; therefore our frictions must be given rather more gently in that region. Should the pain extend lower than this, treatment on the same lines is applied to the lower parts of the leg, or to the foot.

PASSIVE MOVEMENTS.—

Nerve Stretching.—Adhesions will have formed round the nerve, and in the case of a true perineuritis, within its sheath. It is necessary to stretch these, but it must be done gradually and carefully. To 'break down adhesions'—a thing which, as a matter of fact, a masseuse very rarely does in any case, and which needs considerable courage, skill, and experience to do successfully—would be most undesirable here. Nerve stretching is generally carried out by placing the patient in the supine position, holding the knee in extension, the foot in dorsiflexion, and gradually flexing the hip, as if one were trying to elicit Lasègue's sign. At the point where pain occurs, the leg should be held in the position it has reached for a few seconds, with a gentle over-pressure, and then replaced on the plinth.

ACTIVE MOVEMENTS.—

Gentle active movements are also started. The patient may begin by using muscles not innervated by the sciatic nerve (glutei and quadriceps), and may perform Crook-half-lying 2-Knee-abduction and -inpressing, quadriceps contractions, and Crook-lying Alternate knee-extension. He may then begin to use the hamstrings, beginning with Lying Leg-forward-drawing and -backward-carrying. Abdominal contractions and back-raisings will mobilize the lumbar spine. All these are suitable for the patient while still in bed. Relaxation exercises may well find a place in the scheme—especially if there has been inflammation in the lumbar region.

When able to get up, he continues these or similar exercises, to stretch the nerve-sheath and strengthen the muscles, and gradually goes on to stronger ones, such as High-back-lean-standing Leg-forward-drawing and -hackward-carrying, General correcting position, Wing-standing Trunk-falling-forward and -raising, Standing Forward- and downward-bending, Heave-grasp-crook-lying Alternate leg-lifting, Half-yard-grasp-standing Leg-swinging forward and backward. Later still, strong nerve stretching such as Heel-support-standing Forward-bending, may be added.

Relaxation exercises should be continued throughout the course of treatment; anyone who has had neuritis tends instinctively to hold his or her muscles in contraction. This in the first place is a protective reflex (like muscle spasm after a fracture), designed to immobilize the part and thus minimize the pain. The patient may be taught to relax the hip muscles by being made to stand on a low stool (half-yard-grasp-standing), and swinging the leg gently and rhythmically backwards and forwards in small range, with as little muscle work as possible. Gradually, all contraction should go out of the muscles and the leg hang in complete relaxation. He should also be shown how to relax when lying down. (For suggestions as to this, *see* NEURASTHENIA, p. 195.)

Other Varieties of Sciatica

Many forms of sciatica, as those caused by septic foci, by certain poisons, by pregnancy, tumours or constipation (*see* p. 183), tend to disappear as soon as the cause is removed by medical or surgical means. In such cases, the patients, if sent for treatment, require primarily massage and active exercises to strengthen the muscles and restore the function of the limb. Relaxation exercises should also be given.

Sometimes, in arthritic cases, the hip or some other joint may be manipulated, or open operations may be performed on it. The masseuse who undertakes the post-operative treatment should ascertain the exact intentions of the surgeon with regard to the joint (e.g., whether it is to be fixed or mobile, and, if the latter, to what extent), and should carry out scrupulously any instructions he may give as to the nature and range of the movement permitted. Apart from any modifications thus required, the treatment may be on much the same lines as that described above (*see also* OSTEO-ARTHRITIS, p. 94).

MULTIPLE NEURITIS

This consists of an inflammation of the peripheral nerves due to some form of poisoning.

ETIOLOGY.—Neuritis of this type is always due to some kind of poison in the blood. These poisons may be: (1) *Extrinsic*, consisting of poisonous chemical substances which enter the body in various ways, as by ingestion, or inhalation: such as alcohol, arsenic, lead, etc. (2) *Bacterial*: the toxins of diphtheria, influenza, etc. (3) *Such as are formed in the body as the result of disordered metabolism*, for instance in constitutional diseases, such as gout or diabetes. Neuritis of this kind also occurs after long periods of over-exertion, or in connection with anæmia or debility.

PATHOLOGICAL CHANGES.—This form of neuritis is both *interstitial* and *parenchymatous*—that is, it attacks not only the sheaths, but the axons as well. The sheaths are acutely inflamed, and press on the sensory fibres, causing intense pain. The axons undergo degenerative changes (*see* p. 105) resulting in paralysis of the muscles, and anæsthesia.

VARIETIES.—The type most commonly encountered in hospital work is the *alcoholic*. We may also meet with the lead-poisoning cases, more rarely

with those due to arsenic; cases of neuritis due to overwork and debility appear occasionally. The post-diphtheritic type is rarely sent for treatment.

We shall first of all describe the clinical features of the different forms, and afterwards deal with the subject of treatment.

Alcoholic Neuritis

SYMPTOMS—

Onset.—This is generally *gradual*. The acute form, starting abruptly with high fever, quickened pulse, and sudden paralysis extending from the nerves of the limbs to the phrenic and vagus nerves, is far less common, and is often fatal, the patient dying of respiratory or cardiac failure. The more ordinary form has a long course, but generally ends in complete recovery.

Sensory Symptoms.—(1) *Paræsthesia* is an early symptom, tingling and numbness being felt in hands and feet. (2) *Pain*: shooting or aching pains in the nerve trunks, and great tenderness in the muscles. (3) *Anæsthesia, to light touches* in hands feet. and lower legs.

Motor Symptoms.—Spreading paralysis, affecting the arms and legs more or less symmetrically on both sides of the body. The terminal branches of the nerves are first affected, so that the hand and forearm muscles, and those of the foot and lower leg, are the first to be paralysed. Other muscles, as the quadriceps, may suffer later. *Extensor* muscles are more seriously affected than *flexors*, producing wrist-drop and foot-drop. In alcoholic neuritis the feet are involved before the hands, and recover much more slowly.

The Reflexes are lost in the affected parts.

Reaction of Degeneration is complete or partial.

Trophic Changes.—There is atrophy of muscles, and characteristic changes in the skin (*see* pp. 106, 107, *and* 110).

Contractures and Deformities tend to occur.

The type of multiple neuritis due to debility, anæmia, etc., closely resembles the above.

Lead Neuritis

This occurs in those occupied in trades where lead is much used, as painters, plumbers, etc.

SYMPTOMS.—*The extensors of the wrist are principally affected*, producing wrist-drop. This is said to be because in many of these workers there is constant strain on these muscles entailed by the use of brushes and hammers (Purves-Stewart). The supinator longus and extensor ossis metacarpi pollicis, for some unknown reason, are rarely affected, though supplied by the same nerve as the others. The feet generally escape. There is hardly ever any *pain* in this form.

Arsenic Neuritis

This occurs in workers in trades in which arsenic is used—certain colourings contain this poison; or, occasionally when too much of the drug has been taken in medicine.

SYMPTOMS.—Arsenical paralysis resembles the alcoholic type in many ways. The most important signs are: (1) *Marked sensory symptoms*, paræsthesia, anæsthesia, and pain. (2) *The feet* are more affected than the hands, though both may suffer. (3) *Skin eruptions* are a prominent feature.

Both lead and arsenic poisoning have many symptoms other than those of neuritis; but with these we are not concerned.

Post-diphtheritic Neuritis

This appears *after recovery* from diphtheria.

SYMPTOMS.—

ANÆSTHESIA AND PARALYSIS OF THE SOFT PALATE, causing indistinct speech, and difficulty in swallowing, fluids regurgitating through the nose because the paralysed soft palate hangs inertly and cannot shut off the nasal cavity from the throat.

EYE SYMPTOMS.—The power of accommodation is lost and there may be diplopia, or double vision, the patient seeing two images, a false and a true one. This is due to paralysis of the intrinsic muscles of the eye. There may also be a squint.

THE LIMBS OR THE VAGUS NERVES are sometimes affected.

PROGNOSIS.—This is good in all these forms, complete recovery being the rule. Occasionally one or more muscles remain weak or powerless. The recovery, however, is often very slow, and a year or more may elapse before it is complete. Vagus involvement is the chief danger.

Treatment (e.g., for an alcoholic case).

EARLY PERIOD

GENERAL TREATMENT.—The patient is kept in bed, with suitable and nourishing food, and appropriate medical treatment. Our aims at this stage are: (1) To prevent contractures and deformity by affording proper support to the limbs, and maintaining mobility in the joints. (2) To relieve pain.

SUPPORT.—Appropriate splints should be provided; this point is too often neglected. *Cock-up splints* should be used for the hands, and '*bed-boots*', or, better still, light '*tin-shoes*' for the feet. As a rule, these need not come above the knee. *Sand-bags* are often used to support the feet, but these are unsatisfactory, for if the patient turns on to his side or pulls himself up in the bed, the feet may be left unsupported. If they have to be used temporarily, a cradle should be provided, and great care should be taken to see that the toes are not pressed down, or a rigid hallux flexus may result, as well as trouble with the other toes.

PHYSICAL TREATMENT.—

ELECTRICAL TREATMENT.—Radiant heat and the constant current may be used to relieve pain.

MASSAGE AND MOVEMENTS.—As soon as the patient can bear it, very gentle massage may be tried, consisting at first only of vibrations, and possibly light kneading and reflex stroking. Passive (relaxed) movements should be given, when possible, especially to the lower extremity. Contractures are rare in the arms, but can be very troublesome in the legs, feet, and toes. The toes should be moved gently at all joints, and the ankle brought into full dorsi-flexion (the calf-muscles are rarely paralysed). If both the anterior tibial group and the peronei are affected, the foot must not be brought into *full* inversion or eversion, but moved carefully in a small middle range, inversion, the more important movement, being carried a little further than eversion.

LATE PERIOD (STAGE OF RECOVERY)

To our earlier aims, we now add that of *re-education in movement* as soon as power returns.

SUPPORT.—The splints are retained as long as necessary. The feet should be splinted *at night* until the muscles are quite strong. The hand splints may be removed much sooner. (N.B.—The reverse is the case in lead poisoning.)

PHYSICAL TREATMENT.—

MASSAGE.—This may be strengthened as the patient improves. When all

tenderness has passed away from the nerves and muscles, the light, brisk, stimulating movements suitable for a typical lower motor neuron lesion may be used. The masseuse must not be in a hurry, however; the treatment must never be painful. Nerve frictions and vibrations, and hacking, are added as the nerves recover, and the atrophied muscles begin to fill out again.

As a rule the limbs only are treated. Dr. Mennell recommends general massage for cases of lead and arsenic poisoning. This would, undoubtedly, be most beneficial to the patient, but, unfortunately, when all four limbs have to be massaged, and re-education exercises practised as well, time is apt to fail one. Abdominal massage, at least, may be given once or twice a week.

PASSIVE MOVEMENTS.—These must be continued. When the muscles are sufficiently recovered to bear stretching, the last degrees of mobility must be regained by forced movements.

RE-EDUCATION EXERCISES.—In order to carry these out successfully, the masseuse must know exactly how things stand with her patient. Accurate knowledge of anatomy is essential, for she has to determine which muscles are paralysed, and which nerves—or nerve branches—are out of action. No two cases are alike, nor are the two arms, or legs, of the same patient always similarly affected. Variations are common in the debility type of neuritis. For instance, though the extensors of wrist and fingers are nearly always in trouble, the muscles supplied by the median nerve may be affected in one hand, and those supplied by the ulnar nerve in the other; or both these nerves may suffer on one side, and one on the other. Having ascertained precisely what is wrong, and, if possible, tested the muscles electrically, the masseuse will proceed to deal with the situation, exercising each recovering muscle, eliminating 'trick' movements (*see* pp. 160, 161, 164), watching closely the progress of recovery, and pointing out the signs of improvement to a patient who may well be depressed and discouraged by the length of his illness. Particular care is required when two antagonistic muscles, or groups of muscles, are paralysed, e.g., tibialis anticus and the peronei, or opponens pollicis and the extensors of the thumb. Like the passive movements, the active ones must at first be given in *middle range*, so that neither group may be stretched.

The same general rules must be observed as in any other lower motor neuron lesion (*see* p. 128). For exercises, *see* those suggested for individual nerve lesions (Chapter XII).

Order of Recovery of the Muscles.—Of the extensors in the forearm, those of the wrist generally recover first, then the extensor communis digitorum, and, finally, the extensors of the thumb. In the legs, either the extensor longus hallucis or the tibialis anticus may be the last to regain power.

FARADISM may now be used with advantage.

CO-ORDINATION EXERCISES.—When the recovery of individual muscles is well advanced, the patient must be taught to co-ordinate his movements, and use the limbs normally.

The Hands.—The fine movements of the hands are difficult to regain. When once he has mastered the more difficult exercises in the lists, the patient may practise the following actions: Writing; handling of small objects; threading of large beads on string; tying each bead on to the string with a knot; knitting and crochet with large needles and coarse wool; threading beads with needle and cotton; use of knife and fork. In the case of a woman: sewing with wool on coarse canvas—cross-stitch with a blunt wool needle; then sewing with a large darning needle on soft material; progress to finer sewing; use of scissors, making buttonholes, threading needles, cutting out pictures, etc. In the case of a man, sewing may be replaced by any fine movements he is accustomed to perform.

Re-education in Walking.—This must not be begun too soon, that is, until the invertors have regained sufficient strength to prevent a bad standing position. The calf muscles, meanwhile, must not have been neglected. Exercises in sitting will be given first. Then the patient is allowed to try and stand, with support, the weight on the outer sides of the feet. A little later, he takes single steps forward and back, and re-education gradually progresses in the usual manner, but very slowly. A 'valgus wedge' (*see* p. 172) should be worn on the shoes for some time, and the patient should be carefully watched for signs of flat-foot.

A course of general exercises may well be given at the conclusion of the patient's treatment.

II. CRAMP

A spastic condition, due to over-contraction of the muscles, without relaxation —in other words, a *tetanus*. The name cramp is generally given to the *tonic* variety of spasm—that is, to a condition of fixed spasm—rather than to a series of spasmodic jerks (*clonic* spasm).

ETIOLOGY.—Cramp is a symptom, not a disease in itself. It is due either to irritation of a nerve by pressure, or to increased excitability in a motor nerve which for some reason is in poor condition. The general health may be at fault, but some kinds of cramp appear in people who seem to be otherwise quite healthy. It sometimes accompanies rheumatism.

Cramp very frequently occurs in the calf muscles, or in the sole of the foot (interossei), and sometimes in the sternomastoid (in rheumatic torticollis), the quadriceps, or the abdominal muscles. Other muscle-groups are also attacked, but less commonly.

Gastrocnemius Cramp

Gastrocnemius cramp, or cramp in the calf muscles, is a form which has been experienced by most people at some time or another, generally while in bed at night. It is brought about by *an over-strong plantar-flexion of the foot*, whether passive—produced by the pressure of heavy bed-clothes—or active. The patient's health may be otherwise good. There may be, however, deep (intramuscular) varicose veins in the calf.

A similar condition is the very dangerous cramp which is sometimes the cause of a bathing fatality. Strong work of the leg muscles and the coldness of the water produce cramp of some muscle-group in the leg, and disable the swimmer.

SYMPTOMS.—There is *intense tonic spasm of the gastrocnemius*, which feels as hard as iron. *The pain is very severe* during the attack. The muscles are sometimes tender in the intervals between the attacks.

Treatment.—

PHYSICAL TREATMENT.—

During the Attack

When an attack of cramp occurs, anyone present should try to stretch the affected muscle group. In this case, the *knee should be straightened and the ankle dorsiflexed.* The patient is generally unable to reach his foot to do this for himself, and it is impossible for him to dorsiflex it actively against the spasm of the powerful calf muscles. (Anyone subject to this form of cramp at night generally rises and tries to walk, since, when he is putting his foot to the ground, the ankle is dorsiflexed by the weight of his body.) If a skilled worker is present, she may add soothing strokings and rhythmic kneading.

If the cramp affects the *quadriceps*, the knee should be *fully flexed.*

Between Attacks

Massage.—Deep massage of the affected limb or limbs is given, with precautions as regards varicose veins, if such be present (*see* Chapter XX). Bandages to support the veins should be worn if any of the latter are superficial.

Passive and Active Movements.—These are given to all joints, the movement that causes the cramp not being carried to the limit. Flexion of the knee should be given with the ankle dorsiflexed. The patient should not plantar-flex the ankle strongly, nor should the operator carry this movement to its extreme limit passively, since it is this plantar-flexion which generally brings on the contraction of the gastrocnemius, and not flexion of the knee. Apart from this, all free active exercises are good for this condition.

If the patient is weak or debilitated, general massage and graduated exercises are necessary.

CHAPTER XIV

FUNCTIONAL NERVOUS DISEASES

Neurasthenia—Hysteria—Spasmodic torticollis—Occupation neuroses—Epilepsy.

THE study of functional nervous disease is most interesting, but as, generally speaking, it is the affair of the psychologist rather than of the masseuse, we can do no more here than consider briefly some of its physical manifestations and their treatment as far as these concern us as medical gymnasts.

Broadly speaking, we meet with two types, the neurasthenic and the hysterical. The former—that is, if it is understood to mean merely nervous exhaustion uncomplicated by any hysterical element—derives great benefit from physical treatment, and may be dealt with by any worker temperamentally suited to cases of this kind. The latter needs skilled psychical treatment, and unless such is forthcoming, exercises may be useless, and massage often definitely harmful.

Certain conditions, such as spasmodic torticollis and the so-called occupation neuroses, appear to be partly physical and partly psychical in origin. Sometimes one of these elements preponderates, sometimes the other.

NEURASTHENIA

ETIOLOGY.—

PREDISPOSING CAUSES.—The neurasthenic condition generally arises after a long period of overwork, overstrain, worry, or emotion. There is in all of us a certain amount of nervous potential or force (Mennell). In some people it is exhausted sooner than in others, but there is a certain point in every human being when the limit of endurance is reached. Many people have been working heroically against terrific odds for years before the breakdown comes. As Dr. Mennell remarks, the neurasthenic is not a person to be despised, but on the contrary, is often much to be admired.*

EXCITING CAUSES.—These consist of: (1) Various infective diseases, such as influenza; gastric or intestinal diseases; organic nervous diseases (tabes, disseminated sclerosis, neuritis); or constitutional diseases. (2) Traumas, or shocks connected with accidents (an example of 'traumatic neurasthenia' is the development of 'railway spine' after a railway accident). (3) Drug-taking. (4) Eye-strain.

SYMPTOMS.—

ONSET.—This is gradual.

PSYCHICAL SYMPTOMS.—The patient is *depressed*, *introspective*, and *self-centred*. He cannot take his mind off his symptoms, which in most cases he discusses continually with anyone who will listen to him. He is nervous, irritable, and subject to fits of anger without adequate cause, and finds himself unable to concentrate on what he is doing.

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* *Principles and Practice of Massage.*

BODILY SYMPTOMS.—These vary in different individuals. In traumatic neurasthenia, they centre round the part which was the site of the injury. If the condition is not due to trauma, the patient suffers from a vague form of ill health. He becomes very tired and often perspires profusely on slight exertion; the muscles both of the limbs and eyes are weak and easily exhausted. He often complains of *pains in his back or head*, or of severe headache. *The pulse is quick*, and *the blood-pressure low* (from weakness of the heart-muscle, and loss of tone of the muscle-fibres of the walls of the vessels). There may be other circulatory symptoms, such as *palpitations* and *coldness of the extremities*. *Indigestion* and *constipation* are usual features. There may be *tremors* in the limbs, but never real paralysis or anæsthesia, unless the patient is *also* hysterical.

INSOMNIA is an almost invariable symptom, mainly due to the patient's inability to relax his muscles. If the nerves are exhausted, they become over-excitable, and thus the muscles are kept in a continual state of over-tone because of the messages constantly brought down to them by the irritable nerves. Mind and muscles, it must be remembered, react on each other, and a person in a state of anxiety can never relax. On the other hand, if we can induce muscle relaxation, we shall be able to do much towards calming the mind. The fact of this connection between muscular contraction and mental tension is too often forgotten.

Treatment.—

GENERAL TREATMENT.—Neurasthenic patients used at one time to be sent for a 'rest-cure', which meant a course of *Weir-Mitchell treatment*. This consisted of complete rest in bed with special diet, the patient not being allowed to see anyone except the doctor, nurse, and masseuse, or, in some cases, even to read. A modified form of this treatment is now more often adopted. The patient remains in bed for a certain time, say a month. He must be removed from his customary surroundings, and visitors, if allowed at all, should be rare. Relatives are generally best excluded, since they tend to remind the patient of the worries of his ordinary life; and they should be requested not to write too often to the patient, or at least to refrain from worrying him by their letters—or telling him to 'pull himself together'.

The *diet* should be very nourishing, but the patient should not—as under the old regime—be forced to eat, but rather persuaded to do so. His appetite will improve gradually with his general health.

In less severe breakdowns, a holiday in the country or by the sea, with congenial surroundings and occupations, and with freedom from anxieties, will often effect a cure.

PHYSICAL TREATMENT.—Our aims in such cases are, first, to teach the patient to relax, in order that he—or she—may be able to rest; secondly, when the stage of exhaustion is past, to strengthen the muscles, and tone up the whole body.

EARLY STAGE

The patient—more often a woman—is at first treated by general massage only. If possible, there should be two séances—one in the morning, preferably at about eleven o'clock; and the second in the evening, after she is settled down for the night.

THE MORNING TREATMENT.—

Position of Patient.—For limb, chest, and abdominal massage, the patient should be in crook-half-lying. The attainment of relaxation being the main object of our treatment, it is obvious that the patient's position is of

supreme importance. She must be quite comfortable and at her ease, every part of the body being carefully supported. Cushions should be placed under the elbows and knees ; the pillows under the head should be so arranged that it rests comfortably upon them, the neck and throat muscles being thus out of action. The patient must be kept warm, with light coverings, and a hot-water bottle if she requires one.

Relaxation.—The operator has now to obtain as complete a relaxation as possible of the limbs, head, and trunk muscles. She will raise the patient's arms, or make the patient raise them, and let them fall on the cushions, instructing the patient to let them drop as a dead weight. She will do the same with the legs, flexing hip and knee slightly, and allowing them to fall back on the supporting pillow ; then the knees may be pressed together and allowed to drop gently apart, in order to relax the adductors of the thigh. The patient should contract her back muscles, arching the spine, and then relax them ; she should raise her head—putting the abdominal and prevertebral muscles into action—and let it fall back on the pillow ; then the head should be rolled gently from side to side to get rid of the tension of the neck muscles ; she should 'screw up her face', and then let it relax. Finally, she should take several deep breaths, returning gradually to normal quiet breathing. The operator should tell the patient to 'give up her weight entirely to the bed'. The value of the operator's manner during all this cannot be over-rated. It should suggest rest and relaxation. This is even more important before the evening treatment. To convey suggestion in this way is much more effectual, and safer, than to make a definite promise that the patient shall sleep better.

The patient should be disturbed as little as possible during treatment. For this reason, she should wear suitable garments, or should be wrapped in light blankets, so that the various parts of the body may be exposed and re-covered in turn without fuss or difficulty. For back massage she may turn quietly on to her side, or on to her face if she prefers it.

Massage.—In the early stages, this must be very rhythmic and soothing in character. It will consist mainly of stroking movements, with slow, fairly deep kneadings with the palm of the hand, and effleurage. 'Fancy' movements are not appropriate, nor should the masseuse make use of a great variety of different movements. She should pass from one to another without breaking her rhythm, taking her hands off the patient, or changing her own position more than is absolutely necessary. All these things produce a feeling of unrestfulness. If any particular movement appears to irritate the patient, it should be discontinued, and some other substituted for it. Any hypersensitive area in the body must be treated with great care. It should be approached gradually, and should be the last part to be treated (Mennell).

Abdominal massage should consist of stroking, kneading, and fine vibrations. Liver massage is best omitted in the early stages, as too stimulating.

Massage for the head and face should be included if the patient suffers from headache or neuralgia, or if she likes it and finds it soothing.

THE EVENING TREATMENT.—

This treatment is for the purpose of making the patient sleep ; if she is already sleeping well, it will not be necessary, and, in any case, as soon as the insomnia habit is broken, and the patient can do without it, it should be discontinued.

Insomnia, of course, can be caused by other things than neurasthenia. It may be the result of indigestion, flatulence, or some other kind of pain or discomfort. Worry or grief are frequent causes of sleeplessness, or at least of disturbed sleep. A habit is easily established by any one of these physical or emotional disturbances, and it may continue long after the original cause has

ceased to exist. The treatment, described below, is much the same in all these cases, except in those of hysterical origin, which require psychological rather than physical methods of treatment. Sometimes the habit of insomnia may be broken in one or two treatments; in other cases the process of cure is long and slow.

Preparation of the Patient.—The patient should be quite ready to settle down, and the room prepared for the night—the windows opened, the fire made up, or the gas-stove put out, the patient's bedclothes arranged as she wishes, her hot-water bottle filled if she needs one. Nothing should be left to be done after her treatment. In a private house the patient's friends must say good-night to her before the treatment begins, and no one should enter the room after it has begun. The light in the room should not be too bright; a single shaded electric lamp is quite enough.

Massage.—

1. The patient should be made to relax as completely as possible.

2. The *arms and legs* should be treated, the type of massage being the same as that used in the morning séance, but even slower and quieter. Effleurage, kneading, and stroking should succeed each other in due order. Abdominal massage is omitted.

3. After the limb massage, final preparations for sleep should be made. The dressing jacket, or any garment not required at night, should be removed. A shawl, or some easily removable covering, may be substituted for it if necessary. If the patient is in the habit of taking hot milk, etc., she should do so at this time. From now onwards she should not talk. She should be told that after the neck massage she is to move gently into whatever position she prefers for the night. Finally, the light is put out, or heavily shaded—the sudden extinguishing of a light later may quite possibly wake a sleeping patient, or startle one who is almost asleep—and the last stage of the treatment begins.

4. *Head and neck massage.*—Stroking down both sides of the neck is given with the hands over the jugular veins, for the purpose of depleting the head, and relieving congestion in the brain. Instead of, or in addition to, this, the patient may turn her head gently to one side, and a stroking movement may be carried downward over forehead, cheek, neck, and shoulder. Dr. Mennell's beautiful method of doing this is most effective, but needs skill and a perfect sense of rhythm.* The movement is then repeated on the other side of the head and neck.

5. *Back massage.*—If the patient is having a long course of treatment, it is as well for her to have a garment opening down the back, so that it may be folded over at the end of the treatment without disturbing her. Failing this, it is often best to give the massage over the nightdress, as it is easy to rouse the patient while attempting to readjust the garment.

The operator should take up as comfortable a position as possible—with a patient on a low bed half-kneeling is generally best.

Two movements only are necessary—kneading and stroking. Effleurage may be given at the beginning if the operator can get into a position where she can use both hands together in a rhythmic manner. Kneading may be given with both hands together or with one at a time—the latter is often easier and more effectual. The stroking is generally done with one hand following the other down the spine, so that it feels to the patient like one continuous movement, or it may be done with one hand, the movements following each other at absolutely regular intervals. This is continued until the patient falls asleep, or, if she does not do so, for about ten minutes, after which the operator rearranges the bedclothes, puts out the shaded light, and leaves the room very quietly.

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* *Principles and Practice of Massage*, Chapter XXI.

Later Stages

As the patient improves, the massage is gradually made a little more stimulating. In, say, about a fortnight—or longer, according to her condition—gentle exercises may be added, while she is still in bed.

In a month, or when the patient is able to get up, a table of exercises may be given and increased in strength little by little. The massage becomes more vigorous, and is then gradually left off as the patient grows stronger. As she recovers, fresh air, walking exercise, and a congenial occupation are essential.

> In treating such patients as these, the operator's *manner* should be quiet, but cheerful. It is generally as well at first to let the patient recount her troubles. A more healthy point of view should be rather *suggested* than *advised*. The masseuse *may*, and *should*, be sympathetic, but anything in the nature of sentimentality on the part of the patient should be discouraged.

HYSTERIA

This is a most interesting condition from the point of the psychologist. Unfortunately, it is too large and complicated a subject to be discussed in a textbook of physical treatment. As gymnasts, we generally encounter it in one of two forms. First, we have the hospital patient with a hysterical paralysis or contracture, or some such local disability; secondly, the private patient, often a lady of means, who suffers from some generally ill-defined and rather mysterious malady. At first sight, she may easily be mistaken for a neurasthenic, but before long we begin to realize that her trouble is not nervous exhaustion, but something very different. The symptoms of hysteria, however, vary enormously, though some are more common than others.

Hysteria is nowadays generally thought to be the result of some conflict in the patient's *subconscious*, or *unconscious*, mind. In this region of our personality dwell things forgotten beyond recall, together with hereditary instincts, desires, and feelings which have never been in our conscious minds at all. If any thought is intensely painful or disagreeable to us, or rouses in us a sense of shame, it is possible sometimes to drive it down into 'the unconscious', and there it may set up a conflict (which ought to have been fought out in the *conscious* mind) and give rise to hysterical symptoms.

There are many types of hysteria, arising from many and various forms of conflict in the mind. The classic example is that of the soldier in the trenches,* whose primitive instinct of self-preservation urges him to run away, but whose social instincts—love of country, loyalty to comrades, and sense of duty—urge him to continue at his post. He may not consciously realize the existence of this conflict; it may take place entirely in his unconscious mind. He may solve it one way or another, in which case he either runs away, or deliberately continues to do his duty. But the conflict may remain undecided. The man has to find some way of avoiding either alternative, and he sometimes does so by developing some disability, for example, blindness, deafness, or paralysis. The actual form the disability will take depends on *suggestion*; paralysis of a limb may follow some trifling injury, blindness or deafness the explosion of a shell. He thus provides himself with a perfectly good reason for getting out of the firing line without loss of self-respect. But all this goes on in the man's unconscious mind. He is not a malingerer; he is firmly convinced that he cannot see, or hear, or move, as the case may be.

The same thing occurs in other forms in civil life. There are 'invalids' whose illness is a defence against being ignored by an unsympathetic family,

* Of course, this is only one particular type of hysteria. There are many others, some of them far less easily explained.

or against a feeling of 'being of no use . Any thwarted instinct or conflict of instincts may set up symptoms in those who cannot fight out the conflict, or set themselves to find an outlet for the instinct, but repress it instead. None of us has any right to judge or to despise these people. The worst that can be said of them is that they cannot—or, at all events, *do* not—face facts ; or that the particular facts are, at least to people of their temperament, too terrible to be faced. Unless we can realize this, we are not capable of dealing with such cases, and shall do well to leave them severely alone.

Treatment.—

PSYCHICAL TREATMENT.—This should be in the hands of a specialist, and is, generally speaking, not the affair of the nurse or masseuse. If the specialist desires her co-operation in any way, he will give the necessary explanations, and issue instructions. Too many imagine, because they are well qualified, by the possession of tact and sympathy, to deal with the troubles of normal people, that they are also able to cope with the complexes of hysterical patients. No mistake could be greater. Not only are exceptional natural gifts required for this kind of work, but also profound psychological knowledge, special training, and prolonged experience. Yet one hears people talking glibly of influencing their neurotic patients by 'suggestion'. We are personally convinced that no ordinary worker has any business to practise any other kind of 'suggestion' than that which may be conveyed to her patient by her own sane, cheerful, and well-balanced outlook on life. The reasons for this are :—

1. *No one can possibly treat any patient of this kind without a full understanding of his or her case.* The diagnosis must be in the hands of an expert psychologist. 'A little learning' in a nurse, masseuse, or friend, is sometimes 'a dangerous thing . It may *appear* to be obvious what is the matter with the patient ; but complexes' are by no means always what they seem. Suggestion, even by an amateur, may quite possibly remove a symptom, but unless the difficulty is attacked at its *root*, the symptom may recur later, or another, even more troublesome, may take its place. It is as well to remember also that incautious questioning or conversation may *produce* a symptom.

2. *Even when discovered, the root complex is not necessarily easy to eradicate.* Many things may be against the patient—his or her own indolence ; the possession of too much money, making for idleness and self-indulgence ; the fear of poverty ; the presence of unkind, sentimental, or selfish relatives, who keep up a continual suggestion of a mischievous kind. The whole thing calls for the guidance of an expert—be he doctor or priest. Unless asked for her assistance, the masseuse should confine herself to the physical side of the patient's treatment.

Two points are important with regard to the relationship between the masseuse and the patient :—

1. It is a mistake to think that the masseuse should be hard, unkind, or even almost brutal. It is equally misguided for her to tell the patient, or let her see that she thinks, that she is hysterical, and that there is nothing the matter with her. This generally confirms the patient in her symptoms. But neither should she be over-sympathetic. *She should be firm and kind, but matter-of-fact.* Above all, any trace of sentimentality must be rigorously excluded from the relationship.

2. *The masseuse must not allow the patient to become dependent on her.* If she does, her own pride may be flattered, but her patient will not recover. A certain type of hysteric asks nothing better than to be allowed to cling to someone. But if the masseuse cannot prevent her from clinging to *her*, she should

give up the case. The patient has to fight her own battle, and solve her own problem. She may be helped to do so, but it cannot be done for her.

PHYSICAL TREATMENT.—

This depends on the symptoms. We will take as examples the two types of case cited above :—

1. The Patient with Hysterical Paralysis

a. Flaccid Paralysis.—

Massage may be required for disuse atrophy in some cases, and *passive movements* to mobilize joints which have become stiff through being held in one position for a long period.

Re-education.—The important thing is to impress on the patient's conscious mind that he *can* move the affected limb. On the physical side, the treatment is best begun by *faradism.* This will demonstrate to the patient that the 'paralysed' muscles *can* act. Then attempts must be made to obtain voluntary movement. The muscles can sometimes be made to work without the patient's realizing that they do so ; e.g., one with wrist-drop may be asked to close his hand tightly, and as he does so, the extensors of the wrist may come into action as synergists to the long flexors of the fingers. The fact that the muscles are working is then pointed out to the patient. Some patients may be cured suddenly in one treatment. But this is not always so. It depends on whether the underlying complex has been, or is being, successfully combated.

b. Spastic Paralysis (*Hysterical Spasm*).—

The treatment is much as above. There is no objection to the use of faradism in *hysterical* cases.

A form of procedure sometimes adopted is 'tiring out the spasm'. The operator stretches the spastic muscles time after time until at last the spasm ceases from utter exhaustion. This is said to be very effective. Sometimes, even, several operators succeed each other until the cure is effected.

2. The Patient Suffering from General Symptoms

The patient suffering from general symptoms (for example, from insomnia, indigestion, extreme irritability, depression, and so forth, is often ordered (or insists upon having) massage, and would most probably be better without it. This is the one who often tends to become dependent on her nurse or masseuse. She would rather be 'soothed' by massage than exert herself and face her difficulties. She does not really need physical treatment ; or if she does, exercises would be better than massage. Her friends are often her worst enemies, either overwhelming her with sympathy, or telling her to 'pull herself together'—advice much too vague to be of any use. She is best treated in a home away from her relatives. If she *must* have massage, it should as a rule be fairly stimulating.

Reflex Palsies

These are similar to the above cases, but although there is a hysterical element present in them, they are not *pure* hysteria. They arise after an injury, the patient manifesting far severer symptoms than could be produced by that injury. The paralysis is hysterical, and is due to suggestion, but is accompanied by vasomotor and trophic changes, so that it is not an entirely functional condition. Treatment is on the same lines as that of the hysterical paralysis. Recovery is often gradual.

SPASMODIC TORTICOLLIS

A spasm, generally clonic, of the neck muscles, producing jerky movements of the head in some one definite direction.

ETIOLOGY.—

AGE AND SEX.—Spasmodic torticollis is more frequent in women than in men, and generally begins in middle-age.

CAUSES.—The cause of the trouble is often uncertain. (1) It may be due to some irritation of the spinal accessory nerve, or (2) To some disease of the lenticular nucleus (Purves-Stewart). (3) It may be wholly a neurotic manifestation, shock, worry or emotions of grief or fear being the exciting causes. (4) Physical and psychical elements may both be present.

PATHOLOGICAL CHANGES. — There are, as a rule, none that can be definitely ascertained.

SYMPTOMS.—The spasm may be *tonic* or *clonic*. In the former type, the head is held rigidly in the same position as it is in the congenital variety, that is, it is flexed to one side—the shoulder on that side being raised—and rotated to the other. This position is, of course, produced by spasm of the sternomastoid, and possibly of other flexors or rotators of the neck. Or it may be *retrocolic*, the head being drawn backward by spasm of both the trapezii, or of some of the deeper neck muscles. The same muscles are affected in the commoner *clonic* form, the patient jerking his head into a position of side flexion and rotation, or performing a purely backward movement. In the former case, the flexion generally takes place towards the left side, both protagonists and antagonists working (in this case, both sternomastoids).

At first the jerks come on in *paroxysms*, but later they become *continuous*. They cease during sleep, and are increased by emotion. The affected muscles eventually *hypertrophy* from overuse. The condition is sometimes *painful*.

Treatment.—

Our aims will be, in the first place, to reduce the spasm and obtain relaxation, whether by physical or psychical means; and then to re-educate the patient in the correct use of her muscles, teaching co-ordination and control.

PHYSICAL TREATMENT.—Spasmodic torticollis is a most troublesome and intractable condition, the uncertainty about its cause making it difficult to decide how to attempt to deal with it. Apart from psychical treatment, which may be undertaken by the doctor in charge of the case, assisted perhaps by the masseuse, the following measures appear to be those producing the best results.

MASSAGE.—

Position of Patient.—She should generally be placed in the side-lying position, on the unaffected side; but the operator will have to find out what position is most comfortable for any individual patient, the point being that she should be as relaxed as possible. The head should be supported, but not fixed. Warmth is essential, since it makes for relaxation.

Manipulations.—Rhythmic stroking is the most important movement, and should be carried from the forehead down over the neck to the shoulder, over all the affected muscles; or from the occiput down the back and sides of the neck over the trapezii. This may be followed by *kneading*, slow and fairly deep, after which the stroking should be repeated.

PASSIVE MOVEMENTS.—The patient may now be allowed to sit up, and, provided there is no pain, rhythmic passive movements may be given in all directions—especially head-rollings. These are to obtain relaxation of the head and neck muscles.

ACTIVE RELAXATION EXERCISES. — These would consist, in this case,

of head-rollings, the patient first taking a deep breath in and out, and then allowing her head to fall forward on her chest by the weight of gravity, all the neck extensors being relaxed. Another deep breath is taken, and then the head is carried slowly to one side, backward, upward (as in an ordinary head-rolling), and across the mid-line, a pause being made at the mid-position for another breath. The movement is then continued, and the head bent sideways and forwards until the force of gravity again asserts itself, and the head is allowed to drop forward.

The arms may be raised to shoulder level, and then allowed to fall passively to the sides. (This should be done in standing, so that there may be no fear of the patient's knocking her hands against chair or stool.)

Trunk-rollings may be given in the same way as the head-rollings, slowly and rhythmically, with breathing. (Anyone who understands Mrs. Archer's excellent method of producing relaxation will do well to employ it.)

EXERCISES FOR CONTROL.—These should include :—

Movements for the Muscles, the Action of which actually produces the Jerk.—The movement which occurs involuntarily and jerkily should be performed in a slow and controlled manner.

Movements for the Antagonists of these Muscles, e.g., the patient who jerks her head to the left, rotating it to the right, should be instructed to bend it slowly to the right, rotating it to the left (that is, to perform the opposite movement).

Double-sided Exercises, especially head-extensions. Arm and shoulder exercises are also given.

Nothing in the nature of 'mirror exercises' should be given, as these tend to increase self-consciousness, which would be most undesirable in these patients.

If as the result of suggestion conveyed by the treatment the type of spasm changes, e.g., a right torticollis becomes a left, the trouble may be assumed to be a pure neurosis. Physical treatment alone will be of little avail.

SURGICAL TREATMENT.—Occasionally, cases are treated by operation, which consists of division of the spinal accessory nerve and of the deep branches from the second, third, and fourth cervical roots (i.e., the nerve-supply of the affected sternomastoid).

POST-OPERATIVE TREATMENT.—This consists of massage of all the muscles of neck and shoulders ; gentle frictions round the scar to prevent it from becoming adherent to the surrounding structures ; and re-education of the patient in head and neck movements, as described above.

OCCUPATION NEUROSES

An 'occupation neurosis' is a form of cramp or spasm which occurs in certain groups of muscles during the performance of some one particular action. It is due to persistent overuse of the muscles in this particular way. The movement which brings on the spasm is, generally, some specialized one, which requires complicated and accurate co-ordination of the muscles.

We find this form of neurosis, therefore, among skilled workers, especially amongst those whose occupation entails fine movements of the hands and fingers. Watchmakers, jewellers, pianists, and clerks are among the chief sufferers. Similar types of spasm occasionally appear in the leg. The best-known occupation neurosis is, of course, *writer's cramp*.

These cases of occupation neurosis, although they often occur in persons of nervous temperament or heredity, must not be confused with similar cases of hysterical origin. It is important that this mistake should not be made, since the latter class of patients is generally unsuitable for physical treatment, whilst the former, as a rule, derive great benefit from it.

PATHOLOGY.—In many cases there appear to be *no definite changes*, and the condition seems to be a pure neurosis. In others, there are accompanying *inflammatory changes in muscles or nerves.* These may, therefore, be considered as really cases of myositis or neuritis.

SYMPTOMS.—

There is *loss of co-ordination for the particular movement concerned.* In true writer's cramp the symptoms only occur when the patient attempts to write. In all other ways he can use his hand quite normally. If the cramp comes on during the performance of other movements as well, the condition probably consists of, or is complicated by, muscle or nerve inflammation.

Various forms are encountered :—

Cramp or Spasticity of muscle when writing is attempted. Pain is sometimes, but not always, present.

Tremor, generally taking the form of pronation and supination.

Paresis.—Weakness, pain and numbness (paræsthesia) in the arm. There is generally muscle or nerve inflammation in these cases, and other movements than writing are affected.

Treatment.—

PHYSICAL TREATMENT.—

MASSAGE.—This must, in the early stages, be entirely soothing in its nature. The séance should begin with slow reflex stroking of the whole arm, especially on its anterior aspect. This is followed by kneading of the upper arm and forearm, the manipulations becoming more and more gentle as the hand is approached. Very careful kneading of hand and fingers follows. Each finger should be massaged as well as the palm and dorsum of the hand ; and *passive movement* must be carefully administered to all joints of the wrist and hand, each finger being moved separately at first.

The nerves of the arm should also receive treatment, rhythmic finger kneading being performed over the brachial plexus in the posterior neck triangle, and down the course of all the principal nerves of the arm, especially the median and ulnar nerves, which supply the flexors of the fingers and the intrinsic muscles of the hand, these being the muscles which go into spasm.

ACTIVE MOVEMENTS.—Any movements of arm and shoulder may be given from an early stage, provided they cause no pain or cramp. Free rhythmic exercises, such as 2-Arm-swinging forward and upward, are best, but resisted movements, concentric and eccentric, may also be given, provided the resistance is not over-strong. For the hand muscles, careful active movements, especially extension and abduction of thumb and fingers, are given—first assisted and then free, and later resisted.

RE-EDUCATION IN WRITING.—It is essential at first that the instrument used by the patient for writing should be of sufficient thickness to prevent an unduly cramped position of hand and fingers. Therefore, it is a good plan to make him write with chalk on a blackboard. He should write very large letters at first, so that he uses the whole arm and not merely the wrist and fingers. The letters should be gradually diminished in size.

He should next attempt to write on paper with a pencil, padded till it is at least as thick as the chalk. Later, he may be promoted to a penholder. The padding should be gradually removed day by day, and the writing should become smaller.

In some obstinate cases it may be necessary to make the patient hold his pen in a different way from that which he has hitherto done, e.g., between the index and middle fingers. This slightly alters the co-ordination of the movement, and the patient may be able to perform it without pain and spasm. In cases

where the patients are in the habit of holding their pens badly, and so possibly putting an undue strain on the muscles, education in the correct method of writing may suffice to effect a cure.

Where myositis and neuritis are present, the case should be treated in a manner suitable to these conditions (*see* pp. 180–182).

EPILEPSY

We are not called upon to treat epileptics as such. The occurrence of a 'fit' in the massage department is, however, not impossible, since epileptics often come to be treated for other ailments. A note should always be made on the letter or card of such a patient, and the worker in charge of his treatment should be informed of his disability, and, if necessary, told what to do should an attack take place.

The causes and changes do not concern us as masseuses. There is some disorganization of the cerebral cortex, causing a violent discharge of energy from the cells in that region.

THE EPILEPTIC FIT.—There may, or may not, be an *aura*—that is, a peculiar sensation preceding the attack and acting as a warning. The aura may be a sensory perception of sound, light, or smell. There may be twitchings of the limbs, numbness, a feeling of intense fear, nausea, palpitation, or giddiness. It only lasts a few moments.

The actual 'fit' follows immediately. It has two phases: (*a*) the tonic and (*b*) the clonic stage.

THE TONIC STAGE.—The patient falls to the ground with a characteristic cry, and becomes unconscious, passing at once into a condition of rigidity. The legs and arms are completely rigid, the former in extension, the latter with bent elbows and clenched hands, the thumb generally flexed across the palm. The face is first pale and then livid. The breathing is almost arrested by the contraction of the thoracic muscles. This stage lasts about half a minute, and is followed at once by the clonic stage.

THE CLONIC STAGE.—This consists of violent convulsions, which begin in the muscles of the face and spread to those of the limbs and trunk. It is at this stage that the tongue is often bitten. The patient foams at the mouth, and the face becomes cyanosed. This phase lasts about three minutes. Then the muscles relax, the cyanosis disappears, the respiration improves, and the patient may recover consciousness or fall into a deep natural sleep. When he wakes he feels exhausted and irritable.

Treatment.—

The only part of the treatment which concerns us is that which is required during an attack. There is little we can do, but that little is important. If the patient has an aura, and we thus get a warning of the approach of an attack, he should be placed flat on a couch or on the floor with a low cushion under his head, well away from furniture or anything with which he might come into contact during the convulsive stage. If the fit comes on without warning, he must be left where he fell. As soon as possible, something should be put between the teeth to prevent the tongue from being bitten in the clonic stage—a spoon, or a pencil or piece of wood wrapped in linen or a bandage will serve the purpose. If there is time, any tight clothing should be loosened. During the clonic stage, the patient must be prevented from injuring himself—any objects round him, such as chairs or tables, should be moved out of the way. The convulsive movements should be restrained, but not forcibly prevented. In a hospital department, screens should be put round the patient,

especially if children are present, but no attempt should be made to move him until the convulsions have ceased. When they are over, he should be put to bed or covered up warmly and allowed to sleep. If a patient *must* go home after a fit, he should be sent in a cab, or at least accompanied by some responsible person in case a second attack should occur.

It is, obviously, not advisable that patients subject to fits should be placed in the head suspension apparatus (e.g., for scoliosis), or allowed to climb high on ladders, walk on the boom high above the floor, or take up any position which might be dangerous or fatal should a fit occur at that time.

CHAPTER XV

DISEASES OF MUSCLE

The dystrophies (Pseudo-hypertrophic muscular dystrophy ; Erb's juvenile type ; Infantile type)—Amyotonia congenita—Thomsen's disease—Myasthenia gravis.

THE DYSTROPHIES

MUSCULAR dystrophy is a disease of the muscles themselves, and not of the nervous system, although the symptoms in some ways resemble those of paralysis. The word dystrophy means a condition of impaired or faulty nutrition (Greek, *dys* = hard, difficult, bad, and *trophe* = nourishment) and the disease is, in fact, a degeneration of muscle. It produces atrophy of some muscles, and enlargement—but not true hypertrophy—of others. There are three principal varieties : (1) The pseudo-hypertrophic type ; (2) Erb's juvenile type ; (3) The infantile or facio-humero-scapular type.

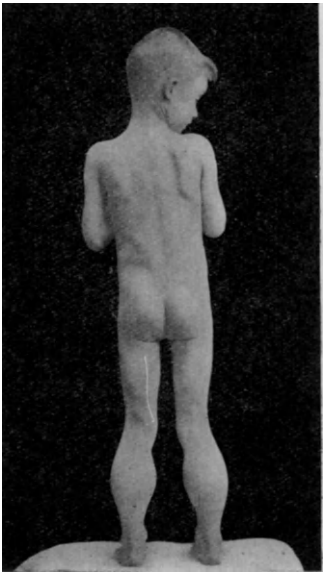

Fig. 103. — Pseudo-hypertrophic muscular dystrophy, showing pseudo-hypertrophy of the calves.

(Case of Dr. Patterson's, from French's 'Index of Diagnosis.')

1. Pseudo-hypertrophic Muscular Dystrophy

ETIOLOGY.—This is an *hereditary and family* disease. Like hæmophilia, it descends in the female line, through the mother to the sons, appearing as a rule in two or more boys in a family. Girls are only very rarely affected. *The age of onset* is childhood (5 to 8 years).

PATHOLOGICAL CHANGES.—Some muscles atrophy, and others increase in size. This *pseudo-hypertrophy*, however, does not make the muscles stronger, for their enlargement is due to increase of interstitial substance, while degeneration of their fibres, partly fatty and partly fibrous, takes place. Hence the muscles, though large, are weak. No nervous changes are present.

SYMPTOMS.—There is *atrophy* of the latissimus dorsi, and the lower part of the pectoralis major ; the biceps, serratus magnus, and the flexors of the hip are also affected.

There is *pseudo-hypertrophy* of the glutei, the calf muscles, deltoid, and infraspinatus. The enlarged calf muscles often attract attention first, being sometimes very noticeable—in fact, the mother is often proud of the boy's well-developed legs (*Fig.* 103).

The child's *powers of walking* suffer; he stumbles and is easily tired. The *gait* is waddling and awkward; the patient walks with the feet wide apart in order to broaden his base. Owing to the weakness of the gluteus maximus he throws his body backwards from the hips, the abdomen protruding, and thus produces the marked lordosis which is one of the characteristics of this condition. His *manner of rising from a supine position* is diagnostic. If he is lying on his back on the floor, he first turns over on to his abdomen, and gets on to his hands and knees. He then extends his knees, working his hands gradually closer and closer to his feet, and then, placing his hands alternately one above the other on his thighs, raises his trunk to an upright position. At a later stage, he is unable to rise without pulling himself up by catching hold of surrounding objects; later still, he is prevented either by weakness or by deformities from rising at all. Some patients adopt a frog-like mode of progression, with hips and knees flexed.

Contractures, especially of the calf muscles, develop late in the course of the disease. The hips and knees become flexed, the foot strongly plantar-flexed (talipes equinus or equino-varus). The lordosis produced by weakness of the gluteus maximus has been referred to above. In the later stages of the disease, when the spinal muscles become involved, kyphosis takes the place of lordosis, and scoliosis may follow.

Reflexes.—The knee-jerk decreases gradually as the quadriceps degenerate, and is lost in the later stages.

Electrical changes.—There is no R.D. at first, but the response to both faradism and galvanism dies away little by little.

PROGNOSIS.—The disease is progressive and incurable, the patient rarely surviving the age of 20. The power of standing is generally lost between the ages of 10 and 14 years (Tubby), and the disease progresses more rapidly after this period. Death is often due to pneumonia, or other forms of lung trouble, to which the patient is subject owing to the thinness of the thoracic wall, brought about by the atrophy of the serratus and pectoralis major.

2. Erb's Juvenile Type

ETIOLOGY.—This form appears later than the pseudo-hypertrophic type, between the ages of 12 and 16, or even after this. It affects both sexes.

SYMPTOMS.—*The muscles of the shoulder girdle and upper arm* are affected first, those of the *legs and spine* later. Those most often implicated are the latissimus dorsi, serratus magnus, pectoralis major, trapezius, the rhomboids, biceps, triceps, and supinator longus. The deltoid and the muscles of the hand escape. The shoulders fall forward, and the scapulæ are winged. Later, deformities develop, similar to those of the pseudo-hypertrophic type.

PROGNOSIS.—The patient may live for many years and be otherwise healthy. The power of walking is lost much later than in the preceding form.

3. Infantile Type (Facio-humero-scapular)

ETIOLOGY.—This form generally attacks infants; occasionally adolescents.

CHANGES.—Atrophy and pseudo-hypertrophy may both be present.

SYMPTOMS.—The *face muscles* are affected first. The sphincter of the eyes is atrophied, the lips may be thickened and the mouth may hang open, the lips being weak and flaccid. This interferes with distinct speech. The intrinsic muscles of the eyes and tongue escape. Later, the disease spreads to the muscles of the *shoulders and arms.*

PROGNOSIS.—Bad, as in the pseudo-hypertrophic type.

Treatment

The aims of treatment (e.g., of the pseudo-hypertrophic type) are: (1) To keep up the strength of the muscles, and by improving their blood-supply to delay degeneration as long as possible. This applies to both the muscles of the limbs, and the respiratory muscles. (2) To improve the patient's general health, increasing his resistance to infections, especially such as attack the lungs.

GENERAL TREATMENT.—Warmth,—these patients are most sensitive to cold—very nourishing food, and good hygiene are most important. The patient should have plenty of fresh air, but the chest should be well protected. The medical treatment will consist of tonics, cod-liver oil, etc.

PHYSICAL TREATMENT.—Here, again, we cannot hope to cure, probably not even to arrest the course of, the malady. We can only delay its development. Erb's juvenile type is the most hopeful, but it is rarely encountered. Most workers, however, will probably have met one or more of the victims of pseudo-hypertrophic dystrophy, though this also is a rare condition.

MASSAGE.—A brisk *general massage* is best, but the affected limbs at least should be treated. The séance, however, should not be too long, a few minutes only being required for each limb. Effleurage, kneading, and picking up may be given, and light hacking should be administered over all muscles where atrophy is not too pronounced.

Attention must be paid to the condition of the *joints*, and passive movement given to prevent the occurrence of contractures. Dorsiflexion of the foot, extension of the hip and knee, and extension of the elbow are especially important, but the condition of the joints of the shoulder should also be watched.

EXERCISES.—A short table of exercises should be given, in which the patient is made to use all the affected muscles. He may first be taught to perform simple movements in lying or side-lying, e.g.—

1. Side-lying Hip-flexion and -extension (for gluteus maximus, and the flexors of the hip).
2. Side-lying 2-Foot-bending and -stretching (calf muscles and anterior tibial group).
3. Lying 2-Arm-raising sideways and upwards and -lowering (serratus magnus and deltoid; latissimus dorsi).
4. Lying Alternate arm-flexion across chest (pectoralis major).
5. Sitting (or half-lying) 2-Arm-rotation-out with breathing (infraspinatus and teres minor).
6. Half-lying (or side-lying) 2-Forearm-bending and -stretching (biceps).
7. Lying (or crook-lying) 2-Arm-bending and -stretching.

In addition to this, if any muscles are very weak, the patient may be taught to contract these muscles individually without producing any movement of the joints. Contractions of the glutei, quadriceps, biceps, and deltoid, for instance, are not difficult to obtain.

Later he may be allowed to try the exercises in standing, and an attempt should be made to improve his posture and gait, although the improvement is not likely to be more than temporary.

Abdominal contractions and Long-sitting Forward-bending (assisted), may be given to prevent the lordosis from becoming fixed, and to strengthen the weak abdominals. Other easy trunk exercises may be attempted, but the child must not be tired.

Breathing exercises are most important and should never be omitted.

Precaution.—The patient should be warmly covered during massage, and should wear a flannel shirt and knickers while doing exercises unless the weather is very warm. If he becomes hot, great care must be taken to prevent his catching cold afterwards. A chill might well be the cause of a tragedy.

AMYOTONIA CONGENITA

A congenital disease affecting the muscles and resembling a flaccid paralysis.

SYMPTOMS.—The *muscles are flaccid*, soft, and toneless; they do not harden in contraction like normal muscles, although there is no actual paralysis, the nervous system not being involved. The *legs* are generally most affected, but sometimes the back muscles are weak and the child cannot sit up. The *joints* are flail-like, owing to the hypotonia of the muscles and consequent relaxation of the ligaments; the limbs can, therefore, be placed in all sorts of abnormal postures (*Fig.* 104). The *sphincters* are normal.

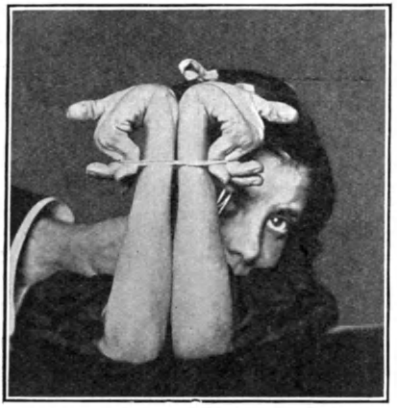

Fig. 104.—Amyotonia congenita.

Electrical changes: The response to faradism and galvanism is diminished, but there are no polar changes (*see* p. 112). The children, even infants, can bear strong faradic currents.

The *deep reflexes* are lost owing to lack of muscle tone, but the *superficial reflexes* are normal (Purves-Stewart).

PROGNOSIS.—Improvement takes place, as a rule, but not cure.

Treatment.—

The aims of treatment are: (1) To improve the nutrition and tone of the muscles; (2) To teach the child to use his limbs, sit up, and walk.

Treatment should be carried out on much the same lines as that for a flaccid paralysis. A long course of treatment will be necessary, and the child should be under supervision while growth continues. Splints are not required as a rule.

THOMSEN'S DISEASE

(*Myotonia Congenita*)

A rare condition in which the voluntary muscles become stiff when movement is attempted.

ETIOLOGY.—It is an *hereditary* disease, generally affecting more than one of a family.

PATHOLOGY.—It is caused by some congenital defect in the muscles, which have too great a proportion of sarcoplasm to fibrils. The muscular fibres are greatly enlarged and hypertrophied.

SYMPTOMS.—The *muscles go into tonic spasm* when the patient attempts to perform voluntary movements. This condition is most marked in the *leg muscles*. For instance, the spasm comes on when he begins to walk, but decreases if he continues to do so. If he stops, it returns when he starts again. If he rests, the stiffness makes it very difficult for him to rise. He cannot voluntarily relax his muscles. The *muscles of face, eye, and tongue*

may be similarly affected. Spasm of the last may make speech difficult. The *sphincters* are normal; *respiration and other vital functions* are not disturbed.

Electrical changes.—The reaction to faradism and galvanism is peculiar. The contraction induced by the current does not, in the case of galvanism, consist of a single quick twitch when the electrode is applied or withdrawn, but the contraction is unduly prolonged. The same is the case with faradism, the condition of contraction continuing after the electrode is withdrawn and the muscle only relaxing gradually. The constant current produces a series of rhythmic contractions. This peculiar response is known as the *myotonic reaction.* There are also polar changes, A.C.C. being equal to K.C.C.

PROGNOSIS.—The disease is incurable, but not progressive and not fatal.

Treatment.—

The aims of treatment are to reduce the spasm and improve the patient's general health.

GENERAL TREATMENT.—Like most victims of muscular disease the patients are very sensitive to cold, which, in this case, increases the spasm. They should, like those suffering from pseudo-hypertrophic and other forms of dystrophy, wear warm clothes and have nourishing food. Warm baths, or whirlpool baths if they can be obtained, help to reduce the spasm.

PHYSICAL TREATMENT.—

MASSAGE AND EXERCISES.—The patient may be treated in much the same way as one with an old hemiplegia (*see* pp. 119, 120).

Soothing massage and rhythmic movements are best, combined with ordinary general exercises. The patient must not be over-tired, but there is less danger of this happening than in the case of one with a lesion of the central nervous system, since his sense of fatigue is normal.

MYASTHENIA GRAVIS

This is a rare condition in which the voluntary muscles are weak and become very easily exhausted on slight exertion, to such a degree that they cannot work at all unless rested.

ETIOLOGY.—Both men and women are affected. The disease comes on in youth or early middle-age. The cause is unknown.

PATHOLOGY.—There are no constant changes in the nervous system, nor are there marked degenerative changes in the muscles themselves.

SYMPTOMS.—

The *face muscles* are most affected, especially those of the eyes, lips, and tongue. This interferes with eating and speaking. The patient cannot keep his eyes open, or hold his head erect, for long at a time. All the affected muscles are temporarily improved by rest, but grow worse and worse during repeated movements, so that they are always at their best in the morning and at their weakest in the evening. Gradually the *muscles of the arms and legs* and the *respiratory muscles* become involved.

Reflexes.—The knee-jerk may be slightly increased, but if the stimulation is constantly repeated it becomes weaker and weaker and finally disappears.

Electrical changes.—The *myasthenic reaction* is found. The contractions are normal at first, but the response lessens gradually and finally ceases.

PROGNOSIS.—The disease is incurable and slowly progressive, death generally occuring from cardiac or respiratory failure.

Treatment.—

No satisfactory treatment has been found. Rest and tonics are indicated. Massage and light exercises, with rest after each exercise, may increase the comfort of the patient.

CHAPTER XVI

DEFORMITIES OF THE UPPER AND LOWER EXTREMITIES

I. Deformities of the upper extremity: Sprengel's shoulder—Club-hand and congenital absence of radius, ulna, or other bones—Dupuytren's contracture—Contracted fingers. II. Deformities of the lower extremity: Congenital dislocation of the hip—Coxa vara—Genu valgum—Genu varum (bandy-legs) and bow-legs—Flat-foot and weak foot—Pes plano-valgus—Metatarsalgia—Talipes—Pes cavus—Hallux valgus—Hallux rigidus and hallux flexus—Hammer toe.

A DEFORMITY is a malformation of any part of the body, due to a distortion of the bony skeleton, or to an alteration in length of some of the soft structures. Deformities may be divided into two classes: (1) *Congenital*; and (2) *Acquired.*

1. **The Congenital Deformities** are caused by retention of the fœtus in some incorrect position before birth, or by some failure or abnormality of development. They may, or may not, be hereditary.

A congenital deformity is one actually present *before* birth. A deformity caused by an injury *during* birth is not a congenital one.

2. **The Acquired Deformities** may be due to one of many causes, the most common of which are: (1) *Bone disease*, e.g., rickets. (2) *Joint disease*, e.g., various kinds of arthritis; gout. (3) *Nerve disease*, as paralysis. (4) *Muscle disease*, e.g., muscular dystrophy. (5) *Trauma*, e.g., injuries at birth; fractures, separated epiphyses, burns, scars, etc. (6) *Mechanical causes*; occupations imposing undue strain or pressure on some part of the body, e.g., on the spine, in those whose trade necessitates the carrying of heavy weights; habitual wrong posture; wrong disposition of the weight of the body, due to loss of sense of the correct posture, resulting from some defect of the postural reflex (*see* p. 263).

Stages of Development of Deformities.—In most acquired deformities, three stages or degrees are recognized. The characteristics of these are as follows:—

1. FIRST DEGREE.—

CHANGES IN MUSCLE TONE AND HABITUAL POSTURE: NO BONY CHANGE.—The patient can himself correct the position of the affected part.

2. SECOND DEGREE.—

DEFINITE CONTRACTURE OF SOFT STRUCTURES, i.e., muscles and ligaments, with A SLIGHT DEGREE OF BONY CHANGE. The patient cannot himself correct the deformity, but it can be corrected to some extent by the operator.

Intermediate between these two degrees we have a stage in which there is definite spasm or even shortening of muscles, etc., without any appreciable alteration in the bone.

3. THIRD DEGREE.—

SERIOUS BONY CHANGES.—Very little correction, if any, can be obtained by the operator.

The first degree deformities are *curable*; those of the second degree may be *improved* by treatment. For those of the third degree little can be done, unless they exist in some part where surgical interference is possible.

I. DEFORMITIES OF THE UPPER EXTREMITY

Deformities of the upper extremity, other than paralytic, are rare, and few call for treatment by physical means. The weight of the body, falling on the lower limb, is the determining factor in most of the *acquired* deformities in that part of the body. This factor not being operative in the case of the upper limb, except in children at the crawling stage, deformity here is uncommon. *Congenital* malformations, also, are found far less frequently in the arms than in the legs. The acquired deformities which do occur are mostly the result of paralysis, rickets, or injuries.

SPRENGEL'S SHOULDER

A rare congenital condition in which one scapula (or occasionally both) is in an abnormally high position on the thoracic wall.

ETIOLOGY.—

CAUSE.—The scapulæ are normally much higher in the earlier stages of fœtal development than in the child at birth. The deformity may be caused by a constrained position of the fœtus in utero, which prevents the descent of one or both scapulæ.

HEREDITY is often a factor, and other deformities are often present in the same patient.

UNILATERAL cases are much commoner than bilateral.

SEX.—The sexes are affected about equally.

DEFORMITY (*Fig.* 105).—

1. In unilateral cases *the position of one scapula is abnormally high.* The condition is generally accompanied by scoliosis in the thoracic region, the convexity being towards the side of the raised shoulder. In bilateral cases, both shoulders are raised, and the thoracic and lower cervical vertebræ stand out prominently.

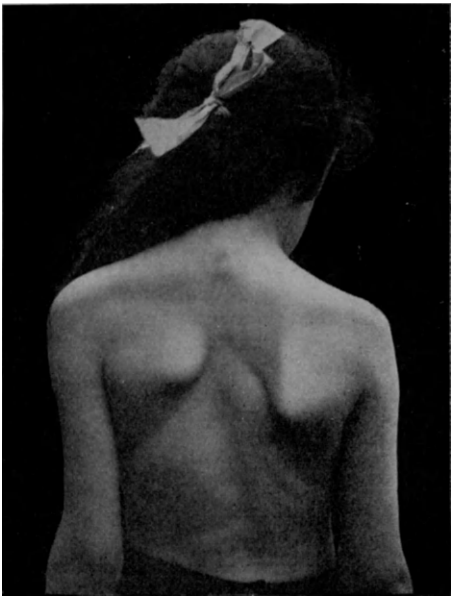

Fig. 105.—Congenital elevation of the left scapula (Sprengel's shoulder).

2. The scapula is not only *raised* but *rotated*, generally in such a way that the upper angle is nearer the spine than the lower (Tubby); or the rotation may be in the opposite direction, with the inferior angle sometimes even overlapping the vertebral column.

3. The *superior angle* shows prominently in the neck.

4. The *clavicle* may be shortened to the extent of one inch, so that the scapula is nearer to the spine on the affected side.

5. The *mobility* of the shoulder is much reduced, because of the fixation of the scapula, abduction and elevation being limited

6. The *upper part of the chest* may be badly developed.

COURSE.—The deformity generally gets worse as the patient grows older.

PATHOLOGICAL CHANGES.—

BONES.—

1. Malformation of the scapula, the long axis of the bone being horizontal instead of vertical.

2. Sometimes a *bar of bone* is found connecting it to the vertebral column, generally to one of the cervical vertebræ.

MUSCLES.—The trapezius is always weak and defective. Various other muscles attached to the scapula may be abnormal—the levator anguli scapulæ, serratus magnus, infraspinatus, latissimus dorsi, teres major, pectoralis minor, rhomboids, etc. The sternomastoid and pectoralis major have also been found to be defective or absent.

Treatment.—

SURGICAL TREATMENT.—This deformity can only, as a rule, be corrected by operation. The incision is made alongside the vertebral border of the scapula (sometimes also along part of the superior border). All the muscles that prevent replacement of the scapula in its correct position are divided; and the bony bar, if present, is removed.

PHYSICAL TREATMENT.—After the wound is healed, the weak muscles should be massaged, and passive and active movements given to the joints of the shoulder girdle. Special attention must be paid to the movements of abduction and elevation of the arm, and to rotation of the scapula. If the muscles are very weak, abduction and elevation may be tried first in the lying or crook-lying position (as for muscles recovering from paralysis), and the patient may then progress to half-lying, sitting and standing (*see* p. 168). The result is not always very satisfactory.

EXAMPLES OF EXERCISES (late stage).—

1. Stride-sitting 2-Arm-raising sideways and upwards, the palms meeting above the head (in early stages, a similar exercise may be given in crook-lying).
2. Sitting, or standing, Hand-clapping over head.
3. Yard-stride-sitting 2-Arm-lifting and -down-pressing (lowering to shoulder level).
4. Standing-2-Arm-swinging forward and upward.
5. Neck-rest position.
6. Head-rest position.
7. Laying front of wrist on back of neck.
8. Lying, sitting, or standing, Shoulder-shrugging.
9. Standing, or sitting, Shoulder-shrugging (resisted at wrist); (or 2-Shoulder-shrugging, in bilateral cases).
10. 2-Arm-bending and -stretching in all directions (free).
11. 2-Arm-bending and -stretching (resisted) in various positions.
12. 2-Arm-parting and -forward-carrying.
13. 2-Plane-Arm-carrying (in sitting, long-sitting, walk-standing, etc.).
14. Prone-lying 2-Arm-backward-carrying.
15. Standing 2-Arm-circling or -swinging in circles.
16. Pulley exercises, etc.

N.B.—It is important to learn from the surgeon which muscles are defective or absent, and which were divided at the operation. Complications such as torticollis or scoliosis must be treated.

CLUB-HAND AND CONGENITAL ABSENCE OF RADIUS, ULNA, OR OTHER BONES

The long axes of forearm and hand should be in a line with one another—any deviation from this line constitutes 'club-hand'. The condition may be congenital or acquired. (1) *Congenital* cases are far less common than similar

deformities in the foot. They are most often associated with congenital absence of radius or ulna. Cases in which the bones are normal are very rare. (2) *Acquired* cases are due to paralysis, arthritis, rickets, or traumas.

CHANGES AND SYMPTOMS (congenital form).—

1. As in club-foot, the hand is in a *position of exaggeration of one of its normal movements*—flexion or extension, adduction or abduction; or two of these may be combined. The position of flexion is much commoner than that of extension; the commonest of all is that in which the hand is *flexed* and *adducted.*

2. *If the radius is absent* the hand deviates to the radial side. The thumb may also be absent, or its metacarpal bone wanting, the phalanges being attached to the carpus only by soft tissues.

3. If the *ulna is absent* there is ulnar deviation, and one or more fingers on the inner side of the hand may be missing.

4. The condition is generally *bilateral* and other deformities are often present elsewhere in the body.

Treatment.—

CASES WITHOUT BONY DEFECT.—These are treated by wrenching, and are put up in plaster, or specially made splints which keep the hand in an over-corrected position.

PHYSICAL TREATMENT is on the same lines as in similar deformities of the foot: massage, especially of the stretched muscles; passive stretchings and active movements, with exercises as soon as the child is old enough.

CASES WITH BONY DEFECT (e.g., absent radius).—

SURGICAL TREATMENT.—The ulna is split to make two bones, and is articulated at the wrist with the carpus. The thumb, if the metacarpal bone is missing, is amputated, being quite useless, or an attempt is made to articulate the first phalanx to a carpal or metacarpal bone (Tubby).

PHYSICAL TREATMENT.—

Pre-operative.—Massage and movements are given to strengthen the muscles.

Post-operative.—The hand is put up in a special splint, or in plaster. Massage is given in the usual way, and passive and active movements of the wrist after some weeks. The range of movement possible should be ascertained from the surgeon.

For acquired forms of hand deformity, *see* description of PARALYSIS OF NERVES OF ARM, ARTHRITIS, and RICKETS (Chapters XII, VII, and XVIII).

DUPUYTREN'S CONTRACTURE

Flexion of the fingers into the palm of the hand due to contraction of the palmar fascia.

ETIOLOGY.—

AGE AND SEX.—The deformity occurs much more frequently in men than in women, and appears in middle life or old age.

CAUSE.—There is some uncertainty about what actually causes the contracture. Heredity, gout, rheumatism, and metabolic diseases have all been blamed for its appearance. Undoubtedly, in many, if not most, of the cases, injury to the tissues of the palm is the *exciting* cause, and the contracture is often found in people whose occupations entail constant pressure on, or irritation of, this part of the hand.

PATHOLOGY.—

1. The seat of the trouble is the *palmar fascia*, which becomes thickened, probably following a chronic inflammation, and later contracts in bands,

drawing down the fingers into the palm of the hand. The *skin* also becomes contracted. The ring finger is most frequently affected and later the little finger, but sometimes the latter is the first to suffer. The other fingers are far less commonly involved, and the thumb very rarely.

2. The finger is drawn down first at the metacarpo-phalangeal joint, then at the first interphalangeal joint, and then at the second, so that finally the fingers are flexed into the palm (*Fig.* 106).

Fig. 106.—Dupuytren's contracture.

3. The *tendons* may become shortened and adhesions may form in the joints in old-standing cases.

SYMPTOMS.—

1. The *position* of the fingers is as described above. As they are drawn down, the shortened bands of fascia stand out like cords in the palm and up to the second phalanges. The skin, which adheres to them, is thrown into wrinkles.

2. The patient may complain of *neuralgic pain* in the hand, or there may be none unless the fingers are forcibly extended, or the fascia subjected to pressure.

Treatment.—

In very slight and early cases, stretching movements for the shortened structures and active movements for the extensors may be tried, with frictions to the palm of the hand; but an operation is generally necessary. Treatment by splinting only without operation is sometimes attempted, but is slow and painful.

SURGICAL TREATMENT. — The operation consists of severance of the contracted bands of fascia by various methods, or removal of the fascia itself.

POST-OPERATIVE TREATMENT.—Support: The finger or fingers are put up in as complete extension as possible on some kind of padded metal splint, applied to the palm of the hand and the front of the affected fingers. It is retained for eight to twelve weeks, but a splint should be worn at night for about six months.

PHYSICAL TREATMENT.—

MASSAGE.—As soon as the wound is quite securely healed, the palm may be massaged, as well as the rest of the hand and the forearm.

MOVEMENTS.—Stretching movements must be given to the fingers, and active movements practised by the patient. He may be taught to do the passive stretching himself, after soaking the hand in hot water. The whirlpool bath is excellent, if obtainable.

General hand and finger exercises should also be given, as well as movements for elbow and shoulder.

In some cases, the correction obtained at the operation is not quite complete, but is finished off by splints afterwards.

CONTRACTED FINGERS

This deformity is congenital and hereditary.

DEFORMITY.—The fifth finger is most often affected, or the fourth and fifth fingers together. The condition gets progressively worse after birth. It is due to contraction of fascia and skin, and exists only in the fingers,

not in the palm of the hand as in Dupuytren's contracture. As a rule, the first phalanx is extended, the second flexed, and the third extended. There is no muscular wasting (Tubby).

Treatment.—

PHYSICAL TREATMENT.—A special splint is used to keep the fingers straight, and they should be manipulated daily, if possible several times a day (*see* notes on manipulation of stiff fingers, p. 77).

SURGICAL TREATMENT.—In more severe or neglected cases, the contracted bands of fascia are divided, the fingers being put up in extension on a small splint.

POST-OPERATIVE TREATMENT.—This consists of massage of the arm, passive movement, and active movement. The patient should be under supervision for some time, as recurrence of the deformity is common.

For VOLKMANN'S ISCHÆMIC CONTRACTURE, *see* p. 26; for the results of sepsis in the upper extremity, *see* p. 98; and for deformities due to paralysis of peripheral nerves, *see* Chapter XII.

II. DEFORMITIES OF THE LOWER EXTREMITY

CONGENITAL DISLOCATION OF THE HIP

In this condition one or both of the femoral heads are found out of the acetabulum at birth.

ETIOLOGY—

SEX INCIDENCE.—The condition is much commoner in girls than in boys (80 per cent). The reason for this is unknown.

SIDE AFFECTED.—The dislocation may be *unilateral* (generally of the left hip) or *bilateral*; the former is much more common.

HEREDITY appears to be a factor in some cases.

CAUSE.—Congenital dislocation is not due to a birth injury, though violence at birth may possibly displace the femoral head from the acetabulum, or increase an already existing displacement. But in either case the acetabulum is defective, owing to some prenatal failure of development, the cause of which is not understood.

PATHOLOGICAL CHANGES.—

BONES.—

1. The *acetabulum* is defective, and takes the form of a small triangular depression; or, even if almost perfect at birth, it does not develop, but fills up with fibrous tissue and fat. Meanwhile, the head of the femur, by exerting pressure on the ilium, makes a new acetabulum, though this is rarely deep enough to form a safe socket for the head. Sometimes more than one of these depressions may be seen if the head has moved from one part of the bone to another.

2. The *head of the femur* is generally displaced backwards and upwards on to the posterior (external) surface of the ilium. Less commonly, it is displaced anteriorly, and lies below the anterior superior spine. It becomes more or less deformed, either flattened at the points where it lies against the ilium, or ultimately destroyed by the friction against that bone. The angle of the neck may be decreased (coxa vara) or the neck itself may be twisted. Sometimes the deformity is so serious as to render the replacement of the head in the acetabulum very difficult.

LIGAMENTS.—

1. The *ligamentum teres* is generally rudimentary or missing.

2. The *capsule* is stretched by the displacement of the femoral head. The weight of the body falls not, as normally, on the head of the femur, but on the capsule, which becomes hypertrophied, especially the front and lower part. This anterior portion is stretched across the acetabulum, finally becoming adherent to its rim, leaving only a small opening, and so making reduction difficult. This difficulty may be increased by the position of the tendon of psoas (*see below*).

3. The *cotyloid ligament* and the *joint cartilage* may also be defective.

MUSCLES.—These changes are most important. For the purposes of description we may divide them into two groups. (1) *The long muscles, passing from the pelvis to the shaft of the femur, or to the tibia or fibula*, viz., the hamstrings, sartorius, rectus femoris, the adductors, gracilis, and tensor fasciæ femoris. These muscles all become more or less shortened, and offer a good deal of resistance to reduction. (2) *The short muscles, passing from the pelvis to the upper extremity of the femur;* the glutei, obturators, quadratus femoris, and psoas. These muscles are not shortened, but owing to the changed position of the upper part of the femur in relation to the pelvis, they are altered in direction, and therefore, also, as regards their function.

The Glutei.—Owing to the higher position of the great trochanter, these muscles, instead of passing *obliquely* downwards and outwards to their insertion, become much more *horizontal* in direction (*Fig.* 107). This puts them at a mechanical disadvantage and makes their pull ineffective both as abductors of the thigh, and also when they act from their insertion on the femur to their origin on the ilium, to keep the pelvis level when one leg is off the ground. The patient therefore, cannot keep the pelvis straight when standing on the affected side; it drops towards the sound side (*see below*). The gluteus maximus, owing to its displacement, no longer covers the tuber ischii, which lies beneath the gluteus medius and minimus only.

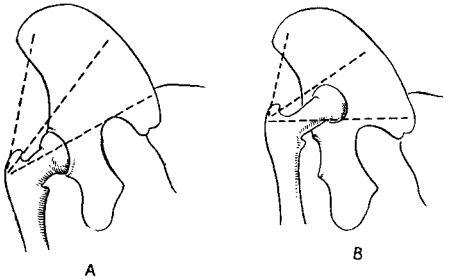

Fig. 107.—Direction of fibres of gluteus medius and minimus. A, Normal; B, In congenital dislocation of the hip. The broken lines indicate the direction of the muscle fibres.

The Psoas.—The tendon of this muscle is displaced as it crosses the brim of the pelvis, so that it compresses the capsule of the hip-joint, producing an 'hour-glass' shape. It thus stretches from its origin to its insertion like a sling, and the pelvis is supported on it and on the capsule. This weight drags the muscle downward away from its origin, and so the lumbar spine is pulled forward, this being one of the reasons for the lordosis found in congenital hip. The position of the tendon may make reduction very difficult.

SYMPTOMS.—These are generally not noticed until the child begins to walk.

1. *Trendelenburg's Sign.*—As described above, the patient cannot hold the pelvis level when he stands on the affected side, because the abductors are at such a disadvantage that they cannot function effectually. This dropping of the pelvis towards the sound side when the patient stands on the affected side constitutes Trendelenburg's sign, and accounts for the peculiar gait.

2. *Gait.*—In unilateral cases, there is a very marked *limp*, the patient dropping his pelvis towards the sound side every time the weight is placed on the affected limb, and jerking his trunk in the opposite direction (i.e., towards the

affected side) in order to counteract this. In bilateral cases, the gait is an exaggerated *waddle*, the pelvis being dropped alternately on either side, and the trunk jerked correspondingly from side to side.

3. In a posterior dislocation there is *lordosis*, partly for the reason given above, and partly because the pelvis is tilted forward, and the back hollowed to compensate for this. It is much less marked in the unilateral cases than in the bilateral. It disappears when the hip is flexed.

4. In unilateral cases, *scoliosis* develops, the convexity of the curve being towards the sound limb, because the pelvis is dropped on this side (*see p.* 263).

5. There is, of course, *apparent shortening* of the leg, because the head of the femur is too high up on the hip-bone; in small children there is increased mobility of the limb, and the head of the femur can be drawn downwards by traction on the leg.

6. The *great trochanter is above Nélaton's line* (i.e., a line drawn from the anterior superior spine to the tuberosity of the ischium) instead of on the line. Since it protrudes above the upper border of the gluteus maximus, it is prominent, this being more noticeable in adults than in children.

7. The buttocks are *broad, flat, and somewhat triangular in shape*, owing to the altered position of the gluteus maximus; and, as we have mentioned, the tuber ischii can be felt to be no longer covered by this muscle.

8. In children there is, as a rule, *no pain*; but as they grow older, there is fatigue on exertion, especially in bilateral cases, and spasm of muscles may cause considerable pain. The symptoms tend to become worse as the patients advance in age.

Treatment.—

SURGICAL TREATMENT.—The condition may be treated by: (1) The manipulative method; (2) Open operation.

1. THE MANIPULATIVE METHOD: THE LORENZ OPERATION.—This is used for children under 10 years in unilateral cases, or under 8 in bilateral (Lorenz). The child is anæsthetized, and the shortened muscles are stretched, the adductors being sometimes divided. The surgeon then first flexes the hip, thus bringing the head of the femur down behind the acetabulum; he then carries the leg backwards into a position of abduction to a right angle, sometimes even carrying it behind the plane of the body, and thus forcing the head over the back part of the rim of the acetabulum.

Fixation.—The limb is secured by a plaster spica bandage into the above position—viz., abduction to 90°, outward rotation, and sometimes slight hyperextension. In bilateral cases both hips are reduced and fixed at the same time.

The period during which this plaster bandage is to be worn, and the number of times it should be renewed, varies so much in the procedure of different surgeons that it is impossible to give any fixed rule for it. Broadly speaking, the fixation lasts from six to twelve months. The knee may or may not be included in the bandage. In unilateral cases, the child is generally encouraged to try and walk with the plaster still on, the heel being raised on the affected side, as the pressure and friction thus caused are thought to help deepen the acetabulum. Even in bilateral cases, the child can sometimes get about with the help of a stick.

Some surgeons bring the limb down a little more from the abducted position each time a new bandage is applied. Others keep it in the fully abducted position during the whole period of fixation.

2. THE OPEN OPERATION.—This is performed in the case of patients too old for manipulative reduction, or in cases where the latter has been tried and has failed. The acetabulum is deepened, and the head of the femur replaced.

PHYSICAL TREATMENT.—

AFTER THE MANIPULATIVE OPERATION

1. DURING THE PERIOD OF FIXATION.—The lower leg should be massaged to prevent wasting of the muscles, and movements should be given to the ankle, and to the knee if it has been left free.

2. AFTER FIXATION HAS BEEN ABANDONED.—As has been said, some surgeons bring the limb down gradually from the abducted position by a series of plaster bandages, while others maintain full abduction throughout the fixation period. In the latter case, the child's limb will be more or less fixed in this position.

Massage.—The child may be placed in the lying position, and the lower limbs vigorously massaged, in order to strengthen all the weak muscles. She should then be turned over into the prone position, and the posterior muscles treated, special attention being paid to the glutei. The back should also receive a dose of effleurage and kneading.

Exercises.—If the limbs are able to be brought side by side, or almost so, active exercises will be needed for strengthening purposes, and correct walking must be taught.

Even if the limb, or limbs, are more or less fixed in the abducted position, it is, as a rule, better to avoid *forced* movement, and trust to *free* active movements to bring the leg gradually to the normal position. Passive stretching of the hamstrings may be carefully given if the knee cannot be fully extended. If an attempt *is* made to mobilize the hip passively, great care is necessary, since too forcible adduction might redislocate the joint even after months of fixation. Gentle hip-rolling is the best movement to give, the pelvis being fixed so that the movement takes place in the hip-joint, not in the joints of the spine.

In older children, the contracted tissues may have to be stretched under an anæsthetic, after which passive movement as well as active must be given to preserve the mobility so obtained.

Active Movements.—Abduction is, of course, the principal movement to be practised. For some time after the end of the fixation period the patient should be able to reproduce the position in which the limbs were put up, and should rest and sleep in this position.

Abduction should at first be done in the lying position, afterwards—in unilateral cases—it may be tried in side-lying; later still, in standing, the patient abducting the affected hip. Then, as a preparation for walking, he may be allowed to stand on the affected hip, and first flex, and later abduct the sound leg slightly, keeping the pelvis level in the meantime.

Extension of the hips should also be practised in the forward-lying position.

Adduction, and with it *inward rotation* should be given carefully, as free movements.

Exercises for the abdominal and back muscles are also necessary, since lordosis is a feature of all cases, especially the bilateral type, and scoliosis is a complication of the unilateral.

Re-education in Walking.—This is undertaken as soon as permitted by the surgeon. The patient will have to be taught not to drop the pelvis on the sound side in unilateral cases, or on each side alternately in the bilateral; that is, the limp or the waddle have to be eliminated. This is often no easy task. The patient walks at first with the feet wide apart, and this must be gradually corrected. The spine must be carefully watched for signs of scoliosis.

AFTER THE OPEN OPERATION

Treatment is on similar lines. The surgeon will decide when it is to be begun.

COXA VARA

This is a deformity consisting of a decrease of the normal angle between the neck and shaft of the femur.

ETIOLOGY.—

SEX INCIDENCE.—Males are more often affected than females.

AGE INCIDENCE.—Coxa vara appears most commonly in adolescence, because at this time of life the still growing bone is subjected to increased strain, the patient leaving school and going to work. But it may be congenital, or occur in infants or in adults.

SIDE AFFECTED.—It is more often unilateral than bilateral.

CAUSES.—

Congenital Form.—The cause of this deformity is unknown. It is sometimes associated with congenital dislocation of the hip.

Acquired Form.—

1. *The adolescent (static) form* is due to the weight of the body—increased by the carrying of heavy objects—falling on bone that is not sufficiently hardened to bear it.

2. *Other causes are*: (*a*) *Injury*; fractures of the femoral neck; separated epiphyses. (*b*) *Bone disease*, e.g., rickets. (*c*) *Joint disease*; e.g., arthritis; tuberculosis of the hip.

PATHOLOGICAL CHANGES.—

BONES.—1. *The neck of the femur*, which, normally, should form an angle of about 130° with the shaft, is *depressed* so as to form a much smaller angle, e.g., 90° (right angle) or less (*Fig.* 108).

2. The neck, besides being depressed, may be otherwise *distorted*; it is most commonly bent backwards, that is, it forms a curve with the convexity forward.

3. *The head is often deformed*, and its lower part is subluxated—that is, not in contact with the acetabulum.

4. Because of the lowering of the head of the femur, and the depression of the neck, the latter comes into contact with the upper part of the rim of the acetabulum, almost as soon as *abduction* of the limb is started, so that *this movement is exceedingly limited.*

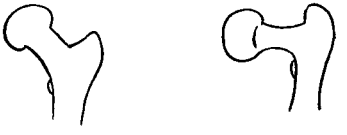

Fig. 108.—Showing deformity of neck in coxa vara. A, Normal angle of head with shaft—about 130°; B, Angle in coxa vara—about 90°.

MUSCLES.—Because of the downward bending of the neck, the great trochanter is correspondingly raised. The same kind of changes are found in the position of the glutei as in congenital hip (*see above*), but not as a rule to such a great extent. The *abductors*, however, are always weak and tend to atrophy, while the *adductors* become shortened.

SYMPTOMS.—Many symptoms are similar to those found in congenital hip.

1. *Limitation of Movement, and Position of Leg.*—

a. In the commoner form, where the neck is depressed and has a forward convexity.

i. *Abduction* is limited, both by contact between the bones, and by adaptive shortening of muscles and ligaments. *Adduction* is increased, and the leg is held in an adducted position.

ii. *Flexion* is limited, and *extension* slightly increased (because of the forward convexity of the neck).

iii. *Outward rotation* is increased and *inward rotation* limited, for the same reason.

iv. The patient stands with the leg *adducted*, the hip *rotated outward*, and the foot *everted*.

b. If the neck is simply depressed, and not otherwise bent, the abduction is even more limited than in the case where there is a forward convexity, but there is little loss of flexion, and the rotatory movements are normal.

2. *Gait.*—In *unilateral cases* there is a pronounced limp, since the abductors work at a disadvantage, as in congenital hip (*see above*). In *bilateral cases*, there is a waddling gait, very clumsy and ungraceful, the patient sometimes even crossing his knees as he walks, owing to the exaggerated adduction in the hip-joint.

3. The great trochanter is *above Nélaton's line*, and is prominent, this being partly due to its elevated position, and partly to the atrophy of the muscles covering it.

4. The leg is *shortened*, because of the decrease of the angle of neck and shaft.

5. *Trendelenburg's sign* (*see above*) is occasionally present.

6. *Pain, weakness*, and *stiffness* are felt in the affected hip in the early stages, or the patient may complain of pain in the knee. The pain may become very severe later.

7. *Complications.*—Lordosis is present in some, but not all, of the bilateral cases; and scoliosis in the unilateral. Compensatory knock-knee and flat-foot may also be present.

Treatment.—

REST AND SUPPORT.—If the onset of the disease is detected at an early stage, the patient will be ordered rest in bed for a time, and later should change his occupation, at least temporarily, if it is a laborious one. In unilateral cases, the patient, after a few weeks' rest, is sometimes fitted with a caliper splint to take all weight off the limb; while if pain and spasm of the muscles surrounding the joint are severe, the limb may be put on extension.

PHYSICAL TREATMENT.—

1. ORDINARY ADOLESCENT CASES. — If physical treatment is ordered, it will consist of *massage* of the hip and thigh muscles, especially the glutei, tensor fasciæ femoris, rectus femoris, and sartorius. If there is pain and spasm, the massage must be very gentle, and consist at first of stroking only, while later, gentle effleurage and kneading may be added. Stretching manipulations may be used for the adductor group.

A little later, *movements, passive and active*, become an important part of the treatment.

Abduction must be practised, but no active *adduction* must be allowed. Abduction may therefore be given as a free movement, the operator carrying the limb back passively to the mid-line of the body, but not beyond; or concentrically and eccentrically. *Inward rotation* and *flexion* must be practised in the same way, if they are limited. If the patient is long in bed, it is wise to give foot and knee exercises as well.

The exercises are best performed in *lying or half-lying.* If the side-lying position is assumed for hip flexion, care must be taken that the hip does not fall into adduction. The patient, even in half-lying, is liable to adduct the thigh during flexion of the hip, and this must be prevented. Side-lying must not be used for cases of bilateral deformity.

2. CASES WHERE THERE IS DEFINITE SOFTENING OR YIELDING OF BONE, AS IN RICKETS, OR IN SEVERE ADOLESCENT CASES.—

Support.—The leg is put up in plaster in *full normal abduction.* This corrects the deformity because, while the head of the femur is held in position

by the lower part of the capsule, the upper border of the acetabulum presses on the neck, straightening it out and increasing the angle between neck and shaft.

3. CASES WHERE THE BONE HAS HARDENED IN THE DEFORMED POSITION, e.g., old rickety cases, cases due to old injury, etc.—

Surgical Treatment.—These cases are generally treated by *osteotomy*, a wedge being cut from the outer side of the upper extremity of the femur, opposite the lesser trochanter, and the opening closed.

After this, or any similar operation, the limb is fixed in an *abduction plaster*, or on some special splint for about 8 weeks, the patient remaining in bed, after which the limb is brought down parallel to the other, and after it has been supported for another period of from 4 to 8 weeks, by a short plaster bandage or by a caliper splint, the patient is allowed to walk without support.

Post-operative Physical Treatment.—This is on the same lines as that described above. It may be begun as soon as the plaster is removed. The massage may be of a brisker kind, and the whole leg should receive treatment with special attention to the weakened, and, in this case, considerably wasted muscle groups round the hip.

LATER TREATMENT OF ALL CASES.—

Re-education in Walking.—As in congenital hip, the patient must be taught to keep the pelvis level, so as to eliminate the limp or the waddle. The operator must pay careful attention to the position of the feet, an everted position being common, and leading ultimately to 'weak' or 'flat' foot. Foot-drill (*see* pp. 232, 233) should therefore be given.

General Leg Exercises should also be practised—gentle Leg-swinging and -circling, or High-reach-grasp-standing Leg-abduction and -inpressing, each leg being exercised in turn. The patient should not do many exercises in standing at first.

Balance Exercises and Free Exercises of all kinds should finally be given to improve posture.

COMPLICATIONS, such as knock-knee, flat-foot, scoliosis, or lordosis must be treated.

GENU VALGUM

(Knock-knee)

ETIOLOGY.—The two principal causes of knock-knee are (1) *Rickets*, in infancy; (2) *Muscular and ligamentous weakness*, in adolescents (static form), at a time of life when increased work is required of them.

Other causes are fractures or injuries in the region of the joint, or operations for genu varum; paralysis (generally infantile paralysis) of the semimembranosus and semitendinosus, or of the quadriceps; or disease of the joint itself. Genu valgum may be secondary to coxa vara, flat-foot, or spinal curvatures.

PATHOLOGICAL CHANGES.—We may distinguish two stages of this deformity: (1) Those in which there are *muscular and ligamentous changes only*; e.g., adolescent (static) cases in their early stages; (2) Those in which there are *bony changes* also, more or less severe; e.g., in rachitic, or in neglected static cases.

The bony changes are most marked in the rickety form of knock-knee, and are therefore most noticeable at the epiphyses, which are enlarged.

BONY CHANGES.—

1. The inner condyle of the femur is hypertrophied and lengthened. Even in a normal knee, the greater weight falls through the external condyle. In a patient with genu valgum, the pressure on the outer side is intensified, while hardly any falls on the inner side.

2. There may be curves in the shaft of the femur or tibia. The lower third of the femur may be convex inwards; the tibia may be curved with the convexity inwards, outwards (bow-legs) or forwards; or there may even be a double curve in this bone.

MUSCULAR AND LIGAMENTOUS CHANGES.—

1. There is shortening of the external lateral, and stretching of the internal lateral ligament.

2. Stretching of the semimembranosus, semitendinosus, sartorius, and vastus internus.

3. Contracture of the tendon of the biceps femoris and the iliotibial band of fascia.

As a result of this relaxation of important ligaments and muscles, we find the following changes as regards stability, and in the position of the bones :—

1. There is *increased mobility* at the knee-joint. Rotation of the knee, normally possible only in semiflexion, can now take place to some extent when the knee is extended. Sometimes the knee is hyperextended.

2. The *patella* may be displaced outwards, or even dislocated.

3. The *tibia is rotated outwards* on the femur, by the contracted biceps tendon. The femur may be rotated inwards.

If the condition is complicated by flat-foot, the latter is often peculiar in that the front part of the foot is twisted inward.

SYMPTOMS.—

1. If the patient's knees are placed together, when standing, there is a space between the feet on the floor, varying from two to twenty inches. If the feet are placed together, the knees are crossed.

2. The angle between the thigh and leg is decreased.

3. The deformity disappears when the knee is flexed.

4. It is more marked when the patient stands, i.e., when the body weight, falling on the weak muscles and ligaments, leads to further yielding.

5. The *gait* is clumsy and uncertain, because of the weakness of the ligaments and instability of the joints, also because the knees tend to cross. A small child generally turns the toes in, and later a peculiar form of flat-foot supervenes.

6. *Complication.*—Besides flat-foot, the patient may develop scoliosis, if the deformity is unilateral or worse on one side than on the other.

Treatment.—

GENERAL TREATMENT.—

1. For *rickety children*, while the bones are still soft, rest must be prescribed, and they must be kept off their feet, splinted if necessary to prevent them from walking. Warmth, suitable food, fresh air, and sunlight, natural or artificial, are important.

2. The *adolescents, and children who are merely weak and not rachitic*, should also have rest, and appropriate medical treatment will be administered. The adolescent should change his occupation for a lighter one.

PHYSICAL TREATMENT.—The patients may be divided into two classes : (1) The first class comprises all children under four years of age; the adolescent cases; and any others in whom bony change is absent or negligible. (2) The second contains *old* rickety cases, in which the bones have hardened, and in which bony deformity is considerable; also *neglected* 'static' cases in which bony change has ultimately developed.

For treatment of RICKETS in itself, *see* Chapter XVIII.

Class I

Cases in Class I, corresponding to *first degree* deformities, are treated by massage, exercises, and, if necessary, by supports.

Massage.—

Position of Patient.—Half-lying, with the knees in extension.

Manipulations.—The whole limb should be treated with stimulating massage in order to improve the circulation, and the condition of all structures. *Stretching massage* should be given to the outer side of the thigh (iliotibial band) and to the biceps; stretching frictions to the tendon of this muscle and to the external lateral ligament. *Special kneading* is to be applied to the inner and front parts of the thigh (the sartorius, the quadriceps—especially the vastus internus—and gracilis); and to the inner side of the posterior aspect (semimembranosus and semitendinosus); hacking to the front, and lower fourth of the inner side; kneading with the fingers and with the palm of the hand to the internal lateral ligament. The object of these manipulations is to bring fresh blood to the stretched and weakened tissues, and, in the case of the muscles, to cause them to contract. *Treatment for flat-foot* must be given if necessary.

Passive Movements.—Passive pressure may be given, with one hand on the inner side of the knee, and one on the outer side of the leg just below the knee, or on the outer side of the ankle. The latter grasp gives the better leverage, but must not be used if the knock-knee is complicated by bow-leg, or if the bones are soft.

In *bilateral cases*, with the same exceptions, the ankles may be tied or strapped together, a pad being placed between the knees, and the patient may be left in that position for ten minutes or so. The operator must be careful to see that the straps are comfortable and not over-tight. This form of stretching is not suitable for little children unless someone can remain to amuse them.

Active Movements.—Knock-knee is a most difficult problem to tackle, because the position of the knee is not that of an exaggeration of one of its normal movements, so that after the joint has been mobilized it may be corrected by the use of the muscles which perform the opposite action, as an everted foot is corrected by the strengthening and re-education of the invertors. Outward movement (abduction) does not exist in the normal knee, and there are therefore no muscles which directly produce inward movement. Certain muscles, however, must help to maintain the knee in the correct position, thus relieving the tension on the ligaments. It is reasonable to suppose that these are the muscles which are now stretched—the vastus internus, gracilis, sartorius, and semitendinosus, and it will therefore be our aim to strengthen them.

We have seen that the deformity disappears when the knee is in flexion. It is not very clear how this happens.* In any case, since the trouble arises from laxity of ligaments, and since flexion further relaxes them, it is obvious that the proper position in which to give exercises is one of *full extension.* This, of course, limits our choice of exercises to a great extent, cutting out many old favourites! We want to strengthen all the muscles of the thigh, but not to produce greater contracture of biceps and the ilio-tibial band.

The following are suggested:—

1. *Half-lying Leg-abduction and -inpressing, with pressure outward on*

* Sir Robert Jones points out that in knock-knee due to rickets, the deformity disappears in flexion because only the lower ends of the femoral condyles are distorted, and not their posterior surfaces. (*Orthopædic Surgery,* chapter xv.)

knee and inward on ankle. This is a much-used exercise. It simply works the abductors of the hip, the knee being meanwhile held in the corrected position. The objection to it seems to be that the use of the tensor fasciæ femoris must surely lead to further shortening of the iliotibial band. This objection does not apply to *Leg-adduction and -outdrawing,* which should shorten the gracilis, and relax the tensor. Provided the operator presses firmly inward on the ankle (or higher on the tibia) all the time, and resists the movement with the hand on the inner side of the knee, it seems a better exercise. Either exercise may be given to both legs at the same time, but two gymnasts will be required in this case.

2. *Quadriceps contractions.* These are easily taught, even to small children.

3. *Outward rotation of the hip, concentric and eccentric, with the knee firmly supported.* This counteracts the inward rotation of the femur, and uses the sartorius. Outward rotation must not be allowed to take place in the knee.

When the patient is again allowed to walk without support, general leg exercises should be employed.

SUPPORTS.—These are required in all but very slight cases. They are applied to the *outer* side of the leg, and the convexity of the curve, the maximum of which is at the knee-joint, is drawn gradually towards the support.

The splint consists of a band round the pelvis, from which a metal rod passes down the outer side of the leg to the foot, where it is secured to the sole of the boot. The support is fastened by straps or metal bands to the leg (*Fig.* 109). The

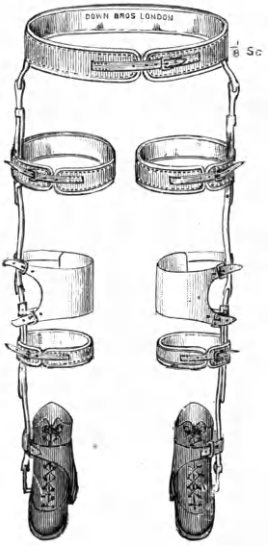

Fig. 109.—Support for genu valgum.

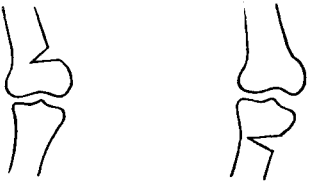

Fig. 110.—Showing two forms of osteotomy for genu valgum.

knee is kept in extension, and the ankle is free to move. The supports prescribed by different surgeons vary in their details, but they are all on the same principle.

Class II

The cases in Class II (second and third degree cases) cannot be cured by support and manipulations alone. Surgical treatment is necessary.

OPERATIONS.—The operation performed is either (1) osteoclasis, or (2) osteotomy.

Osteoclasis.—This consists of fracture of the lower end of the femur, or slight displacement of its lower epiphysis.

Osteotomy.—This is the more usual operation. It generally consists of cutting a wedge from the inner side of the femur, above the knee-joint, and bringing the cut surfaces together. Some surgeons prefer to take the wedge from the inner side of the upper end of the tibia. (*Fig.* 110.)

FIXATION.—The leg is either splinted, or put in plaster for 6 to 8 weeks, after which the patient is allowed to get about on crutches.

POST-OPERATIVE TREATMENT.—This consists of general massage of the leg in the early stages, with exercises later.

When the leg is out of plaster, massage may be begun immediately, and should be brisk and stimulating. The knee may be gently mobilized. Strong passive (lateral) pressures are no longer necessary, if the operation has been successful, and would, in fact, be dangerous, as tending to produce the opposite deformity (genu varum) by over-correction. Active flexion and extension of the knee should be given, and exercises for the hip and the foot.

When the patient is allowed to walk, he must be taught to do so correctly.

GENU VARUM (BANDY-LEGS) AND BOW-LEGS

These are conditions in which a line drawn from the head of the femur to the middle of the ankle-joint falls inside the centre of the knee-joint (MacEwen).

ETIOLOGY.—Genu varum is a more common deformity than knock-knee; it starts in childhood, and is generally bilateral.

Genu varum, or 'bandy-legs', is a deformity of the whole limb, 'bow-legs' of the lower leg only. In both cases the chief cause is rickets, but the deformities are also found in small children who are not rickety, but who have been allowed to walk too soon, the body-weight being too much for the bones which are still soft. This is specially the case in fat, heavy children. Sitting cross-legged on the floor may also be a factor.

PATHOLOGICAL CHANGES.—In both these deformities, there is always some measure of bony change.

GENU VARUM.—

Bones.—The shafts of the femur, tibia, and fibula are all curved outward, the maximum convexity of the curve being at the knee.

Muscles and Ligaments.—The ligaments on the outer side of the knee are lengthened, and those on the inner side shortened. The muscles on the outer side of the thigh and leg—biceps femoris and the peronei—are stretched; the adductors are shortened.

BOW-LEGS.—The shafts of the tibia and fibula only are bent, with the convexity outwards, the peronei alone being stretched. Forward bending of the tibia is also found, with shortening of the tendo Achillis.

PROGNOSIS.—The condition tends to spontaneous improvement, the growing bone filling up the concavities. But complete cure does not always take place, and the patient loses in height.

Treatment.—

Rickety cases must receive appropriate general treatment (*see* Chapter XVIII).

CASES OF WEAKNESS

These are treated by support, massage, and exercises.

SUPPORT.—It is better, as a rule, to give the child an 'iron', and let him run about—except in cases where rickets is still active—rather than take him completely off his feet.

The support for *genu varum* is the reverse of that used for knock-knee—a steel rod on the *inner* side of the leg, from the groin to the internal malleolus fastened to the limb by straps and bands, the convexity of the curve being drawn inwards towards the support.

For *bow-legs*, the support extends only from the internal condyle of the femur to the internal malleolus.

PHYSICAL TREATMENT.—

MASSAGE.—In *genu varum* the whole limb, including the gluteal region, should be treated briskly, the adductors should be stretched, biceps and the peronei require extra kneading and hacking. Stretching frictions are given to the ligaments on the inner side of the knee, kneading to those on the outer side.

In *bow-legs* the massage is similar, but the adductors do not require stretching.

PASSIVE MOVEMENTS.—An attempt may be made to mould the bones gently if they are soft; this is useless in old rickety cases.

For *genu varum*, pressure may be exerted at the knee. The knee itself is pressed inward, while outward pressure is exerted above and below.

ACTIVE MOVEMENTS.—The patient, in half-lying or sitting, may do any exercise calculated to strengthen the leg muscles generally. Foot-drill should not be neglected. Exercises in standing should not be given until the surgeon permits the patient to walk without apparatus. A useful late exercise is as follows: the patient stands with feet parallel and close together (close-standing), and performs outward rotation in the hip-joints.

SEVERE CASES

SURGICAL TREATMENT.—If the bones are hard, as in a late rickety case, the patient is treated by operation. This consists of osteoclasis or osteotomy.

OSTEOCLASIS.—The bone is broken at the point of greatest curvature, and set in an over-corrected position.

OSTEOTOMY.—(1) A wedge is cut from the outer side of the femur above the external condyle. (2) Or from the maximum convexity of the curve of the tibia. (3) Or both bones are so treated (Tubby).

For an *anterior* curve of the tibia, osteotomy or osteoclasis is carried out as well as division of the tendo Achillis.

POST-OPERATIVE TREATMENT.—After any of these operations the limb is put up in plaster—or sometimes splinted—for 6 to 8 weeks. When the plaster is removed, massage and exercises may be begun. All exercises to strengthen the leg are given, but passive pressures will probably be unnecessary. The patient needs careful watching for some time. A relapse is possible, and occasionally the opposite deformity (genu valgum) may result from over-correction, insufficient support, or inadequate after-treatment.

FLAT-FOOT AND WEAK FOOT

Under this heading may be grouped many different varieties of foot troubles. 'Flat-foot' is generally defined as a collapse of the internal longitudinal and transverse arches of the foot, often combined with eversion. We may have, however, many kinds of 'weak foot'—a better name for the condition—of which the following are the most common: (1) *Pes planus*, or flat-foot pure and simple; consisting of dropping of the arch without eversion of the foot. (2) *Pes valgus*, the everted foot, without dropping of the arch. (3) *Pes plano-valgus*, the everted foot, with collapsed arches.

A *flat* foot may cause little or no inconvenience, provided that it is mobile; an *everted* foot is always productive of trouble.

ANATOMY AND FUNCTIONS OF THE FOOT.—

THE ARCHES OF THE FOOT

These may be classified as follows: *The longitudinal arch*—(*a*) Internal; (*b*) External. (2) *The transverse arch*—(*a*) Posterior; (*b*) Anterior.

1. THE LONGITUDINAL ARCHES.—

The Internal Longitudinal Arch is composed of the os calcis, astragalus, and scaphoid, the three cuneiforms, and the three inner metatarsal bones. It is supported by muscles and ligaments, the most important of which are the inferior calcaneo-scaphoid (or 'spring') ligament, which passes like a sling below the astragalus; the tendon of tibialis anticus, inserted beneath the inner border of the foot; the tibialis posticus, which keeps the scaphoid in close contact with the head of the astragalus; the plantar fascia, and the small muscles of the sole.

The inner arch is much higher than the outer, and on its maintenance depends the existence of the 'spring' in walking. It will be noticed that the posterior pillar of the arch, the os calcis, passes down straight to its point of contact with the ground, i.e., the centre of the heel, being thus fitted for bearing weight; while the anterior pillar, sloping gradually, and being formed of several separate bones connected by ligaments, provides the elasticity which breaks the jar when the foot comes in contact with the ground, and gives the spring to the gait.

The External Longitudinal Arch is made up of the os calcis, the cuboid, and the two outer metatarsals. It rests on the ground, and is much stronger and less mobile than the inner arch. It has, moreover, strong ligamentous and muscular supports—the long and short plantar ligaments, the tendon of the peroneus longus, the plantar fascia, and the small muscles of the foot.

2. THE TRANSVERSE ARCHES.—

The Posterior Arch consists of the astragalus, cuboid, scaphoid, and the cuneiform bones, its summit being at the middle cuneiform. It is supported by the tendons of the peroneus longus and the tibialis posticus, the plantar fascia, and the intrinsic muscles of the foot.

The Anterior Arch consists of the five metatarsal bones, the third and fourth forming its highest part. This is the most mobile part of the transverse arch. It is flattened out when the weight is taken on the front of the foot, and is very liable to collapse permanently, causing the front of the foot to spread. Many people whose longitudinal arches are quite good have collapsed anterior arches. This arch is normally maintained by the small muscles of the sole, especially the interossei and the adductor transversus hallucis.

MAINTENANCE OF THE ARCHES

The real supports of the arches are the *muscles*. The ligaments alone would soon give way under the strain imposed by the weight of the body—as indeed they do, if the muscles, from weakness or disease, fail in their work. "It is not the function of ligaments to withstand continuous strain; this is a function of muscles" (Bankart).

The weight of the body tends to produce abduction and eversion of the foot. It is the function of the muscles to counteract this tendency, since *eversion is the position of weakness*, the whole weight of the body being thrown on to the internal longitudinal arch, which is not fitted to sustain it. *The position of strength* for the foot is that of adduction and inversion, the weight falling on the outer arch, so that it is distributed to those parts of the foot which are meant to bear it, that is, to the os calcis, the outer border, and the heads of the five metatarsal bones.

It will be remembered, of course, that the movements of abduction and adduction, and those of inversion and eversion, take place at the sub-astragaloid and mid-tarsal joints. The movements in the ankle-joint are plantar-flexion (extension) and dorsiflexion only, with occasionally a very small amount of lateral movement when the foot is in full plantar-flexion. A slight degree of plantar- and dorsiflexion takes place also in the mid-tarsal joint.

Functions of the Foot

The foot is used in two ways: (1) As a *support* in standing; (2) As a *lever* in walking.

1. As a Support.—Most authorities declare that the '*position of rest*' of the foot—that is, the position maintained while standing as distinguished from that assumed when walking—is one of slight abduction and eversion. We do undoubtedly tend to keep our feet slightly abducted and everted when 'standing at ease'. If this position is allowed to persist, not only when at rest, but during activity, the result will be a *permanently* everted foot, with limitation of the power of inversion. Or, again, if this position is habitually *exaggerated* while standing, whether from fatigue, weakness of muscles, excessive body weight, or a defective postural reflex, the same unfortunate result follows. In the ordinary 'position of rest', the *postural tone* of the muscles would prevent overmuch eversion of the foot, and only if the muscles failed to perform this function efficiently would the ligaments be put on the stretch, with the foot in a position of *extreme* eversion and abduction. Others say that the 'resting position' in all cases *should* be one of slight adduction and inversion. In any case, we shall do well to aim at producing such a position.

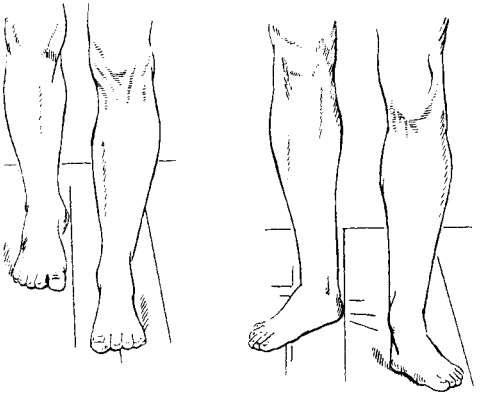

Fig. 111.—Proper (left) and improper (right) attitudes in walking. (*After Whitman.*)

2. As a Lever in Walking.—In walking, the foot is used as a lever to raise and propel the body forward. When taking a step, the heel of the back foot is raised from the ground, the weight of the body being transferred to the front leg, and the final 'push off' is given by all the toes, and especially by the big toe. The *fulcrum* of the lever is considered to be at the heads of the metatarsal bones; the *power* (the calf muscles) being applied at the point of attachment of the tendo Achillis to the os calcis, and the *weight of the body* falling in front of the ankle-joint, between the fulcrum and power, so that the lever is one of the second class. This is the one sometimes known as the 'power lever', because of the great mechanical advantage it gives to the working force, since the power arm must always be longer than the weight arm.

The inner side of the lever, i.e., the first metatarsal, is longer than the outer, and therefore the strain is thrown outward on to the outer and stronger side of the foot, relieving the weak inner border. (*Fig.* 111.)

Errors in Walking

1. If the feet are *everted* while walking, the strain is thrown on the weaker inner side of the foot, and the arch is thus depressed. The big toe is also forced into abduction, since the patient 'pushes off' with the inner side of the under surface of this toe instead of with the under surfaces of all five toes, so that hallux valgus may complicate flat-foot, the two conditions forming a 'vicious circle' and each making the other worse. The advantages of the leverage are lost.

2. Another wrong way of walking is that in which the ankle is not extended at all, or only very slightly, and the person walks in a stiff and ungraceful manner, coming down heavily on his heels—as if, in fact, his feet were in splints. The foot is not used as a lever at all. Patients with weak or flat feet often combine these two wrong ways of walking.

CORRECT WALKING

When the foot is put down again on the ground after the leg has been swung forward, it rests first on the heel; the front part of the foot is then put down firmly. As the weight falls on the foot, the arches, especially the internal longitudinal and anterior transverse arches, are flattened to some extent, and there is a tendency to eversion. The arch should be re-formed and the everted position corrected by the muscles and by the elasticity of the ligaments as soon as the weight of the body is removed. In people who habitually walk with their feet everted, the restoration of the arches and the inverted position have become impossible, the muscles and ligaments being weak and stretched. They should be taught to walk with the feet pointing straight forward, and the tendency to eversion of the foot when the weight falls on it should be counteracted by a slight movement of inversion, transferring the strain over to the outer border, while the toes should be pressed firmly on the ground, so preventing undue spreading of the anterior arch.

PES PLANO-VALGUS

(The Flat and Everted Foot)

Such a case may be regarded as a typical case of flat-foot.

ETIOLOGY.—

AGE.—A form of flat-foot, with very low or dropped arches, but no eversion, is sometimes seen in children. It is generally painless and causes little or no trouble. The painful everted foot is commonest, (1) during adolescence, when increased strain is put on the feet, and (2) after the age of 30 or 35, when the muscles grow weaker.

SEX.—Flat-foot is commoner in women than in men.

SIDE AFFECTED.—It is more often bilateral than unilateral.

CAUSES.—The causes of this very common type of deformity are many and varied. It may be due to *special causes*, such as: (1) *Paralysis* or *paresis* of any of the muscles which invert the foot or support the arches. (2) *Traumas*, including any injury to the lower extremity, but especially Pott's fracture. (3) *Other deformities*; it may be compensatory to genu varum or hallux valgus, or associated with knock-knee (*see* p. 222). (4) *Rheumatism or arthritis*. (5) *Rickets*.

General ill health, anæmia, debility, etc., may predispose to the *static* type, but the actual causes are:—

a. Unsuitable foot-wear.

b. Habitual wrong posture, either in walking, or, worse still, in standing, the foot being allowed to remain for long periods in an exaggerated 'position of rest'—that is, in extreme eversion. This, unless there is definite muscle-weakness, is due to a defect of the postural reflex. (*See* p. 263.)

c. In some cases, there may be a definite *exciting cause*—such as increase of the body weight, as in obesity or pregnancy, overstrain, carrying of heavy weights, much standing. The last-mentioned accounts for its prevalence in nurses, policemen, and shop assistants.

DEFORMITY: DISPLACEMENT OF BONES.—

1. The *astragalus* rotates downwards and inwards in normal eversion; in

'weak foot', this position is exaggerated, and becomes an actual deformity, the bone remaining permanently out of place. It can be seen as a prominence on the inner side of the foot.

2. The *scaphoid* is carried down with it, and the tuberosity can be felt under the foot.

3. The *os calcis* is also rotated downward and inward, the patient walking over on the internal tuberosity.

4. The *longitudinal arch* is lowered, and in bad cases rests entirely on the ground. The inner side of the foot loses its concave appearance, and becomes convex inwards (i.e., towards the middle line of the body).

5. While the *posterior part of the foot* is thus turned downward and inward, the *front of the foot* is turned downward and outward; it is therefore in an everted position.

6. At the same time, the foot is *spread out*, appearing much wider at the part where the arch should be. The front of the foot also spreads from collapse of the *anterior arch* (*see also* p. 236). (*Fig.* 112.)

7. The *heel* projects; the *external malleolus* is less prominent than usual, while the *internal malleolus* is lowered, and becomes much more prominent than in the normal foot. If looked at from behind, the tendo Achillis may be seen to describe a curve with the convexity inwards.

Fig. 112.—Talipes valgus with flat-foot.

PATHOLOGICAL CHANGES. — Muscular changes occur first, as stated above; then ligamentous changes, with displacement of bones; last of all, actual bony changes. The latter are not marked in the average case.

MUSCULAR AND LIGAMENTOUS CHANGES.—These consist of:—

1. *Stretching of ligaments* on the inner side of the foot; the inferior calcaneo-scaphoid ('spring') ligament; the internal lateral (deltoid) ligament of the ankle, the small ligaments and plantar fascia on this side of the sole.

2. *Shortening* of those on the outer side; external lateral ligament of the ankle, etc.

3. *Stretching*—and later, in severe cases, *atrophy*—of tibialis anticus and posticus, and the intrinsic muscles of the foot, especially of the interossei.

4. *Spasm*, and later *structural shortening* of the peronei, from overaction of these muscles.

5. Sometimes *shortening* of the Achilles tendon, with contraction of the calf muscles. (Some surgeons say this is *always* the case, and is, indeed the original factor in the condition, the patient trying to compensate for her inability to obtain complete dorsiflexion at the ankle by extension and eversion at the mid-tarsal joint and abduction at the subastragaloid.)

BONY CHANGES.—

1. The bones are subjected to pressure on the outer side of the foot, and hence become *wedge-shaped*, this being especially the case with the cuboid. On the inner side they become wider.

2. *The neck of the astragalus* is lengthened.

3. A small facet may form on the outer side of the os calcis for articulation with the external malleolus.

SYMPTOMS.—

1. There is a sensation of *weakness and strain* on the inner side of the foot.

2. *Pain* is usually a prominent symptom; it consists of fatigue and aching

while the foot is at rest, and increases when the patient stands or walks. It is most commonly found under the inner border of the foot, where it is due to stretching of the ligaments; or it may be at the heads of the metatarsal bones (METATARSALGIA, *see* p. 236); round either malleolus, over the dorsum of the foot, up the calf or the front of the leg; or, in a few cases, in the knee, hip, or even in the lumbar region.

3. *Mobility*: *Inversion* is limited because of the displacement of astragalus; *extension and flexion* may also be incomplete. *The movements of the toes* are often limited also, because the whole foot is held stiffly in walking, with little movement of the toe-joints. In the later stages all the joints of the foot become stiff.

4. *Loss of spring in walking*: the gait is awkward and ungraceful, the patient walking with feet turned out, and bringing the heels down heavily.

5. The *position and appearance* of the foot is as described above.

6. *Circulatory symptoms*: coldness, numbness, or increased perspiration, of the feet.

In examining such a case, the patient's shoes should be inspected, to see in what places they are worn down. Not only the state of the heel, but also that of the sole, should be observed.

DEGREES.—

This deformity, like others, may be divided, roughly, for purposes of description, into three degrees:—

FIRST DEGREE.—(*a*) Mere postural deformity; the patient can herself correct the position. (*b*) Transition stage. Alteration in muscular and ligamentous structures, with displacement of bone, and probably pain; the position of the foot may be corrected by the operator.

SECOND DEGREE.—Stage of slight bony change, marked spasm and contracture of muscles; complete correction not possible.

THIRD DEGREE.—The arthritic foot; changes in bones; marked changes in joints; almost complete rigidity.

Treatment.—

Our aims of treatment, as in all deformities, will be to mobilize the joints of the foot if necessary, to restore the muscles to their normal length, and to re-educate the patient in the correct use of them. Principles of treatment will therefore be somewhat as follows:—

FIRST DEGREE.—(*a*) *Postural deformity*: Attention to the patient's general health; rest, i.e., from too much standing; correct footwear; general exercises; re-education in correct posture by means of foot-drill and walking exercises; massage if pain is marked. (*b*) *Transition stage*: Rest in bed at first; massage; passive movements to restore mobility; special active movements in inner range for the affected muscles; exercises without putting weight on the foot; later, re-education exercises as above.

SECOND DEGREE (Rigid Flat Foot).—Wrenching; plaster; later, proper supports for varying periods; change of occupation if possible; massage. Later, movements and exercises as above.

THIRD DEGREE (The Arthritic Foot).—Wrenching or open operation if possible; permanent supports; post-operative massage, movements, and exercises for a time. Complete cure cannot be expected, but relief may be afforded to the patient.

FIRST DEGREE (POSTURAL DEFORMITY)

FOOTWEAR.—Special footwear is not necessary at this stage, provided the patient wears *sensible* shoes, at least during hours of activity. The shoes should be sufficiently large (if the toes are pointed a larger size should be worn).

The front of the shoe should not compress the toes; that is, the sole should be wide enough for the whole of the front of the foot and toes to rest on it, nor should the upper in any way press upon them. The inner side of the shoe should be straight from the waist to the tip. The waist should fit closely to the foot. The sole should be flat, and should have no downward convexity from side to side at the front part, so that the toes are crowded into the hollow thus formed. As to the height of the heel, some surgeons allow two inches, others only one; in any case, it should not be so high that the foot slides forwards in the shoe, the toes being pressed against the end of it. Moreover, it should form a support for the heel of the foot; a high and narrow 'Louis' heel is unsuitable for much standing or walking. (For other defects in shoes, *see* p. 236.)

PHYSICAL TREATMENT.—If the patient is delicate, anæmic, or otherwise out of health, a table of general exercises may be given, and in this should be embodied special re-education exercises. If she is healthy, a more intensive scheme of foot exercises may be given. These patients may be treated in classes, but not until they have learned to do the exercises correctly.

EXERCISES.—These may be given at first in sitting or half-lying, but most patients in this class may also do them in standing from the outset.

In Sitting.—

1. Heel-raising, Toe-raising, Alternate toe- and heel-raising (*see* p. 45).
2. Sitting with feet crossed, resting on outer borders.
3. Sitting active Foot-inversion ('clawing').
4. Tailor-sitting position.
5. Tailor-sitting, or sitting with leg crossed over knee, Passive Foot-rolling by patient. The patient is taught to do this in the same way as would the operator; one hand is placed above the ankle, the other grasps the foot from beneath. The foot should be rolled inward, and not carried outward beyond the mid-line.
6. Starting position as above, Active Foot-rolling.
7. Half-lying Toe-flexion and -extension. The operator gives support with the ball of her thumb, or her fingers, just behind the metatarsal heads as the patient flexes her toes, the ankle being kept in dorsiflexion meanwhile; the toes should be extended with the ankle in plantar flexion.
8. Sitting picking up objects with the toes: (*a*) Pencil, (*b*) marble, (*c*) golf-ball, etc.
9. Sitting Toe-separating (abduction) if possible.
10. Sitting Foot-shortening, re-forming arch. (*See* p. 233, where the same exercise is described in standing; the principle is the same in sitting.)

In Standing.—

1. Correct standing.

The patient stands with the feet parallel, and about 3 inches apart at the heels. She must be taught the correct position of the foot for weight-bearing. She should be made to perform a slight movement of inversion, throwing the weight on to the outer border of the foot; but the toes, meanwhile, should be kept on the ground in their whole length, and should be pressed down firmly against it. These two movements, inversion of the foot and flexion of the toes, counteract the natural tendency to eversion and flattening of the arches when weight falls on the foot. The tibialis anticus acts not only as an invertor to throw the weight outwards, but also as a synergist to the long flexors of the toes, fixing the ankle while these expend all their power on the toes, and in so doing it raises the inner arch, while the interossei and small muscles of the sole are likewise strengthened, so that they prevent the flattening of the transverse arches.

2. Standing Foot-shortening, re-forming the arch (*Figs.* 113, 114).

This is really only a stronger form of the above, the inversion being carried slightly beyond what is required for correct weight bearing, and the toes pressed down very hard on the ground. If the foot is mobile, the tibialis draws up the internal arch very strongly, and the whole foot may be shortened about half an inch. After the position has been held for a few seconds, the muscles should be relaxed, but the foot should not be allowed to jerk back into the everted position. The exercise should be frequently repeated, but the position should not be held for more than a few seconds at a time. Both in this and the previous exercise, the knees should be firmly braced.

3. Standing 2-Foot-inversion. This—a much easier exercise—consists of simple inversion (clawing) of both feet, repeatedly performed. Here, again, the patient must not jerk her feet back into eversion between the movements.

4. Standing and walking on the outer borders of the feet (*see* p. 84).

5. Walking on the inclined board (*see* p. 85).

6. Standing at edge of plinth, toes over the edge. Flexion and extension of the toes of both feet.

7. Correct walking (*see* 'RE-EDUCATION IN WALKING', p. 44).

Fig. 113.

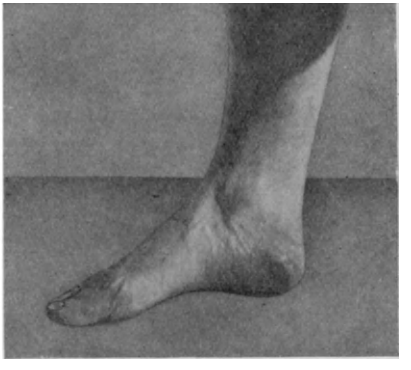

Fig. 114.

Figs. 113, 114.—Standing Foot-shortening, re-forming the arch. *Fig.* 114 shows the increase in height of the arch.

If the tendo Achillis is shortened, it must be stretched. This, however, is best done manually by a skilled operator, so that the stretching may really take place in the *ankle*, and not merely farther extend the *mid-tarsal* joint. (*See* p. 240, and *Fig.* 116.)

Tip-toe Exercises.—These are obviously inadvisable in cases where the Achilles tendon is shortened. In any case, they are probably best relegated to the later stages of treatment. They should be performed at first only with the feet inverted, so that the tibialis anticus may not be unduly stretched. Running and dancing exercises are useful when the patient has regained the correct posture, though neither should be indulged in to excess.

Home Exercises.—Most of the above are suitable for home exercises, *as soon as the patient thoroughly understands how they should be done.* She should be told to sit with crossed feet resting on their outer borders, and constantly to invert her feet while at home or at work, when sitting or when standing. This impresses the position on her mind. She must be instructed to walk with the feet straight and not turned out.

FIRST DEGREE (TRANSITION STAGE)

The patient ought in this case to rest in bed for a time, or on a couch.

FOOTWEAR.—This should be as described above, but it is advisable to raise the heel and sole of the shoe about a quarter of an inch on the inner side by inserting a leather wedge. This is known as a 'valgus wedge', and has the effect of tipping the foot over towards the outer border and preventing eversion during standing and walking.

Other forms of support may be used to hold up depressed arches. They should always be prescribed by the doctor. Many patients attempt to treat themselves by buying ready-made supports. They should always be discouraged from doing this, as many of these supports are quite unsuitable, or at all events inappropriate for their particular trouble.

PHYSICAL TREATMENT.—

MASSAGE—This may be begun at once, and is necessary in most cases of painful flat-foot. The whole leg should be treated if time permits. At all events, the lower leg should receive brisk massage to improve the circulation and remove products of fatigue or inflammation from the muscles. The details of the special manipulations are well-known to most. They may be briefly summarized as follows :—

1. *The Leg.*—

The Peronei.—Stretching massage—picking up and frictions—have been advocated for these muscles. It does not seem possible to do much stretching with the fingers, and the movement, being painful, may well aggravate the spasm. They may be stretched later by passive movements. Soothing kneading may be given at this stage.

The Anterior Tibial Group.—Kneading and hacking.

The Calf Muscles should be thoroughly kneaded, since both they and the deep group beneath them, especially the tibialis posticus, tend to waste. If the tendo Achillis is shortened, stretching petrissage should be applied to the calf muscles.

2. *The Dorsum of the Foot and Malleolar Region.*—Finger kneadings and effleurage to reduce inflammation.

3. *The Sole.*—The sole may be treated as soon as the patient can bear it. The following movements are required : *Effleurage and Kneading* to improve the nutrition of the intrinsic muscles ; *Stroking* under the inner border to remould the arch ; *Frictions*, with upward pressure under the displaced astragalus. The bone can be replaced quite effectually in some cases. It does not remain in the correct position, of course, but such temporary replacement will prevent it from becoming fixed in the position of deformity. *Clapping or Hacking* is also given under the inner border, to stimulate and contract the small muscles in that area.

PASSIVE MOVEMENTS.—The following are necessary :—

1. Inversion.
2. Dorsiflexion and extension of the ankle ; eversion during dorsiflexion must not be allowed.
3. Foot-rolling, as described above.
4. *Mobilization of the joints between the metatarsal bones.* Each metatarsal bone should in turn be grasped and steadied by the fingers and thumb of one hand, while the bone next it, similarly grasped, should be moved backwards and forwards upon it.
5. Toe-flexion and -extension.
6. Toe-rolling, and adduction of the big toe.

ACTIVE MOVEMENTS.—The following should be practised :—

1. Inversion of the foot, concentrically and eccentrically in the inner range.
2. Flexion and extension of the ankle, free, then resisted.
3. Flexion and extension of the toes, free, then resisted.

Later, exercises should be given as for the slighter cases, first in sitting, then in standing.

SECOND DEGREE (RIGID FLAT-FOOT)

Mobility must be restored before any re-education is possible.

SURGICAL TREATMENT.—

WRENCHING.—This is performed under an anæsthetic, the foot being mobilized in every direction, all adhesions being broken down, and the Achilles tendon divided if shortened. The foot is then put in plaster, in dorsiflexion and inversion for about a month or six weeks. The patient is often allowed to walk during the latter part of this period. The plaster is then removed and supports are applied ; these are worn for varying periods.

PHYSICAL TREATMENT.—

PRE-OPERATIVE.—This, if ordered, should consist of massage to strengthen the weak muscles ; and to reduce inflammation and pain in the foot.

POST-OPERATIVE.—This is begun when the plaster is removed, and consists of :—

Massage.—The leg should be treated as described (FIRST DEGREE, TRANSITION STAGE, p. 234) ; the massage of the ankle and dorsum of the foot may be more vigorous, since pain and swelling will not now be present ; the muscles of the sole should receive brisk effleurage ; kneading with the palm of the hand and with the fingers ; and hacking or clapping.

Passive Movements are most important. The correction obtained by the surgeon's manipulation must be maintained. They are given on the same lines as for the less severe stage.

Re-education follows on the usual lines, first without, then with, the superimposed body weight.

THIRD DEGREE (THE ARTHRITIC FOOT)

This, like the third degree scoliosis, is an unsatisfactory condition to treat. If the surgeon decides to operate, the treatment to follow depends entirely on the nature and purpose of the operation chosen. In cases in which no operation takes place, the patient will probably wear permanent supports. *Massage* will be directed towards increasing the patient's comfort, strengthening the weak muscles, and removing the products of fatigue from them. *Passive (forced) movements* will be inadvisable. *Active exercises* and *re-education in walking* may be attempted, though in many cases it will be unwise to allow the patient to walk without her supports.

SPASMODIC FLAT-FOOT

This troublesome condition is generally encountered in young people, and may have a toxic origin. The foot is flat and markedly everted, the peronei and extensor longus digitorum being in spasm, and is rigid and painful.

Treatment.—

As long as the pain and spasm persist, the patient must be kept off her feet, possibly for from four to six weeks. In unilateral cases she may use crutches, so long as she is careful not to put the affected foot to the ground.

During this period, only *soothing massage* of the leg and foot is permissible. The masseuse should endeavour to teach the patient to relax her foot, but no other exercises should be required of her.

When the spasm has subsided, and the pain is gone, exercises are given in the usual way, first without taking any weight on the foot. Later, when the patient is allowed to walk, the ordinary flat-foot exercises in standing are added.

Correct footwear is essential.

METATARSALGIA

(*Morton's Disease*)

A condition in which pain in the front of the foot, generally in the region of the fourth toe, is the predominant symptom. It is due to a collapse of the whole anterior arch of the foot, or to displacement of the head of one of the metatarsal bones which compose it.

ETIOLOGY.—

AGE.—Metatarsalgia generally occurs in middle-aged people.

SEX.—It is more common in women than in men, probably because the former more often wear tight and narrow shoes.

CAUSES.—

1. *Displacement of one bone* is generally caused either by unsuitable footwear or by an injury. Shoes with a convexity downward from side to side cause the middle metatarsals to be lowered, while the outer ones are raised; those which are too narrow as well exert pressure on the displaced bones and cause pain; too high heels cause the foot to slide forward, the toes being forced into the narrow front part of the shoe, and there compressed.

2. *Collapse of the whole anterior arch* is caused by the same factors as give rise to ordinary flat-foot, by rheumatism, or by shoes having the defects described above. Whitman* lays great stress on the danger of the 'rocker sole', by which he means one which is convex downwards from before backwards, and which therefore keeps the toes in extension, preventing the interossei (the chief supports of the anterior arch) from being used, and pushing down the metatarsal heads (Whitman; Tubby). These defects in footwear are emphasized here because it is most important that they should be recognized and avoided.

Metarsalgia may also be a complication of talipes equinus or pes cavus.

PATHOLOGICAL CHANGES.—If the fourth, or the third, metatarsal—or sometimes both—is displaced, the pain is due to the compression of one of the nerves to the toes by the depressed bone—that is, the pain is due to *neuralgia* or *neuritis*.

If the whole arch is collapsed, the lesion appears to be more often a *traumatic arthritis* (Mennell), due to injury of, or undue pressure on, the joints. The foot may become rigid and very painful.

SYMPTOMS.—

IF THE FOURTH METATARSAL ALONE IS DISPLACED.—

1. Attacks of *very sharp and severe pain round the fourth toe*, always occurring when the patient is wearing a shoe, and not ceasing until the latter is removed.

2. Pressure on any part of the fourth metatarsal head causes pain.

3. The displaced head of the fourth metatarsal can sometimes be felt in the sole of the foot. A corn may form below it.

IF THE WHOLE ARCH IS COLLAPSED.—

1. The pain is *dull and aching* in character.

2. The metatarsal heads are prominent in the sole of the foot. Corns and false bursæ form underneath, and the latter may become inflamed.

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* *Orthopædic Surgery.*

Treatment.—

SUPPORTS AND FOOTWEAR.—

1. *Suitable shoes* must be worn, wide in front, with flat soles and not too high heels. Unless the patient is prepared to be sensible in this matter, treatment will be of little use. The shoes need not necessarily be unsightly.

2. In order to take pressure off the nerves or painful joints, a *pad* is placed across the sole of the foot behind the metatarsal heads. It may be made of felt, is about a quarter to half an inch thick and about one inch wide, and has bevelled edges, so that it fits comfortably to the foot (Tubby). It may be fixed to the foot by adhesive strapping. Cork and leather pads are also used.

In slighter cases, *adhesive plaster* applied round the bases of the metatarsals separates the heads of these bones and so relieves pressure and friction.

Various other methods are employed, such as fixing a leather bar across the sole of the boot (the 'metatarsal bar'), or thickening its sole behind the metatarsal heads ; or more elaborate arch supports are used within the shoe.

BATHS.—*Whirlpool baths*, or ordinary hot baths if these are unobtainable, are very beneficial, relieving pain, softening the tissues and improving their nutrition.

PHYSICAL TREATMENT.—

MASSAGE.—This should be given to the leg and foot to improve the nutrition of all the tissues ; if there is muscle spasm, it must be relieved by soothing stroking and kneading. Care must be taken when working in the neighbourhood of the fourth toe.

PASSIVE MOVEMENTS.—Movements should be given to the ankle, mid-tarsal, and subastragaloid joints, but the most important movements are those of the toes, especially *flexion*. The metatarsals may be moved carefully on each other.

Toe flexion is given with the foot dorsiflexed, the operator, as described above (p. 232), supporting the metatarsals with her hand just behind their heads, and flexing the toes with her other hand.

Extension of the toes, which should not be carried to the limit, may be given with the foot in some degree of plantar-flexion. (In cases where the toes are already hyper-extended, e.g., talipes equinus, etc., toe extension will obviously not be given at all.)

ACTIVE MOVEMENTS.—As inversion is the chief movement for the typical flat-foot, so *flexion of the toes* is the chief movement for the collapsed anterior arch, or a displaced bone in that arch, since it brings into action the interossei, lumbricales, and other small muscles of the sole, which are its principal supports.

Such exercises as the following may be used :—

1. Half-lying active Toe-flexion, with support by operator, as described on p. 232 ; ankle dorsiflexed.
2. Standing on plinth, toes over the edge, Toe-flexion (and -extension).
3. Sitting Toe-abduction (if possible).
4. Picking up objects with the toes.
5. Correct standing.
6. Foot-shortening (*see* p. 233 and *Figs.* 113, 114).
7. Correct walking (*see* p. 44).

If the longitudinal arch is also depressed, or the foot everted, exercises for flat-foot must also be given. In any case they are useful as a precaution. *Tip-toe exercises* are not advisable, since they produce hyperextension of the toes, depress the metatarsal heads, and put too much strain on the anterior arch.

SURGICAL TREATMENT.—Very severe cases of Morton's disease are sometimes treated by operation, the head of the fourth metatarsal being removed.

TALIPES

(Club-foot)

The foot has, as we know, four principal movements, viz., flexion and extension at the ankle; inward movement, including inversion and adduction; and outward movement, consisting of eversion and abduction. The side-to-side movements take place at the subastragaloid and mid-tarsal joints. A fixation of the foot in any of these positions, or in an exaggerated form of one of them, with inability to carry out the opposite movement, or at least with great limitation of that movement, constitutes the deformity of *talipes*. The name of 'club-foot' is applied either to the whole group of these deformities, or, more especially, to talipes equino-varus, the commonest type.

We find, therefore, four principal varieties: (1) *Talipes equinus*, in which the foot is in extension (plantar-flexion); (2) *Talipes calcaneus*, in which it is in dorsiflexion; (3) *Talipes varus*, in which it is adducted and inverted; (4) *Talipes valgus*, in which it is abducted and everted. In addition to these we find cases in which the arches are depressed or abnormally high, and therefore we may include in this category: (5) *Pes planus*, in which the arch is obliterated (*see* p. 226, *also* PES PLANO-VALGUS, p. 229); (6) *Pes cavus*, in which it is exaggerated (*see* p. 249).

These malformations exist in varying degrees of severity, from slight limitations of movement, to obvious and fixed deformities. In neglected cases, the foot may become twisted and distorted in an extreme degree. Frequently, two of the above-mentioned varieties are combined. Thus we may have *talipes equino-varus*—the commonest type of all—in which extension is combined with inversion; *talipes calcaneo-valgus*, in which dorsiflexion of the ankle is combined with eversion; or the rare forms, *talipes equino-valgus* and *calcaneo-varus*.

CAUSES.—These deformities may be: (1) Congenital; or (2) Acquired.

1. The *congenital form* is due to a bad position of the fœtus before birth. In some cases, heredity is a factor.

2. The *acquired forms* are due to flaccid paralysis (especially acute anterior poliomyelitis); spastic paralysis; injuries or diseases of bones, joints, or soft tissues; or formation and contraction of scar tissue. Hysterical forms of contracture are also seen. Of these causes, the commonest is flaccid paralysis.

Treatment.—

In describing the various kinds of talipes we shall give most attention to the congenital variety. The treatment of the congenital and of the paralytic forms is similar, but in the latter the rules for treating paralysed muscles must be observed (*see* p. 128). We shall not have space here to describe in detail the pathological changes occurring in all these varieties—they must be studied in the orthopædic text-books dealing with the subject.

In order to avoid repetition, we may notice, with regard to the massage treatment, that in all such cases it consists of:—

1. Stretching manipulations to the shortened muscles—picking up, or stretching frictions.

2. Stretching frictions to shortened ligaments.

3. Movements to improve nutrition of stretched muscles, and to obtain contraction—effleurage, kneading, and hacking.

Pre-operative treatment includes muscle massage, and active movements if possible—both given so that the muscles may be in as good a condition as possible before the period of immobilization.

Talipes Equinus

The congenital form is rare, the paralytic more common.

DEFORMITY.—

CONGENITAL FORM.—The heel is raised from the ground, and the patient walks on his toes, the weight falling on the heads of the metatarsal bones. The deformity involves the ankle-joint only, the foot being in full extension; the position of the mid-tarsal joint is quite normal. The longitudinal arch is increased, but the front of the foot is broadened, because the heads of the metatarsal bones are spread out in consequence of the weight which falls on them. Both feet may be affected. In congenital cases the deformity is often slight.

PARALYTIC FORM.—The deformity is similar, but more marked, because the foot is dropped not only at the ankle, but at the mid-tarsal joint as well, the arch being very much increased in height (*Fig.* 115). The toes later become clawed.

Fig. 115.—Talipes equinus.

PATHOLOGICAL CHANGES.—

BONES.—The changes are not marked.

LIGAMENTS.—(*a*) There is *stretching* of the anterior ligament of the ankle, of the anterior parts of the lateral ligaments, and of all the ligaments on the dorsum of the foot. (*b*) There is *shortening* of the 'spring' ligament, the long and short plantar ligaments, the small ligaments of the sole, and the plantar fascia.

MUSCLES.—(*a*) *Lengthening* of the anterior tibial group. (*b*) *Contraction* of the calf muscles and tendo Achillis, long flexors of toes, and peroneus longus.

In the paralytic form of this or any other type, the characteristic trophic changes in skin, nails, and muscles are present in varying degrees. Painful corns may form at points where undue pressure is exerted on the foot.

Treatment.—

SLIGHT CASES IN INFANTS.—These are treated by fixation, massage, and manipulation.

FIXATION.—The following splints may be used:—

1. A *specially made splint*, generally of aluminium or some other light metal, kept in position by straps.

2. A *malleable iron splint*, consisting of a flat bar of iron about an inch wide, soft enough to be bent to the desired position. It is padded in the usual way, and covered with waterproof material. The foot is dorsiflexed to a right angle, or as near this as possible, and the splint is bent to the same angle, and applied to the back of the leg and the sole of the foot. When it is removed for treatment the foot should be kept in as correct a position as possible until it is replaced. In paralytic cases, this is, of course, absolutely essential.

3. The foot is sometimes put in *plaster*.

4. In slight paralytic cases, where the child is old enough to walk, some form of apparatus is used to prevent plantar-flexion beyond a right angle.

PHYSICAL TREATMENT.—This consists of:—

Appropriate Massage.—See above.

Passive (Forced) Movements.—The foot must be pressed up into dorsiflexion; this should be done several times a day, if possible. If the ankle-joint alone is affected, the operator should grasp the heel with one hand, pressing it downward, while with the other she takes hold of the foot as close in front of the ankle as possible, and forces it upward (*Fig.* 116). If the foot is dropped also at the mid-tarsal joint, as in the acquired form, the heel grasp remains similar, but the other hand may be placed beneath the sole, its upward pressure producing movement in both ankle and mid-tarsal joints (*Fig.* 117).

Fig. 116.—Manipulation of the foot in talipes equinus (congenital form).

Active Movements.—Dorsiflexion of the ankle must be practised as soon as the child is old enough. Later, foot exercises are given, and the patient must be carefully watched when beginning to walk.

SEVERE CASES (e.g., neglected cases in older patients).—These have to be rectified by operation.

SURGICAL TREATMENT.—The Achilles tendon and the plantar fascia are divided, and sometimes the tendons of both the flexors and extensors of the toes, if the latter are much deformed. The foot is put up in plaster, or on a splint.

PHYSICAL TREATMENT (POST-OPERATIVE).—This consists of massage, passive movements, and active movements.

Massage is given to the whole leg, to improve the condition of all the structures. Special stretching movements may be given to the calf muscles, if necessary, after about three weeks.

Passive movements are important, for the tendon must not be allowed to re-unite too short. At the same time, it must be remembered that it is possible for it to be too much lengthened, producing the opposite deformity of talipes calcaneus, or at least interfering gravely with the efficiency of the foot. Passive movements should be begun at about three weeks, if the plaster has been removed, but the movement of dorsiflexion must not be carried beyond the *normal* limits.

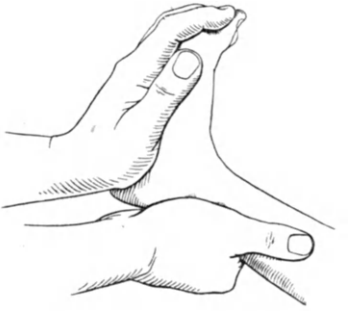

Fig. 117.—Manipulation of talipes equinus (acquired).

Active movements are also given. As soon as the tendon is firmly united (6 to 8 weeks) the patient is allowed to walk. He must be taught to do so correctly. Exercises for dorsiflexion of the foot are continued, and the patient may be given movements to stretch the calf muscles, such as curtsey-standing, lunge position, etc. These are, of course, added gradually.

Talipes Calcaneus

This is not such a common deformity in either the congenital or acquired form as talipes equinus or equino-varus. The acquired form is generally the result of anterior poliomyelitis. It may occur after an operation on the tendo Achillis, if this has been too much stretched or lengthened.

Congenital Form

POSITION OF THE FOOT.—The foot is not deformed, but the ankle is dorsiflexed, the foot forming an acute angle with the leg (*Fig.* 118). In infants, the dorsum of the foot can sometimes be brought up against the tibia. The cases, however, vary in severity. Some hardly amount to more than a slight limitation of plantar-flexion. The arch is not exaggerated in congenital cases.

Fig. 118.—Talipes calcaneus.

PATHOLOGICAL CHANGES.—

Bones.—The deformity affects only the ankle-joint. There is very little displacement or deformity. Occasionally, certain bones of the foot, the tibia or fibula, may be defective or absent.

Muscles.—The extensor longus digitorum and extensor longus hallucis are contracted. The calf muscles are stretched. The deep posterior group is normal.

Ligaments.—The anterior ligament, and the front part of the internal and external lateral ligaments of the ankle are *shortened*; the back parts of the lateral ligaments, and the posterior ligament are *stretched.*

SYMPTOMS.—

1. *The position* and appearance of the foot is as described above.
2. *Gait.*—This is slow and clumsy, but is not so noticeable as in the more serious paralytic type.

Treatment.—

SLIGHT CASES.—Massage of the whole limb, especially of the calf muscles; stretching movements (extension of the ankle), and active movements when possible, are indicated, with splinting if required. In many cases the deformity corrects itself when the baby begins to walk and the calf muscles gain strength. If a splint is used, it is generally a small malleable iron one, the foot being put up in plantar-flexion.

SEVERE CASES AND THOSE OF OLDER CHILDREN.—

Surgical Treatment.—Tenotomy of extensores longi hallucis et digitorum.

Fixation.—The foot is put up in plantar-flexion, either in plaster or on a '*tin shoe*', that is, a light metal splint.

Physical Treatment.—Massage, stretching (*Fig.* 119), active exercises when possible, and later, re-education in walking (6 to 8 weeks) are required.

Paralytic Form

POSITION OF THE FOOT.—The ankle is dorsiflexed, as in the congenital form; but in these cases the arch is exaggerated, sometimes to an extreme degree. The heel is lengthened and its tuberosities stand out prominently. The patient walks on the back of the heel, which is covered with skin hardened by the undue weight thus placed on it.

PATHOLOGICAL CHANGES.—

BONES.—

1. There is far more displacement in this type than in the congenital variety and the deformity affects *not only the ankle but the mid-tarsal joint.*

2. The *os calcis* drops, since both the calf muscles and deep posterior tibial group are out of action. It becomes oblique or even vertical in direction, the patient walking on its posterior surface, over which a pad of fat develops, and beneath this hardened skin.

3. The *foot is dorsiflexed at the ankle, but drop sat the mid-tarsal joint,* the scaphoid and cuboid having slipped downwards and forwards, so that the longitudinal arch of the foot is much increased in height. This happens, partly because the force of gravity draws the front of the foot down, and partly because the patient, in walking, tries to get his toes to the ground. Finally, the muscles and fascia of the sole contract, and the mid-tarsal joint, abnormally mobile at the beginning of the trouble, is held down by these structures. Since the heel is altogether dropped, even the pull of the extensors of the toes only serves to draw the front and back of the foot closer together.

4. The *astralagus* is displaced backwards.

MUSCLES AND FASCIA.—Paralysis and atrophy of the calf muscles, and posterior tibial group; contraction of the anterior tibial group, the muscles of the sole and the plantar fascia.

LIGAMENTS.—Shortening of the anterior ligaments of the ankle, and small ligaments of the sole, and stretching of the posterior ligaments.

SKIN.—The trophic changes typical of paralysis are present. Corns form under the heel, and the skin is abnormally thin under the front part of the foot.

SYMPTOMS.—

1. *Position of foot*; as described above.

2. *Gait.*—This is far worse than in the congenital form. The patient may be quite lame. He brings the heel down first, and the front part of the foot drops down afterwards.

Treatment.—

SLIGHT CASES.—These are treated as cases of paralysis with stretching *massage* for the shortened muscles in front, and brisk, but not heavy, manipulations of the posterior groups. Frictions (stretching) should be given to the ligaments at the front of the ankle and to the small muscles and fascia of the sole.

PHYSICAL TREATMENT.—

Passive Movements (*forced*) are required :—

1. To stretch the contracted structures in the sole. The posterior part of the foot should be held firmly in one hand, while with the other hand the front part of the foot is forced upwards. The ankle-joint must be held steady during this movement, which should take place only in the mid-tarsal articulation (*see Fig.* 122).

2. To stretch the contracted structures on the front of the leg and foot. The foot should be grasped as near the ankle as possible, and an endeavour made to plantar-flex it; the other hand should grasp the os calcis and draw it upwards (*Fig.* 119). This movement should be so carried out as not to increase the plantar flexion at the mid-tarsal joint.

Active Movements will be given as in any lower motor neuron lesion, the same rules being applicable (*see* p. 128).

SEVERE CASES.—

SURGICAL TREATMENT.—These cases require surgical intervention, and are treated by one of the following operations :—

1. Fasciotomy and Wrenching.—Division of the plantar fascia, and manipulation of the foot into shape, followed by fixation in plaster for some weeks.

2. Shortening of the Achilles Tendon.

3. Whitman's Operation.—This operation is used in cases of talipes calcaneo-valgus, and in severe cases of talipes calcaneus. It consists of removal of the astragalus (astragalectomy), backward displacement of the foot, and sometimes of tendon transference.

The astragalus is entirely removed and the whole foot moved backwards until the internal surface of the external malleolus lies against the calcaneo-cuboid joint, and the outer surface of the internal malleolus against the inner surface of the os calcis behind the scaphoid (the sustentaculum tali also having been removed). The cartilage is stripped off these surfaces of the malleoli, and a thin layer of bone cut from the parts of the os calcis and cuboid beneath them, so that they grow together. The tendons of the peronei are sometimes used to supplement the Achilles tendon.

Fig. 119.—Manipulation of talipes calcaneus.

The patient's foot is kept in plaster in a slightly equinus position, and he remains in bed for three weeks, after which a new plaster is applied, and he is allowed to walk. In two to four months, the new joint will have become stable, and he discards the plaster for walking apparatus, which will be worn for a year or more.

Post-operative Physical Treatment.—The result of this operation is to do away with *lateral* movement of the foot, while preserving flexion and extension at the ankle. Dorsiflexion, however, is now limited by the contact of scaphoid with the tibia, so that the deformed position cannot be reproduced. Moreover, the weight of the body now falling nearer the middle of the foot, the heel is not pressed downward. The shortening of the leg occasioned by the removal of astragalus is compensated by the slightly equinus position of the foot. We have to remember these points when giving movements.

Massage may be begun as soon as the plaster is removed. The whole limb should be treated. Special attention should be paid to the peronei, if they have been transplanted into the Achilles tendon, since the patient now depends on them for plantar-flexion of the ankle.

Passive Movements.—Plantar- and dorsiflexion of the ankle are to be given, but *no lateral movement is to be attempted.* The toes should be kept mobile.

Active Movements.—Movements of the ankle (especially plantar-flexion) and of the toes are to be practised.

Re-education in Walking.—When the patient begins to walk, even in his plaster, he must be taught to do so as correctly as possible, taking equal steps, and bearing weight on the front of his foot. When the retentive apparatus is finally removed, he will be provided with a shoe to keep the foot in the slightly equinus position. We have now to teach him to walk correctly without

undue tipping of the pelvis, and without a limp; and foot exercises, such as heel-raisings, may be added. In cases of extensive paralysis, in which supports will have to be worn permanently, the foot is kept at a right angle to the leg.

The spine should be watched carefully for signs of scoliosis.

4. ROBERT JONES'S OPERATION.—This produces *arthrodesis* (fixation) of both the ankle and mid-tarsal joint. It is used in very severe cases of talipes calcaneus or calcaneo-valgus. A wedge of bone is cut from the tarsal bones on the dorsum of the foot to get rid of the cavus deformity, and at a subsequent operation, part of the upper surface of astragalus is removed, and also the articular cartilage from the tibia and fibula, and the ankle-joint fixed with the foot at a right angle. This operation is performed if there is complete loss of power in the calf muscles. If any remains, the second operation (arthrodesis of the ankle) does not take place, but, instead, the tendo Achillis and posterior ligament of the ankle are shortened.*

Post-operative Treatment.—

Massage.—The limb should be massaged, with special attention to any muscles that are still acting.

Passive Movements are given to the toes, but not, of course, to ankle or mid-tarsal joint.

Active Movements.—The calf muscles and posterior tibial group are probably both useless. The long extensors of the toes should be exercised, also the muscles of the sole and the interossei, if these are still in action; if the toes can be pressed down hard on the ground, the tibialis anticus will contract, acting as a synergist to them. The peroneus longus and brevis will similarly come into action if the toes are strongly extended. The patient, if old enough, should sit on a chair or stool with his feet resting on the ground.

He will not be allowed to walk until the union of the bones is quite secure. If the leg is shortened, a raised sole will be necessary, since the shortening cannot be compensated by plantar-flexion of the foot. As the ankle is stiff, walking can never be normal, and in our re-education we have to 'make the best of a bad job.'

If the ankle-joint has *not* been fixed, movements may be given as soon as the foot is out of plaster.

After Whitman's operation the scar is on the *outer* side of the foot, starting above behind the external malleolus, passing down behind it, and curving forwards over the dorsum of the foot. The Robert Jones operation leaves two scars, one on the inner side of the foot (first stage of the operation) and one at the back of the heel (second stage).

Talipes Varus

This is a rare condition, and need not occupy us long here; details of its symptoms, treatment, etc., can easily be worked out from the account of talipes equino-varus which follows.

DEFORMITY—The foot is in a position of exaggerated *inversion* and *adduction*, so that the patient walks on its outer border, where the skin is thickened and corns develop.

PATHOLOGICAL CHANGES (*see also* TALIPES EQUINO-VARUS).—In pure varus there is no change in the ankle-joint, the inward twisting taking place in the subastragaloid and mid-tarsal joints only.

The contracted muscles are the tibialis anticus and posticus, while the peronei are stretched; the ligaments on the outer side of the foot and ankle are lengthened, and those on the inner side shortened.

* Dunn's operation has a similar result—arthrodesis of the mid-tarsal and subastragaloid articulations, and sometimes of the ankle also.

Treatment.—

The treatment is on the same lines as that for talipes equino-varus, except that no stretching of the calf muscles or tendo Achillis is required. A malleable iron splint is generally used, applied to the outer side of the foot and leg.

SEVERER CASES.—

SURGICAL TREATMENT.—The operation performed may be one of the following :—

1. *Wrenching of the foot*, under an anæsthetic.

2. *Tenotomy* (*see* p. 130) of the tibialis anticus and posticus ; the internal lateral ligament being also divided.

3. *Osteotomy.*—In very severe cases, a wedge of bone is cut from the outer side of the tarsus, so that the foot can be straightened.

Post-operative Treatment.—*See* TALIPES EQUINO-VARUS.

N.B.—Hysterical contracture may simulate this form of talipes.

Talipes Equino-varus

This is by far the most common form of talipes.

DEFORMITY.—

CONGENITAL FORM.—The heel is raised, and the foot plantar-flexed at the ankle-joint ; it is also turned inward at the subastragaloid and mid-tarsal joints, so that all three articulations are involved ; and the deformity is therefore a very complex affair (*Fig.* 120).

Fig. 120.—Congenital talipes equino-varus.

The inner border of the foot is raised and shortened, and its natural concavity greatly increased ; the longitudinal arch is generally exaggerated ; the outer border of the foot is convex, and the patient, if of an age to walk, puts his weight on this border, or, in very severe cases, even on the dorsum of the foot. The skin in these regions is thickened, and corns and false bursæ develop. These may become inflamed, or even suppurate. (Tubby.)

Fig. 121.—Bony changes in severe congenital talipes equino-varus. **A**, Bony ridge on astragalus which locks against tibia and prevents reduction ; **B**, Abnormal quadrilateral surface on outer aspect of astragalus ; **C**, Prefibular tubercle.

The heel remains small, not developing as the patient grows, and the skin under it, never having been subjected to pressure, remains thin. The whole foot, in untreated cases, fails to attain its proper size, and in unilateral cases, is smaller than its fellow ; even the leg on the affected side may be shorter than the other.

The *gait* is awkward and waddling if the deformity is bilateral. The patient walks on the outer borders of the feet, and in bad cases, has actually to lift one foot over the other in walking.

PARALYTIC FORM.—The appearance of the foot is similar to that of the congenital type, but there are characteristic changes in muscles, skin, nails, etc.

PATHOLOGICAL CHANGES.—

BONES.—These are too numerous and complicated to be here described in detail. The reader is referred to Tubby's *Deformities* ; Robert Jones's *Orthopædic Surgery* ; or Whitmans' *Orthopedic Surgery*.

The most important are as follows (*Fig.* 121) :—

The *astragalus* is displaced forwards, and its head and neck twisted inwards ;

the neck becomes lengthened, and the front of the bone enlarged, from lack of the pressure of the malleoli on either side of it, so that reduction is made very difficult, the bone being too large to be fitted into the mortice of the ankle-joint.

The *os calcis* has its upper part raised, because of the extended position of the ankle; it is also twisted downward and inward.

The *scaphoid, cuboid, and the other tarsal bones* are drawn upward and inward; the bones on the inner side of the foot are unduly compressed, while those on the outer side are released from the normal pressure, and hence overgrowth takes place.

LIGAMENTS.—Those on the front and outer side of the foot are *stretched*; those on the inner side are *shortened*, especially the 'spring' ligament, and the posterior and internal lateral ligaments of the ankle; also the plantar fascia.

MUSCLES.—

The *calf muscles*, the *muscles of the anterior tibial group*, and the *tibialis posticus* are all shortened, and their tendons displaced inwards.

The *peronei* are stretched.

Treatment.—

SLIGHT CASES.—These are treated by massage, manipulation, and fixation or support.

SUPPORT.—The foot is maintained in the correct position, or in as correct a position as is obtainable for the time being, the means of support in the latter case being altered from time to time as the correction progresses. The splint most commonly used for infants is :—

The Malleable Iron Splint.—This is of the same kind as that described on p. 239, but is now applied to the *outer* side of the leg and foot, and is gradually bent more and more until the over-corrected (valgus) position is attained. These splints are not very easy to apply, and are liable to become displaced unless firmly bandaged, but at the same time the masseuse must make quite sure that there is no interference with the circulation before letting the child go. When the varus has been completely corrected, the splint is applied as for talipes equinus.

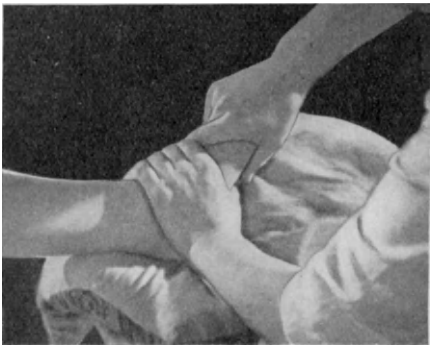

Fig. 122.—Manipulation of pes cavus.

Various other kinds of supports are used, from simple 'tin shoes' to specially made metal splints furnished with pads and straps, and sometimes with hinges by which the position of the foot can be altered as required.

A succession of plaster bandages is sometimes applied. These are not so suitable for very young babies because of their liability to become soiled. Another method is to fix the foot in the correct position by means of *adhesive strapping*.

MASSAGE.—This is on the usual lines.

MANIPULATION (PASSIVE MOVEMENTS).—This must have been seen to be properly understood. The different components of the deformity are treated in the following order: (1) Pes cavus, or exaggerated arch; (2) Adduction and inversion; (3) Plantar flexion of the ankle. The operator stands on the outer side of the deformed foot, or sits with it on her knee.

1. *Pes Cavus.*—The foot should be grasped at the back and front, and the contracted structures of the sole stretched (*Fig.* 122) (*see* p. 242.)

2. *Adduction and Inversion.*—The thumbs of both hands are placed over the astragalus, and the fingers encircle the leg and foot. The astragalus thus becomes the fixed point or fulcrum round which the stretching movement takes place. The front part of the foot is then carried outwards; the sole is also turned outwards, and its external border raised, steady pressure being all the time exerted on the astragalus. (*Fig.* 123.)

3. *Plantar-flexion of the Ankle.*—Not till the varus deformity is rectified is any attempt made to correct the equinus. The procedure is then as described on p. 240 (*Fig.* 117).

Fig. 123.—Manipulation of congenital talipes equino-varus to overcome the inversion.

In slight cases, the manipulation is easily done; in more resistant ones, it will cause some pain, which will, however, cease as soon as the stretching is over. It is therefore best done quickly.

Active Movements.—If, or as soon as, the child is old enough, active movements in the desired directions must be encouraged.

SEVERE CASES (SECOND DEGREE).—

Surgical Treatment.—The operation performed may be: (1) Wrenching of the foot; (2) Division of the contracted structures; (3) The two combined.

1. *After Wrenching*, or forcible correction and mobilization of the foot, the latter is generally maintained in position by a succession of plaster bandages for 3 to 4 months, the plaster being removed every 2 to 4 weeks. It is finally replaced for a time by walking apparatus of some kind to prevent relapse. Infants wear a splint until they are able to walk.

Post-operative physical treatment: This consists of: (*a*) *Massage* of the whole leg, at the time when each bandage is removed. (*b*) *Re-education in walking.* If the patient has walked, he is usually allowed to continue while the foot is in plaster. He should be taught to do so as correctly as possible. (*c*) *When the plaster is finally removed*, massage, passive movements and active movements are required. Correct walking, first with, and then without, apparatus has to be taught.

2. *Division of Shortened Structures.*—This consists of: (*a*) Division of the contracted ligaments on the inner side of the foot, and of the plantar fascia (fasciotomy). (*b*) Sometimes division of the tibialis posticus; occasionally of the tibialis anticus also (tenotomy). (*c*) Later, division of the Achilles tendon and posterior ligament of the ankle. The foot is put in plaster, or supported on an appropriate splint.

Post-operative treatment: Massage and movements are given as described above. Passive movements must not be carried beyond the normal range before the ligaments and tendons are firmly re-united (6 weeks), or the opposite deformity (talipes calcaneus or calcaneo-valgus) may be produced.

After-care: Importance of Supervision.—Although correction may thus be obtained in a few months, the patient will need supervision for years, as relapse is not uncommon. He should continue to receive treatment once a week for some months after he appears to be completely cured, and should attend for examination by the surgeon at intervals for some years after his operation. The importance of this should be most strongly impressed on the

parents, and they should be told to report *at once* the slightest sign of anything wrong with the child's foot or manner of walking. If seen immediately, the relapse can be prevented; if it is neglected, the damage may be irreparable.

VERY SEVERE (THIRD DEGREE) CASES.—These, if the above-mentioned operations fail or are impracticable, are sometimes treated by *operations on the bones.* followed by prolonged fixation in plaster.

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Talipes Valgus

The congenital form of this deformity is fairly common; the acquired forms, apart from flat-foot, are not of frequent occurrence.

DEFORMITY.—The position of the foot is similar to that seen in ordinary flat-foot (*see Fig.* 112, p. 230). The deformity varies greatly in severity, from a slight limitation of inversion with an abnormal amount of eversion, to a fixed and rigid position of the foot. There is pain under the inner border when the child walks.

PATHOLOGICAL CHANGES.—

CONGENITAL FORM.—The changes are similar to those present in flat-foot (*see* p. 230). Talipes valgus is sometimes complicated by partial or complete absence of the fibula, or some other abnormality of the leg bones.

ACQUIRED FORM.—This is caused by paralysis, rickets, or bone injuries. Insufficient training in correct walking after a Pott's fracture is a fruitful source of trouble. The changes are as described above. In the *paralytic form* the tibialis anticus is paralysed, and other muscles may be involved as well.

Treatment.—

SLIGHT CASES.—The treatment is the same as that for 'weak foot' with appropriate fixation. A *malleable iron splint* is used in the case of an infant—applied to the *inner* side of the leg and foot, or *plaster bandages* are used.

For treatment of paralytic cases, *see* ANTERIOR TIBIAL PARALYSIS, p. 173.

SEVERE CASES.—These have to be treated by operation. This may consist of:—

FOR CONGENITAL CASES.—

a. Without Absence or Defect of Bone.—Tenotomy of the peronei.

b. Very Severe Cases with Absence of Fibula.—(i) Fixation (arthrodesis) of foot and ankle. (ii) Amputation of the foot (since pain and discomfort are always present).

FOR PARALYTIC CASES.—

a. Tendon transference, e.g. of the peroneus brevis to the inner side of the foot.

b. Arthrodesis of the ankle and foot.

c. Dunn's operation (*see* p. 244, footnote).

d. Whitman's operation (*see* p. 243).

POST-OPERATIVE TREATMENT.—

1. *After tenotomy* treatment is carried out on the lines indicated earlier in this chapter (*see* TALIPES EQUINUS, p. 240): massage, passive movements, active exercises, etc.

2. *After arthrodesis*: massage of all muscles; no attempt at mobilization; re-education in walking.

3. *After tendon transference*: massage of all muscles, especially the peroneus brevis; faradism; passive movement; re-education of the peroneus brevis in its new function. Later, re-education in walking.

4. *After Dunn's and Whitman's operations: see* pp. 243, 244.

Talipes calcaneo-valgus is uncommon and *talipes calcaneo-varus* still more so. The changes, symptoms, and treatment may be worked out from those present in the simple varieties. Whitman's operation, or that of Robert Jones, is used for talipes calcaneo-valgus. *Talipes equino-valgus* is also a rare form.

PES CAVUS

(*Hollow or Contracted Foot*)

In this condition the arch of the foot is exaggerated, so that it is abnormally high. Pes cavus is very rare as a congenital affection, but much more common in the acquired form. It may accompany talipes equinus, calcaneus, or varus, or may itself be the only deformity.

CAUSES.—The chief causes of the acquired form are: (1) Too short boots or shoes. (2) Rheumatism. (3) Slight paralysis of the anterior tibial group of muscles in post-diphtheritic or other forms of multiple neuritis, or after scarlet fever, measles, etc.

DEFORMITY AND CHANGES.—In paralytic cases, paralysis of the anterior tibial group allows the foot to drop slightly at the mid-tarsal joint, thus increasing the *longitudinal arches*. The paralysis may pass off, but the contracting muscles of the sole perpetuate the displacement. At first this merely amounts to an abnormally high arch, the outer border of the foot still resting on the ground. Later the deformity becomes aggravated, the front part of the foot being so much depressed that the toes are lower than the heel, and the structures of the sole so contracted that not even the outer border of the foot touches the ground. The *anterior* (transverse) arch is depressed by the strain put on it, or even has its convexity downwards. The toes are hyper-extended at the metatarso-phalangeal joints, because of the lowering of the metatarsal heads. (*Fig.* 124.)

Fig. 124.—Pes cavus.

SYMPTOMS.—*Pain* develops in the sole of the foot and up the front of the leg. This rarely occurs till the age of adolescence. *Corns* may form beneath the metatarsal heads, which are prominent under the foot, or over the first phalanx of the toes, and these also may become very painful.

Treatment.—

Since the pain develops so late, these cases are rarely brought for treatment during the early stages, so that it is almost always too late for manipulation alone to be of any use.

Besides massaging the anterior muscles, and stimulating them with the faradic current, we may attempt to stretch the contracted tissues of the sole, by grasping the back of the foot and trying to force its front part upward (*see Fig.* 122); or we may make the patient bend his knees while keeping the feet flat on the ground. But nothing is likely to be of much avail. Operation is necessary to obtain correction, and we may be called upon to give massage and exercises as a pre-operative measure.

In cases where symptoms are slight, proper shoes with arch supports may minimize the inconvenience.

SURGICAL TREATMENT.—Among the operations performed are :—

1. FASCIOTOMY.—Division of the plantar fascia and stretching of the foot, with severance of the extensor tendons of the toes if these are contracted. This is followed by fixation for about 6 to 8 weeks. If the foot is in plaster, the patient is allowed to walk, as his weight will help to flatten down the arch.

Post-operative Treatment is carried out on the usual lines. If the scar becomes painful, gentle frictions should be given round and over it.

2. STEINDLER'S OPERATION.—This is sometimes used in the severer cases. It consists of 'stripping' the whole under surface of the os calcis, viz., of division of the plantar fascia, the abductores hallucis and minimi digiti, and flexor brevis digitorum.* The foot can then be stretched and the arch flattened to the desired extent. The scar will be found in a horse-shoe shape round the heel from the internal tuberosity of the os calcis almost as far forward as to the cuboid on the outer side.

Post-operative Treatment is on the usual lines—massage, stretching, active exercises, and re-education in walking.

HALLUX VALGUS

A deformity of the great toe, in which the latter is in a position of abnormal abduction (from the middle line of the body).

ETIOLOGY.—

AGE.—Hallux valgus begins in early life, but may not give rise to trouble until middle or old age.

CAUSES.—(1) The chief cause of hallux valgus is the wearing of wrongly shaped shoes, which may be too short, too tight, or too pointed—so that the big toe is forced outwards—or may have too high heels. (2) Injury, rheumatism, gout, or arthritis may cause or aggravate the deformity.

DEFORMITY.—The toe is in abduction, the first phalanx being subluxated outward, while the first metatarsal is farther from the others than in a normal foot. Therefore its head becomes prominent, forming the well-known 'enlarged joint', and on this prominence a 'false bursa' (*see* p. 99) forms, with a painful corn on top of it. This constitutes the condition known as a 'bunion'.

PATHOLOGICAL CHANGES.—These amount to an arthritis of the joint. The cartilage on that part of the articular surface of the metatarsal bone which is now not in contact with that of the first phalanx atrophies; while new bone is laid down on the inner side of the metatarsal head. The ligaments on the outer side of the joint (i.e., that next the second toe), become shortened, those on the inner side lengthened. The phalanges may also be displaced outwards, in which case the extensor longus hallucis, pulling on the displaced toe, increases the deformity.

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* The muscles are divided near their origin on the os calcis. They slide forward, and become re-attached to the bone in their new position.

COMPLICATIONS.—

1. *If the joint is not painful*, the foot becomes everted, and the arch may drop, owing to inadequate support of its anterior pillar.

2. *If pain is present*, a varus position may result, the patient tending to throw his weight on to the outer side of the foot in order to avoid putting weight on the painful joint.

Treatment.—

SLIGHT CASES.—

FOOTWEAR AND SUPPORT.—Correct shoes of sufficient size must be worn. The inner border is slightly raised (*see* 'Valgus Wedge', p. 234), and should be *straight*, and not convex inwards; and the heels must not be too high. Various contrivances are advocated to relieve pressure on the bunion. A splint along the inner side of the foot and toe may be worn at night, but it must be so shaped as not to exert pressure on the painful joint.

MASSAGE AND MOVEMENTS.—

Massage may be administered to the leg and foot if necessary, as the painful joint, by producing a strained and unnatural manner of walking, causes fatigue and pain all over the foot and even up the leg.

Passive movement (adduction of the toe) should be given at least twice a day; the patient may do this himself.

Active movements, consisting especially of flexion, and, if possible, voluntary adduction of the toe, should also be given.

If the foot is weak or flat, appropriate treatment and support must be provided for the arches.

SEVERE CASES.—

SURGICAL TREATMENT.—This consists of either: (1) *Removal of the protruding part of the head of the first metatarsal*, that is, of the osteophytes, or new bony growth; with division of the shortened ligaments, so that the toe may be replaced in the correct position; or (2) In more serious cases, *removal of the whole head of the first metatarsal, and the sesamoid bones.** In either case, the tendon of the extensor longus hallucis is generally divided, as it may reproduce the deformity. The toe is then splinted or strapped into the correct position.

Post-operative Treatment.—This consists of *massage* of the foot from the beginning; and *gentle passive and active movements* as soon as the stitches are removed (10th to 14th day). Later, stretching passive movements must be given; active foot and toe exercises, first in sitting, later in standing; and finally, re-education in walking. The patient is probably allowed to take weight on his foot in three to four weeks.

HALLUX RIGIDUS AND HALLUX FLEXUS

Hallux rigidus is a condition of limitation of movement, partial or complete, of the great toe at the metatarso-phalangeal articulation.

CAUSES.—(1) Injury, e.g., kicking the toe against a stone. (2) Tight shoes.

DEFORMITY AND SYMPTOMS.—In the early stages, extension of the toe causes pain. Later, the toe may become almost or quite rigid, all extension beyond a straight line being lost, and sometimes the power of flexion as well. Sometimes the first phalanx is even fixed in the position of *flexion* on the metacarpal bone (hence the name 'hallux *flexus*'), but more often it is in a line with the metacarpal bone. Movement at the interphalangeal joint is usually unimpaired. In bad cases, great pain is felt in the joint when walking, or after standing for some time, due to the forced extension of the joint.

* Some surgeons leave the sesamoid bones in place.

PATHOLOGICAL CHANGES—The head of the metatarsal bone is enlarged, though not to a great extent, and the cartilage eroded. The pad of synovial membrane which lies between the two sesamoid bones in the tendons of the flexor brevis hallucis is acutely inflamed, and the cause of much pain, especially in hallux flexus.

Treatment.—

SLIGHT CASES.—Special shoes are prescribed, which are designed to relieve the joint of all pressure, the 'valgus wedge' (*see* p. 234) and the 'metatarsal bar' (p. 237) being both used. Flat-foot, if present, must be treated.

SEVERER CASES.—

SURGICAL TREATMENT.—This is similar to that for hallux valgus—removal of the osteophytes round the head of the bone, with reduction in size of the joint surface; or removal of the metatarsal head and sesamoid bones.

Post-operative Treatment.—This is the same as for hallux valgus, but the most important movement is *extension*, which must be given passively and actively.

HAMMER-TOE

A contraction generally of the second toe, consisting of extension of the first phalanx and flexion of the second.

ETIOLOGY.—(1) This deformity may be *congenital*, and heredity is a marked factor. (2) In the *acquired form*, tight or short shoes are to blame. The second toe, which is most often affected, is often the longest, and is pressed backward and kept in a position of flexion by too short a shoe; while lateral pressure from one that is too narrow forces the big toe outwards over the others, compressing especially the last two phalanges of the second (Tubby).

DEFORMITY; CHANGES.—The first phalanx of the toe, as mentioned above, is in extension, the second is flexed; the third may be flexed, extended, or in a straight line with the second (Tubby).

A *corn* forms over the prominent first interphalangeal joint, and this corn, which may become inflamed, is the most troublesome symptom of the deformity.

The lateral ligaments of the joint are shortened, holding it in the deformed position. The skin beneath the toe is contracted, and also the long flexor and extensor tendons.

Treatment.—

SLIGHT CASES.—Correct shoes must be worn, and care must be taken, in the case of growing children, that neither shoes nor stockings are too short. A small splint is worn within the shoe, and the toe should always be splinted at night. It should be frequently manipulated.

SEVERE CASES.—

SURGICAL TREATMENT.—(1) The toe may be forcibly straightened by manipulation under an anæsthetic. (2) Contracted ligaments and tendons may be divided. (3) The first interphalangeal joint may be excised, in order to produce ankylosis.

Post-operative Treatment.—

If the joint is to be movable, passive movements may be given. After simple manipulation they may be begun at once. If the extensor tendon was severed, the toe must not be flexed beyond the position in which it is put up for three weeks, and not *forcibly* flexed for six weeks.

If the joint is to be ankylosed no movements must be given until union is firm, when exercises for the other joints of the toe are begun. The patient is generally allowed to walk soon after the operation, but wears a small toe-splint inside his boot until the ankylosis is quite firm.

CHAPTER XVII

DEFORMITIES OF THE SPINE

I. Antero-posterior curves: Kyphosis—Lordosis—Kypho-lordosis—Flat-back.
II. Lateral curves: Scoliosis—Torticollis. III. Pott's disease.

I. ANTERO-POSTERIOR CURVES

VARIETIES.—(1) *Kyphosis*; (2) *Lordosis*; (3) *Kypho-lordosis*; (4) *Flat-back.*

1. In *kyphosis*, 'round back', there is an exaggeration of the normal backward curve in the thoracic region, this curve encroaching on the normal lordosis, or forward curve, in both the cervical and lumbar regions. The condition is invariably accompanied by 'round shoulders'; while other signs of weakness or defective postural reflex are often present—for example, flat-foot.

2. In *lordosis*, 'hollow-back', the lumbar curve forward is increased. The pelvic tilt may be increased or decreased, i.e., the pelvis may be tilted forward or backward.

3. *Kypho-lordosis* consists of an exaggeration of both curves.

4. *Flat-back*: in this far less common condition, both thoracic and lumbar curves are diminished, and the spine is nearly straight.

KYPHOSIS

(*Kyphosis Arcuata. Round Back*)

This deformity may make its appearance at any period of life, but is most common in childhood, adolescence, or old age.

CAUSES.—

IN INFANCY AND CHILDHOOD.—

1. Failure of development of the normal curves of the spine. At birth, the spine has one long backward curve; the other curves develop later.

2. Rickets (*see* Chapter XVIII).

3. Weakness or paralysis of longitudinal back muscles.

4. Nasal obstructions, which, by causing a flat or pigeon chest, produce a correspondingly round back and shoulders.

5. The wearing of badly-made clothes, or clothes which have been outgrown, especially among girls. The garments are too narrow and too tight across the chest; or the mere weight of the clothes, suspended from the shoulders, may produce the condition.

6. Finally, and most commonly, habitual bad posture, often acquired at school. The school furniture may be to blame—the desks may be too low, or the support for the back inadequate; the child may be suffering from undetected defects of sight or hearing, or may constantly assume an incorrect attitude in writing, etc. Naturally, such children must be predisposed to the deformity by muscular weakness or reflex deficiency, since many children and adults constantly assume extremely bad postures without ever acquiring an actual deformity.

Kyphosis is commoner in girls than in boys.

IN ADOLESCENCE AND ADULT LIFE.—Besides habitual bad posture, the condition may be brought about by certain occupations, viz., those entailing the carrying of heavy weights, or much stooping; by arthritis or rheumatism; by lung affections in which both lungs are involved, e.g., emphysema; and by various paralytic conditions.

IN OLD AGE.—The causes may be similar to those operative at an earlier time of life, or the deformity may simply be due to muscular weakness.

DEFORMITY.—The back is rounded, the head carried forward, and the chest flat. The shoulders also are round, the scapulæ being too far forward on the chest wall.

PATHOLOGICAL CHANGES.—This deformity, like others, may be divided into three degrees or stages (*see* p. 210).

MUSCLES AND LIGAMENTS.—

The pectoral muscles are shortened. This contracture interferes with the mobility of the thorax, and hence with respiration, especially with full inspiration. The upper parts of the *longitudinal back muscles are stretched and weak*, as are the *transverse back muscles*, especially the rhomboids and the middle part of the trapezius.

The posterior ligaments of the vertebral column are lengthened, and those on the *anterior aspect* are shortened.

BONES.—In the late stages, the vertebræ may become wedge-shaped, i.e., much narrower in front than behind, owing to the pressure on their anterior margins.

Treatment of Kyphosis

General and Medical Treatment.—

1. The general health must receive attention, since such patients are often delicate, their weakness being either the cause or the effect of the deformity. Any predisposing causes, such as short sight, nasal obstructions, etc., will be treated by the physician or surgeon.

2. The mother must be instructed to see that the child's clothes are not too tight. If, in a girl, the clothes are suspended from the shoulders, the shoulder straps should be so arranged that the weight does not fall near the points of the shoulders, dragging them forward.

3. The patient's *habitual posture* must be corrected, and those in charge of a kyphotic child should be made to understand the importance of this.

Physical Treatment.—

MASSAGE is of little use alone, except in infants, and in cases of definite muscle weakness or fibrositis, when the patient may suffer from backache. *In cases of fibrositis*, frictions should be given to all the affected parts of the muscles, and the massage should be deep.

In ordinary cases, the back may be massaged after exercises to remove products of fatigue from the muscles; effleurage, kneading, and petrissage may be used for this purpose; also hacking, to nourish and contract the stretched muscles.

REST is an important factor in the treatment. The patient should lie down for a short time before and after treatment. She may lie prone or supine, or each in turn. Since few children will lie still for long, their rest includes a certain amount of exercise; in the prone position, the back muscles are used in raising the head, in the supine position, the abdominal muscles (Forrester-Brown). If the child lies on her back on the *floor*, a *low* cushion should be provided for her head; otherwise the discomfort will cause her never to be still at all. Crook-lying is a better position than lying.

EXERCISES.—

I. First Degree, or Postural, Curves

Postural curves are to be treated by special double-sided exercises for the longitudinal and transverse back muscles, fitted into a scheme of general exercises arranged on the usual model.

Mobility Exercises should be given if there is any tendency to stiffness, or if the pectoral muscles are short, both to stretch these muscles and also to keep the thoracic spine flexible. Passive movements may be used for this purpose (Arvedson recommends arm-rollings, trunk-rollings, etc.), but most of the vigorous free exercises designed to strengthen the weak back muscles have also a mobilizing effect.

Special Exercises for the Back Muscles.—These include exercises for: (1) The longitudinal back muscles; (2) The transverse back muscles; (3) Combined exercises for both the longitudinal and transverse muscles.

1. *For the Longitudinal Back Muscles*

a. Head-extensions.—

i. *Forward-lying Head-raising.*—The patient lies prone, her forehead resting on her clasped hands, and raises and lowers her head.

ii. *Elbow - grasp - stoop - stride - sitting Head - backward - bending.*—The patient clasps her elbows with her hands behind her back, and carries her head backwards.

In these two exercises, the longitudinal back muscles work concentrically and eccentrically in their inner range, the force of gravity being used as a resistance. The same result is obtained by giving resisted movements, in such positions as reach-grasp-stride-sitting, tailor-sitting, or hanging.

iii. *Free Head-backward-bendings* in stride-standing or -sitting, crook-sitting, or tailor-sitting.

In these movements, the back muscles do not work, but the flexors of the head and neck are used in the outer range, and so lengthened.

b. Back-raisings.—Done concentrically and eccentrically in stride-sitting, tailor-sitting, or knee-sitting.

c. '*General Correcting Position*'.

2. *For the Transverse Back Muscles*

a. 2-*Arm-parting*, in reach-standing or -sitting, reach-stoop-stride-sitting, or reach-long-sitting.

In these exercises, the transverse back muscles and extensors of the shoulder work in the inner, the abductors of the scapulæ and flexors of the shoulder (the pectorals) in the outer range. The resisted form of this exercise is the Swedish 2-Plane-Arm-carrying.

b. Forward-bend 2-*Elbow-backward-carrying* in long-sitting, tailor-sitting, or stoop-sitting (*see* p. 72). Also 2-*Arm-flinging* in the same starting positions.

c. 2-*Arm-bending and -stretching outward and backward.*

3. *Combined Exercises for Both Longitudinal and Transverse Back Muscles*

a. Stretch - grasp - stoop - stride - standing Shoulder - pressing + Holding in corrected position.—The patient, in stretch-stride-standing, bends forward and grasps one of the wall-bars, about 2–2½ feet from the ground. By a series of small flexion and extension movements of the hips, she produces a stretching of the pectoral muscles. She follows this by contracting both longitudinal

and transverse back muscles, and so flattening the back and shoulders, and this position she holds for a short time. The exercise is then repeated. Lower bars may be grasped as the patient improves. Care must be taken not to allow her to hollow her back as she rises to the erect position at the end of the exercise.

b. Yard-sitting 2-Arm-rotation-out with Head-backward-bending.

c. Static Corrections.—These include :—

1. Neck-rest-, heave-, or talk-sitting or -standing.
2. Arch-(leg)-forward-lying, with foot support.
3. Marching with a book on the head.
4. Marching with a stick held behind the head (arms in heave-grasp position).
5. Neck-rest marching.
6. Correct sitting and standing.
7. Balance walking on the balancing form or boom.

Breathing Exercises, especially inspiratory movements, are needed to stretch the pectorals, expand the chest, and increase the range of respiration.

Precautions Against Lordosis.—1. Since most exercises that correct kyphosis tend to increase lordosis, careful attention must be paid to the choice of *starting positions*, so that this tendency may be counteracted.

Long-sitting, tailor-sitting, and *crook-sitting positions* may be used for arm and head exercises (e.g., for 2-Arm-parting, and for 2-Arm-bending and -stretching); in long-sitting, the operator must see that the patient does not thrust her head forward.

Crook-lying should in all cases replace the lying position ; e.g., for 2-Knee-upraising and -lowering, or its resisted form.

Arch-position should not be used where there is a tendency to lordosis, because it stretches the abdominal muscles. *Arch-hanging* is only suitable for a long kyphosis extending down into the lumbar region, or for a kyphosis combined with flat-back. Arching backwards while in the forward-lying or leg-forward-lying position is theoretically correct ; but practically it is almost impossible to confine this arching to the thoracic region.

Stoop-position may be used for many of the trunk exercises, the flexion of the hips preventing lordosis in most patients.

2. *The abdominal exercises* of the table should be those in which these muscles are used in the inner range. Strong static exercises (e.g., Trunk-raising and -backward-falling) should be avoided.

3. *Lordosis should be carefully corrected* if it occurs during any exercise. Especially must the patient be watched while performing any movement in which the arms are raised above shoulder level (*see* p. 260).

Postural Treatment by Free Exercises only.—Dr. Arvedson, to whom we all owe so much, bases his treatment of deformities on the strengthening of particular weak and stretched muscle groups by means of resisted exercises, as well as the stretching of their shortened antagonists by so-called passive movement, the latter being really a form of *forced* movement. It has, however, been the tendency of late years to treat these cases rather by free than by resisted exercises, the idea being that the posture of the body *as a whole* needs attention, rather than any single muscle group, since the trouble is caused as a rule not so much by definite muscle weakness as by some defect in the postural reflex (p. 263). This is undoubtedly true in most cases. If the exercises are to be free, it is advisable, when possible, to treat the children in *small classes*, so that they shall have the stimulus of each other's presence, and of movements carried out in harmony with others, and at the same time a due share of the gymnast's attention. The work should be in the hands of a skilled teacher,

who should have at least some knowledge of educational methods, and who is capable of getting the best out of the class. The rhythm, the activity, the marching and running exercises will stimulate the children, and music may well be used as an auxiliary to the drill. Bad posture should be carefully corrected throughout the treatment.

Exercises designed to increase, or to preserve, mobility of the spine and thorax, and to correct the posture of the head, back, and shoulders will, of course, be a special feature of the table.

Games and folk dancing, English or foreign, are used by many to produce mobility and improve posture. Most children love dancing—and it is most important that they should *enjoy* their treatment. Other systems of dancing, e.g., that taught by Miss Margaret Morris, are also in use. The æsthetic value of her dances and exercises will be obvious to all who have been fortunate enough to attend one of her demonstrations.

This form of treatment is valuable both from the physical and the psychological point of view. If it be true that the physical posture influences the mental attitude, it would seem particularly important that, in these cases, we should strive to improve the former by every means in our power. One can hardly imagine that a person who stands with bent back, head thrust forward, narrowed chest, and rounded shoulders is likely to face the world with the best and most courageous attitude of mind. The very pose of the kyphotic patient suggests shrinking, timidity, and the 'inferiority complex', though naturally in many cases the suggestion is quite unfounded. On the other hand, since mind works on body even more powerfully than body on mind, we cannot help feeling that if we can inspire in these patients confidence, increased *joie de vivre*, fearlessness, and energy, we shall have gone a long way towards correcting their bad bodily attitude. The teacher with enough personality to inspire her patients with enthusiasm and obtain their co-operation has more than half effected their cure.

A child who must perforce be treated alone may do similar exercises, and, in her case also, the piano or gramophone may be a great help. Since she cannot have the stimulus of concerted movement, her table should be constantly varied, and she must be kept interested at all costs. Swedish resisted exercises may alternate with free movements.

Mr. Bellis Clayton recommends self-correction before a mirror for these and other spinal cases, and this should prove useful for children and adults treated at home.

II. Second and Third Degree, or Structural, Curves

Aims of Treatment.—When a patient with a structural kyphosis comes for treatment, the first thing needed is to *mobilize the spine* as far as possible by stretching the soft parts. In third degree cases little improvement can be expected; all we shall attempt is to mobilize the thorax, so as to reduce interference with respiration to a minimum.

Later, we shall try definitely to *correct* the deformity, strengthen weak muscles, and improve the posture generally.

Method.—The patient's *first table* consists mainly of mobilizing and stretching exercises, and of breathing. The former include such *passive* movements as Trunk-rolling and Chest-expansion, or *active* mobility exercises as 'Sawing', quick Trunk-rotation, Alternate side-bending, Back-raising, and 2-Elbow-backward-carrying.

Correct breathing is taught, special prominence being given to inspiratory exercises. Hanging in the head-suspension apparatus is very effective, because the whole spine is stretched in this position.

When a *decided improvement in mobility has taken place*, definitely corrective exercises may be begun, passive stretchings of the contracted structures being immediately followed by active contractions of the stretched muscles. For instance, any passive movement bringing about hyperextension of the thoracic spine, such as Stretch-grasp-crook-lying Passive Chest-expansion may be followed by an active Head-extension against gravity or an Arch-forward-lying position; or a passive Chest-expansion in neck-rest, producing stretching of the pectorals, by 2-Arm-parting, 2-Arm-flinging, or 2-Elbow-backward-carrying, or the corresponding resisted exercises. It is often possible, however, to obtain both the above effects in one exercise; e.g., in (Tailor-sitting) 2-Elbow-backward-carrying the pectorals are stretched by the jerk at the end of the quick backward movement of the arm, while the transverse back muscles are shortened by working in their inner range.

Some *mobility exercises* should always be retained in the scheme, and breathing exercises in lying, sitting, and standing must be continued.

PRECAUTIONS AGAINST LORDOSIS.—These are necessary as in postural cases; and abdominal exercises must be assiduously practised.

OTHER STRETCHING AND MOBILITY EXERCISES.—

1. *Stretch-grasp-knee-sitting Chest-downpressing.*—This is a well-known exercise. The patient sits on her heels, grasps the wall-bar in front of her about eighteen inches from the ground, and tries to force her chest downward to the floor. Lower bars may be grasped as the condition improves. This is really a variant of Stretch-grasp-stoop-stride-standing Shoulder-pressing + Holding, the exercise described above, but can be used for patients with long hamstrings because the knees are kept flexed. Moreover, the danger of lordosis when rising to the erect position is eliminated. The exercise is corrective as well as productive of mobility.

2. *Klapp's Stretching Exercise.*—The patient kneels with thighs upright and hands (turned inwards) on the floor. She lowers the body till the chest is brought as near the floor as possible. She then stretches her arms as far forward as she can. (This generally produces lordosis.)

3. *Mr. Bellis Clayton's Crawling Exercises.*—These are designed both to obtain mobility and also to exercise the weak muscles. An account of them will be found in the final chapters of his *Physio-therapy in General Practice.*

4. *Strap Exercises.*—These are specially advocated by Dr. Timberg, of St. Thomas's Hospital, and others. One of these, devised for the treatment of kyphosis or kypho-lordosis, is as follows:—

The patient lies on her back on a plinth, and, with arms raised above her head, grasps a wall-bar or some other support. One strap is placed across the abdomen, and the gymnast, standing astride the patient, places one foot on either end of this strap, so holding the abdomen down and preventing lordosis. The other strap is passed beneath the maximum convexity of the kyphosis, and the operator, holding it by the handles, pulls in an upward direction, thus applying pressure to and correcting the curve.

Structural cases are difficult to treat, and often disappointing in their results. The tendency nowadays is to discard pressures or strong passive corrections, and to treat even structural cases by means of free exercises. Perhaps a combination of Swedish remedial exercises and free gymnastics, or of the best features of all systems, is most satisfactory. Crawling, strap, or mirror exercises may be used as 'specials'.

Home exercises are only advisable if there is some likelihood of their being conscientiously and intelligently done. Otherwise, they are worse than useless.

LORDOSIS

CAUSES.—

1. Lordosis may be simply a compensatory deformity to kyphosis, or to conditions involving the hip-joint, e.g., bilateral congenital dislocation of the hip, or tuberculosis of the hip involving the fixation of the joint in flexion, etc. (*see* p. 263, and *Fig.* 130).*

2. Weakness or paralysis of the abdominal muscles, the flexors of the lumbar spine.

3. An habitual incorrect posture, or a wrong idea of the correct posture. In the former case, the patient generally stands with the pelvis tipped backwards and the abdomen protruding; in the latter, she draws in the abdominal wall, and tips the pelvis forward, so that the gluteal region becomes unduly prominent, and the lumbar spine arched.

4. Careless gymnastic treatment of kyphosis, or continual practice of backward bending exercises.

PATHOLOGICAL CHANGES.—

MUSCLES AND LIGAMENTS.—

1. *The abdominal muscles* are stretched, the lumbar muscles contracted.

2. *The hamstrings* are also affected. If the pelvis is tipped forward, they are lengthened; if backward, they are shortened.

3. *The ligaments* on the front of the spine are lengthened, those on the back shortened.

BONES.—Bony change is uncommon in lordosis.

MOBILITY is rarely much impaired in the spine, but the shortness of the hamstrings considerably limits flexion of the hip.

Treatment of Lordosis

It rarely falls to our lot to deal with this condition alone, as it is in most cases found in connection with kyphosis or some other deformity, or is the result of weak abdominal muscles after pregnancy, long illness, etc. If it is present alone, as a result of bad posture, we must of course guard against the development of a compensatory kyphosis.

The aims of treatment will be to mobilize and stretch the lumbar spine if its range of movement is diminished; to stretch the hamstrings if shortened; and to strengthen and shorten the abdominal muscles.

Physical Treatment.—

MASSAGE.—This is not required unless backache is a symptom, but may be used after exercise, as in kyphosis.

EXERCISES.—

MOBILITY AND PASSIVE STRETCHING.—All quick and strong trunk movements round the transverse (frontal) axis mobilize the lumbar spine and stretch the hamstrings, e.g., 'Hewing', Stretch-standing Forward- and downward-bending, Reach-long-sitting Forward-bending (touching toes), etc. The operator should see that the lumbar spine is not *hyperextended* at the end of any of these movements. This is most liable to happen as the patient raises herself after the downward movement of 'Hewing', or Forward- and downward-bending, because of the raised position of the arms. Crook-sitting-position, the knees secured by a strap, is recommended by Arvedson. This is suitable for a patient with *long* hamstrings.

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* The *original* trouble may be even lower down the limb, e.g., in some deformity of knee or ankle.

ACTIVE CONTRACTIONS FOR THE ABDOMINAL MUSCLES.—Many exercises of the kind mentioned above combine active contraction with passive stretching.

1. *Starting Positions.*—Long-sitting is, *par excellence*, the position for lordosis, since it is impossible to hollow the lumbar spine in this attitude. Crook- or tailor-sitting may take its place if the hamstrings are long. Crook-lying and stoop-sitting are also good starting positions, though it is possible for the patient to hollow his back in either.

2. *All the Inner Range 'Straight' Abdominal Exercises*—that is, those in which these muscles act as flexors of the spine—are excellent for lordosis. Reach-long-sitting Forward-bending (touching the toes) serves the treble purpose of stretching the hamstrings, stretching the spine, and shortening the abdominals. '*General Correcting Position*' is a very good exercise, since it avoids the possibility of ending in a bad position, which is such a pitfall in Forward- and downward-bendings. Abdominal contractions, with or without breathing, are also excellent. *Strong* static abdominal exercises should not be used. (For additional free exercises, *see* Chapter XXIII.)

3. *Leg and Abdominal Exercises Combined.*—Single knee-updrawings and leg-liftings cause static contraction of the abdominals. Such exercises, e.g. 'bicycling movement' (Alternate knee-raising) may be given in (heave-grasp-) crook-lying, provided the gymnast is careful to see that the patient's lumbar spine is kept flat throughout. *Double* Knee- (or leg-) raising and lowering, so often recommended, has the disadvantage—even in crook-lying—of often actually *producing* lordosis at its beginning, because of the forward drag of the strongly working psoas on its spinal origin. If this exercise, or its resisted form, is used at all, the patient should be made to contract her abdominal wall before beginning to raise the knees.

If the pelvic tilt is increased (i.e., if the pelvis is tipped forward), there may be weakness of the glutei as well as of the abdominals, and special exercises for these muscles should be included in the scheme.

PRECAUTIONS AGAINST KYPHOSIS.—These consist in giving exercises in positions corrective of that deformity; e.g., heave-grasp, neck-rest or yard-sitting or -standing; in careful supervision of the posture of the patient's head- and shoulders during exercise; and in special movements for the back and shoulder muscles.

For arm exercises, *see below*, KYPHO-LORDOSIS.

KYPHO-LORDOSIS

This, being merely a combination of the two preceding conditions, does not need further description. In most cases, but not in all, the kyphosis is the primary condition.

Treatment.—

Since in nearly every case a treatment for kyphosis or lordosis is practically a treatment for kypho-lordosis, little more need be said on this subject.

EXERCISES.—The exercises for back muscles should be given with the lumbar spine held corrected; those for the abdominals, with the thoracic spine extended and the shoulders held well back. Stretch-grasp-stoop-stride-standing Shoulder-pressing + Holding in corrected position (*see* p. 255) is one of the best exercises for this deformity. It is useful both in postural and in structural cases. Crook-sitting position, at the wall-bars, with a cushion behind the thoracic spine, is recommended by Arvedson.

ARM EXERCISES.—Exercises in which the arms are raised above the head always present a difficulty, since the patient hollows the lumbar spine in the last phase of the movement, owing to the upward and backward drag of the

pectorals on the thorax. To prevent this, the exercises may be given as follows:

1. Crook-lying—the patient raises the right arm forward and upward, and flexes the left hip; she then lowers these, while flexing the right hip and raising the left arm (*Fig.* 125).

2. Crook-lying—she flexes one leg, e.g., the right, on the abdomen, and keeps it there while she swings both arms forward and upward over her head, and then down again to her side three times. She then replaces the right hip in the crook position, flexes the left on the abdomen, and repeats the arm movement. She next progresses to:

Fig. 125.—Arm exercise for kypho-lordosis (No. 1). Full flexion of left hip combined with elevation of right arm.

3. Crook-lying 2-Arm-upflinging and lowering. As the arms are flung forward, the patient draws in her abdominal muscles, pressing her lumbar spine against the ground.

4. Back-lean-standing, with the feet about one foot (or more) from the wall—2-Arm-raising forward and upward, the spine being pressed against the wall as in 'General Correcting Position'.

FLAT-BACK

This condition is too uncommon to appear often in our departments.

Treatment.—

Here we have to try and *increase* instead of *diminish* the normal curves. If the case is one of kyphosis combined with flatness in the lumbar region, we shall treat the kyphosis, attempting at the same time to *produce* a lordosis. Here the *arch positions* may be freely used, and other exercises are not difficult to find. The long straight spine with neither of the normal curves developed is a more difficult proposition. We can only mobilize the spine, strengthen the lumbar and cervical extensors, give expiratory exercises, and try to produce a sense of correct posture. Crawling exercises may be useful, and free gymnastics are indicated.

II. LATERAL CURVES

These consist of: (1) *Scoliosis*; and (2) *Torticollis.* The latter, though not strictly a spinal deformity, may end by producing one.

SCOLIOSIS

By the term *scoliosis* is meant a bending of the vertebral column to one side combined with rotation of the bodies of the vertebræ towards the *convexity* of the curve.

MECHANICS.—The line of gravity of the human body is an imaginary line drawn vertically downwards through the centre of the body from the crown of the head to a point between the two feet, on either side of which line the weight is equal. The weight is also equal in front of and behind it. The line represents the direction of the pull of gravity, i.e., of the force by which the earth attracts other objects towards its own centre. This force always acts at right angles to the earth's surface—that is, if an object be dropped from a height it must always fall perpendicularly. (*Fig.* 126.)

If the body is to balance properly and without effort, the line of gravity must fall well within the base, or supporting area—that is, the space occupied by the two feet upon the floor. For perfect balance, in the erect position, the line should fall right through the centre of the base.

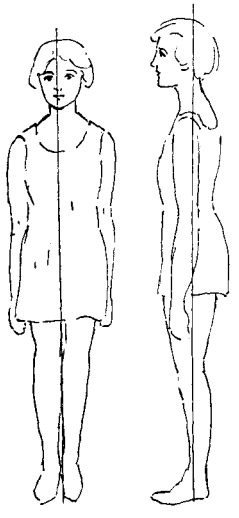

Fig. 126.—Line of gravity. A, Anterior view; B, Lateral view.

If, in inclining the body to the right or to the left, it were simply bent to the side, the movement taking place, let us say, between the intervertebral joints only, the line of gravity would no longer fall within the area covered by the feet, but outside this area on one side or the other; or if the body were bent forward or backward at the hip-joints, or at the invertebral joints, the line of gravity would similarly fall in front of or behind the base. In either case, the balance of the body could not be maintained at all without support.

How is it then that we are able to stand in stoop-, arch- or side-arch-standing position at all? For the reason that in the first case (stoop-standing) we make up for having carried one part of our body forward by carrying another part backward; that is, we fall backward at the ankle-joint, so that the hip and gluteal regions are carried backwards, and so balance is maintained. In bending backward (arch-standing) the opposite movement takes place at the ankle, and the abdomen and pelvis are carried forwards. Similarly, in bending to the side, e.g., to the right side, we carry the opposite (left) hip outward, producing abduction in the right hip and adduction in the left. (*Figs.* 126, 127.)

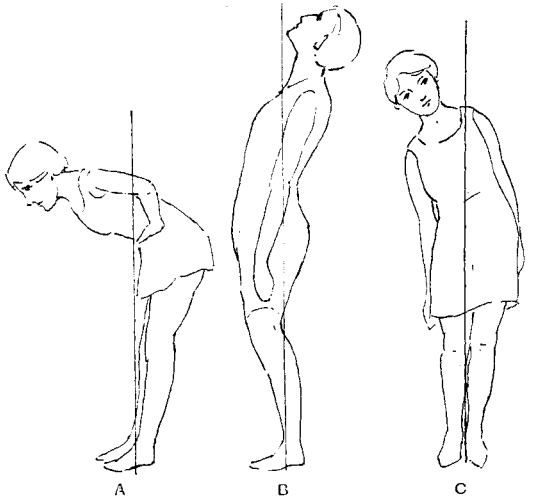

Fig. 127.—Position of line of gravity in bending: A, Forward; B, Backward; C, Sideways.

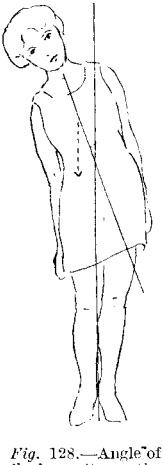

Fig. 128.—Angle of pull of gravity on the flexed spine.

But even if, by this means, the line of gravity is kept within the base, to stand with the body bent, even slightly, in any direction, imposes a strain on

the muscles on the side from which the bending takes place, because the force of gravity, instead of falling through the centre of the body, pulls on the flexed upper part at an angle. The more the body is bent, the greater is the angle of its pull, and the greater the strain on the muscles. (*Fig.* 128.) If this bend is *fixed*, as in some cases of scoliosis, the patient will tend to relieve the strain by bending his spine in the opposite direction at a higher or a lower level. In other words, he *compensates*.

These facts have to borne in mind in considering the causation and development of scoliosis, kyphosis, and, in fact, of all deformities. In scoliosis, the trouble need not begin in the vertebral column itself. It may have its origin in the feet, knees, hips, or even in the arms. If a person has one leg, e.g., the right, shorter than the other, the pelvis will be lower on the right side. If the spine were kept in its normal relationship to the pelvis, i.e., at right angles, the whole body would be carried over to the right. This constitutes a curve with *the convexity to the left*. To obviate this, he compensates by flexing his lumbar spine to the left, thus forming a second curve with its *convexity to the right*, so as to keep his head in a line with his sacrum and bring the line of gravity back to its median position. The lumbar curve may in turn produce a third curve above it (*left* thoracic) and this again may compensate even higher (*right* cervical). The same process may take place from above downwards, beginning with the cervical spine or shoulder girdle. (*Fig.* 129).

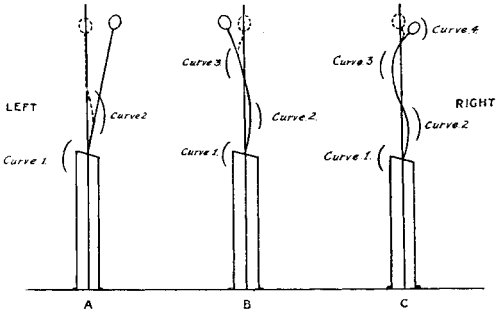

Fig. 129.—Diagram to illustrate development or compensatory curves in scoliosis. A, Shows shortened leg on the *right* side; pelvis tilted downwards on this side. Pelvis and spine at right angles to it constitute *Curve* 1, convex to *left*. This is compensated by *Curve* 2, a lumbar curve convex to *right*. B, The right lumbar curve compensated by *Curve* 3, *left* thoracic. C, The left thoracic curve compensated by *Curve* 4, *right* cervical.

The same thing happens in the case of the antero-posterior curves. If a person has both hips fixed in a slightly flexed position, he has what amounts to a curve with its convexity backward. To compensate for this, and keep his body upright, he bends his spine backward, producing a curve with its convexity forward in the lumbar region (lordosis). This in its turn is compensated by a curve with the convexity backward in the thoracic region (kyphosis), and sometimes by a final curve, convex forwards, in the cervical region. The antero-posterior curvatures, as well as the lateral, may begin in the upper part of the spine, producing compensatory curves below them. (*Fig.* 130.)

THE POSTURAL REFLEX.—Normally, the body is kept in the correct posture by the beautifully balanced action—that is, by the *tone*—of muscles on both sides of the trunk (we must not forget that this includes the muscles on the front, as well as those on the back, of the body), and by the efficient working of the nerves which control this type of muscular activity. The same is true of all the other parts of the body—the feet, legs, etc., being kept in the correct position by means of this 'postural' tone of the muscles. This form of work does not produce fatigue in the same way as do voluntary contractions of the same muscles. If a man be asked to extend his spine, or even his knee

repeatedly, the muscles will soon tire ; yet he can remain in a sitting or standing position for a very long time.

It is not understood exactly what mechanism is responsible for the maintenance of this 'postural reflex'. It is said by some to be carried out by means of sympathetic fibres which go to the *sarcoplasm* of the muscles, whereas the ordinary motor fibres for voluntary contraction go to the *sarcostyles* or muscle fibrils. The path of the reflex is much in doubt. The afferent impulses probably pass upwards by way of the columns of Goll and Burdach (the paths for muscle sense) to the pons, and thence to the cerebellum ; some fibres may also ascend in the direct cerebellar and antero-lateral tracts. The efferent impulses may return by way of the vestibulo-spinal tract, the anterior horns, and the sympathetic ganglia to the peripheral nerves. (*Fig.* 131.)

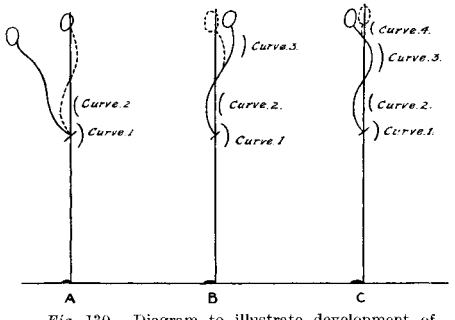

Fig. 130.—Diagram to illustrate development of compensatory curves in kypho-lordosis. A, Shows flexed hip, with pelvis tilted forward. This constitutes *Curve* 1, with convexity backward. This is compensated by *Curve* 2, hyper-extension of lumbar spine (lordosis). B, The lordosis compensated by *Curve* 3, flexion of thoracic spine (kyphosis). C, The kyphosis compensated by *Curve* 4, a curve with convexity forward in cervical region.

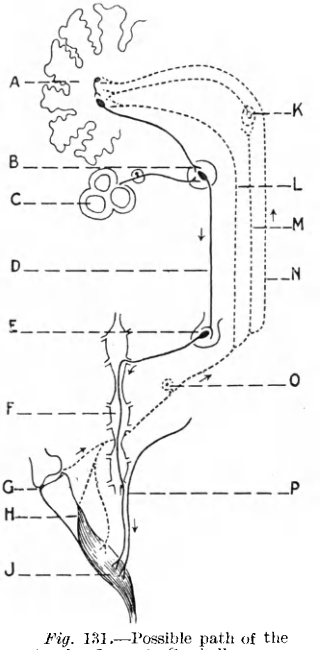

Fig. 131.—Possible path of the postural reflex. A, Cerebellum ; B, Cell of Deiter's nucleus ; C, Labyrinth of ear ; D, Vestibulo-spinal tract ; E, Anterior-horn cell ; F, Sympathetic chain ; G, Joint ; H, Tendon ; J, Muscle ; K, Cell of nucleus gracilis or cuneatus ; L, Direct cerebellar tract ; M, Part of columns of Goll and Burdach ; N, Part of Gower's (antero-lateral) tract ; O, Posterior-root ganglion cell ; P, Peripheral motor nerve.

VARIETIES.—The varieties of scoliosis may be classified as follows :—

1. Simple Curves, consisting of a single curve in one direction only : (*a*) *Cervical* ; (*b*) *Thoracic* (generally, if not very correctly, known as 'dorsal') ; (*c*) *Lumbar* ; (*d*) *Long* C curve, involving the whole, or a large part of the spine (*Fig.* 132). The simple curves are generally—though not always—postural (*see below*), since as soon as a simple curve becomes fixed, it usually compensates above or below.

2. Compound Curves, consisting of two or more curves in different directions. Thus we may have : (*a*) *Double curves* (S curves), e.g., cervico-dorsal, or dorso-lumbar (*Fig.* 133) ; (*b*) *Triple curves*, cervico-dorso-lumbar ; (*c*) *Quadruple curves* (rare), which consist of four curves distributed over the three regions of the spine.

CAUSES.—As regards their cause, cases of scoliosis may be divided into two classes—*primary* and *secondary*.

1. PRIMARY SCOLIOSIS arises spontaneously, not as the result of any previous known disability. It is due presumably to some deficiency of the postural mechanism, or to general muscular weakness.

2. SECONDARY SCOLIOSIS is the result of some previously existing deformity or disease. Some of the commonest causes are as follows :—

Deformities in other Parts of the Body.—The curve may be compensatory to other deformities of neck, arm, leg, or trunk—congenital, paralytic, rickety, or static; especially to any which cause the lower extremities to be of unequal length.

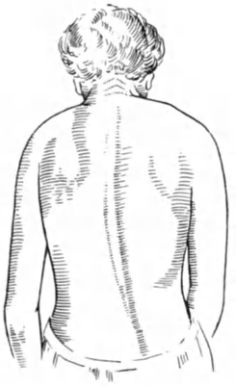

Fig. 132.—Scoliosis. Long C curve.

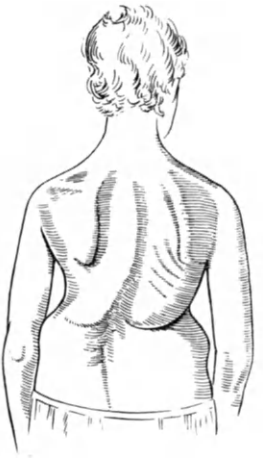

Fig. 133.—Scoliosis. S curve.

Tuberculous Disease of the Hip.—If the hip is shortened by being fixed in *flexion* only, the convexity of the curve is to the side of the *shortened* leg, the pelvis being lower on this side; if the hip is also *adducted*, the convexity is towards the *sound* side because the patient, in trying to get the affected leg to the vertical position, raises the pelvis on this side (since no movement can take place in the hip-joint) walking on the toes of this foot. (*Fig.* 134.)

Unilateral Paralysis of Abdominal or Back Muscles, or Psoas, the concavity of the curve being toward the healthy side, owing to the unopposed pull of the normal muscles.

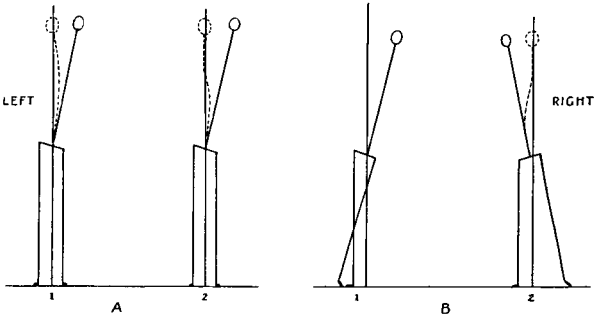

Fig. 134.—Diagram to illustrate scoliosis resulting from tuberculous disease of the hip. A, Right hip fixed in flexion only. The result is a long C curve convex to the *right* (1) or a simple lumbar curve in the same direction (2). B, Right hip fixed in flexion and adduction (1). The result is a lumbar (or long C) curve convex to the *left* (2).

Injuries to the Spine.

Unilateral Lung Disease (pleurisy, empyema, etc.) in which either one side of the thorax is bound down by adhesions, or else one lung has collapsed altogether. This produces a curve convex to the sound side.

Congenital Causes.—There is a form of congenital scoliosis with malformation of some of the vertebræ.

Hysteria.—Hysterical scoliosis is occasionally seen.

Scoliosis is more common in girls than in boys.

PATHOLOGICAL CHANGES.—Cases of scoliosis may be divided, like those of other deformities, into three degrees (*see* p. 210), the first merely postural (the term 'functional', sometimes applied to this class, is misleading, and should be avoided), the second and third being marked respectively by slight, and severe, degrees of structural change.

MUSCULAR AND LIGAMENTOUS CHANGES.—There is stretching of all structures on the convex side and shortening of all those on the concave side of the curve.

BONY CHANGES.—These are present in varying degrees in the second and third stages. It must be remembered that the bending of the spine in scoliosis is always accompanied by *rotation* of the bodies of the vertebræ towards the convexity of the curve; the more marked the curve, the greater the rotation. (*Fig.* 135.)

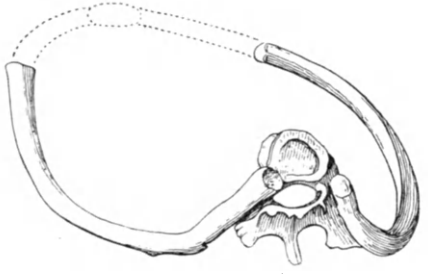

Fig. 135.—Horizontal scheme of vertebræ and ribs in scoliosis.

Changes in the Vertebræ.—

The vertebral bodies become wedge-shaped, owing to constant pressure upon them on the side of the concavity.

The pedicles: That on the convex side becomes more antero-posterior in direction than in the normal vertebra; that on the concave side is more transverse in direction; and, being compressed, becomes smaller than its fellow.

The laminæ: That on the convexity of the curve lies more transversely, and that on the side of the concavity in a more antero-posterior direction than normally. The laminæ are not much altered in shape.

The transverse processes also are altered in direction, that on the convex side being more antero-posterior, that on the concave side more transverse in direction. That on the convexity of the curve is carried farther backward than its fellow, and therefore lies closer to the spinous process.

The spinous processes are less altered in position than the bodies, or any other part of the vertebræ. These processes may be almost, or entirely, in the middle line, so that the severity of the curve may not be apparent from their position. They are, however, generally curved in such a way that the tip points to the convex side.

The articular processes may become ankylosed with those above and below.

Changes in the Ribs and Thorax.—The ribs on the side of the convexity of a thoracic curve become more sharply bent at their angles, and bulge backwards, owing to the rotation of the vertebral bodies to that side; also, they slope more vertically downward. There is a flattening of the angles on the concave side, and the ribs are more horizontal in direction. At the front of the thorax, there is a compensatory flattening of the ribs on the side of the convexity, and a bulging on the side of the concavity. This produces what is known as the 'diagonal thorax'. (*Fig.* 135.)

Changes in the Pelvis.—In lumbar curves, rotation of the pelvis, if present, may similarly cause a 'diagonal pelvis'.

THE VISCERA.—In severe cases there may be pressure on, or displacement of, thoracic, abdominal, or pelvic organs.

SYMPTOMS AND EXAMINATION OF A CASE OF SCOLIOSIS.—The patient, suitably dressed, should be placed in a good light with her back to a window. The whole of the back should be visible to the examiner, but it is inadvisable to expose the patient more than is necessary. Little girls, especially those of a shy and nervous temperament, often become acutely uncomfortable and upset if required to stand up before others in a minimum of clothing. This should not be insisted upon, as not only does it cause unhappiness to the child, but makes it impossible for the gymnast to discover what her ordinary posture is, as she will stand stiffly with all her muscles in contraction. Dark knickers with elastic at the waist for girls, with a special garment covering the chest but leaving the back exposed, and shorts or short knickerbockers with a belt for boys are suitable for purposes of examination, and may be worn during the performance of exercises. The feet and legs should be bare.

The feet should be a little apart, but the patient should not be told to stand straight, and the operator should wait a few minutes before beginning her examination, so that the patient may assume her habitual posture.

The following points should be carefully noted :—

1. THE FEET.—Look for signs of flat-foot, or any other deformity of foot or toes. Note if unilateral or bilateral.

2. THE LEGS AND KNEES.—Look for signs of bow legs, genu valgum or varum, etc.

3. THE HIPS.—Look for coxa vara, or signs of fixed flexion or adduction of either hip. Notice if there is any wasting of muscles in leg, thigh, or buttock. This may point to a slight attack of paralysis in the past.

4. THE PELVIS.—

a. See if the pelvis is *tilted laterally*. This suggests a difference in the length of the legs. Note this, and measure later.

b. Look for *rotation* of the pelvis, often present in a lumbar curve. The hip may be rotated forward either on the side of the convexity or on that of the concavity. This depends on the position of the last lumbar vertebra and of the sacrum. If they form part of the existing lumbar curve, the pelvis will be rotated forward on the side of the concavity ; if they form the beginning of a compensatory curve, the hip will be forward on the side of the convexity. If the curve ends with the fourth vertebra and there is no compensatory curve below, the pelvis will be normal in position.

5. THE LUMBAR REGION.—Notice :—

a. Any obvious signs of lateral deviation.

b. The comparative prominence of the iliac crests. That on the concave side will *appear* the higher, because the soft structures are drawn away from that side.

c. The width of the back on the two sides of the spine. It will sometimes appear wider on the concave side.

d. The contour of the body at the waist-line ; the angle is accentuated on the concave side, decreased or obliterated on the convex.

6. THE THORACIC REGION (*Fig.* 136).—Notice :—

a. Any obvious signs of lateral deviation.

b. The relative level of the shoulders ; that on the convex side is higher, unless there is a marked cervical curve in the opposite direction.

c. The contour of the ribs, which bulge backward on the convex side of the curve, and are flattened on its concavity.

d. The relative position of the scapulæ, as regards their height, rotation, and distance from the vertebral column. On the side of the convexity of a thoracic

curve, the scapula is raised and its inferior angle rotated out, and it lies farther from the vertebral column than it would if the spine were normal, since it slips outwards over the sharply bent angles of the ribs. The scapula on the concave side is lower, lying vertically, and closer than normal to the vertebral column, having been carried inwards over the flattened ribs.

e. The width of the back. The back appears wider on the convex side owing to the bulging ribs.

f. Folds in the flesh of the back. In an S curve a fold is seen passing upwards from the region of the waist, and following the line of the thoracic concavity.

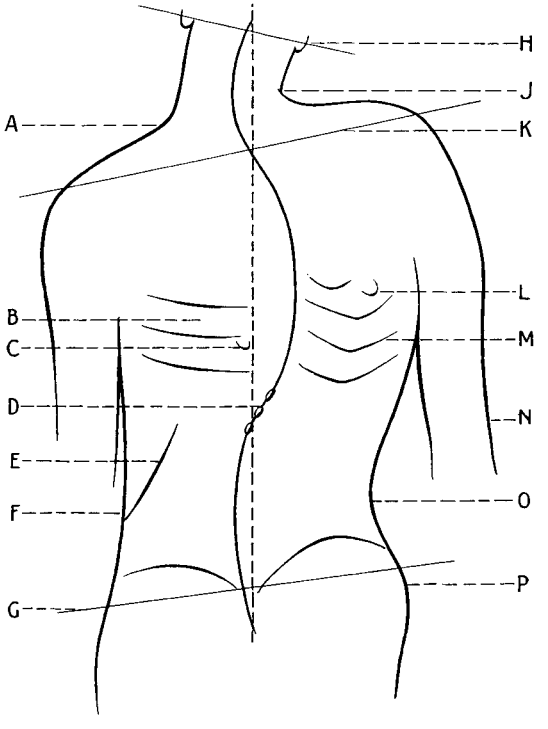

Fig. 136.—Examination for scoliosis.—A, Angle of neck and shoulder increased; B, Flattened ribs on thoracic concavity; C, Position of inferior angle of scapula; D, Prominent vertebræ at the junction of the two curves; E, Fold of flesh following line of thoracic concavity; F, Angle at waist obliterated; G, Inclination of pelvis; H, Level of ears; J, Angle of neck and shoulder decreased; K, Level of shoulders; L, Position of inferior angle of scapula; M, Bulging ribs on thoracic convexity; N, Position of arm, denoting displacement of trunk to side of thoracic convexity; O, Angle at waist accentuated; P, Prominent hip on side of concavity.

7. CERVICAL REGION. — The following points should be noted:

a. The position of the head, and the contours of the two sides of the neck. In a cervical curve, the angle between neck and shoulder is increased on the convex, decreased on the concave, side.

b. The relative level of the ears.

8. ANY PROMINENCE OF THE VERTEBRÆ in any region should be noted. They often appear prominent at the junction of two curves.

9. DISPLACEMENT OF THE TRUNK.—Notice whether one arm hangs farther away from the body than the other, and whether the whole body is carried over to one side. This is most markedly so in fixed thoracic curves, when the whole trunk is displaced towards the side of the convexity.

10. ACCOMPANYING KYPHOSIS OR LORDOSIS should be noted.

11. EXAMINATION OF THE WHOLE SPINE IN FLEXION.—The patient is now told to bend forward with the back rounded, the arms hanging loosely, and the head down. The examiner stands in front of her, and looks along the spine. The lateral deviation and the rotation of the vertebræ are much more obvious in this position. (Many gymnasts prefer to take this view of the back first of all, in order to get a general idea of the nature of the curve or curves).

12. The Front of the Thorax.—

a. Notice if the bulging of the ribs on one side, and the flattening on the other, correspond to the deformity observed when examining the back.

b. Watch the patient's breathing, and note any peculiarity.

PALPATION AND MEASUREMENTS.—The patient is placed on a plinth in the prone position.

1. Pain.—Feel for any tender spots in the muscles, especially on the convex side of the curve. Press each vertebra and see if any pain is caused anywhere by the pressure. If so, mark the vertebra and report to the doctor.

The patient is now placed in the supine position.

2. Verify the Rotation of the Pelvis by measuring the distance between the anterior superior spine on either side and the umbilicus. (This is not an *entirely* reliable test, as the umbilicus is not always exactly in the middle line.)

3. Measure the Length of the Legs.—The measurement may be taken from the anterior superior spine to the internal malleolus, or from the great trochanter to the external malleolus. The latter gives the actual length of the leg from the great trochanter downwards, but would not show such differences in length as would be occasioned by abnormalities of the neck of the femur, such as coxa vara ; or of the hip-joint, such as tuberculosis or congenital dislocation. The former measurement is, therefore, the more reliable.

TESTS FOR MOBILITY.—

1. Let the patient bend forward, and then to both sides in the flexed position —noting any limitation of movement.

2. Place her in the head-suspension apparatus, if one is available, and see if the curve is partially or completely obliterated.

3. Hanging by the hands is a test for a lumbar curve, but is of little use in a thoracic, and of none in a cervical, curve.

4. If the curve proves mobile, test the patient's ability to correct her own position.

Treatment of Scoliosis

Prophylactic Treatment.—

Much might be said on this very important subject, but a few words must suffice here.

1. Attention must be paid to the *general health* of the children ; good food and hygiene, plenty of fresh air and exercise, with sufficient rest, are all essential. The last point is often forgotten.

2. Children of the school age are most liable to develop scoliosis. Habitual bad posture should be corrected—kindly !—by parents and teachers, and suitable desks and chairs should be provided.

Special care is needed in the case of dull and backward children, or in that of the nervous and highly-strung. Neither of these classes has a normally functioning nervous system, and the postural reflex may be deficient in either. Children should not be kept too long at work without an opportunity for relaxation and exercise. Girls in the secondary schools are often sufferers from overwork. The large amount of 'preparation', the continuous classes without rest between them, the strain entailed by frequent examinations, and the over-organization of the child's whole life, may leave no time during the day for any real relaxation at all. On the other hand, these children benefit by the games and gymnastics taught in such schools. It should be remembered, however, that sometimes either work or play—or both—may be over-strenuous for the weaker children, and that though these games are a joy and a stimulus to the majority, there *are* children to whom they are as much a task as their

school-work, and a less congenial task at that. The freer life at boys' schools imposes far less of a strain, and most boys of the preparatory school age are quite capable of protecting themselves against overwork!

3. Children's backs should be inspected at regular intervals, since only by detecting the curvature at its very beginning can a cure be obtained. Education of parents on this subject is most necessary. This precaution is of special importance after any illness, or in the case of a child with any already existing deformity. If a child habitually takes up any particular bad posture, the cause should be investigated. Short sight or slight deafness may easily occasion a cervical or thoracic curve. A slight curve developed in childhood or adolescence *may* remain stationary and cause no trouble. Many adults have slight curves without being aware of the fact. But we have no right to assume that such will be the case; nor is the possibility an excuse for the neglect of scoliosis in children or young people.

Treatment of the Cause.—

Any pathological condition which is at the root of the trouble must be dealt with, medically, surgically, or by physical measures; if this condition is incurable, steps must be taken to prevent its causing further mischief.

Special Cases.—

Hysterical scoliosis must be treated by psychological methods. Scoliosis following pleurisy or empyema needs special precautions—the treatment is that of the causative disease (*see* Chapter XXII).

Physical Treatment.—

Most forms are dealt with by exercises of various kinds, sometimes combined with massage. In certain cases, supports for the back are used.

I. Postural Curves (First Degree)

AIMS OF TREATMENT.—To strengthen the muscles, to secure even innervation on both sides of the back, and to re-educate the patient in the sense of correct posture.

METHOD.—

1. Double-sided Exercises.—The exercises are to be double-sided. They may be free or resisted. If the exercises are of the resisted type, the muscles may be worked concentrically, or concentrically and eccentrically, the resisted forms of 2-Arm-bending and -stretching being an example of the former, the resisted 2-Knee-upraising and -downpressing of the latter.

2. Posture.—The patient must be taught how to assume and to hold the correct posture (*see* p. 274). This may be practised in lying, sitting, and standing. Balance exercises, e.g., walking on the boom or balancing form, Wing-standing Heel-raising and knee-bending, etc., are useful in this connection, and may be used for any type of curve.

3. Mobility Exercises, as such, are rarely necessary, but it is as well to include a few in order to prevent the development of any stiffness.

4. Massage is applied to the back muscles to improve their nutrition and remove products of fatigue, which are most likely to accumulate on the convex side of the curve. (The long C curve, convex to the left, is the most common type in postural scoliosis.)

See also remarks on free postural treatment (p. 274).

II. Structural Curves (Second Degree)

AIMS OF TREATMENT.—

1. *To mobilize the back* as much as possible in all directions, by stretching the soft parts—muscles and ligaments.

2. *To stretch* any specially contracted or shortened structures on the side of the concavity of the curve.

3. *To correct the curve* as far as possible by bringing about a shortening of the stretched muscles on the convex side. This is done by using them in the *inner range*, and producing as complete a contraction as the deformity will allow.

4. *To teach the patient to hold herself habitually in as correct a position as she can attain*, so that both the muscular and nervous systems may be enabled to adapt themselves to the changed mechanical conditions. A fixed curve is most commonly an S curve, or will end by developing into one. If the primary curve is improved, or at least prevented from becoming extreme, while the secondary curve is developing, a compensation may be obtained which will minimize the bad results of the deformity.

METHOD.—

First Stage

EXERCISES FOR MOBILITY.—When a patient with scoliosis of this degree first comes for treatment, we shall attempt to render her spine as mobile as the degree of structural change will permit. For the first month or more, therefore, most of her exercises will be directed to the attainment of this result. Such exercises as the following may be used :—

For a Cervical Curve.—Hanging in head-suspension apparatus. Head-rolling, in grasp-sitting, reach-grasp-sitting or -standing, or lying. In all but the last position, the movement may be done actively or passively. Great care must be taken not to rotate the head, or the patient will become giddy.

For a Thoracic Curve.—Trunk-rollings, in wing-high-ride-sitting, stride-sitting, or back-lean-standing ; (quick) Alternate trunk-rotations in various positions—stride-standing with arms swinging loosely, or forward-bend-tailor-sitting (in this case the movement may be combined with Alternate arm-flinging) ; or the patient may be on hands and knees (*Figs.* 171–174) ; 'Sawing', etc.

For a Lumbar Curve.—Trunk-rolling ; 'Rolling in rings' ; 'Sawing' ; Alternate side-bending ; etc.

Suitable 'crawling exercises' (*see* p. 258) may be used for any type of curve.

The importance of breathing exercises in connection with thoracic mobility must not be forgotten.

Second Stage

Correction of the deformity is brought about by *passive stretching*, followed by *active contraction* of muscles.

PASSIVE CORRECTION.—When the mobility of the patient's spine has definitely improved, movements producing a strong stretching of the shortened structures on the concave side are added to the table. This stretching is obtained by means of forcible side-bendings towards the convexity of the curve, the patient remaining as passive and relaxed as possible.

PRESSURES.—Some surgeons have attempted to bring about this passive correction by the use of various appliances which exert pressure on the convexity of the curve. Others believe that the best results are obtained by manual correction. Dr. Arvedson is of the latter opinion, and gives a list of special pressures to be used for the various types of curve. If pressures of this kind are to be given they should be carried out as follows :—

In a *simple curve* the gymnast first bends the patient slightly towards the concave side to straighten the lower part of the curve. She then applies pressure with her hand on the summit (maximum convexity) of the curve, and

carries the patient's body over towards the side of the convexity, so that a correction of the whole curve may be obtained (*Fig.* 137).

In the case of a *double curve*, two operators are required to give pressure and counter-pressure on the two convexities. If no assistant is available, a single gymnast may apply the pressure with a hand on each of the curves.

Points to be Observed in Giving Pressures.—

1. The pressure must be given in such a way as to correct not only the *lateral flexion* of the spine, but also the *rotation of the vertebral bodies* towards the convexity. Therefore, in the thoracic region, the gymnast's hand is placed on the angles of the ribs, and the pressure is directed forwards, upwards, and inwards; in the lumbar region, the hand is placed over the transverse processes close to the vertebral column, and the pressure is in a forward direction.

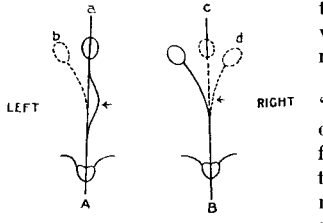

Fig. 137.—Diagram to illustrate correction of a simple thoracic curve by pressure. **A**, Showing first position (*a*)—the uncorrected curve; *b*, Second position—the patient's spine bent towards the *concavity*, straightening lower part of the curve; the *arrow* indicates the maximum convexity. **B**, Pressure is applied at the maximum convexity, indicated by arrow, fixing this point. *c*, The curve corrected; *d*, The curve over-corrected.

Pressures in the cervical region, though theoretically possible, cannot safely be given with sufficient force to accomplish what is required.

2. The pressures are given either with the 'heel of the hand' or with the dorsal aspect of the fingers. Care must be taken in the former case not to press with the base of the thumb, and in the latter the knuckles must not be used. Both of these errors cause considerable pain to the patient.

3. The pressure should be exerted firmly, strongly, and continuously, and not in a series of jerks. Though certainly not comfortable for the patient, it should not, if correctly given, be painful.

4. If the administration of the pressure is not to be utterly exhausting for the gymnast, she must contrive to get the weight of her body behind her hand, as she does in giving massage; hence the importance of a correct stance. A pressure given by muscular strength alone (i.e., by contraction of arm and shoulder muscles) cannot be maintained long enough, or be sufficiently strong, to have any effect at all.

Active Contractions of Muscles.—These should follow immediately on the passive stretchings, so that the weak muscles of the convex side may work under the best possible conditions—that is, when the shortened structures on the concave side, having been stretched to their utmost, will offer least resistance to the movement. The muscles must, of course, be worked in their *inner range of contraction* only. The exercises consist of active side-bendings, trunk-rotations, etc., the patient bending towards the convex side, and then relaxing; or, if possible, the movement may be performed concentrically and eccentrically. It is necessary that the origin of the working muscles should be firmly fixed. To this class of exercises belong also the *static holdings*, in which the patient takes, or is placed in, a corrected (or over-corrected) position, and is required to maintain that position for a certain time (e.g., Spring-sitting position, Lunge position, Leg-forward-lying, and correct standing.

Points to be Noted:—

1. Sometimes passive stretching and active contraction are combined in one exercise, free or resisted.

2. The 'holdings' must not be kept on beyond the point of fatigue. The appearance of tremor indicates the necessity of rest.

3. Throughout the treatment the patient's position must be watched and carefully corrected. Self-correction before a mirror may be taught to older children and adults.

4. Patients with deformities involving difference in the length of the legs should wear their apparatus during treatment; or, when standing, a book or some object of suitable height should be placed under the foot of the short leg. Failing this, all exercises should be given in sitting, lying, or hanging, or in one of their derived positions.

5. Too many exercises in standing are not advisable in any case. The above positions may be employed, and the all-fours position is sometimes useful, since in it the spine is supported at both ends.

6. Periods of rest should be allowed in the course of the scheme if required, and the patient should at all events lie down for at least half-an-hour after treatment.

Balance Exercises, such as Walking on the Boom, or Wing-standing Heel-raising and knee-bending are also recommended. These make for correct innervation.

III. Structural Curves (Third Degree)

The treatment is much the same as for the second degree types, but far less improvement can be expected. What mobility is left in spine and thorax must be maintained, and, if possible, increased. *Breathing exercises* are most important. The patient must be taught to maintain as erect an attitude as possible, holding the shoulders and pelvis as level as she can. At this stage she may be provided with some kind of plaster jacket, or other support. Supervision and treatment are specially necessary during the period of growth, but even after this is over, the patient should visit her doctor periodically for examination. The general health of these cases needs care, and their occupation should be in accordance with their strength.

The above outline of treatment is founded on the Swedish system of remedial exercises for scoliosis. This system can be studied in detail in Dr. Arvedson's useful text-books, or in the work of other Swedish authors. The question of how best to deal with the structural forms of scoliosis is a difficult and controversial one, to which at present no entirely satisfactory answer can be found. The tendency to-day is to treat all types of spinal curvatures by *free exercises* rather than by the specialized Swedish movements, on the principle that we should treat the *patient*, and not any special muscle-group or groups, since it is—at all events, originally was—her postural sense, and not her back muscles, that is at fault.

While this is quite true, in the more advanced cases there are certainly many adaptive changes in muscles and ligaments before the bony alterations become pronounced, and one cannot help feeling that there must be a transition stage between the first and second degree curves when *passive stretchings* (not necessarily pressures) and *localized active contractions* should be useful. Moreover, in *fixed* curves, the lateral flexors on the convexity of the curve need to be specially strengthened, since they are called upon to do far harder work than would be required of them were the spine normal.

However this may be, a knowledge of the Swedish system, worked out as it is on accurate anatomical lines, forms an excellent foundation for the student of the vexed question of the treatment of scoliosis. But a gymnast who wishes to specialize in orthopædics will do well to acquaint herself with the best features of all systems, and adapt them to the needs of the individual cases with whose treatment she is concerned.

Postural Treatment by Free Exercises for Curves of all Degrees

The chief objections to the attempted correction of scoliosis by 'pressures' are :—

1. It is impossible to obtain much correction by manual pressure, because no gymnast could give it forcibly enough to rectify the deformity to any extent ; and even if she were able to do so, she could not maintain the pressure for a sufficiently long time to produce a definite and permanent stretching.

2. The correction is rendered impossible not only by the resistance of actually shortened structures, but because the patient involuntarily *contracts* the muscles which the operator is trying to stretch, in order to avoid the pain—or, at least, the discomfort—produced by this stretching. In an active movement, on the contrary, the antagonists relax as the prime movers (the muscles performing the action) contract.

3. Most of these pressures cannot be given without special apparatus or the co-operation of a skilled assistant, neither of which may be obtainable.

It is also held that general strengthening of muscles and postural re-education should precede any definite attempts to restore mobility. In certain cases, "to mobilize a rigid curve before building up the muscles is to court disaster" (Forrester-Brown), since if the muscles cannot support the spine, and the patient has no idea of the correct position, the greater the mobility, the greater the danger.

Principles of Treatment by Postural Methods.—

1. *Rest.*—Adequate rest during and between treatments is essential. Fatigue must be avoided at all costs (*see* p. 254).

2. *The Body as a Whole must be Treated*, all muscles being exercised. It is constantly forgotten that the muscles on the posterior aspect of the body are not the only ones acting on the spine. The abdominal muscles are equally important, both as flexors and side-benders ; but this is not often realized. Abdominal contractions, and indeed most 'straight' abdominal exercises, provided they are not too strong, are useful. Side-bendings should also find a place, e.g., Knee-sitting or Tailor-sitting Side-bending, the patient's hand being placed on her ribs to ensure movement in the thoracic region. 'General Correcting Position' is also a good exercise. Arm and leg exercises and breathing exercises should also be included.

3. *The Importance of Activity.*—The tables should have plenty of variety, movement, and activity. The advantages—both physical and mental—of games and dancing have been already indicated in connection with kyphosis (p. 257). Children's tables should appeal to their imagination and play instinct, as well as to their love of movement.

4. *Re-education in the Sense of Correct Posture.*—The patient has to be taught, first, to maintain the correct posture by itself—e.g., in simple forward-lying, sitting and standing positions ; that is, she must learn to take and keep *deliberately* a posture which ought to be maintained *automatically* ; and she must practise this until she regains the *feeling* of correct posture. The operator will probably begin by herself putting the patient into the correct attitude—straightening the pelvis, pressing down the high shoulder, bending the spine to one side or the other—and then making her hold it for a few seconds. This is repeated several times. Later on, the gymnast makes the patient correct herself by means of *verbal instructions*, e.g., "Lower your right shoulder", "Hold your head straight", "Draw in the muscles here" (touching the place), and so forth. The position, when gained, is held as before. Later still, the patient must correct herself without directions, and must constantly practise this self-correction. She must next proceed to perform movements, simple at

first, and then of increasing complexity, in that right posture, until its maintenance becomes once more habitual and automatic—that is, until the postural reflex is fully re-established. In a severe *structural curve* we shall endeavour to obtain as good an attitude as is possible in the circumstances.

5. *The Importance of Rhythm* is more and more realized in these days. All the processes of the body are normally rhythmic—the heart's beat, the respiratory movements, the peristaltic action of the unstriated muscle tissue. The harmony of music depends on the perfection of its rhythm ; so does the health of the body, as well as that of the mind. The failure of the postural reflex brings about a loss of rhythm in the body—a loss of harmonious co-operation between different parts of the nervous system, and between groups of muscles. The sense of rhythm has to be won back, and with it the sense of right posture—though its gradual restoration may be a long process. Hence, most of the favourite exercises of to-day are free, rhythmic movements, set to music. There are many different systems—mostly designed, it is true, for the perfecting of bodily movement in *normal* men, women, or children, but many of them adaptable to the needs of scoliotic or kyphotic patients, or those suffering from various other deformities of limbs or trunk. Folk-dancing, English or foreign ; dances modelled on the Greek, like those of Miss Margaret Morris and others ; rhythmic exercises like those taught by Madame Agnete Bertram ; and many other systems which have been demonstrated from time to time at the Chartered Society's congresses and meetings, offer a wide field of choice to the worker. Space forbids any description of these systems here ; moreover, they should be studied at first hand. The experienced gymnast will take, perhaps, something from each, or may even work out a system of her own ; and this will be well, provided that she bears in mind the limitations of her patients, and does not ask more of them than they are able to perform.

Besides the systems mentioned above, readers are advised to study the methods of Dr. Goldthwait.

TORTICOLLIS

(*Wry-neck*)

A malposition of head and neck due to a unilateral shortening of the sterno-mastoid, and sometimes of other muscles as well. Torticollis may be congenital or acquired.

The Acquired Form

This may be acute, subacute, or chronic.

ACUTE AND SUBACUTE FORMS are due to inflammatory processes in the neck : e.g., myositis, tuberculous glands, or rheumatism (Tubby).

CHRONIC FORMS are caused by :—

1. Injuries of the neck, dislocations, scar tissue (burns, wounds, etc.) ;

2. The same reasons that cause cervical scoliosis—defective eyesight or hearing resulting in bad posture, rickets, etc. ;

3. Nervous conditions, organic or functional ; irritation of the spinal accessory or deep cervical nerves ; neuralgia of the brachial plexus ; occupation neuroses. Under this heading comes also the form known as 'spasmodic torticollis', which is considered in the chapter on nervous diseases (p. 200).

Treatment.—

The cause, if possible, is removed. The *chronic* form may then be treated on the same principle as the congenital variety. The *acute* form, after the removal of the cause, generally clears up of itself. For the *rheumatic form*—'STIFF-NECK'—*see* Chapter XVIII. The nerve cases are in a class by themselves (*see* OCCUPATION NEUROSES, p. 201, and SPASMODIC TORTICOLLIS, p. 200).

The Congenital Form

ETIOLOGY.—The deformity is slightly more common in girls than in boys, and is more often found on the left side than on the right. Occasionally, *both* sternomastoids are contracted. The cause is malposition in the uterus, or some prenatal defect of circulation in the affected muscle.

PATHOLOGICAL CHANGES.—

1. The sternomastoid on one side is shortened, and occasionally other muscles are also affected (the scalenes, platysma, splenius, or trapezius). There is a sclerosis, or hardening, of the muscle tissue (i.e., a degenerative change), especially in the sternal portion.
2. The skin and fascia are also contracted.
3. If the case is untreated, bony changes arise, as in a cervical scoliosis.

DEFORMITY.—

POSITION OF THE HEAD.—In a *left* torticollis, the head is bent to the left, and the face rotated towards the right. The left shoulder is raised. The whole head is displaced towards the sound side. The contracted muscle feels hard, with sometimes a localized swelling near its centre ; but there is no pain. The deformity increases as the patient grows, and it is therefore important that it should be corrected as early as possible.

ASYMMETRY OF THE FACE.—The face is smaller on the side of the contracture, in this case on the left. The corners of the eye and mouth are drawn down, the former appearing smaller than that on the sound side, and of a different shape. The nose deviates slightly towards the left. This condition of facial distortion, not very obvious in a baby, becomes more so as the child grows older. After operation, when the head is held straight, it becomes much more noticeable, but gradually improves, and finally disappears. In young children, it may right itself in a few months ; in older patients, it may take two to three years (Tubby).

COMPLICATIONS.—Scoliosis, of course, is present in the cervical region, the convexity being towards the sound side. In neglected cases, this may produce a compensatory curve or curves lower down. It generally, though not always, rights itself after operation.

In bilateral cases, which are rare, *both* sternomastoids are shortened. The head is bent forward, and kyphosis is a complication.

Treatment.—

SLIGHT CASES (IN INFANTS)

These are the only cases that can be cured without operation. The treatment should begin as soon after birth as possible, and may be carried out two or three times a day if this can be managed.

PHYSICAL TREATMENT.—

POSITION OF PATIENT AND OPERATOR.—An infant should be placed on its back on a suitable plinth or table, with its head near the edge, and the operator should stand at the end of the plinth behind the child's head, which must be held in as correct a position as possible during treatment. A very low pillow should be placed under the head.

MASSAGE OF THE NECK.—The movements required are :—

On the Affected Side.—(1) Strong stroking, to stretch the contracted muscle, skin, and fascia. (2) Picking up and frictions for the same reason.

On the Opposite Side.—A different type of massage is needed : (1) Effleurage and finger-kneading given briskly but not heavily, to bring nutrition to, and strengthen the stretched antagonist of the shortened muscle. (2) Gentle hacking, to bring about contraction of this muscle.

PASSIVE (FORCED) MOVEMENTS.—The child is now placed with his head beyond the edge of the table, supported by the operator's hands. If possible, an assistant should steady the child's shoulders, while the operator gives the passive stretching. In a left torticollis, the head is to be bent to the right, and rotated to the left, and brought as far as possible towards an over-corrected position. The fact of the shifting of the head towards the sound side must not be forgotten, since this also requires correction. It is best to perform all this part of the treatment expeditiously, and get it over. The baby will cry, and probably struggle, but the pain—which cannot be very great, since some children do not cry at all—ceases as soon as the stretching is finished; and it is much kinder to be quick and decisive than to endeavour to console the baby between movements.

'Head-suspension' is sometimes tried with rather older children. If so, it is best carried out by placing one hand under the child's chin, and the other beneath the occiput and lifting her off her feet in this manner. A small child should not be placed in the head-suspension apparatus.

ACTIVE MOVEMENTS.—In very young infants these are impossible. As soon as the child is old enough, we may try to obtain movement by making her look at toys or brightly coloured objects held in such positions as will necessitate her turning her head in the desired direction. Later, the fascinating occupation of listening to the 'tick-tick' may perhaps induce a lateral flexion! The operator must be careful, however, to see that the movement is really performed in the *cervical* region, and not merely produced by a *trunk* flexion or rotation. To prevent the latter, the shoulders must be fixed.

The cases suitable for treatment without operation are rarely old enough to be capable of performing resisted exercises; eccentric movement is obviously beyond them.

MASSAGE OF THE BACK.—The child may now be turned over into the prone position, and the upper part of the back kneaded. In this position, again, head extension may be obtained, and the child may be persuaded to try and look back over her shoulder, e.g., in a left torticollis, she should look over her left shoulder.

SEVERER CASES

These consist of older children or adults with neglected congenital torticollis, and some cases of acquired torticollis. Massage and manipulation alone are insufficient for these; they must be treated by operation. A few of the acquired cases may yield to physical treatment.

PHYSICAL TREATMENT OF OLDER PATIENTS.—The treatment is on the same lines as that for infants, the chief differences being as regards the active exercises, and the position of the patient during the administration of massage and passive movements.

MASSAGE.—

Position of Patient and Operator.—For these patients the sitting position will be found to be the best, the operator standing behind the chair or stool on which she sits, and supporting the head in as good a position as can be obtained, by placing one hand under her chin.

The movements are the same as those used for infants, except that naturally, they will be stronger.

PASSIVE STRETCHING.—

Position of Patient.—While this is given, the patient may steady her own shoulder on the *affected* side by grasping a bar of the rib-stalls beside which her stool has been placed (talk-grasp-sitting), or the edge of the stool itself.

This shoulder, being too high, should be fixed as *low* as possible. (*See also below.*)

The side-flexions and rotations should be given strongly, and with small over-pressures at the extreme limit. Head-suspension in apparatus is also useful.

ACTIVE MOVEMENTS.—

Position of Patient.—For active movements it is necessary to fix the origin of the working muscle, so the shoulder on the *convex* (sound) side must be fixed. The patient may take crutch-standing or -sitting position beside the boom, the shoulder being kept *high*. It is simpler, however, and saves unnecessary moving about, if she simply grasps the stool below her with both hands, thus fixing both shoulders. In this case she may keep the same position for both passive and active movements. It is easy to arrange for the shoulder on the affected side to be a little lower than the other.

MOVEMENTS.—Concentric and eccentric head-side-bendings away from the affected side and rotations towards it are given in the inner range. Head extension should also find a place, the patient changing to the reach-grasp position for this exercise.

SURGICAL TREATMENT.—The sternal and clavicular heads of the sterno-mastoid are divided close to their origins, and any contracted bands of fascia are also severed.

The head is put up in plaster in an over-corrected position, or kept in place by sandbags or other apparatus, generally for about a fortnight.

PRE-OPERATIVE TREATMENT is sometimes ordered. It is carried out in much the same way as if it were to be the only treatment, but special attention should be devoted to improving the nutrition of *all* the muscles of the neck, shoulder, and upper part of the back, as after the operation they must be immobilized for a time, and so tend to waste. Passive stretchings are less important in these cases. Any active movements that are possible should be practised.

Fig. 138. — Sayre's apparatus for elastic traction after operation for torticollis.

POST-OPERATIVE TREATMENT.—Relapse is very apt to take place unless this is carried out efficiently.

Support.—The head is kept in position by apparatus, generally consisting of straps. A common type consists of a strap round the forehead, and another round the shoulder and axilla on the sound side, between which a third strap is fixed, much in the direction of the sternomastoid muscle itself. (In Sayre's arrangement this third band is of elastic.) (*Fig.* 138.)

In bed, the patient should lie on the affected side, with a pillow under the head.

Massage and Passive Movements.—These are given as for the cases treated without operation, except that the presence of the scar must be considered.

Active Movements.—These are most important of all. They are given as described above, and free exercises also should be taught to the patient, and practised several times a day at home, provided that either the patient or his mother is intelligent and reliable. Self-correction before a mirror may also be enjoined. But 'home exercises', however conscientiously done, must not be made a substitute for attendance at the hospital or treatment room, as these cases need careful watching.

III. POTT'S DISEASE

(*Vertebral Tuberculosis. Spinal Caries. Kyphosis Angularis*)

A tuberculous affection of the spine, attacking generally the vertebral bodies, and producing angular deformity.

ETIOLOGY.—Like all tuberculous diseases, spinal caries (Latin, *caries* = decay) is commoner among the poor than the rich. It is probably not hereditary. It is most common in children under 10, the majority of cases occurring under the age of 5 years.

PATHOLOGICAL CHANGES.—The tuberculous process generally starts in the front of the *body* of a vertebra (*Fig.* 139), and spreads to neighbouring vertebræ. It destroys the bone substance (*see* p. 360), and finally forms a large cavity, so that the vertebra collapses under the body weight transmitted through the bones above. The whole spine bends forwards and downwards at this point, one or more spinous processes project noticeably, forming the 'lump' or break in the normal contour of the back.

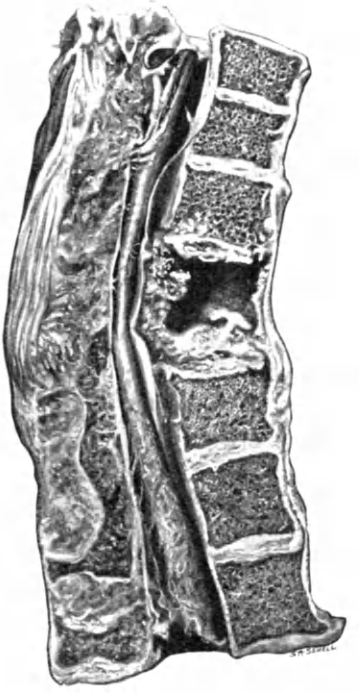

Fig. 139.—Tuberculous disease of the body of a vertebra.

POSITION OF THE LESION.—The *lower thoracic region* is most frequently attacked, then the *upper lumbar*. Caries of the upper thoracic region is much less common, and cervical caries is rare.

SYMPTOMS.—

PAIN—either at the seat of the disease, or in the form of a 'referred' pain—that is, one found somewhere in the distribution of the nerve or nerves which supply the affected vertebræ. Any jarring of the spine causes sharp pain.

STIFFNESS.—This is due to spasm of the back muscles; the patient using these muscles, voluntarily and involuntarily, to immobilize the spine and so avoid pain. The child, moreover, will not attempt to bend his back, and if asked to pick up an object from the floor, does so by flexing hips and knees, keeping the spine rigid.

GAIT AND POSTURE.—In advanced cases, the child either will not stand at all, or else he holds on to objects round him, and will not walk unless he can obtain such support. The attitude is characteristic, always being one which will procure support for the affected part of the spine, thus relieving pressure on the diseased vertebræ, and decreasing pain.

DEFORMITY.—There is angular deformity backward, shown by a break in the normal contour of the curves of the spine, best seen when the child bends forward. It is very slight in early cases, but may develop to an extreme degree if untreated, as in 'hunch-backs'. Scoliosis does occur, if the *side* of the body of a vertebra is diseased and collapses, but it is rare.

COMPLICATIONS.—

PRESSURE.—In bad cases of thoracic caries, there may be serious pressure on the *heart and lungs*, and grave interference with their functions.

ABSCESS FORMATION.—Abscesses may form at the site of the lesion, or elsewhere.

COMPRESSION PARAPLEGIA—that is, paralysis (generally spastic) of the lower extremities, due to compression of the spinal cord, the neural canal being narrowed by the collapse of the vertebræ and the bending of the spine.

We need not further discuss this disease in its early stages, as we are not much concerned with its treatment until a later period. Should any of the above signs, or anything which appears to resemble them, be noticed in any case of scoliosis or kyphosis under our care, they must be immediately reported to the surgeon, and treatment stopped pending his decision.

Treatment.—

GENERAL TREATMENT.—The general treatment is important. Good food and hygiene, fresh air, and sunlight are essential. That the sun is our best ally in such cases has been abundantly proved at Leysin in Dr. Rollier's clinics for the treatment of surgical tuberculosis. Similar treatment, as far as is possible in our climate, is carried on at the Treloar Home at Alton, at Hayling Island, and at many other homes and hospitals, where it has been wonderfully successful. During the summer the patients, wearing a minimum of clothing, spend all their days in the sun—having been, of course, accustomed to this by gradual exposure—their heads being protected by a shade. Artificial sunlight is also used when necessary.

MECHANICAL TREATMENT (SUPPORT).—The patient is placed in the recumbent position, with the spine in hyper-extension. This attitude diminishes the pressure on the diseased vertebral body, or bodies, and thus relieves pain, prevents flexion deformity, and gives the spine a chance to heal, this being brought about by partial replacement of the destroyed bodies by new bone, and generally by ankylosis of the joints between the affected vertebræ. When there is reason to believe that healing has taken place, the child is successively allowed to sit up, stand, and walk, wearing a plaster jacket, or some other form of support. The duration of the treatment is long, three to four years in thoracic caries, and rather less if the disease is in the cervical or lumbar regions. Supervision is necessary for a considerable time in order to obviate all danger of relapse.

PHYSICAL TREATMENT.—

DURING THE PERIOD OF RECUMBENCY AND SUPPORT

Massage of the limbs is sometimes given to prevent wasting of the muscles from disuse. *Compression paraplegia* generally disappears in time, in the course of the general and mechanical treatment of the disease. Massage and movements may be given as for SPASTIC PARAPLEGIA (*see* p. 123). If recovery does not take place, an operation may be undertaken for its relief, after which treatment may proceed as before, but it must be very gentle and careful, as these operations are very severe ones, and not always successful.

WHEN THE PATIENT IS CURED, HEALING HAVING TAKEN PLACE, AND THE SPINE BEING CONSOLIDATED AT THE SEAT OF THE LESION

Our chief aim in treatment is to strengthen all the patient's muscles and to increase mobility, if impaired, in all joints *except those in the area attacked by the disease*. Since it is difficult to confine movement entirely to one region of the spine, this means, in practice, that no *forcible stretching* or mobilization

of the spine is to be attempted (*see also below*). The method of treatment is as follows :—

MASSAGE.—General massage is advisable, or at least massage of the back muscles, weakened through non-use. The work may be stimulating as far as the limbs are concerned, though not over-vigorous ; the back must always be treated gently. Effleurage, kneading, and 'picking up' are the best movements. If frictions and pressure vibrations are used at all, the area of the disease should be given a wide berth. *Spinal back-hacking* is inadvisable, unless well away from the lesion, e.g., on the lower parts of the spine in cervical caries.

GENTLE EXERCISES.—These are essential, provided, as mentioned above, that no attempt is made to increase the range of movement in that part of the vertebral column which has been the seat of the disease. No overstretch or overpressure should be given in any trunk exercise. The thorax needs mobilizating ; but this has to be done with care, and no movement must be undertaken which could put any strain on the spine. Special care is necessary with regard to any movement which takes place most freely in the affected region. Thus, trunk-turnings, or any exercise including rotation of the trunk, must be given most carefully if the caries was in that very common situation, the lower thoracic region, since rotation is so free in this part. The same applies to forward-bendings in the cervical and lumbar regions. Forward-bendings, in fact, need more caution than any other movements, in whatever region.

1. *Breathing Exercises* are most important, in order to mobilize the thorax, and obtain full range of respiration. The patients should be made to expand all parts of the lung, being instructed in costal, diaphragmatic, and apical breathing. It is as well, in fact, to treat these patients as if they were in danger of phthisis. All free breathing exercises may be given, also Half-lying Chest-lift-stroking and -shaking Sitting Chest-lifting movements, free or assisted, may be used with care, but passive Chest-expansions of the Swedish type are not advisable because of the pressure on the back. Circle-turning (Arvedson) may be given gently and without stretching, if the patient can relax completely ; Chest-clapping is also beneficial.

2. *Arm Exercises.*—Most free movements may be given, so long as they are suited to the strength of the patient. Resisted exercises like 2-Plane Arm-carrying, and Arm-rotation with rod are also suitable. Some of the resisted forms of 2-Arm-bending and -stretching, e.g., in half-lying, are permissible, but the usual strong overstretch when the arms are raised above the head must be omitted if the lesion included, or was below, the sixth thoracic vertebra. Hanging by the hands is, of course, contra-indicated for the same reason—the stretching of the spine by the drag of the latissimus dorsi, attached to the spinous processes from the seventh thoracic vertebra downwards. On the whole, *free* exercises are safer.

3. *Leg Exercises.*—Most of these may be given, provided they are not too strong. Those in which the abdominal muscles also work concentrically and eccentrically are not suitable (*see below*).

4. *Head Exercises.*—In thoracic and lumbar cases, all movements may be performed in the ordinary way, with the shoulders fixed. In cervical cases, all must be given with great care, without overstretch, slowly, and with little or no resistance. Passive movements are only given in complete relaxation.

5. *Trunk Exercises* (*see above*).—The following are contra-indicated : strong mobility exercises, (e.g., Trunk-rolling) ; pressures of any kind ; exercises with overstretch or overpressure ; movements with strong resistance by the force of gravity, or by the gymnast ; free exercises in very quick time,

producing a jerk at the end of each movement (e.g., Hewing, Yard-standing (quick) Alternate trunk-rotation).

The best exercises are free movements done in rather slow time.

Examples

Back Exercises.—

1. Back-raisings vertebra by vertebra (unresisted); Forward- and downward-bending and raising; 'General Correcting Position'.
2. Trunk-falling-forward and -raising; Wing-high-ride-sitting Back-raising, etc.

Abdominal Exercises.—

1. Abdominal contractions (in crook half-lying); Lying Head-raising, etc.
2. Trunk-rotations; in stride-lying, sitting, stride- or close-standing (*see above*).

Side-bendings.—

Wing (high) ride-sitting Alternate side-bending (free or with gentle resistance); Standing Alternate side-bending, etc.

Any free exercises similar to the above may be given.

6. *Balance Exercises* may always be used. The patient should walk along a line drawn on the floor, or on the boom *at its lowest*; otherwise, should he suddenly lose his balance, he might jar his spine in jumping off.

Probably few exercises of ordinary strength would be harmful to these patients, provided that all forced movements were avoided, but spinal caries is too serious a disease to justify the taking of any risks, and it is better to err on the safe side. Obviously, the exercises must be carefully graduated.

CHAPTER XVIII

CONSTITUTIONAL DISEASES

Chronic rheumatism of joints—Rheumatism of muscle tendons and aponeuroses—Muscular rheumatism—Rickets—Gout—Diabetes mellitus—Obesity.

CHRONIC RHEUMATISM OF JOINTS

ETIOLOGY.—

SEX.—Men and women are both affected.

AGE.—The condition appears most frequently in middle-aged or elderly people, especially as the result of long-continued exposure to cold and damp.

THE ACTUAL CAUSE is probably a toxic one; the toxins being due to the presence of bacteria, or to some derangement of the metabolic processes of the body.

PATHOLOGICAL CHANGES.—

1. The synovial membrane of the joint is inflamed, but exudation, though present, is slight.

2. The fibrous tissues round the joint are most affected. There is inflammation and consequent thickening of the ligaments, and also of the tendons or aponeuroses of the muscles attached close to the joint.

3. Bony changes are not marked.

SYMPTOMS.—*Pain*, *stiffness*, and sometimes *slight swelling of the joints*, and enlargement of surrounding tissues are the main features. The pain, which is of a dull aching character, is generally worse at night, or when the patient has been at rest for a long time. He is often very *sensitive to changes of weather*. *Many joints* are affected. Knees and shoulders frequently suffer.

Treatment.—

HEAT, BATHS, AND APPLICATIONS.—Certain kinds of *baths* are useful, and the patient should, if possible, live in a warm, dry climate, especially during the winter. Such English spas as Droitwich and Buxton are suitable; or, on the continent, Aix-les-Bains, Dax, or Pistany. The mud-baths at the last-named are said to be very beneficial. This mud is also sent to England, and is highly recommended by some doctors for rheumatism and allied conditions. In this case it is applied in the form of a pack or compress to the affected limbs. The whirlpool bath, if available, is also valuable for relieving pain.

Radiant heat may also afford relief, and *salicylic ionization*, or some other form of electrical treatment, sometimes effects an improvement.

Painting with iodine, or the application of iodex, is useful in some cases.

MASSAGE should be very deep and strong, in order to break down thickenings round joints and in muscle aponeuroses. General massage is advisable if many joints are affected, and abdominal massage should help the general metabolism and assist the elimination of toxic substances.

EXERCISES.—

PASSIVE MOVEMENTS should be vigorous, and should be performed quickly, in order to get rid of stiffness and to improve circulation.

ACTIVE MOVEMENTS are also of supreme importance, since they bring blood to, and so strengthen, the muscles which work on the joints moved.

The Knee-joint

We give below the detailed treatment of a typical chronic rheumatic condition, viz., rheumatism of the knee.

MASSAGE.—This consists of:—

MASSAGE OF THE THIGH.—This is particularly important, and includes vigorous effleurage, very deep kneading and picking up of all muscles, especially of the quadriceps; hacking and clapping of the thigh.

MASSAGE OF THE KNEE-JOINT.—This consists of effleurage round the knee; kneading with the palms of the hands on either side of the joint; deep frictions to all the ligaments, and to the tendons of the muscles in the neighbourhood.

MASSAGE OF THE LOWER LEG.—This is less important than that of the thigh, unless the ankle-joint is also affected. It is nevertheless advisable to give a short, but deep and vigorous treatment to this part, in order to improve the circulation through the whole limb.

MOVEMENTS.—Quick and vigorous passive flexion and extension of the knee may be given, and free exercises with plenty of movement and activity should be used to reduce stiffness, strengthen the muscles, and improve circulation. High-sitting Knee-swinging is very effective. General exercises are valuable if the patient's age and health permit. (The knee exercises may be chosen from those on pp. 81, 82, or any similar exercises may be used. Quick, rhythmic, swinging movements are the best.)

RHEUMATISM OF MUSCLE TENDONS AND APONEUROSES

(*Chronic Fibrositis*)

In this condition the rheumatic products are deposited, not in the ligaments of joints, but in the tendons and aponeuroses of muscles close to their attachments to bone. The deposits are probably found here rather than in the contractile tissue, because in these parts the circulation is less active than in the muscle itself. A common example of this kind of chronic fibrositis is to be found in the ordinary 'rheumatic headache', or occipital neuralgia. We shall therefore take this condition as typical, though fibrositis may be present in many other parts of the body. (*See also* SCIATICA, p. 183.)

Rheumatic Headache

SYMPTOMS.—*Tenderness and thickenings* are found in the areas indicated above. These are *pains in the shoulders*, and *headache in the occipital region*; occasionally the rheumatism appears also in the face, and there is tenderness in the branches of the fifth nerve, especially at the points where they emerge through their respective bony foramina. There is also *stiffness* of the neck.

Treatment.—

POSITION OF PATIENT.—The condition is easiest to treat if the patient sits on a stool, places his elbows on a table, and supports his forehead on his hands. If the table be a high one, it is possible for him to rest his forearms on it, with one hand on top of the other and his forehead on them. This support

is most necessary in order to relax the trapezius and other extensors of the neck. If in bed, he must lie prone, with pillows suitably arranged as for any back and neck massage. The operator stands behind the patient.

MASSAGE AND MOVEMENTS.—Our aims will be to break up the thickenings, and to improve the circulation so as to ensure their removal. To this end, as in the case of fibrositis round joints, our massage will be of the deepest possible kind.

We shall begin with the *upper part of the back and the shoulders*, and give firm effleurage and deep kneading to this region. We shall then give strong frictions to any thickenings which can be felt, working round their edges and gradually approaching their centres. We shall follow this by a second series of deep kneadings to disperse the broken-down tissue, and by strong effleurage to assist in its removal by the lymphatic circulation. If the patient can bear it, hacking may be employed to bring fresh blood to the part.

We shall then proceed to *the region of the neck*. Here we shall repeat the same series of movements, dealing especially with the upper fibres of the trapezius. Our frictions will be given on either side of the ligamentum nuchæ, along the superior curved line, below the mastoid process, and over the top of the shoulder. Hacking is not always advisable in this region.

We shall now change our own position, and stand in front of the patient to treat *the head*. In women, if the hair is long, all hairpins must be removed. The best movements that can be used here are frictions. They should be given firmly but gently. It is impossible to give them as deeply in this region as in the back and neck, since the epicranial aponeurosis lies over bone, and bruising of the nerves would certainly be the result of too heavy work. Done carefully, however, they bring great relief to the patient, who often desires to prolong this part of the treatment.

Finally, with the patient sitting upright, we shall give *passive movements*—Head-rolling being the most useful; and *active exercises*, such as Head-side-bending, Head-rotation, active Head-rolling, Head-extension, Back-raising, and 2-Arm-parting and -forward-carrying.

In an old-standing case, the treatment may need to be continued for from two to three months. If a complete cure is obtained, the patient may remain free of the trouble, and if, on any subsequent occasion, he should again be attacked, prompt treatment will generally succeed in cutting the attack short.

Trigeminal Neuralgia due to Rheumatism

This affection must not be confused with a true neuritis of the trigeminal nerve ('tic douloureux'), which condition is not suitable for treatment by massage. The painful points, as mentioned above, are found where the branches of the fifth nerve emerge on the face. Most common is pain over the points of emergence of the supra-orbital and supra-trochlear branches of the frontal division of the ophthalmic nerve. Other possible points may be: (1) At the emergence of the terminal branch of the superior maxillary (the infra-orbital nerve), immediately below the eye; (2) At the emergence of the temporal branch of the orbital (temporo-malar) nerve (a branch of the superior maxillary) above the zygoma; (3) Occasionally at the emergence of the mental nerve (a branch of the inferior dental division of the inferior maxillary). (*Fig.* 140.)

Treatment.—

POSITION OF PATIENT.—The treatment is best given in the lying or half-lying position. The patient's head should be supported on a soft cushion, and his eyes closed. The masseuse should stand at the side of the couch, facing him.

MASSAGE.—The treatment of these neuralgic pains of rheumatic origin in the face must perforce be much gentler than in other less sensitive regions. Only the area where pain is present need be treated. The séance should begin with stroking, very gentle at first.

For the Forehead.—The stroking may be performed with one hand, across the forehead and down to the temple. Gentle frictions should next be given, all over the frontal region, special attention being paid to the points of emergence of the supra-orbital nerve and the supra-trochlear nerve (*see Fig.* 140). After this, the stroking movements may be repeated.

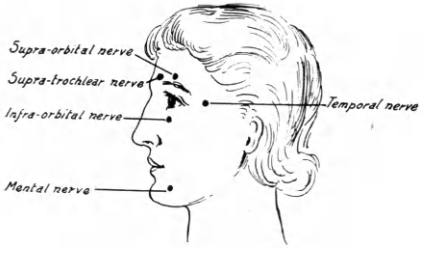

Fig. 140.—Points of emergence of sensory nerves on the face, showing where pain is most commonly present in trigeminal neuralgia.

Temporal Region.—Stroking should be given at the beginning and end of the treatment, in the manner described above. Frictions are also given, especially over the point of emergence of the temporal nerve.

Region of the Cheek.—Stroking is given to one or both sides of the face. The hands are placed lightly over the patient's eyes, the tips of the index fingers resting lightly on the forehead. The hand then passes downwards, the index fingers being drawn down between the eye and nose, the others slightly raised so as not to press heavily on the eyes. The hands are then carried downwards and outwards over the cheeks and over the lower jaw. This movement might really be classed as effleurage, because it follows more or less the course of the facial vein. Frictions are given over the cheek, especially at the point where the infra-orbital nerve leaves the foramen of the same name.

The Mental Region is rarely affected. If pain is present here, the stroking should be from the middle line of the chin, upwards toward the angle of the jaw; and the frictions over the point of emergence of the mental nerve through the mental foramen.

General stroking of the whole of one side of the face and neck may conclude the treatment. (For a description of this, *see* Insomnia, p. 196.)

Later on, the patient should be made to use the face muscles actively, screwing up the face, and then relaxing it.

MUSCULAR RHEUMATISM

(*Myalgia*)

By this is understood an *acute* inflammatory condition in the muscles or their tendons or aponeuroses.

ETIOLOGY.—It is more common in men than in women. It does not follow acute rheumatism (rheumatic fever), but gout seems to predispose to it.

Causes.—

1. Chill, exposure, cold, and damp.
2. Overstrain of muscles, rupture of their fibres, or other injuries.
3. Probably, in most cases, the origin of the disease is *toxic*, i.e., due to an infection originating elsewhere in the body, and the above are merely the *exciting* causes.

PATHOLOGICAL CHANGES.—The changes are those of inflammation in the connective tissue of the muscles (*acute fibrositis*). The swelling of these tissues sometimes causes pressure on nerve-endings, setting up neuralgic pain.

In chronic cases the connective tissue of the muscles is increased, i.e., scar tissue is formed, resulting in limitation of movement in the part.

SYMPTOMS.—Any of the voluntary muscles in the body may be affected, in varying degrees of severity. The arm muscles or the leg muscles may suffer, or those of the trunk. *Pain and aching* in the muscles is sometimes very severe, and often neuralgia develops, this being due to compression of the nerves by the fibrositic products. The least stretching of the muscles causes pain, as does pressure on the inflamed area.

VARIETIES.—Besides muscular rheumatism in the *limbs*, the following are the commonest forms: (1) *Lumbago*; (2) *Pleurodynia*; (3) '*Stiff neck*'.

Lumbago

This consists of inflammation in the muscles of the lumbar region, especially in the latissimus dorsi and erector spinæ. Every movement causes pain, and the patient's gait becomes stiff and awkward. Sometimes the condition seems to be directly due to a strain or a chill, while in other cases it appears to come on without any ascertainable cause, though often *habitual* strain of the muscles may be responsible, at least as the exciting cause.

Treatment.—

ACUTE STAGE.—Since this is a case of acute muscle inflammation, the proper treatment is *rest*. Either the patient remains in bed, or at least refrains from movement of the part, which may be strapped to reduce such movement to a minimum.

Hot baths, radiant heat, diathermy, and the constant current are all used to reduce inflammation and pain, by improving the circulation in the part, and also to assist the elimination of toxins by bringing about an increased activity of the sweat glands.

SUBACUTE STAGE.—

MASSAGE should be begun as soon as the patient can bear it. He should be placed in the prone-lying position, suitably supported by pillows. It is particularly important that all the muscles in the affected area should be completely relaxed.

The treatment is best begun with *kneading*, since effleurage often causes pain by dragging on the inflamed tissues. The movement should be carried out with one hand at a time, since to endeavour to treat both sides of the back simultaneously, by using the two hands, is unnecessarily painful. The kneading should be given first to the less painful parts of the lumbar region, and the masseuse should approach the most inflamed area gradually and with great care.

Frictions are next added, to break up the inflammatory deposits. These also should, at this stage, be performed with the fingers of one hand only, first down one side of the spine and then down the other. Kneadings should now be repeated, to disperse the products which have been broken up, and facilitate their passage into the lymphatic vessels.

Later, *effleurage* may be added. It is as well to treat not only the lumbar, but also the gluteal region, as inflammation is always liable to spread.

CHRONIC OR CONVALESCENT STAGE.—

MASSAGE will have been gradually deepened as the patient recovers. Effleurage and kneading are by this time being given fairly vigorously, while the frictions are as strong and deep as possible. The treatment in fact has become similar to that of a chronic fibrositis.

Frictions should be used to disperse any thickenings which can be felt in the

lumbar or gluteal muscles. They are most frequently found at the sides of the vertebræ and round the iliac crests.

EXERCISES should be introduced as soon as possible in the course of the treatment, both to preserve mobility, which may become limited by these bands of fibrous tissue, and also to improve the circulation and nutrition of the lumbar and gluteal muscles. Back exercises, which work the extensors of the spine in this region, and 'straight' abdominal exercises which flex the spine and stretch its posterior ligaments and muscles, are both required, and side-bendings are also beneficial.

In the early stages, the patient, lying on his side, with hips and knees flexed as much as is possible without discomfort, may attempt alternately to extend and to flex the lumbar spine by using first the lumbar extensors and then the abdominal muscles. The same exercise may then be tried in crook-lying. Back-raisings (concentric) are added, in sitting, as well as trunk-rotations.

The following exercises, or others of a similar kind, may be given as the patient improves :—

1. Wing-high-ride-sitting Trunk-rolling (passive and active).
2. Wing-standing active Trunk-rolling.
3. Lax-stoop-sitting Back-raising (concentric).
4. 'General correcting position'.
5. Stretch-stride-standing Forward- and downward-bending.
6. Reach-grasp-leg-lean-standing Back-raising.
7. 'Donkey' (*see Fig.* 142, p. 301).
8. Reach-long-sitting Forward-bending (trying to touch toes).
9. High-ride-sitting } Alternate side-bending.
10. Standing }
11. Stretch-half-lying 2-Arm-bending and -updrawing.
12. Prone-lying Back-raising (with feet supported).
13. All trunk-rotations.
14. Sawing.
15. Hewing.

Pleurodynia

This consists of inflammation and thickenings in the pectoral muscles, the intercostals, or the serratus magnus, generally on one side of the body only. The pain is felt most on *inspiration*. This affection often develops into intercostal neuralgia or even neuritis. It is sometimes mistaken for pleurisy—or pleurisy is mistaken for it. The latter condition, however, shows other signs and symptoms, which are not present in pleurodynia, e.g., raised temperature.

Treatment.—

Similar to that for intercostal neuralgia (*see* p. 182), but may be progressed more quickly.

Stiff Neck

Inflammation in the sternomastoid and, sometimes, in other neck muscles. As a rule, this affection clears up completely in a short time, but it must not be forgotten that this does not always happen, and some patients are left with impaired mobility, especially in the matter of rotation of the neck.

Treatment.—

On the same lines as for the previously mentioned forms of myalgia, but recovery may be expected in a shorter time, and exercises, especially head-rotations, should be given as soon as possible.

RICKETS

(*Rachitis*)

Rickets is a nutritional disease occurring in infants and young children, the most characteristic changes taking place in the bones.

ETIOLOGY.—

AGE.—The disease generally appears between the ages of six months and two years. It may last till the age of five. 'Late rickets', occurring at puberty, may be a recurrence of slight infantile rickets, or it may start at this period.

CAUSE.—Long has been the controversy that has raged about the causes of rickets, and many are the theories that have been put forward. The most modern ideas on the subject are :—

1. *That it is due to a deficiency of vitamin D*, a substance found in some, but not all, of the same articles of food as vitamin A. For instance, both vitamins are found in cod-liver oil, but many fats which are rich in vitamin A contain little of vitamin D, e.g., cow's milk. Without this vitamin, the calcium salts and phosphates in the body—which are not themselves deficient—cannot be used to produce ossification of the bones.

2. *That sunlight, real or artificial, may compensate for a deficiency of vitamin D in the food*, because the ultra-violet rays, acting on a substance in the human skin—ergosterol—bring about a formation of vitamin D in the body itself.

3. *That an ill-balanced dietary*, especially one containing an excess of carbohydrates and a deficiency of fats, *aggravates the condition.*

PATHOLOGICAL CHANGES.*—The most marked changes are found in the bones, the process of ossification being delayed and irregular.

In a normal bone, the process of ossification begins from one or more centres, and spreads outwards from these in a regular manner. In the case of a long bone, e.g., the humerus, the first centre to appear—early in fœtal life—is in the middle of the diaphysis (i.e., the shaft). The centres in the epiphyses make their appearance much later. If such a bone were examined microscopically, it would be found to consist of regular zones, each at a different stage of development. Next the centre would be a ring of true bone, clearly marked off from that beyond, where calcification would be far less advanced ; then a zone where there was merely a re-arrangement of cartilage cells preparatory to ossification, and beyond this again an area of unchanged cartilage.

In the rickety bone, the ossification is irregular, the zones being no longer marked off from each other. Small portions of ossifying bone are found among the cartilaginous parts, and groups of cartilage cells in the bony layer. Moreover, the deposit of calcium and phosphates is insufficient, and the bone remains too soft, though when it does harden, the acute stage of the disease being past, it becomes very hard and ivory-like. The increase in length is arrested for a time, while the disease is active, so that the bone never grows as long as it should have been, while growth beneath the periosteum is excessive, making it abnormally thick. The changes are very marked at the epiphyseal junction which is swollen, hyperæmic, and increased in thickness. This condition is often very noticeable in such situations as the wrists and ankles.

SYMPTOMS.—*Sweating of the head* and throwing off the bedclothes at night are usual symptoms. The child has slight *fever*, and sometimes cries when handled, though the tenderness is not always marked. He is generally pale, and may be *thin and wasted*, or *fat and flabby*. The muscles suffer as well as the bones, and are weak and badly developed. The patient does not learn to

* The student is advised to revise carefully the process of normal ossification.

walk until long after the normal time, or ceases to do so if he has already begun.

The general health suffers, and the child is subject to such complications as bronchitis, catarrh, or convulsions. *The abdomen is distended and prominent*, partly because the spleen and liver are enlarged, partly from flatulence. The patient often suffers from constipation or diarrhœa. *The teeth appear late*, and are generally defective.

Bending of the long bones takes place, and *deformities* tend to develop.

THE DEFORMITIES OF RICKETS.—

1. THE SKULL.—

a. The flat bones of the cranium, especially the frontal and parietal bones, are much thickened, so that the head becomes square in shape, and appears abnormally large. This is the more noticeable because the over-development does not take place in the bones of the face, which appears very small in comparison to the vault of the cranium. The occipital bone, however, is an exception, as it is thinned, probably because of the pressure exerted on it as the baby lies with its head on the pillow. It may sometimes be felt to crackle

Fig. 141.—Rickets. Severe deformities of chest, clavicle, and long bones.

beneath the fingers. This symptom is known as 'cranio-tabes' (Latin, *tabes* = wasting, decay).

b. Ossification of the bones of the skull is much delayed, and the sutures are late in uniting. The fontanelles, especially the anterior one, do not close until long past the normal period.

2. THE SPINE.—The most common deformity is *kyphosis*, consisting at first of one long curve backward, involving both the thoracic and the lumbar region. Later, when the child walks, a lumbar lordosis may develop, owing to the prominent abdomen with its weak muscular wall. *Scoliosis* is less common. These deformities, in rickets, are due partly to muscular and ligamentous weakness, and partly to the softness of the bones. A rickety kyphosis tends to improvement and recovery, but scoliosis is often a very serious matter.

3. THE THORAX.—The ribs being very soft, alterations in the shape of the thorax are marked (*Fig.* 141). The following are the most usual :—

a. Pigeon Breast.—The thorax is compressed at the sides, and is therefore elongated from before backwards ; its posterior aspect is flattened, and the sternum is thrust forward.

b. Vertical Grooves on either side of the sternum, where the ribs are joined to their costal cartilages, and also at the mid-axillary lines, where they are farthest from their fixed points (Tubby).

c. Harrison's Sulcus, passing obliquely from the ensiform appendix towards the axilla, "corresponding to the upper level of the abdominal viscera" (Tubby). It is probably formed by the pull of the diaphragm on the six lower ribs.

d. The 'Rickety Rosary'.—This consists of bony enlargement at the junction of the ribs with their cartilages—at which point growth is very active at the age when rickets occurs.

4. THE UPPER EXTREMITIES.—Deformities of the upper limbs are uncommon, and only occur if the child puts weight on his arms in crawling. The bones of the forearm, and the elbow-joint, are most often affected.

5. THE LOWER EXTREMITIES.—Besides shortening of the bones and consequent dwarfing of the patient, almost any kind of distortion may take place, e.g., coxa vara, genu varum or valgum, bow-legs or forward curving of the tibiæ, flat-foot (talipes valgus), etc.

6. THE PELVIS.—The pressure of the femoral heads, as well as other factors, tends to decrease the size of the true pelvis. This, in women, may have serious consequences in pregnancy and childbirth.

PROGNOSIS.—In untreated cases the disease may go on for several years, the child generally beginning to walk during its third year, at which time the deformities of the lower extremities develop. These tend to spontaneous improvement as he grows, the concavities of the long bones being filled in with new bone laid down by the periosteum. But traces always remain and the child's growth is stunted if the rickets has been severe.

Of the spinal deformities, the kyphosis often rights itself, but the scoliosis does not. On the contrary, it increases, careful and early treatment being therefore essential.

The thoracic deformities, and those of the upper extremities, also tend to improvement.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—

1. The patient should wear woollen under-garments, and be carefully protected from cold. He should have warm baths daily, and should spend as much time as possible in the fresh air and sunlight. A town child should be taken into the country if this can be managed. In any case, the importance of warmth, sunlight, adequate ventilation, good hygiene, and suitable food should be fully explained to those in charge of him.

2. The *diet* is all-important. Since the deficiency of vitamin D is at the root of the trouble, measures must be taken to see that this is made good. For infants, the food will be chiefly milk, and it is important that this should be of the best quality. If the baby is still being nursed by its mother, attention to her food is necessary. In older children, the diet should contain plenty of protein and fat, and the amount of starchy food should be restricted. There must also be a proper supply of the other vitamins—A, B, and C.

3. Cod-liver oil will be ordered for the patient, as this is rich in vitamin D, as well as A. Ergosterol (obtainable from yeast, ergot of rye, etc.), which

has been subjected to the action of the ultra-violet rays, is also used in treatment.

PHYSICAL TREATMENT.—Our chief aim at the early stage, when the disease is still active, is to prevent the occurrence of deformities while the bones are soft. We shall also hope to strengthen the flabby muscles, especially those of the abdominal wall, to reduce flatulence, and improve the condition of the child's whole body, while he is undergoing medical treatment.

SUPPORT.—If deformities are to be avoided, proper support must be afforded to the bones while they are still soft.

Infants and little children should be kept in the lying position, either prone or supine, in order to prevent the development of a rickety kyphosis or scoliosis. In bad cases a plaster-of-Paris bed moulded to the normal curves of the back has been recommended (Tubby). Babies should be carried about on some support, and not in any way which produces a lateral curve in the spine. When able to sit up, the child should be supported by proper apparatus. He should not be allowed to walk while the leg bones are still soft. If it is difficult to prevent this, in children who have already learned to walk, splints coming below the child's feet should be used.

MASSAGE.—Ordinary general massage is best in these cases, to strengthen the weak muscles, provided the child can tolerate it. It should, of course, be given very gently at first. The child may be placed on a pillow near a fire or in a warm room, and effleurage and kneading applied to the limbs and back. Abdominal massage also is most important. Kneading and rolling of the intestines will reduce flatulence, increase the nutrition of the abdominal wall, and provide a reflex stimulation of the unstriated muscle beneath. Stroking and frictions may be administered to the colon. All organs should receive careful attention, though, naturally, in an infant, elaborate manipulations are not possible. Kneading with the palm of the hand over the whole of the abdomen will be found one of the most useful of movements. Needless to say, the abdominal massage should be carried out most gently and carefully. If diarrhœa should be present, it is better omitted for a time. The back should be watched carefully for any signs of curvature.

PASSIVE MOVEMENTS.—Gentle moulding of the long bones, if deformed, is *possible* while they are still soft; but it requires great care and skill. In giving movements to joints, care must be taken not to carry the movement beyond the normal limit, lest the weak ligaments and muscles should be overstretched, a deformity produced, or the joint rendered unstable.

ACTIVE MOVEMENTS.—These will be practised a little later. Movements of the limbs without any weight being taken on them should be given if or when the child is able to understand what is required of him. They will, of course, be free movements, and will be given in the form of play. He may be shown brightly coloured objects and persuaded to try and catch them; and should also be encouraged to kick his legs about and touch things with his toes. He will thus be able to use his limbs, and so maintain circulation in them and develop their muscles without putting any strain on his soft bones. The complete treatment should not be too long.

BREATHING EXERCISES.—These are important and should be taught from the beginning if the child is of a suitable age, in order to prevent thoracic deformity, and increase the intake of oxygen. These exercises are the more necessary because these children often suffer from nasal obstruction, and are subject to lung affections. Inspiration is especially important. Even quite little children can be taught simple exercises. Older ones should be made to expand every part of the lung, especially any parts the full expansion of which has been hindered by any existing deformity. This part of the treatment needs

much patience and skill, but it is more than worth the trouble. Similar exercises would be given to patients in whom deformities such as pigeon breast had already developed.

ARTIFICIAL SUNLIGHT is of considerable value in these cases. The reason for this is given above. The value of *real* sunlight must not be underrated.

For treatment of deformities in the later stage, *see* the articles on the individual deformities.

GOUT

Gout is a disorder of metabolism, due to the presence of an excess of uric acid and other purin bodies in the blood, chiefly affecting the joints, and often producing other constitutional disturbances.

ETIOLOGY.—

AGE AND SEX.—Gout, in its typical form, is now a rare disease. It is most common in men over the age of thirty.

PREDISPOSING CAUSES.—These consist of unwise indulgence in food, especially in rich nitrogenous substances; or in sweet heavy wines or malt liquors. It is commoner in the rich than in the poor. The influence of heredity is well marked.

EXCITING CAUSES.—A single very heavy meal may bring on an attack, or a shock, accident, or period of mental grief or worry may be responsible.

PATHOLOGY.—It is not necessary to go in detail into this very difficult subject. The actual cause of gout is, as stated above, an excess of 'purin bodies', among which is uric acid. Purin bodies result from the breaking down of *nucleins*, complex chemical substances containing protein, phosphorus, etc. These nucleins may be forming part of the tissues of the body itself, or may be taken in in the food. In either case, they may be broken down to form uric acid, and other purin bodies. The difficulty is to get rid of these substances. Birds and snakes excrete uric acid; most mammals are able to convert it into a more soluble substance by means of a special enzyme; but man has not this power to any great extent. He has to eliminate it as it is, in the urine.

Many theories have been advanced to account for the occurrence of gout. All that can be said for certain is that some people cannot, for some reason, easily get rid of these purin bodies (Osler). The kidneys are often diseased in gouty patients.

The chief pathological changes are as follows:—

1. THE JOINTS.—The joints are most affected, the metatarso-phalangeal joint of the big toe suffering most frequently and most acutely. A deposit of biurate of soda takes place, affecting first the articular cartilage, then the synovial membrane and the ligaments. The changes are similar to those of arthritis—erosion and final destruction of the cartilages, thickening of the membranes, and enlargement of the bone-ends round their articular surfaces. The deposits also appear in the structures round the joints, forming small hard nodules known as 'chalk-stones' or 'tophi'. They are common in the hands at the metacarpo-phalangeal joints, and in this position may actually work their way out through the skin. They are sometimes found also in the ear-lobes or in other cartilaginous structures in the body.

2. THE KIDNEYS.—These organs may contain similar deposits, causing inflammation (nephritis).

3. THE HEART AND ARTERIES.—Arteriosclerosis is often associated with gout. This puts a strain on the heart, and may cause myocarditis (*see* Chapter XIX).

SYMPTOMS.—Gout may manifest itself in various forms. It may be acute

or chronic; or it may cause symptoms quite unconnected with the joints, e.g. cerebral, cardiac, gastric, or intestinal symptoms, neuralgia or neuritis, bronchitis, etc. (irregular and suppressed gout).

ACUTE GOUT.—The acute attack is often heralded by twinges of pain in the joints of hands or feet, by an attack of dyspepsia, or by restlessness and irritability.

The attack itself generally begins at night, with agonizing pain in the big toe. The joint is acutely inflamed, hot, red, and very tender; the skin is shining in appearance, and rapid swelling takes place, sometimes extending upwards over the foot. The patient's temperature rises to about 103°. Towards morning the pain decreases, only to return the next night. This may go on for a week or more, the patient being comparatively free from pain during the day, and always worse at night. The attacks occur at variable intervals. The big toe only may be involved, or the pain may spread in later attacks to other joints—the hands, or even the ankles and knees becoming successively involved. The acute attacks may result in the establishment of the chronic condition. The patient's health may be good between the attacks.

CHRONIC GOUT.—This may produce crippling somewhat similar to that of arthritis. The joints become enlarged and misshapen. The toes and fingers are most often affected, though wrists, elbows, ankles, and knees may suffer later. The fingers become stiff, with enlarged joints, and are sometimes drawn over to the ulnar side, as in arthritis. The 'tophi' found at the metacarpophalangeal joints and possibly elsewhere in the body are, however, characteristic of gout. Symptoms of nephritis, arteriosclerosis, or heart trouble may be present.

SUPPRESSED GOUT.—This generally follows sudden improvement of the joint condition. The symptoms are variable, and may consist of gastro-intestinal disturbances, vomiting, abdominal pain, diarrhœa, etc.; heart symptoms, such as dyspnœa, pericarditis or irregular action of the heart; or cerebral symptoms, such as coma or apoplexy (Osler).

IRREGULAR GOUT.—This is generally found in those with a 'gouty diathesis' (hereditary predisposition), sometimes in more than one member of the same family. The symptoms are very variable. They may consist of cutaneous eruptions, abdominal disturbances, such as 'biliousness' or constipation, cardiac or vascular symptoms, bronchitis, kidney troubles, eye diseases, or nervous affections, such as headache, neuralgia, sciatica, and cramp. Cerebral hæmorrhage may occur or, more rarely, meningitis (Osler).

Treatment.—

GENERAL AND MEDICAL TREATMENT.—

DURING THE ATTACK.—The leg is raised, hot fomentations or anodyne liniments, such as lead and opium lotion, are applied, and the limb is wrapped in cotton-wool. The patient is kept on a milk diet, and is made to drink water freely.

THE GENERAL CONDITION is treated as follows:—

Diet.—The patient should eat at regular hours, and not take too much food. Alcohol is forbidden, or reduced to a minimum. The diet will be prescribed by the doctor. As a rule, nitrogenous food (protein) is not forbidden altogether, but very rich food of this kind (liver, kidneys, etc.) is not allowed. Carbohydrates should be taken in moderation. Most fruits and vegetables are permitted, as are milk and eggs.

Fresh air, exercise, and regular hours are essential.

The skin must be kept active; Turkish baths are sometimes recommended.

Dress.—The patient should dress warmly and avoid chills.

Spas.—Many patients derive much benefit from residence at various spas—Buxton, Bath, Aix-les-Bains, or Pistany. The regular life at these places is probably as beneficial as the waters.

PHYSICAL TREATMENT.—

ACUTE GOUT.—During the crises of acute pain nothing can be done, as the patient cannot bear to be touched; in fact, he can hardly bear to be approached at all, and anyone merely walking across the room may make the pain unendurable. Even during the day-time, when he is fairly comfortable, few workers would venture on treatment by massage. This is generally deferred until the attack is at an end.*

WHEN THE ATTACK IS OVER, OR BETWEEN ATTACKS.—The patient should be treated by exercises, *abdominal massage* or even general massage being also advisable in some cases. The exercises chosen should be vigorous, and such as require the use of large groups of muscles, in order to quicken the general circulation, so that the urates may not be so easily deposited in the tissues.

Abdominal exercises are important for the purpose of increasing peristalsis. It is obviously most necessary to prevent the occurrence of constipation in these cases. *Trunk exercises*, which improve the portal circulation, should also be included. In fact, all exercises should be directed to improving circulation, excretion and metabolism generally, and building up the patient's health.

Extremity exercises may include passive, free, or resisted movements, e.g., 2-Arm-rolling (passive); 2-Arm-carrying in circles (active); 2-Arm-swinging forward and upward, or in circles; Hand-clapping over the head; 2-Arm-swimming; Stretch-half-lying 2-Arm-bending and -stretching; 2-Plane Arm-carrying; Half-lying Hip-rolling with leg-outstretching; Standing Heel-raising and knee-bending; Leg-swinging; Reach-grasp-standing Leg-carrying or -swinging in circles, etc.

Breathing exercises are essential for circulatory reasons. They are, moreover, specially important in those in whom the acute form tends to pass into the chronic, the possibility of bronchitis or emphysema having to be considered.

The condition of the patient's heart and lungs should be known, and if any other complications are present, due allowance must be made for these. The patient's age, of course, has also to be taken into consideration when selecting exercises.

CHRONIC GOUT.—The *general treatment* is similar to that described above, but may have to be considerably modified owing to involvement of the heart, lungs, kidneys, or arterial walls. (*See* the articles on these conditions).

The *local treatment* of the joints involved is similar to that for osteo-arthritis, massage to the muscles and joints (effleurage, kneading, frictions, etc.) being always useful. Passive movements, not too vigorous, may be given to the affected joints to prevent their becoming fixed. These, of course, are useless if bony change has produced a true ankylosis. Active movements are always required.

CASES OF SUPPRESSED AND IRREGULAR GOUT are rarely sent for treatment. They must be dealt with according to the symptoms they manifest.

DIABETES MELLITUS

Diabetes is a disease of metabolism characterized by the presence of an abnormal amount of sugar in the blood, and by its excretion in the urine.

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* Dr. Mennell, however, is of opinion that massage at this stage is very beneficial. (*Massage, its Principles and Practice*, Chapter xxvi.)

ETIOLOGY.—

AGE.—Diabetes is generally a disease of middle life, appearing between the ages of 40 and 60. A very acute form, however, occurs in children.

SEX.—It is commoner in men than in women.

It attacks certain *races*—notably the Jews; heredity appears occasionally to predispose to it; the rich are more often victims than the poor.

It may follow *specific fevers*, other constitutional diseases, or affections of the nervous system. The neurotic and emotional are more liable to it than others, and worry, grief, or shock sometimes appears to be the exciting cause.

PATHOLOGY.—The cause of diabetes was long in dispute. There now appears no doubt that it is due to a deficiency of the internal secretion of the pancreas, to which the name of *insulin* has been given because it is produced in the interstitial cells of the pancreas, the 'islets of Langerhans'.

PHYSIOLOGY: CARBOHYDRATE METABOLISM.—In studying this subject we have to take into consideration the activities of three of the endocrine glands.

1. THE ADRENALS (suprarenal glands), the medulla of which secretes the substance called *adrenalin*. This hormone, among other functions, has that of causing an outpouring of sugar from the liver. If the adrenals are stimulated, this output is increased. They have been called the glands of emergency, and are thrown into increased activity by the emotions of fear or anger. In an animal, this brings about bodily changes which enable it to fight or to flee. A man, by the exercise of his will, may refrain from doing either, but the physiological reaction takes place none the less.

2. THE PANCREAS, which secretes *insulin* (as well as its external secretion, the pancreatic juice), the function of which is to enable the tissues—in some way not well understood—to take up and use glucose.

3. THE POSTERIOR LOBE OF THE PITUITARY BODY, the secretion of which appears to act in a manner antagonistic to that of the pancreas, and *inhibits* the taking up of sugar by the tissues. If it is deficient, the individual is able to ingest abnormally large amounts of sugar without its appearing in the blood or in the urine. If *insulin* is absent, the action of the pituitary secretion is unopposed.

In diabetes, there is now no doubt that the trouble is due to disease or exhaustion of the cells of the islets. The glucose poured out by the liver cannot be burned up in the tissues, and consequently remains in the blood. Its excretion in the urine is nature's attempt to get rid of a substance which—necessary and valuable in its proper quantity—is a deadly poison when in excess.

This disorder of carbohydrate metabolism leads, moreover, to disorder of the metabolism of *fats*, which cannot be fully oxidized in the tissues in the absence of carbohydrates. Hence, certain acids are formed, the products of incomplete oxidation. They appear in the blood and urine, causing *acidosis*, and producing serious symptoms.

THE MORBID ANATOMY, then, consists of disease of the whole pancreas, or of the islets only. Degenerative changes may also be found in other organs—the liver, kidneys, and central or sympathetic nervous system. The blood contains: (1) Excess of sugar; (2) Excessive acid; (3) Sometimes fat.

SYMPTOMS.—The *amount of urine is greatly increased*—to between 10 to 20 pints a day—and is pale in colour. There is *intense thirst*, owing to this large loss of fluid; and *great hunger*, because the tissues, being unable to take up their proper fuel food, are starved, however much is eaten. A prominent symptom is *emaciation*, since neither of the fat-forming foods can be properly used. Occasionally there is *obesity* instead, due to storing of unoxidized fat

in the superficial tissues. The *muscles* are weak, and the *skin* in an unhealthy condition ; there may be boils, carbuncles, etc. There may be *diarrhœa*, which is dangerous because of its weakening effect.

Later symptoms are : *Diabetic dyspnœa* or 'air-hunger', the patient taking long sighing breaths, and *diabetic coma*, brought about by the acidosis, and ending in death. The patient, however, often dies of some intercurrent disease, such as pneumonia, or tuberculosis.

Other possible *complications* are eye troubles, especially cataract ; nervous affections, neuritis or neuralgia (e.g., sciatica), multiple neuritis with dropped-foot, mental changes, trophic changes in skin and nails, ulcers, or gangrene ; and kidney or lung diseases.

PROGNOSIS.—In children and young people, in whom the disease takes an acute form, the prognosis is bad. In older people the disease is more chronic. It is only curable in the very early stages, but with proper diet and treatment patients may live for years.

Treatment.—

GENERAL TREATMENT.—

1. The patient should live a quiet and regular life, all worry, excitement, or over-exertion being eliminated as far as possible, since these increase the activity of the adrenals. Warmth, rest, and gentle exercise are all important.

2. The patient's *diet* will be prescribed by the doctor. The carbohydrate element in the food is reduced to a minimum. Nitrogenous foods are permitted, with eggs, butter, cheese, green vegetables, etc. The necessity of vitamins should not be forgotten.

MEDICAL TREATMENT.—The administration of insulin, made from the pancreas of animals, is now the chief feature in the medical treatment. It is given by means of injections, since if taken by the mouth it is destroyed by pepsin and trypsin, and so never reaches the blood-stream.

PHYSICAL TREATMENT.—

1. MASSAGE.—

General Massage should be given, to strengthen the weak muscles, improve the circulation, and help in the elimination of waste substances. The heart, as well as the rest of the muscular tissue of the body, is suffering from a defective supply of sugar, so that its energy is impaired, and the circulation is naturally affected. Effleurage and kneading will help venous return, and so relieve the heart while improving the nutrition of the body. Tapôtement should not be given.

Abdominal Massage is most important ; it assists portal circulation and digestion, and prevents constipation. The tendency to diarrhœa in these patients must be remembered. If it occurs or threatens, abdominal treatment should cease for a time.

Dr. Mennell considers that massage has a very beneficial effect in preventing the onset of gangrene, or in checking its progress if it has already appeared. For this reason, massage should always be given to the lower limbs : it should consist of effleurage, kneading, and picking up, and should be most gently and carefully performed, as indeed should all the massage for this condition.

2. EXERCISES.—

Gentle Exercises should be given according to the patient's strength. The use of the muscles should help the combustion of carbohydrate—in the presence of insulin—but over-exertion will defeat its own object.

An ordinary short '*general strengthening*' table is quite suitable. There should be exercises for trunk and extremities, and if constipation is present,

this must receive consideration, though obviously only the less vigorous movements can be used.

The general exercises may consist of free movements, or these may be combined with gentle resisted ones. Trunk-rotations, abdominal contractions, and concentric back-raisings in some form are among the best trunk exercises. The massage may be spaced between the exercises. The weaker patients may perform movements in the half-lying or crook-lying position during the course of their general massage.

Breathing Exercises are obviously essential, and at least three should be included in any scheme.

COMPLICATIONS, such as multiple neuritis, should receive appropriate treatment.

We have to remember that in treating such a condition as this we cannot expect to produce quick or 'dramatic' results. It is no use for the patient to make up his or her mind that a marked and permanent improvement can be obtained in half-a-dozen séances. In bad cases, treatment must be continued for a long time, at all events at intervals, and in the slighter cases, it should go on at least until the insulin treatment has done its work, and some measure of recovery of the islets has taken place.

OBESITY

TYPES.—There are various types of obesity, some much more amenable to treatment than others.

1. There is the *hereditary form*, which nothing seems to benefit permanently. This, however, beyond the discomfort of the extra weight which the patient has to carry, does not cause serious disability.

2. There is that form which appears to be caused by some *endocrine defect*—probably by under-secretion of the thyroid or the posterior pituitary ; that is, the deficiency of the product of some gland upsets the metabolism of carbohydrates and fats, so that they cannot be properly oxidized. In this form, the distribution of fat is not so general, but it tends to accumulate round the hips and abdomen, producing the so-called 'girdle type' of obesity. Allied to this is the type which often occurs in women at the menopause, and which is presumably due to cessation of the internal secretion of the ovaries. These types of obesity, though they may benefit by massage, require medical treatment, probably by means of gland extracts.

> N.B.—It is not at all uncommon for people with this—or any other—type of obesity, to ask their masseuses, or their friends, whether it would be a good thing for them to take thyroid extract, or some other preparation guaranteed to 'reduce' them quickly and easily. They should always be deterred from taking anything of this kind without consulting their medical adviser.

3. Finally, there is the type caused by *excess of food, insufficient exercise*, or both. This is the type which we can most successfully treat. It may occur at any age, but is commonest in middle-aged people, both men and women, who have begun to lead a less active life than they have done hitherto, and have not modified their diet accordingly. When the more physically active part of life is over, less meat and 'fuel foods' are required, while vegetable foods may be increased. At the same time, there is no reason why a man or woman who retires from his or her profession in middle life should immediately cease to take proper and sufficient physical exercise. With the lack of this generally goes a lack of fresh air, and consequently of oxygen, so that there is not enough of the latter to oxidize the fat-forming foods.

SYMPTOMS.—The patient suffers from fatigue on slight exertion, and a

feeling of weight and heaviness ; she feels the heat very much, perspires profusely, and easily becomes breathless. The condition may be complicated by a weak heart, chronic cellulitis, or varicose veins.

Treatment.—

It is necessary to distinguish, in treating these cases, between those whose hearts are sound, or who are at worst suffering from *fatty infiltration* of the heart—that is, from deposits of fat around that organ, as well as between its muscular fibres—and those who have *fatty degeneration*, which implies actual degeneracy of the fibres themselves. The latter must be treated as 'heart cases' ; they cannot really be treated for obesity at all. The former will benefit by exercise, provided that it is not excessive, and that suitable precautions are taken in each case.

GENERAL TREATMENT.—The *diet* should be prescribed by the patient's physician, and varies according to his ideas and the condition of the patient. Broadly speaking, all starchy foods, sugars, and fats, are reduced, and some are forbidden. As a rule, the patient is told to drink much water, hot or cold, especially about half-an-hour before meals. Exercise should be taken daily in the fresh air, regulated according to the patient's capabilities.

PHYSICAL TREATMENT.—The following applies to a case without heart symptoms. The patient should be weighed at least once a week, so that the operator may be able to gauge her progress.

MASSAGE.—It has been the custom in the past to rely very much on massage for the treatment of obesity—and this was entirely to the liking of many of the patients, who preferred 'having massage' to exerting themselves, or restricting their diet—even if the massage were not of a very comfortable kind ! The result was, too often, an exhausted masseuse, and a patient losing weight very slowly if at all, and promptly regaining it as soon as the massage was discontinued ! Massage, as part of the cure of obesity, has its uses ; but massage alone never brought about the desired result, and never will. It has been said that over the door of every massage department should be written : " We cure nobody here ; we help people to cure themselves." In no condition is this more applicable than in that of obesity ; the patient must help herself, or the work of the masseuse will be wasted.

If the patient's weight is to be substantially reduced, three points are of the greatest importance :—

1. She must render strict obedience to her doctor's orders as to her diet.
2. She must be willing to use her own muscles, and to work hard.
3. Massage is useful in assisting the elimination of fat stored in the superficial tissues in certain areas of the body, by *crushing* it ; therefore if the manipulations are to be of any use, they must be *vigorous*.

In some cases, a general massage is advisable ; but more often it is better to space the massage in between the exercises, treating only those parts of the body where the fat masses are found. These, in most patients, are the neck, shoulders, and sides of the thorax under the arms ; the hips and gluteal region ; and the abdomen.

Effleurage, kneading, and pétrissage (kneading and wringing) should be used, strongly, vigorously, and as deeply as possible, in quick time. In the *kneading*, the tissues are pressed forcibly against each other ; in the *wringing* they are squeezed and crushed between the operator's hands. The abdomen may be treated quite strongly. Hacking—or beating and pounding over large groups of muscles—is also given.

EXERCISES.—Three points have to be considered :—

1. The patient's need of oxygen to assist in the combustion of the body-fats.

2. The necessity of vigorous muscular work to set free energy, and break down the fat. (It should be understood that the *stored* fat cannot be forthwith oxidized. It has to be *desaturated* first—that is, it has to be carried back to the liver, where it undergoes certain chemical changes. But if the desaturated fat is burnt up quickly by exercise, there will presumably be a 'call' for fat from the storehouses to supply the requisite energy. Hence the value of exercise.)

3. The extra weight the patient has to carry, and hence the importance of avoiding unnecessary *static* work, which is of no assistance to her, and simply produces fatigue.

With regard to the first point, it is obvious that *breathing exercises* must take a large part in our treatment. They should be given not only at the beginning and end of the table, but several times during its course. Any deep breathing exercises, or such as promote interchange of gases in the lungs, are useful; and abdominal breathing is valuable, both for the purpose of obtaining full expansion of the lungs and also of increasing the work of the abdominal muscles. If the patient is inclined to become breathless during the scheme, she may take several deep breaths between each exercise.

The exercises must be vigorous, but not too numerous, especially at the beginning of the course. Resisted exercises may be given if desired, but we have to remember that the extra weight of the patient's body and limbs does constitute a resistance in itself, and moreover that the muscles are weak and hampered by fatty deposits between their fibres. Vigorous free movements of the 'pendulum' type, therefore, seem the most suitable for these cases. They should at first be given in the lying or crook-lying position, so that the whole of the body—except for the muscles actually required for the work to be done—is relaxed. Later, the sitting position may be assumed, and only at the end of the course should exercises in standing be given to any extent. Static work, as mentioned above, does no good, and merely tires the patient.

The scheme used in such a case may be arranged somewhat as follows :—

1. Breathing exercise
2. Neck and shoulder massage
3. Head exercise
4. Arm exercise
5. Breathing
6. Abdominal massage
7. Abdominal exercise
8. Breathing
9. Back exercise
10. Gluteal massage
11. Leg exercise
12. Breathing.

This scheme contains only five exercises, apart from the breathing and massage. More exercises may be added as the patient progresses, and the number of times each is performed may be increased daily.

The following are examples of suitable exercises :—

Head Exercises.—

1. Sitting (or ride sitting) Head-forward- and backward-bending.
2. ,, ,, ,, Head-side-bending.
3. ,, ,, ,, Head-rotation.
4. ,, ,, ,, Head-rolling (active).

All free, in full range, done quickly and vigorously. The patient may be in reach-grasp-sitting if desired.

Arm Exercises.—

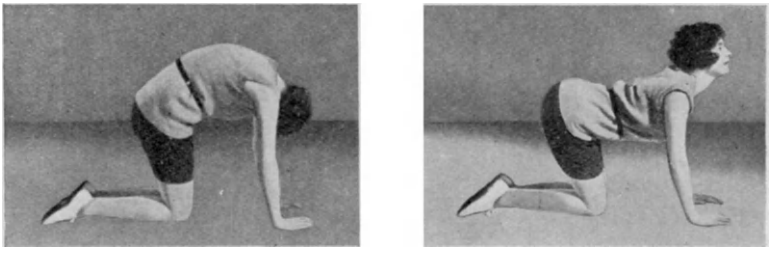
1. Lying 2-Arm-swinging upward and downward. The patient lies on a plinth, with the top of her head level with its edge, and her arms beside her body. She swings her arms from her sides straight above her head, and then brings them down again. This should be as free and relaxed a movement as possible.

2. The same exercise in sitting.
3. Sitting 2-Arm-circling, or -swinging in circles.
4. Forward-bend-ride-sitting 2-Elbow-backward-carrying (*see* p. 72).
5. Forward-bend-ride-sitting Alternate arm-flinging + trunk-rotation.
6. Sitting (later, standing) 2-Arm-bending and -stretching in all directions.

N.B.—The ride-sitting position may be taken on an ordinary chair, the patient sitting astride it and facing its back. The advantage of this position in Exercise 5 above is that the patient is more likely to keep her arms in the correct position, as she will be afraid of knocking them against the chair-back if she allows them to fall below shoulder level.

Leg Exercises.—

1. Crook-lying 2-Knee-abduction and -adduction (free).
2. As (1) resisted.
3. Crook-lying 2-Knee-abduction and -inpressing.
4. Lying Alternate knee-updrawing ('bicycling movement').
5. Half-yard-grasp-standing Leg-swinging forward and backward.
6. High-reach-grasp-standing Leg-circling (resisted).
7. High-reach-grasp-standing Leg-swinging in circles (free).
8. Reach-grasp or wing-standing Heel-raising and knee-bending.
9. 'Dancing step' (forward or sideways).



A B

Fig. 142.—'Donkey' (A, Abdominal contraction B, Lumbar contraction). (*See* text.)

Abdominal Exercises.—

1. Crook-lying Abdominal contractions.
2. Side-crook-lying Abdominal contractions.
3. On hands and knees Abdominal contractions.
4. Yard-ride-sitting Alternate trunk-rotation (free).
5. Wing-close-sitting Alternate trunk-rotation (resisted).

N.B.—Most free trunk-rotations may be used. For stronger exercises, see those at the end of the article on VISCEROPTOSIS (Chapter XXIII) But the stronger ones must be used with discretion. The strongest group of all is unsuitable except in a very few cases.

Back Exercises.—

1. Lax-stoop-stride-sitting Back-raising (concentric).
2. Knee-stoop-sitting Back-raising (concentric).
3. Sitting (or lying) Alternate side-bending.
4. Stretch-standing Forward- and downward-bending.
5. Hewing.

Combined Exercises.—

1. Sawing.

2. 'Donkey' (abdominal and lumbar contractions): The patient is on her hands and knees. She contracts her abdominal muscles, rounding her back and lowering her head. She next contracts the back muscles, hollowing the back, and carrying the head upwards and backwards. These two movements are done alternately. (*Fig.* 142.)

3. Crook-lying Abdominal, gluteal, and adductor contractions: The patient should not be allowed to *hold* the position for long.

4. Crook-lying 2-Knee-abduction and -inpressing (or adduction and outdrawing) + Pelvic-lifting.

In many cases, free *educational* exercises are suitable after the weight has been considerably reduced. Such patients will be wise to attend a gymnastic class once or twice a week after leaving off treatment, if young enough and strong enough to do so.

CHAPTER XIX

DISEASES OF THE HEART

Physiology. Diseases: I. Pericarditis. II. Disease of the endocardium: Valvular disease of the heart—Aortic disease—Mitral disease—Tricuspid insufficiency. III. Disease of the myocardium: Acute myocarditis—Myocardial degeneration. IV. Disorders of the cardiac rhythm: Disordered action of the heart.

THE heart (*myocardium*) is a hollow muscular organ, enclosed in a two-layered fibroserous sac known as the *pericardium*, and lined by a delicate membrane called *endocardium*. Any of these parts may be attacked by disease.

The anatomy of the heart, on which we have no space to dwell here, should be carefully studied by any who have to deal with such cases. In no class of diseases, except, perhaps, in affections of the nervous system, is such knowledge more essential. A few points only can be noted in this chapter.

PHYSIOLOGY.—

THE CONTRACTION OF THE HEART.—The impulse of contraction of the heart passes in a wave-like manner from base to apex. It begins in the right auricle at a point near the mouth of the superior vena cava, in a mass of specialized tissue known as the sino-auricular node. This has been called the 'pace-maker' of the heart. From here the impulse passes downwards over the walls of the auricles to a point near the coronary sinus called the auriculo-ventricular node ('A-V node'), and thence it is carried to the ventricles by way of a bundle of muscular tissue, the auriculo-ventricular bundle or bundle of His, which, running first in the ventricular septum, divides into two parts, one of which is distributed to each ventricle. If this bundle is injured or destroyed by disease, some or all of the beats of the auricles are *blocked* and do not pass on to the ventricles. We shall have occasion to refer to this later.

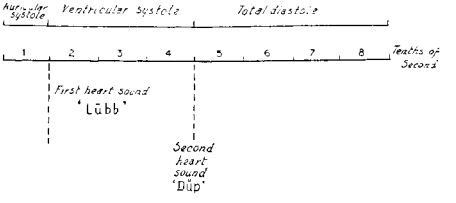


Fig. 143.—Diagram of cardiac cycle.

THE CARDIAC CYCLE AND THE ACTION OF THE VALVES.—The *cardiac cycle* is the name given to the sequence of events which takes place during a single beat of the heart. The beat occupies about $\frac{8}{10}$ of a second, and occurs about 76 times a minute. The first $\frac{1}{10}$ is occupied by the contraction of the auricles, or *auricular systole*, the next $\frac{3}{10}$ by the *ventricular systole*, and the last $\frac{4}{10}$ by the *total diastole*, or pause during which the whole heart relaxes and is at rest. (*Fig.* 143.)

1. *During the Auricular Systole* the contraction of the auricles closes the mouths of the great veins, the superior and inferior venæ cavæ, coronary sinus, and pulmonary veins, so that no blood enters the heart. At the same

time the rising pressure in the auricles forces open the auriculo-ventricular valves, tricuspid and mitral, and the blood pours through into the ventricles.

2. *During the Ventricular Systole* the auricles relax and the blood again begins to enter the heart from the great veins. The rising pressure in the contracting ventricles closes the tricuspid and mitral valves, which are prevented from being forced backwards into the auricles by the tension of the chordæ tendineæ, and opens the semilunar valves of the aorta and pulmonary artery, so that the blood is pumped into these vessels. During the ventricular systole occurs the first heart-sound (lūbb), caused by the contraction of the ventricular walls and the vibration of the chordæ tendineæ. (Disease of either of these will therefore alter the nature of this sound.)

3. *During the Total Diastole* the whole heart relaxes. The aortic and pulmonary valves close, because the pressure in the great vessels now becomes higher than that in the relaxing ventricles; and they remain closed until the beginning of the next ventricular systole, thus preventing regurgitation of the blood. The auriculo-ventricular valves open as the ventricular pressure falls, so that the blood trickles from auricles to ventricles, as well as from the open mouths of the great veins into the auricles. At the beginning of diastole takes place the second, or short, heart-sound (dŭp), caused by the closing of the aortic and pulmonary valves. This sound is altered or absent in disease of either of these valves.

Causation and Regulation of the Heart's Beat.—The heart contracts simply because it is the property of cardiac muscle to do so—that is, not as the result of impulses from the central nervous system. Its *rate of contraction*, however, is controlled by the vagus and sympathetic nerves, the former slowing the beat, the latter accelerating it. Slowing of the heart is brought about, therefore, by reflexes which stimulate the vagus centre (that is, the cells of origin of that nerve in the medulla oblongata); and quickening by stimulation of the sympathetic. The secretion of the medulla of the suprarenal glands (adrenalin) stimulates the sympathetic system, the action of these glands being increased in emergencies, especially in such as occasion the emotions of fear or anger. Among the results of this increased secretion are, therefore (1) a quickening of the rate of the heart, and (2) a raising of blood-pressure, owing to constriction of the arteries, especially in the abdominal region, the vaso-constrictors of which are supplied by sympathetic nerve fibres. The heart has therefore to work harder to drive the blood through the narrowed vessels, as well as to beat more quickly. This, if the heart is not sound, involves a risk of overstrain and failure; hence the danger of undue excitement in a patient with heart disease.

Effect of Muscular Exercise on the Heart.—When muscular exercise is taken, more blood is carried back to the heart, because the deepened respiratory movements increase the suction action of the thorax, and the pressure of the contracting muscles on the veins further assists venous return. The heart, therefore, being better filled during diastole, can pump out more blood during the ventricular systole, the cardiac muscle, like other muscles in the body, working more strongly when it has been stretched. Because the heart's impulse is more forcible, and the volume of blood pumped out is greater, the blood-pressure is raised.

The blood is taken to those parts where it is most required, i.e., to the working muscles, because, by a local reflex, the arterioles in these parts become dilated.

The work of the heart is thus increased by muscular exercise. The normal heart, however, has a certain amount of *reserve force*, upon which it is able to call in emergencies. When the need for increased blood-supply

ceases, the heart soon returns to its normal rate and strength of work. As we shall see later, the unhealthy heart may be obliged to use all its reserve force merely to maintain the circulation during rest, having then nothing left to fall back upon in emergencies. Hence a *sudden* demand upon it may produce serious or fatal results.

Diseases of the heart may be divided into: (1) *Diseases of the pericardium*: Pericarditis, acute or chronic. (2) *Diseases of the endocardium*: Endocarditis often leading to valvular disease. (3) *Diseases of the myocardium*: (*a*) Acute myocarditis; (*b*) Degeneration of the heart—(i) fatty, (ii) fibrous. There are also 'functional' conditions, of which the most important from our point of view is that known as *disordered action of the heart* (D.A.H.) or *effort syndrome.* (Syndrome = a set of symptoms.)

I. PERICARDITIS

(*Inflammation of the Pericardium*)

ETIOLOGY.—

AGE AND SEX.—People of any age may be attacked. Both sexes are liable, males rather more than females.

CAUSES.—Pericarditis only rarely occurs as a primary affection. Its most common causes are rheumatic fever, tuberculosis—which may attack the pericardium only, or involve other parts of the body as well—scarlet fever, pneumonia, or septicæmia. It may also occur in the late stages of chronic diseases, such as gout, nephritis, or diabetes.

As in pleurisy, there are two forms: (1) *Fibrinous or 'dry' pericarditis*; and (2) *Pericarditis with effusion* ('moist' pericarditis).

1. Fibrinous Pericarditis

PATHOLOGICAL CHANGES.—These are similar to those found in 'dry' pleurisy. There is no exudation of fluid, or only a small amount, within the pericardial cavity, but a deposit of fibrin takes place on the inner surfaces of the membranes, which gives them a rough or 'shaggy' appearance. There is generally, in addition, a slight myocarditis; that is, the heart muscle itself is inflamed for a little distance beneath the visceral layer of the pericardium.

SYMPTOMS.—The patient complains of *pain*, slight or severe, *over the heart*; or it may be referred to other regions of the body. There may be *cough* and *dyspnœa*. *The temperature is raised*, generally to about 103°.

COURSE AND PROGNOSIS.—'Dry' pericarditis is in itself never fatal—though the disease causing it may prove so. It may clear up entirely without damage to the membranes, clear up leaving the two layers firmly united by adhesions, or pass on to 'moist' or to chronic pericarditis.

2. Pericarditis with Effusion

PATHOLOGICAL CHANGES.—Exudation takes place freely, and may be serofibrinous, seropurulent, or purulent. When it subsides, it leaves both layers of the membrane much thickened and bound together by extensive adhesions. The heart muscle is always more or less affected.

SYMPTOMS.—These are occasioned partly by the inflammation of the pericardium and heart, and partly by the pressure exerted by the distended sac on the surrounding tissues.

There is *pain*, or at least discomfort, in the region of the heart; *dyspnœa*, partly owing to the heart's action being hampered and partly to pressure on the respiratory organs; and *restlessness*, *delirium*, or *insomnia*. *The pulse* is quick, weak, and sometimes irregular. (Osler.)

COURSE AND PROGNOSIS.—Most of the cases in which the effusion has been serofibrinous recover, though with more or less injury to the heart itself. If the effusion is purulent the patient is in great danger. Recovery is rare in the tuberculous forms, and the septic forms are almost invariably fatal. (Osler.)

Chronic Pericarditis and After-results of the Acute Forms

Osler points out that the final results of pericarditis depend on the amount of damage to the membranes, and the nature and situation of the adhesions. The weakened pericardium may no longer adequately support the heart. If the adhesions are only between the two layers of the pericardium, few symptoms may arise; but if, in addition, there are adhesions between the pericardium and the pleura or chest wall, the situation is much more serious. The heart's action is hampered, and it may become much dilated and hypertrophied. This will lead to general heart symptoms (*see* p. 308) and sometimes to very marked abdominal symptoms, similar to those present when there is primary involvement, or relative insufficiency, of the tricuspid valve (*see* p. 310).

Treatment.—

Acute pericarditis is not, of course, treated by physical means. Rest, medical treatment, and nursing only are required. In severe cases the fluid may have to be evacuated, either by drawing it out with a syringe or by opening the cavity. The operation is known as *paracentesis.*

When the patient has recovered, or the disease has become chronic: The physical treatment, in most cases, is so similar to that for degeneration of the heart muscle itself that it need not be given in detail here (*see* p. 319). It is only necessary to note that *no attempt should be made to break down adhesions between the pericardium and the chest wall*, and that therefore no strong stretching movements or vigorous tapôtement should at any time be given to the thorax. Severe cases should be treated with extreme caution.

The less serious cases, where myocardial damage may be presumed to be slight or non-existent, and where the heart is not appreciably hampered, may be dealt with on the same lines as valvular disease (*see* pp. 310–317).

II. DISEASE OF THE ENDOCARDIUM: VALVULAR DISEASE OF THE HEART

Deformity of one or more of the valves of the heart, preventing them either from opening fully, or else from closing completely.

ETIOLOGY.—The commonest causes of valvular disease are:—

1. ENDOCARDITIS, which may be the result of acute rheumatism (it is often associated with chorea); one of the diseases of childhood—measles, scarlet fever, etc.; pneumonia, or various other diseases.

2. ARTERIOSCLEROSIS; this leads to hardening of the valves, especially of the aortic valve, with curling and puckering of their segments, causing incompetence.

PATHOLOGICAL CHANGES.—

1. The endocardium is inflamed, this condition being most marked in the valves.

2. The so-called '*warty vegetations*' are small growths which appear on the auricular surface of the mitral, or on the ventricular surface of the aortic, valve. They are at first composed of little masses of fibrin and corpuscles, and are sometimes only attached to the valves by very thin stalks, so that they are

easily detached. Later, they become organized into connective tissue. They are commonest on the mitral valve; hence the greater danger of embolism in mitral disease.

3. The valves themselves may become thickened, deformed, and puckered, so that the cusps no longer meet, this state of things being known as *insufficiency*, or *incompetence*; or the edges of the cusps adhere to each other, so that the valve will not open fully, this condition being called *stenosis* (Greek, *stenos* = narrow). Stenosis and insufficiency are often combined, the valve neither opening nor closing completely.

4. The mitral valve is most frequently affected, then the aortic; both are involved in many cases. Tricuspid disease is rare, and affections of the pulmonary valve still rarer—these lesions are generally found in cases of *congenital* valvular malformation.

RESULTS OF VALVE LESIONS.—

Back Pressure.—To explain exactly what is meant by this term, it will be easiest to take a concrete example. Let us suppose the aortic valve to be incompetent. When the left ventricle relaxes after its systole, some of the blood flows back into it from the aorta. The ventricle, since it has to hold not only the blood sent on into it by the left auricle, but that which has regurgitated from the aorta, becomes over-full, and has to work harder in order to pump on this extra blood, i.e., to overcome the back pressure on it. It *dilates* in order to accommodate the increased amount of blood, and *hypertrophies* as the result of the extra work. If, however, too much strain is placed on the heart, the dilatation exceeds the hypertrophy, and owing to this excessive dilatation the auriculo-ventricular orifice becomes larger, and the cusps of the mitral valve can no longer meet across it. This is called *relative incompetence*. There is therefore a backflow of blood into the left auricle when the ventricle contracts, i.e., back pressure on the auricle. This chamber now becomes over-full. In its turn, it dilates and hypertrophies. The auricles, however, are not capable of any great degree of hypertrophy, and the dilated and engorged condition of the left auricle soon forms an obstruction to the entrance of blood from the lungs; there is therefore back pressure on the pulmonary circulation. The resulting congestion causes back pressure on the right ventricle, which, like the left ventricle at an earlier stage, dilates and hypertrophies. The same process which we noted on the left side of the heart is now repeated on the right. The tricuspid valve becomes relatively incompetent. The right auricle, capable of but little hypertrophy, dilates and becomes engorged with blood, and a condition of back pressure on the systemic circulation is set up, since the return of the blood from the body by way of the superior and inferior venæ cavæ is obstructed. This leads to serious symptoms due to venous congestion in the body, and especially in the abdominal cavity.

Compensation.—A patient with valves injured by disease may notwithstanding live long and enjoy fair health, provided that he does not subject his heart to sudden strains, or undertake violent exercise. This is because the heart muscle, if it is healthy, is able to accommodate itself to the changed conditions; in other words, to *compensate* for the valvular deficiency.

As we have already seen, the heart has a certain amount of reserve force which it does not use in the ordinary affairs of life, but is able to draw upon in times of emergency. In valvular disease, an increased amount of force is required even when the body is at rest, to drive on the blood through the narrowed opening in stenosis, or to pump out both the oncoming and the regurgitating blood in insufficiency. The heart has therefore less force in reserve for emergencies.

However, as we have seen, the increased work strengthens the heart muscle, and causes its fibres to hypertrophy. It has, therefore, actually more power than the normal heart. But, in spite of this, it has *less in reserve.* A *sudden* demand upon it will cause symptoms of exhaustion long before they would occur in the normal heart ; that is, *the compensation breaks down.* The heart of the patient with diseased valves is always much nearer to the breaking point (*Fig.* 144). It is most important to remember this in treating such cases.

It must also be borne in mind that 'compensation' is a relative term. A patient's heart may be compensated in lying, but not in sitting, in sitting but not in standing. He may be comfortable as long as he sits in a chair, but show signs of distress if he tries to walk about.

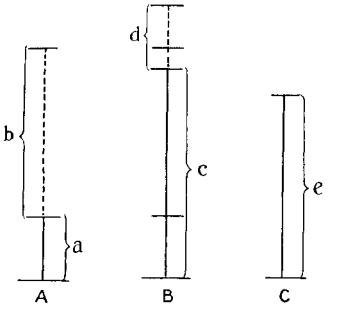


Fig. 144. — Diagram illustrating reserve force of heart. A, Normal heart : *a*, Power of work (body at rest) ; *b*, Reserve force = Accommodation-capacity. B, Heart in valvular disease in stage of compensation : *c*, Power of work (body at rest) ; *d*, Reserve-force = Accommodation-capacity. C, Heart in uncompensated valvular disease : *e*, Total power of heart less than amount needed when body is at rest—insufficiency of the heart. (*After Osler.*)

If the heart, for any reason, such as degenerative processes in the muscle fibres themselves, is *incapable of hypertrophy*, and its total strength is only just sufficient to maintain the circulation during rest, cardiac failure takes place suddenly on the least extra exertion, with fatal results.

GENERAL HEART SYMPTOMS.—The symptoms of all types of heart disease are similar. It will be most convenient, therefore, to summarize them here. Later, we shall compare the special symptoms of the various lesions.

1. Cyanosis : due to the slow circulation, a large amount of oxygen being given off to the tissues, and an extra quantity of CO_2 being collected ; this is most apparent in the face, which is high-coloured, the lips having sometimes a bluish tinge. In other cases, the skin may be pale owing to poor arterial supply to the part.

2. Œdema : also due to slow circulation, an abnormal amount of lymph being exuded from the vessels. It is most often seen in the extremities. In very severe cases, e.g., tricuspid insufficiency, there is marked œdema in the abdominal cavity. This is known as *ascites*, or dropsy.

3. Dyspnœa : owing to engorgement of the blood-vessels in the lungs, causing interference with the normal interchange of gas.

4. Pain occurs in some types of lesions, either as a dull ache in the region of the heart, or as a sharp pain radiating up to the neck, or even down the left arm (*angina pectoris*). The origin of this acute pain is uncertain, but it is probably due to involvement of the aorta.

5. Palpitation.—This consists of quick, strong, irregular beating of the heart perceptible to the patient. (Such action when *not* perceptible to the patient does not constitute palpitations.) It is due to the heart's increased efforts to drive on the blood while working at a disadvantage. It may also be purely functional in its origin.

6. The Pulse.—The character of this varies with the nature of the lesion. Hypertrophy produces a strong slow pulse. In failing compensation, the pulse becomes weak, rapid, and irregular.

7. Cerebral Symptoms.—These are generally found in aortic disease. They consist of syncope (faintness) due to anæmia of the brain ; and of mental symptoms, irritability, and depression. Cerebral hæmorrhage may occur.

8. ABDOMINAL SYMPTOMS: due to venous congestion in the abdomen: constipation, indigestion, etc.

AORTIC DISEASE

1. AORTIC INSUFFICIENCY is the most dangerous of all the valvular lesions, especially if it be the result of arteriosclerosis. In this case the coronary arteries may become involved, and blocked, and the myocardium itself may thus be deprived of its blood-supply, with fatal results.

2. AORTIC STENOSIS is rare, and is often combined with a certain degree of incompetence. It is a less serious condition than aortic insufficiency.

COMPENSATION.—In *aortic insufficiency*, some of the blood which has been pumped by the left ventricle into the aorta regurgitates through the incompetent valve when the ventricle ceases to contract. Therefore, less blood is pumped out into the body under a lower pressure, and the arterial circulation throughout the body becomes deficient.

Compensation in *aortic insufficiency* is brought about by dilatation and hypertrophy of the left ventricle, enabling it to hold the increased amount of blood, and to pump out this blood with sufficient force to maintain the circulation in its normal condition. The cardiac hypertrophy is greater in aortic insufficiency than in any other valvular lesion. Compensation in *aortic stenosis* is brought about in the same way, but the dilatation and hypertrophy are not so great.

SYMPTOMS.—In aortic disease, the symptoms are caused by *poor arterial supply* to all parts of the body; the whole of the systemic circulation is affected, the symptoms being therefore those of anæmia. The pulmonary circulation, however, does not suffer, unless the mitral valve is also involved. The symptoms are more marked in regurgitation than in stenosis. The most important are:—

1. *Pallor*, seen in the face, due to poor blood-supply.

2. *Pain* in the region of the heart is a frequent and early symptom, probably due to involvement of the aorta itself. Angina pectoris is common in these patients.

3. *Palpitations.*

4. *Œdema* is not marked, and only occurs late in the course of the disease.

5. *Dyspnœa* is less troublesome than in mitral disease, as are all the pulmonary symptoms.

6. *Cerebral Symptoms* are marked; headache, faintness, and giddiness occur. The patient often sleeps badly, or suffers from actual insomnia. He is often irritable and depressed.

7. *Abdominal Symptoms*, if present, are slight.

Sudden death is common in aortic insufficiency, from angina pectoris, syncope, or cerebral hæmorrhage, the frequency of the last being due to arteriosclerosis of the vessels of the brain.

MITRAL DISEASE

Mitral insufficiency may be the result of disease of the valve itself, or it may be a *relative insufficiency*, due to extreme dilatation of the left ventricle. Stenosis and incompetence often coexist.

COMPENSATION.—In mitral insufficiency, when the left ventricle begins to contract, some of the blood regurgitates through the mitral valve into the left auricle. This cavity becomes over-full, having to hold both incoming blood from the lungs and regurgitated blood from the ventricle, and therefore it dilates and hypertrophies. It is now able to drive on this increased volume

of blood into the left ventricle, and this cavity, therefore, also dilates in order to accommodate it, and hypertrophies in order to drive it on into the aorta, and thus the systemic circulation is kept normal in spite of the fact that some blood passes back into the left auricle.

Meanwhile, the distension of the left auricle obstructs the return of the blood through the pulmonary veins, producing venous congestion in the lungs. In order to overcome this back pressure, the right ventricle also dilates and hypertrophies.

Compensation is therefore established by : (*a*) Dilatation and hypertrophy of the left auricle ; (*b*) Dilatation and hypertrophy of the left ventricle ; (*c*) Dilatation and hypertrophy of the right ventricle.

In *mitral stenosis*, the changes are similar, but the left ventricle does not hypertrophy, since the left auricle, though itself distended, can only force on the blood very slowly through the narrowed opening into the ventricle.

If the right ventricle fails to compensate the lesion, the tricuspid valve becomes relatively incompetent.

SYMPTOMS.—The symptoms in mitral lesions depend, not on poor arterial supply, but on *venous congestion*, appearing first in the pulmonary vessels, and then in the systemic. The principal are as follows :—

1. *Cyanosis*, specially noticeable in the face (*see* GENERAL HEART SYMPTOMS, p. 308).

2. *Palpitations.*

3. *The Pulse*, in advanced cases, may be very irregular.

4. *Œdema*, especially of the extremities, is marked, owing to the slowed circulation throughout the body. Ascites may follow later.

5. *Dyspnœa* is a very marked feature, owing to the congestion of the lungs. The patient may cough, and hæmoptysis (hæmorrhage from the lungs) is not uncommon.

6. *Cerebral Symptoms* are not marked.

7. *Abdominal Symptoms* are much in evidence, because of the back pressure on the systemic and portal circulation.

8. *Emboli* are common in mitral disease. They may reach the brain and cause hemiplegia, or may lodge in one of the coronary arteries, so endangering life.

Sudden death is rare in mitral lesions. It may occur as the result of an embolus, but generally the heart gives out gradually.

TRICUSPID INSUFFICIENCY

Tricuspid insufficiency cannot be compensated for long, as the right auricle is incapable of much hypertrophy. When this auricle gives out there is back pressure on the whole of the systemic circulation.

SYMPTOMS.—These are similar to those of the late stages of mitral disease : extreme *cyanosis* ; marked *œdema* ; *ascites* ; great *dyspnœa* ; and serious *abdominal derangement.*

Treatment of Valvular Disease

GENERAL TREATMENT.—

STAGE OF BROKEN COMPENSATION.—The patient remains in bed, propped up with pillows if he has difficulty in breathing, otherwise lying flat ; he is kept on a milk diet.

WHEN COMPENSATION IS ESTABLISHED.—The patient must lead a quiet and regular life, without worry or over-exertion, must take exercise in proportion to his strength, and follow carefully any directions given by his doctor with

regard to diet or other matters. Very hot baths are dangerous. Excessive smoking is also injurious. The patient should live in a good climate, but not at too high an altitude, and should not expose himself unnecessarily to infection, e.g., of influenza.

PHYSICAL TREATMENT.—

PRINCIPLES.—In treating any case of organic heart disease, three great principles have always to be kept in mind.* They form our chief aims of treatment :

1. *The heart must be rested and relieved* as much as possible. This is most essential, especially in the early stages of treatment.

2. *The supply of oxygen to the body must be increased.* The patient, with his embarrassed breathing, is not able to take in enough oxygen, or to breathe out enough carbon dioxide, the interchange of gases in the lungs being also deficient owing to the congested condition of these organs. Unless this state of things can be remedied, all the metabolic processes will be adversely affected, and all the tissues of the body, including the heart muscle itself, will become weak. This has to be kept in mind at all stages of treatment.

3. *Hypertrophy, as we have seen, is Nature's compensation. This must be helped on* by suitably graduated exercises, so that little by little the heart's strength is increased.

The three principles enumerated above may be applied as follows :—

1. RELIEF OF THE HEART.—To bring about this result, we shall endeavour to decrease the peripheral resistance in the vessels by assisting venous return to the heart. This may be done by :—

a. Massage and Passive Movements.—The former should be rhythmic and rather slow. Effleurage, and kneading with the palms of one or both hands, are the best movements. The limbs are treated, and sometimes the back, but abdominal massage is contra-indicated in the early stages because, although it improves the portal circulation, it causes so great an inflow of blood to the right side of the heart that that organ is obliged to work much harder than usual, and the blood-pressure is raised. It would therefore impose more strain on the weakened muscle instead of assisting it, and in cases complicated by arteriosclerosis, there would be the added risk of cerebral hæmorrhage.

b. Breathing Exercises.—These help venous return by increasing the pressure changes in the thorax (*see* p. 353). Inspiratory and expiratory exercises may be given ; but *forced* respiratory movements must be avoided, since they too raise blood-pressure and strain the heart. In mitral disease especially, the patient should not breathe too deeply, because to do so would increase the congestion in the already engorged lungs. Most workers prefer to instruct the patient to breathe freely in his own time, without commands, seeing that he breathes deeply, but not too deeply. Others give careful assisted exercises to command (Arvedson), such as Half-lying Chest-lift-shaking or -stroking. In this case, it is important that no pressure should be exerted over the heart. The gymnast must content herself with careful vibrations.

The massage and breathing exercises may also be of value at an early stage in reducing any œdema that may still be present.

2. INCREASE OF OXYGEN SUPPLY.—This also will be brought about by means of breathing exercises. Vibrations over the thorax are said to assist the interchange of gases in the lungs ; at a later stage, gentle chest-clapping or back-hacking may be added.

3. PRODUCTION OF HYPERTROPHY.—Hypertrophy, as we have seen, is

* *See* Arvedson, *Notes on Diseases treated by Medical Gymnastics and Massage.*

brought about by *graduated active exercises*. The gymnast has need of all her skill and judgement if the case is to progress uninterruptedly to a successful conclusion. She has to give the heart just enough work to strengthen it, but not enough to cause another breakdown. The progression is to be steady but gradual. If at any time it becomes evident that the patient has attempted too much, the amount of active work must be reduced for the time being.

When beginning a course of exercises for a patient whose heart is compensated in lying or half-lying, we shall at first give movements of the wrists, feet, and ankles only. Each movement will be given about six times on the day of its introduction, and increased by one or two each day. We shall then proceed to movements of the knee and elbow, daily increasing the number of times they are to be performed, and later to those of hip and shoulder. The effect on the patient is carefully watched. Then easy trunk exercises are added, provided that they are such as do not hamper the breathing, as concentric back-raisings and free trunk-rotations. All these are suitable for the patient while still in bed. When the doctor allows him to get up, he will begin to practise walking, starting with a walk of a few yards only and increasing the distance daily. After this, he goes on to harder exercises, always keeping in mind the necessity for *gradual* progress.

In order to know whether the patient is doing enough, but not too much active work, we have to observe carefully its effect on (1) his respiration, (2) his pulse, and (3) his general appearance.

1. *Respiration.*—The exercise should be hard enough to increase slightly both the range and rate of the breathing, but the patient should not be made breathless. The respiration should have returned to its normal rate during the second minute after exercise (Hunt).

2. *Pulse.*—This is our principal test. As to how much it is permissible to raise the pulse, the late Dr. Hunt,* of Guy's Hospital, gives the following figures :

1. In early cases, *at the beginning of treatment*, the pulse should not be raised more than 6 beats by any exercise.
2. After 10 *days* treatment, it should not be raised more than 8–14 beats.
3. After 3 *weeks*, not more than 12–16 beats.
4. After *the patient gets up*, not more than 16–20 beats.

In any case, the pulse should have returned, or almost returned, to its *resting* rate, that is, to what it was before the exercise began, at the end of two minutes.

At this stage (when the patient is up), Dr. Hunt used what he called the '*pulse ratio*' to test the patient's capacity for work. A certain exercise in the scheme—the hardest—is chosen. The patient's pulse is taken before beginning it. Immediately on its completion, the pulse is counted for two consecutive minutes. The pulse after exercise is then divided by the 'resting' pulse, the result being the 'pulse ratio', e.g. :—

Pulse before exercise			80
Pulse after exercise :—First minute	100		
Second minute	85		
	185		
Ratio = 185 ÷ 80 = 2·3			
Pulse before exercise			80
Pulse after exercise :—First minute	105		
Second minute	90		
	195		
Ratio = 195 ÷ 80 = 2·4			

* *Guy's Hospital Reports.*

The ratio in valvular disease should not as a rule exceed 2·3 at this stage, and in muscular disease 2·1. If it is used at a slightly earlier stage of valvular disease, it is safer not to let the ratio be above 2·2.

A ratio of 2·3 means, roughly, that the pulse is not raised more than about 20 beats, and has returned to its resting rate, or within a few beats of it, by the end of two minutes.

3. *General Appearance.*—Obviously, no pain or distress ought to be caused. This should never occur if the pulse and respiration are carefully studied.

Record of Observations and Progression.—

1. *Of Work Done.*—The importance of keeping an accurate record of the progress of these patients cannot be over-emphasized. The exercises performed should be noted down, with the number of times each was done, and the amount of resistance, if any. Later, the distance the patient has walked, and at what rate, will be entered. Unless this record is carefully kept, a proper graduation of the exercises is impossible.

2. *Of the Pulse-rate.*—The pulse at the beginning and at the end of the whole series of exercises should be recorded. The hardest exercise in the table constitutes the test of the patient's ability to do active work. The pulse is taken for one minute before it is begun, and immediately after its termination he is placed in a relaxed position, and the pulse counted for two minutes. The pulse ratio is taken, in the manner described above, and recorded (*see* specimen of record). In earlier cases the pulse may simply be taken during the first quarter of a minute after exercise, and multiplied by 4. By comparing the result with the resting pulse, we may ascertain as nearly as possible the exact number of beats it has been raised by the exercise, e.g. :—

Pulse before exercise = 90
Pulse during first quarter-minute after exercise = 25
25 × 4 = 100
Pulse is therefore raised 10 beats by exercise.

All these facts must be written down at once, or they will certainly be forgotten by the next day. Any remarks concerning the respiration, the general condition, etc., may be added if necessary. If this chart be conscientiously kept, the gymnast has ready to hand a complete record of her patient's progress, on which she may base her future treatment.

Detail of Treatment.—

Early Stage

The patient is in bed, compensation established in half-lying.

1. When treating the patient for the first time, *look at his chart*, and notice the average speed of the pulse. *The chart should always be consulted before treatment*, so that any general alteration in the pulse-rate may be observed. (The gymnast need not allow herself to be alarmed by sudden *isolated* rises of the rate, as there is often a perfectly natural explanation—as a rule, the patient has been agitated, startled, or suddenly waked from sleep.)

2. *Take the pulse, and record it.* Put the patient at his ease as far as possible before doing so, as if he is nervous his pulse will quicken. After placing the fingers on his wrist allow half a minute or a minute to elapse before beginning to count. These points are specially important at a first treatment, or until the patient is used to the masseuse. At the same time, note the respiration rate. Pulse and respiration will be taken again at the end of the treatment. Until active work is added, it should be the same as, or lower than it was, at the beginning.

N.B.—In many cases, especially if the pulse is irregular, it is best to take it over the apex of the heart, and not at the wrist.

EXAMPLE (TEST EXERCISE IN ITALICS)

EARLY STAGE (e.g., after 12 days' treatment)

DATE	ARM EXERCISE	NO. OF TIMES	LEG EXERCISE	NO. OF TIMES	PULSE		PULSE AS REGARDS TEST EXERCISE		REMARKS
					Before Treatment	After Treatment	Before	First ¼ min. after	
March 16th	2-*Arm-bending and -stretching outwards*	8	Alternate knee-bending and -stretching	10	90	86	90	100	

LATER STAGE

DATE	ARM EXERCISE	NO. OF TIMES	LEG EXERCISE	NO. OF TIMES	PULSE		PULSE AS REGARDS TEST EXERCISE			REMARKS
					Before Treatment	After Treatment	Before	During 2 min. after	Ratio	
May 3rd	2-*Arm-bending and -stretching upwards*	10 times a min. for 3 mins.	Alternate knee-updrawing	12 times a min. for 3 mins.	86	82	84	190	2·2	
May 4th	2-*Arm-bending and -stretching upwards*	12 times a min. for 3 mins.	Alternate knee-updrawing	14 times a min. for 3 mins.	84	80	82	190	2·3	

3. At first the scheme of treatment consists only of massage, passive movements, and breathing. Early treatment should be very short—not lasting for more than fifteen minutes at most.

Scheme.—

1. Half-lying Breathing.
2. ,, 2-Arm-kneading + (passive) wrist-rolling.
3. ,, Breathing. (Omit in mitral lesions.)
4. ,, 2-Leg-kneading + (passive) Foot-rolling.
5. ,, Breathing.

Progression.—Gradually substitute passive movements to elbow and knee for wrist- and foot-rolling.

As the patient improves—generally in a few days, or after a somewhat longer period if progress is slow—active movements are added, beginning with those of small joints.

Scheme.—

1. Half-lying Deep breathing.
2. ,, 2-Arm-kneading + (active) wrist-bending and -stretching (6 times).
3. Half-lying Deep breathing.
4. ,, 2-Leg-kneading + (active) Foot-bending and -stretching (6 times).
5. Half-lying Deep breathing.

Progression.—Add to the amount of work done in the following ways :—

1. *Increase the number of times each movement is to be performed* (one more each day). When the patient is stronger the movements may be done *at a certain rate*, which is also increased daily. For instance, 2-Arm-bending and -stretching upward and downward may be done so many times a minute for two minutes. Let us suppose the patient performs the movement 6 times a minute for 2 minutes, and continues until he can do 16 times a minute (32 times in all). He may then try, say, 12 times a minute for 3 minutes (i.e., 36 times in all). (This is, of course, a fairly advanced exercise, and will probably be the 'test' exercise for some time, i.e., the pulse will be taken before and after it, and the result compared.)

2. *Let the movements be performed in larger joints*, e.g., add successively exercises for the elbow and knee, for the hip and shoulder, and for the trunk. A new movement should never be done more than 6 times at first in the case of extremity exercises, or 3 times in that of trunk exercises. Do not alter both the arm and leg exercises for harder ones on the same day.

3. *Resisted exercises may, in part, replace the free ones.* The resistance may be given by the operator, or, in certain arm exercises, the patient may hold small weights in his hands, first 1 lb., then 2 lb. When resistance is added, the number of times the movement is performed is reduced, and gradually increased again, e.g., if he has been doing 2-Arm-bending and -stretching upward 15 times a minute for 3 minutes, free, and he is now made to hold a 1-lb. weight in each hand, he will go back to 6 times a minute for 3 minutes. If his pulse rises unduly, the work will be even further reduced.

Schemes performed at different stages might be somewhat as follows :—

Scheme I.—

1. Half-lying Deep breathing.
2. ,, 2-Leg-kneading.
3. Crook-half-lying Alternate knee-bending and -stretching (6 times; increase daily).

4. Half-lying Deep breathing (or vibrations over thorax).
5. ,, 2-Arm-kneading.
6. ,, Alternate elbow-bending and -stretching (8 times; increase daily).
7. Half-lying Deep breathing.

N.B.—In Exercise 3, the thighs should be supported by a cushion.

Scheme II.—

1. Half-lying Deep breathing.
2. ,, Leg-kneading.
3. ,, Alternate knee-updrawing (free) (6 times; increase).
4. ,, Deep breathing (or gentle chest-clapping).
5. ,, 2-Arm-kneading.
6. ,, 2-*Arm-bending and -stretching outward and downward* (6 *times*).*
7. ,, Deep breathing.

Scheme III.—

1. Half-lying Deep breathing.
2. ,, 2-Leg-kneading.
3. ,, Alternate knee-updrawing (14 times a minute for 2 minutes).
4. ,, Deep breathing.
5. Sitting Alternate trunk-rotation (free) (3 times each way).
6. Half-lying 2-Arm-kneading.
7. *Sitting* 2-*Arm-bending and -stretching upward and downward* (6 *times a minute for* 2 *minutes*).*
8. Half-lying Deep breathing.

Scheme IV.—

1. Half-lying Deep breathing.
2. ,, 2-Leg-kneading.
3. ,, Alternate knee-updrawing (12 times a minute for 3 minutes).
4. Sitting (on edge of bed) Alternate trunk-rotation (6 times each way).
5. Half-lying Deep breathing.
6. Sitting Back-raising (4 times).
7. Half-lying 2-Arm-kneading.
8. ,, 2-*Arm-bending and -stretching upward and downward* (8 *times a minute for* 3 *minutes*).* †
9. Half-lying Deep breathing.

Later Stages

The patient is now allowed up.

Walking Exercise may now take the place of the leg exercise, the patient's daily walk being regulated in some definite way. For instance, in a private house, he may walk once across the room and back; in a hospital ward, as far as the end of the bed next to his own and back; the next day the exercise may be 'two bed-lengths'; later, half the length of the ward, etc. The same method will be used when he comes to the gymnasium or treatment room.

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* 'Test' exercise.

† Some workers declare that, in a heart case, the arms should never be raised above shoulder level, and would therefore strongly disapprove of this exercise. The author can only say that in the many cases she has seen treated, she has never known of any untoward results produced by it, nor has she heard of any such. After all, a patient suffering from valvular disease can hardly go through the rest of his life without ever raising his arms above shoulder level. Obviously, the exercise ought not to be allowed until a fairly advanced stage of the course; but provided that it is introduced at the proper time, and that its effects on pulse and respiration are watched, there can be no real objection to its use.

After a little time, he might be doing such a scheme as the following :—

1. Half-lying Deep breathing.
2. Wing-sitting Head-rotation.
3. *Walking* (*length specified*). *Progress by increasing distance and rate.**
4. Half-lying Deep breathing, with outward rotation of arms.
5. Wing-close-sitting Alternate trunk-rotation (resisted).
6. Wing-stoop-stride-sitting Back-raising.

Rest.

7. Sitting 2-Arm-bending and -stretching upward and downward (8 times a minute for 3 minutes with 1-lb. weight. Progress.)
8. Half-lying Deep breathing.

Massage may at this stage be discontinued.

'*Stepping*' is the final test exercise suggested by Dr. Hunt. A small platform or stool about twelve inches high is provided, and the patient steps up on to it and off again (backwards) a given number of times, beginning with 6 times a minute for 3 minutes. The pulse is taken before and immediately after the exercise, and the ratio calculated in the usual way. The exercise must be stopped at once if the patient shows signs of becoming breathless. Those unused to this method are often surprised to find that a 'heart case', after some practice, can step on and off that stool considerably quicker without getting breathless than they can themselves !

By this time the patient will probably be almost ready for discharge. (The course of treatment, in most cases, lasts some months.) Younger men or women may sometimes join a general gymnastic class, if such is available in hospital ; an ordinary educational class might not be suitable.

Some patients suffer from periodical break-down of compensation, generally as the result of overwork. These may require a rest and a course of graduated exercises at intervals.

III. DISEASE OF THE MYOCARDIUM

Affections of the myocardium consist of states of : (1) *Acute inflammation* and (2) *Chronic degeneration.*

THE ACUTE FORM: ACUTE MYOCARDITIS

ETIOLOGY.—Inflammation of the heart muscle is generally the result of acute rheumatism (rheumatic fever), diphtheria, typhoid fever, or influenza ; or the inflammation may begin in the pericardium and spread inwards to the heart itself.

PATHOLOGICAL CHANGES.—The changes are those of inflammation. The heart is weakened, and may become very much dilated.

SYMPTOMS.—*See* GENERAL HEART SYMPTOMS (p. 308). The symptoms in these cases vary in intensity. In a severe case there may be a *very weak and irregular pulse. The temperature*, of course, *is raised* as long as the inflammation persists. If the endocardium has also suffered and the valves are injured, a damaged heart muscle is a serious hindrance to the establishment of compensation.

Syncope (fainting) is common during the convalescent stage.

Treatment.—

The first two great principles of heart treatment are applicable in this form of heart trouble as in valvular disease (*see* p. 311). *The heart must be*

* 'Test' exercise.

rested, and *the oxygen intake increased*. With regard to the third, *the production of hypertrophy*, the principle still holds good, but the method of its application needs modification, because we are not now dealing with a healthy, though exhausted, musculature, but with one that has recently been the seat of an acute inflammatory process, and can therefore stand no strain at all. In the majority of cases, moreover, the heart has suffered some permanent damage, and hence cannot hypertrophy to the same extent as could a normal muscle. We shall indeed begin, at the proper time, to work up the strength of the organ, but we shall have to proceed with the utmost caution, since over-work may lead to disaster. These cases, especially those which are the result of acute rheumatism in children or young people, are much more difficult to deal with than the valvular lesions, and a satisfactory result is much less certain. *They should only be undertaken by experienced workers in close co-operation with the physician.* A recently qualified worker, with little or no experience of heart treatment, ought not to attempt these cases. If she wishes to do so, she should avail herself of the opportunities offered by some of the hospitals for studying this form of treatment. Otherwise—unless the physician merely orders massage alone—she assumes a grave responsibility.

EARLY STAGE.—It *may* be possible to begin treatment 4 to 6 weeks after the onset of the attack. If so, the treatment should consist *only* of massage and passive movements. The latter must be *really* passive—that is, the patient must be completely relaxed. Unless he is, the movements will amount to eccentric active movements, and will be dangerous. If he cannot relax, massage alone is the safest form of treatment (Hunt).

ACTIVE MOVEMENTS.—It is entirely for the physician in charge of the case to decide when these shall be begun. In slight cases, they may be allowed six weeks after the onset of the attack; in severe cases, not for three to four months, or even longer. Dr. Hunt* tells us that they are contra-indicated if there is the least rise of the patient's temperature—even to 99°—or the slightest increase of the pulse-rate above normal, since should either of these take place, it would be an indication that the inflammatory process still continued. Since we can rarely be certain of what *is* the normal pulse-rate for any particular person, he considers that it is better not to give active movements if the pulse is over 80.

The movements will, of course, be given only to wrists and ankles at first. The pulse should be taken even after such small movements as these. It should not be raised more than 4 beats in the early stages, or 6 beats later, and *never* more than 8 beats (Dr. Hunt).

PROGRESSION.—This will be on the same lines as for valvular disease, but it must be *very much slower*. A similar record should be kept (*see* p. 313). The patient's chart must be studied, and if there is any rise of temperature or general increase in pulse-rate, active work must cease until the doctor has been consulted. It will probably have to be reduced or omitted for a time. These cases rarely improve steadily without any set-backs.

THE CHRONIC FORMS: MYOCARDIAL DEGENERATION

CAUSES OF DEGENERATIVE CHANGES.—

1. The chief cause is a narrowing or blocking of one of the coronary arteries, or of a large branch of one of them, this being generally due to arteriosclerosis at the beginning of the aorta. That part of the heart which is supplied by the obstructed branch degenerates and dies.

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* *Guy's Hospital Reports* and Lecture in *C.S.M.M.G. Journal*, 1920.

2. Acute myocarditis, the chronic condition following upon the acute attack.
3. Certain poisons, alcohol, phosphorus, etc.
4. Anæmia.
5. Overstrain of the heart, due to long-continued over-exertion or to anything which raises the peripheral resistance and so gives the heart harder work, e.g., arteriosclerosis, or obstruction of the passage of the blood through the lungs, as in emphysema, mitral disease, etc.

There are various forms of degeneration, the best known types being (1) the *fatty*, (2) the *fibrous*.

1. Fatty Degeneration

PATHOLOGICAL CHANGES.—This condition must not be confused with *fatty infiltration*, which is often present in obese persons, and consists of deposits of fat *between* the muscle fibres, which are themselves intact. The action of the heart may be thereby seriously hampered.

In *fatty degeneration*, fat is actually present *in* the fibres themselves, which degenerate. The right ventricle is generally most affected. The heart may be dilated.

SYMPTOMS.—Elderly people are most often the sufferers. The symptoms are ill-defined. *The extremities may be cold*, and the patient may easily become *breathless*. *Faintness*, or attacks resembling epilepsy or angina pectoris, may occur. *The pulse* is slow and sometimes irregular. The patient may die suddenly without having previously manifested any symptoms at all (Osler).

2. Fibrous Degeneration

PATHOLOGICAL CHANGES.—The left ventricle is most often affected, because this form is generally caused by obstruction of the anterior coronary artery, which supplies this part of the heart. The muscle fibres degenerate and are replaced by connective (non-contractile) tissue. The heart is often hypertrophied.

SYMPTOMS.—The onset is generally gradual. There is *pronounced dyspnœa, slight cyanosis, œdema of the feet.* The patient dies of cardiac failure, sudden or gradual.

Treatment of Myocardial Degeneration

The *principles of treatment* are the same as in other cases of heart disease. But in the case of the third principle, the extent of its possible application is even more restricted. We are not even dealing with a muscle which has been inflamed, but in which some definite degree of improvement may be expected, but with an unhealthy muscle in which the degenerative changes are probably still proceeding. In addition to this, our patients are often elderly people, and in these, naturally, the recuperative powers are not so good as in youth or middle age. Still, many derive benefit from physical treatment. Our aim is to increase the strength of any healthy fibres which remain.

MASSAGE AND PASSIVE MOVEMENTS may, of course, be employed. Abdominal massage is best avoided, unless specially ordered for constipation, in which case it must be of the gentlest description. The limbs and back receive effleurage and kneading, and passive movements are given carefully, beginning with the small joints. In an advanced case, hip and shoulder movements would not be given for some time, and then not in full range, e.g., the hip would not be fully flexed on the abdomen.

ACTIVE MOVEMENTS.—Arvedson and others forbid any active movements at all in these cases. But it is obvious that no patient, however serious may be the condition of his heart, is going to lie absolutely still in bed for weeks or months, without ever moving a finger. Moreover, these people, though they will always be in danger, do not necessarily spend the remainder of their lives in bed. Many of them improve sufficiently to be able to get up, walk about, and resume a limited activity. If they are to do this, surely their own unregulated efforts are more dangerous than the carefully graduated exercises arranged for them by a skilled gymnast. There is a risk either way, but it has to be taken if the patient's life is to be worth living.

The active exercises, of course, must be even easier than those given for the 'rheumatic heart', especially in old people, who are particularly liable to fatal syncopal attacks.

ARM EXERCISES.—We shall probably do well in most cases never to advance beyond 2-Arm-bending and -stretching outward and downward, and to avoid the *upward* movement. No shoulder movement should be performed more than 4 to 6 times running, quite slowly. Resisted movements, or the holding of weights in the hands, should not be allowed.

LEG EXERCISES.—The patient may progress as far as slow Alternate leg-updrawing (free), which is far easier work than walking. No resisted movements are given.

TRUNK EXERCISES.—Back-raisings and trunk-rotations may be added in due course.

WALKING.—This must be undertaken with the utmost caution. It is enough for the patient simply to stand for a few seconds on the first day.

BREATHING EXERCISES.—In such cases, these should certainly be done *freely* by the patient, without commands.

A *careful record should* be kept as in other heart cases. The *pulse* should never be raised more than 6 beats at most.

NOTES.—

1. In *all* organic heart lesions under physical treatment, the patient, and especially his relatives, should be warned of the danger of his condition—and this not only in fairness to him and to them, but also to the gymnast who treats the case. The friends should fully realize the *possibility* of a sudden collapse; otherwise the gymnast may be unjustly blamed should such a thing occur. Important in any form of heart disease, this is doubly important in cases of myocardial degeneration. A fatal syncopal attack might just as easily take place during or after a treatment as at any other time. It is not, of course, the duty of the gymnast to inform the relatives, but she will be wise to make sure that they have been so informed.

2. In treating a private case, the gymnast should ask the doctor to explain to the patient and his friends that they must be prepared for a long course of treatment, extending perhaps over months. Otherwise, they are liable to become impatient at the slowness of the progress made, and worry the gymnast with questions or complaints: "How much longer will this have to go on?" "He seems to get on so slowly", and so forth. If this continues, the gymnast is assailed by an almost irresistible temptation to try and hurry things—to advance just a little quicker than is wise or safe. To this she must on no account yield. It is better to throw up the case altogether.

IV. DISORDERS OF THE CARDIAC RHYTHM

Various disorders of the heart's rhythm occur in cases of muscular disease, or in valvular disease in which the heart muscle is to some extent involved. They produce an *intermittent* or *irregular* pulse. These disorders arise either

because : (1) The impulses of contraction, instead of beginning in an orderly manner from the sino-auricular node (*see* p. 303) start at other parts of the auricles as well (owing to disease of their walls) in very rapid succession, and sometimes at irregular intervals ; or (2) Because the bundle of His fails partially or completely to carry the impulses of contraction from auricles to ventricles. Both these factors may be present together. The auricles may beat very rapidly, but all the impulses may not get through to the ventricle, so that the pulse-rate in some cases may not be unduly quickened, though if the auricles are beating irregularly, so will the ventricles, unless the impulses are not getting through at all. We have not space here to describe these anomalies, interesting as they are. A full description of them may be found in Wheeler's *Handbook of Medicine* or in Osler's *Principles and Practice of Medicine*, and in other medical works.

Other disorders of the heart's rhythm, however, are *functional* in origin —that is, not due to any actual disease.

DISORDERED ACTION OF THE HEART (D.A.H.)

(*Effort Syndrome. Functional Heart. Soldier's Heart*)

This is not a disease, but a 'syndrome', or set of symptoms, no signs of organic heart trouble being discoverable.

ETIOLOGY.—

1. The disorder occurs in men, women, and sometimes in children. It came prominently into notice during the war, when it acquired the name of 'soldier's heart', a somewhat misleading term, soldiers being by no means the only sufferers. The patients are generally subnormal physically, sometimes of poor muscular development, and unaccustomed to hard physical work or strenuous athletics. If they are suddenly called upon to undertake such exertions, the symptoms appear. The explanation of the break-down is obscure. We can only say that the patient's general physical make-up is such as to enable him to lead a life of ordinary activity without inconvenience, but is inadequate to meet any call for excessive exertion or endurance.

2. Infection, however, may be at the root of the trouble. Tonsillitis, influenza, rheumatic fever, or some septic focus in the body may be responsible, and if the infection be removed, the symptoms disappear. Shock or disturbance of the nervous system may be a factor in their development.

SYMPTOMS.—The most marked symptoms are *palpitations*, *dyspnœa*, and *præcordial pain*—all produced by exertion. *The pulse-rate* is greatly increased (160–180) by exercise, and returns very slowly to the normal after its cessation. *Faintness* and *giddiness* are not unusual. There may be *vasomotor symptoms*—coldness of the extremities or profuse perspiration. The patient is weak, easily tired, and sometimes nervous and irritable.

Treatment.—

Any known cause will be suitably treated, and any focus of infection eliminated—e.g., by removal of infected teeth, tonsils, etc.

PSYCHOLOGICAL TREATMENT.—*Explanation of his condition to the patient.* He will be assured by his doctor that he is *not* a victim of 'heart disease'—which to the general public suggests sudden death, or, at best, a life of invalidism. It is most important that he should realize that he is in no danger, and that his heart is sound ; and having realized this it is well for him to forget that organ as completely as he can. He should, of course, be examined by a physician in whom he has entire confidence.

GENERAL TREATMENT.—The requisite amount of rest and exercise will

be prescribed by the doctor. The patient may be sent away for a change of air or a holiday. Smoking and alcohol may be forbidden. Good hygiene is essential.

PHYSICAL TREATMENT.—The aim is to improve the patient's general health. To this end we shall make use of graduated exercises, which may be more strenuous than in organic heart troubles. The amount of work to be done may be increased quickly, and there is little danger of overstrain. The difficulty is, sometimes, to persuade him to do enough.

RESPIRATION AND PULSE.—The patient may be made short of breath, provided that he does not suffer actual distress. The respiration should have returned to normal after two minutes of rest.

The pulse-rate should have fallen below 100 two minutes after leaving off exercise.

> N.B.—At the same time, it is a mistake to indulge in too much pulse-taking in these cases, as it tends to direct the patient's attention continually towards his heart and its vagaries.

Massage and passive movements are not required.

EXERCISES.—It is usually quite unnecessary to begin with movements of small joints only. The progress at first will be on the same lines as for the valvular cases, but the patient may advance much more quickly. He will probably begin with Sitting 2-Arm-bending and -stretching outward and downwards, and Lying Alternate leg-updrawing, as arm and leg exercises respectively, the trunk movements being added as soon as possible, and several breathing exercises being included in each scheme.

Later Stages.—When the patient is able to come to the gymnasium or treatment room, he may have ordinary Swedish remedial or free exercises, as well as walking exercise, gradually increased as to rate and distance, and followed by running, skipping, etc. Later, he may join a class of educational gymnastics, if one is available.

'Stepping' (*see* p. 317) may be retained as a test of progress if desired.

Some patients are sent by their doctors for a holiday, with instructions to increase the amount of exercise taken each day.

CHAPTER XX

DISEASES OF BLOOD AND LYMPH-VESSELS

I. Diseases of the arteries: Arteriosclerosis—Aneurysm—Raynaud's disease—Chilblains.
II. Diseases of the veins: Phlebitis—Thrombosis—Varicose veins—Hæmorrhoids.
III. Obstruction of lymphatics: Œdema.

MANY of these conditions are not, in themselves, suitable for treatment by physical means. We are merely concerned with them because they may be present in patients who require treatment for injuries, deformities, or other disabilities, and certain precautions must be observed in such cases.

I. DISEASES OF THE ARTERIES

ARTERIOSCLEROSIS

(*Atheroma*)

A condition of chronic inflammation of the innermost coat of the arteries, leading to degeneration, and spreading to the two outer coats.

ETIOLOGY.—Hardening of the vessels is always present to some extent in old age, as the result of the wear and tear of the arteries during life; but it may supervene in middle-age from various pathological causes. (1) Hereditary predisposition. (2) Very laborious occupations, which cause continual strain on the arteries, by keeping the blood-pressure high. (3) Any other conditions producing high blood-pressure, e.g., poisoning by lead or alcohol, which brings about changes in the blood which make it flow less easily through the vessels; gout, kidney disease, over-eating, too much nitrogenous food, etc. (Osler).

ANATOMY.—It will be remembered that arteries have three coats: the *tunica adventitia*, or outer coat of connective tissue; the *tunica media*, or muscular coat, composed of unstriated muscle fibres running circularly round the vessel; and the *tunica intima*, or inner coat, formed of epithelial cells. The tunica media is thick and strong in the arteries, whereas it is thin in the veins. The structure of each set of vessels is otherwise similar.

PATHOLOGY.—The larger arteries are most often affected, especially the aorta. This is because the blood-pressure is higher in these than in the smaller vessels. White patches appear on the tunica intima. These either soften or become hard and brittle, lime salts being deposited in them. The tunica media is next involved, and its muscular fibres atrophy; the tunica adventitia is thickened. Veins as well as arteries sometimes become sclerotic.

SYMPTOMS.—*Superficial arteries* (e.g., the radial), if affected, may be felt to be *hard and thickened*, even when the pulse is obliterated by pressure. The *blood-pressure* is high and the *pulse* tense.

The *heart*.—The left ventricle is hypertrophied, because of the hard work entailed in pumping blood through the unyielding arteries. *Sclerosis of the coronary arteries* (cardiosclerosis) may lead to angina pectoris, to sudden death from thrombosis, or to fibrous degeneration of the heart. If dilatation takes

the place of hypertrophy, owing to failure of the reserve force (*see* pp. 307, 308) the symptoms will be similar to those of valvular disease.

RESULTS.—As the result of arteriosclerosis, there may also be : (1) Aneurysm (*see below*), especially in the arch of the aorta ; (2) Thrombosis, due to clotting of the blood over the degenerate patches on the arterial wall ; (3) Rupture of an artery from some trivial cause, as a slight blow or injury, or a sudden rise of blood-pressure, e.g., as in cerebral hæmorrhage.

PROGNOSIS.—If it is due to some disease which is now cured, if the process is not advancing, and if other organs are sound, little inconvenience will ensue. If the degenerative process is continuing and the heart and kidneys are involved, the prognosis is bad.

Treatment.—

GENERAL TREATMENT.—The patient should live a quiet life, taking gentle exercise, but avoiding overstrain of any kind. He should eat simple food, and not too much of it. Alcohol is not allowed. Care should be taken to prevent constipation, and the action of the skin should be promoted by daily baths, since it is important that all toxins which might further irritate the vessel walls should be removed from the system.

PRECAUTIONS.—Arteriosclerotic patients requiring massage or exercises for any other disability should be treated with great caution. Slight cases are unlikely to come to harm, but even in them over-exertion is to be avoided. Exercises must be very carefully chosen, and nothing be attempted which would raise the blood-pressure to any extent. The pulse must be taken before and after exercise, and should not be raised more than 10–15 beats. The severer cases should be treated as for myocardial degeneration.

ANEURYSM

An aneurysm consists of a dilatation of the wall of an artery, forming a sac in communication with that vessel.

ETIOLOGY.—

AGE AND SEX.—Aneurysm is most common in men between the ages of 30 and 45. It occurs most frequently in those who follow laborious occupations.

CAUSES.—The most usual causes are the acute infections, the specific fevers, and syphilis ; also overstrain.

PATHOLOGY.—The vessel wall is weakened ; in some kinds of aneurysm the two inner coats rupture altogether.

VESSELS AFFECTED.—The vessels affected are generally the large arteries, or those near the joints where they are subjected to constant bending (Hey Groves). The thoracic aorta is the most often affected of all the vessels.

COURSE AND PROGNOSIS.—The prognosis depends on which artery is implicated. It is bad as a rule in the case of the thoracic aorta. Rupture of the aneurysm or pressure on some vital organ or nerve (e.g., vagus or phrenic) may cause death. The patient may live for many years, but is always in danger. Spontaneous recovery occasionally takes place, either because the aneurysm presses on the artery and occludes it altogether, and this, in a small vessel, leads to cure, the blood passing through the vessels of the collateral circulation ; or because clotting takes place within the sac, and the clot becomes organized, the aneurysm remaining as a mere fibrous body on the arterial wall.

SYMPTOMS.—These depend on which artery is implicated. For example, *in aneurysm of the thoracic aorta*, the symptoms are caused by pressure on the structures in the neighbourhood of the tumour, and vary according to its exact position. We may, therefore, find such symptoms as :—

Intense pain (pressure on the vertebræ or chest wall); or *paraplegia.*

Angina (involvement of the beginning of the aorta and the coronary arteries).

Œdema of the arm (pressure on the subclavian vein or superior vena cava).

Cough, dyspnœa, loss of voice (pressure on the respiratory organs, or on the nerves that supply them).

Difficulty in swallowing (pressure on the œsophagus), etc.

Treatment.—

GENERAL TREATMENT.—The following are the main points in the *early stages.*

1. Absolute rest in bed.

2. Special diet: as little food as possible, and especially very little liquid, since fluids increase the volume of the blood and so raise blood-pressure.

3. Prevention of constipation, since any straining might be fatal.

The patient will receive appropriate medical treatment.

Later.—The patient must live a quiet life, without excitement or over-exertion of any kind.

SURGICAL TREATMENT.—Operations are sometimes undertaken to induce clotting in the sac.

PHYSICAL TREATMENT.—Arvedson recommends treatment of cases of aortic aneurysm by physical methods, though it must be rarely indeed that such a case is ordered treatment of this kind. Our aim would be to relieve the heart by assisting venous return, without doing anything that could possibly raise blood-pressure.

Treatment will therefore be the same as that for muscular disease of the heart (*see* p. 319). Half-lying Chest-lift-stroking or -shaking, and Back-hacking, however light, though recommended by Arvedson, are surely not worth the risk, at all events at an early stage. Since the aneurysm often tends to erode the vertebræ, it would surely be unwise to give percussion near the spine.

RAYNAUD'S DISEASE

A disease of the circulatory system probably due to spasm of the muscular fibres of the superficial arteries in certain parts of the body. This spasm causes constriction of the vessels, and hence deficient blood-supply to the part affected.

ETIOLOGY.—The condition is probably due to some irritation of the vaso-motor centre in the medulla. The cause is unknown, but the patients are generally of a neurotic type. The disease may follow one of the specific fevers. It is more common in women than in men, and generally appears in young people or in early middle life.

SYMPTOMS.—

1. Local Syncope.—This resembles the condition brought about by intense cold. It most often affects the fingers, but the toes, lobes of the ear, or tip of the nose may also suffer. The parts affected become white and 'dead'. Sensory changes, such as tingling, or dulling of sensation, occur. The attack may last from a few minutes to several hours. Pain and tingling accompany the return of the circulation to normal.

2. Local Asphyxia.—Similar areas become congested, and are blue, or even black, in colour. If the finger is pressed upon the part, a white mark appears, which disappears slowly after the pressure is released (Purves-Stewart). There is swelling, stiffness, pain (worse than in syncope), or, later, anæsthesia. There is almost complete stasis in the part.

The two conditions may occur in the same person, or only one variety may appear. Either may end in—

3. Local (Symmetrical) Gangrene.—This is, as a rule, limited to a small part of the area affected by syncope or asphyxia. It varies in severity from a mere peeling of the skin, or a blister which bursts and leaves an ulcer, to necrosis of finger or toe bones, though the latter is rare.

Treatment (between attacks).—

GENERAL TREATMENT.—The patient's general health needs attention. There should be no overwork or mental worry. Good food, fresh air, sufficient sleep, and some regular occupation are necessary, as in all cases with a neurotic tendency.

PHYSICAL TREATMENT.—Massage of a light, stimulating, but not too stimulating, type may be tried, also passive and active movements, all for the purpose of improving the circulation. Radiant heat is sometimes useful, but of course must not be applied during a syncopal attack.

ELECTRICAL TREATMENT.—Galvanic or sinusoidal baths, or other forms of electrical treatment, are recommended.

CHILBLAINS

Inflammation of the superficial tissues, generally those of the hands or feet. The toes, and sometimes the heels, as well as the fingers, frequently suffer, and occasionally the ears or even the nose.

CAUSES AND PATHOLOGY.—The cause of this troublesome affection is obscure. It is commonly ascribed to 'bad circulation', but since chilblains are so common in children and young people, many of them in robust health, and with their circulation apparently satisfactory, there must surely be some other cause. There may be a deficiency of some substance in the blood; or again, the condition may possibly amount to a slight degree of Raynaud's disease, cold having the effect of producing spasm of the muscles of the arterial walls, which results later in a reaction producing the congestion which is so marked a feature of chilblains.

SYMPTOMS.—The part is *red and congested*; at first, *irritation* is intense; later, *pain* may follow. Chilblains on the heels may make walking almost impossible, the pressure of the shoe on the inflamed part causing intense pain. If the part is not adequately protected, the skin over the chilblain may break.

Treatment.—

GENERAL TREATMENT.—Warm clothing should be worn, and all tight garments avoided. Active exercise should be taken in the open air.

PHYSICAL TREATMENT.—

Massage.—This should be given to the whole of the affected limb as for Raynaud's disease, with careful finger-kneadings to the affected parts.

Exercises.—A general table may be given, or simply extremity exercises, especially movements for hands and feet. Vigorous free exercises of the educational type are best, with marching, running, and skipping. Dancing is excellent, provided it is of a kind which entails plenty of movement and activity.

Electrical Treatment.—High frequency, the sinusoidal bath, or other forms of electrical treatment are often used.

A *broken chilblain* should be dressed with ointment spread on lint. Finger-kneadings should be given round it. The hands of the masseuse should be surgically clean.

II. DISEASES OF THE VEINS

PHLEBITIS

Inflammation of the wall of a vein.

CAUSES.—

1. Injury of the vessel; pressure exerted upon it either by tumours in its course, or by constriction due to tight garters or other garments.
2. Varicose veins (*see* p. 330).
3. Inflammatory or septic cases arise by extension of infection from tissues round the vein, e.g., from septic wounds.
4. Sometimes no definite cause can be found.

PATHOLOGICAL CHANGES.—The inflammation may involve only the tunica intima, or may spread to the tunica media and adventitia as well. In simple cases a clot forms, which becomes organized (*see* THROMBOSIS). The inflammation may even spread to surrounding tissues, and an abscess may form (Hey Groves).

SYMPTOMS.—Phlebitis is most common *in the veins of the leg*, e.g., in the femoral vein. *Pain is felt in the line of the vein*, with a hard, cord-like swelling. In the case of a superficial vein, the skin over it is *dark in colour and œdematous*.

If the large deep main vessels of a limb are affected, there is much lymphatic obstruction, the slowed venous circulation involving a greatly increased exudation of lymph. An *œdema* similar to that described as following the removal of the axillary glands will make its appearance. *The superficial veins may be seen to be increased in size*, in order to carry on the collateral circulation, and so compensate for the block. In septic cases *abscesses* may develop round the inflamed vessel.

General symptoms: The patient has fever and shivering fits; these symptoms are more pronounced in infective cases.

Treatment.—

The treatment of phlebitis is so similar to that of thrombosis that the two will be considered together (*see below*).

THROMBOSIS

Blocking of a vein by the formation of a blood-clot.

CAUSES.—

1. Injuries to the vessels; e.g., in fractures, or through compression by forming callus.
2. Phlebitis; or extension of inflammation from surrounding structures.
3. Degeneration of the vessel walls; varicose veins.
4. Any conditions that produce abnormal slowing of the circulation: anæmia, debility, heart or lung disease.

PATHOLOGICAL CHANGES.—If there is an inflamed area on the vessel wall, it acts as a source of irritation, like a foreign body, and fibrin is deposited upon it by the blood, a clot being thus formed. If the circulation is very slow, the blood sometimes becomes stagnant behind the valve cusps and clots there, especially if the vein is dilated and the valves do not close. The clot may completely fill up the lumen of the vein, preventing any flow of blood through it.

Thrombosis may terminate by:—

1. RESOLUTION.—The clot may be removed by the leucocytes, in which case the circulation through the vessel again becomes normal. This rarely happens.

2. ORGANIZATION.—New connective tissue is laid down, until the clot becomes a fibrous mass, completely blocking the vein. New blood-vessels, however, grow into the fibrous clot, and to a certain extent re-establish the circulation by forming passages through it.

3. EMBOLISM.—The thrombus, or part of it, may become detached from the vessel wall, and carried away by the blood-stream. This free body circulating in the blood is known as an *embolus*, and is a source of considerable danger.

4. DISINTEGRATION.—The thrombus—generally a septic one—may dissolve and be carried away by the blood, spreading infection through the body. Abscesses may form elsewhere, or the patient may die of *pyæmia* (general poisoning).

THE COLLATERAL CIRCULATION.—It must be realized that even should a main vein be completely blocked, the circulation is not entirely stopped in that area. If that were so, the arterial circulation would also cease, no new blood could reach the part, and gangrene would set in. This does not happen because the branches of veins anastomose very freely, so that the blood is able to return to the heart by way of these branch veins, which form what is known as the *collateral circulation.*

SYMPTOMS.—*A definite tender point* can be felt at the site of the thrombus. The patient complains of *pain resembling cramp* in the surrounding tissues. There is great *swelling* in the part below the thrombus, and the power of moving the limb is thus much impaired. *Marked enlargement of the collateral veins* can be observed. The patient's temperature may rise.

EMBOLISM.—Emboli may be *simple* or *infective.* The amount of damage that can be done by an embolus depends on its nature, and on the position in which it finally lodges. If it occludes an artery which forms the only blood-supply of an important organ, the results are likely to be fatal, since the part thus deprived of its blood-supply degenerates and dies. A septic embolus causes the formation of an abscess in the area where it lodges.

The most usual situations in which an embolus may lodge and give rise to serious danger are :—

1. The *pulmonary artery* (causing sudden death because all outflow from the right side of the heart is stopped).

2. One of the *coronary arteries*, also causing sudden death, as these are 'end-arteries', that is, they do not anastomose with other arteries, or to any extent with each other, so that that part of the heart which is deprived of its blood-supply is unable to work at all.

3. The *brain*, generally in the middle cerebral artery. Softening of the area supplied follows, with resulting hemiplegia (*see* p. 115).

4. One of the *vessels of the lung*, causing pain, dyspnœa, or hæmoptysis.

Treatment of Phlebitis and Thrombosis

GENERAL TREATMENT.—The patient is kept in bed for at least six weeks, with the limb raised. Belladonna applications are used to relieve pain.

SURGICAL TREATMENT.—In recurrent cases of phlebitis in superficial veins, the latter are sometimes excised.

PHYSICAL TREATMENT.—Our aim in both phlebitis and thrombosis is to assist the return of the blood to the heart by way of the collateral circulation. We have always, however, to bear in mind two points : (1) *In phlebitis, the danger of clot formation.* (2) *In thrombosis, that of dislodging an imperfectly organized thrombus*, and so setting free an embolus which may bring about a serious, or even a fatal, result.

We must remember, therefore :—

1. That in a *case of phlebitis, nothing must be done which could possibly increase the inflammation.* The condition must not, of course, be treated during the acute stage, and the area of the diseased vein should always be given a wide berth.

2. That if in any patient who is being treated by massage, e.g., one with a fracture, a case of anæmia, or a woman after childbirth, *any of the symptoms of thrombosis should arise, the treatment must be immediately discontinued,* and the matter reported to the doctor, the patient being in the meantime instructed to remain in bed, and keep as quiet as possible. This should be done if the masseuse has even a suspicion of the formation of a thrombus—she should not wait to be sure. No one wants to trouble the doctor unnecessarily, but the responsibility of neglecting to send for him in a case of this kind is one no masseuse should assume.

3. That, in cases where a clot has formed, *no treatment must be given until it is firmly organized.* It is for the doctor to decide when this has taken place. If the thrombus has been of the infective variety, the treatment must be deferred for a still longer period.

Dr. Mennell considers that in aseptic thrombosis, massage may be given carefully about four weeks after the symptoms have ceased to spread, and active movements two weeks later ; while in septic thrombosis massage should not be begun for at least two months, massage of the whole limb not taking place till the fourth month.* Less experienced workers will be wise to postpone the beginning of treatment for another week or ten days in all these cases.

METHOD OF TREATMENT.—

THROMBOSIS.—Since our purpose is the assistance of venous and lymphatic circulation, the most useful manipulation of all will be effleurage.

We shall begin lightly, carefully avoiding the area of the vein in which the organized clot is situated ; that is, we shall carry our stroking round, but not over, it. If the thrombus is situated in one of the deep veins of the leg, e.g., in the posterior tibial vein, we shall be able to massage the thigh, and also the front and outer side of the leg. If the femoral vein is affected, we must avoid the inner side of the thigh, especially Scarpa's triangle, or if the popliteal vein, the popliteal space.

A few days later, gentle kneadings may be added, and in two to three weeks, careful active movements. These will assist venous return by exerting pressure on the vessels, but since such pressure must of necessity fall on the affected vein as well as on the others, it is not wise to permit these movements until all possibility of embolism has disappeared.

In old-standing cases, where a *firmly organized* thrombus is giving rise to lymphatic congestion and severe œdema, the effleurage and kneading must be given *deeply and firmly*, as described on page 333. The position of the patient before and during treatment should be the same as that for varicose veins (*see below*).

The patient, when allowed to walk, should begin by doing a very little at a time. We must not forget that the lack of exercise will predispose to weakness and eversion of the foot.

PHLEBITIS.—Similar treatment is given, the only difference being in the date chosen for its commencement. This, however, is so entirely a matter for the physician to decide in each individual case, that it is impossible to dogmatize on the subject. The area of the inflamed vein should be given a very wide berth.

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* *Principles and Practice of Massage.*

PHLEGMASIA ALBA DOLENS

(*See* Chapter XXIII, p. 412)

VARICOSE VEINS

A condition in which the veins become dilated, lengthened, and tortuous, with incompetent valves.

CAUSES.—

1. Heredity is sometimes a factor.

2. Occupations necessitating constant *standing*, as those of nurses, shop-assistants, etc., predispose to this condition. The veins are continually over-distended, because the force of gravity tends to keep the blood in the lower parts of the body. In *walking*, the pressure of the muscles on the vessels, and the deepened respiration, causing increased changes of pressure in the thorax, help venous return, and so prevent this congestion.

3. Anything therefore which hinders respiration or limits its range will for the same reason predispose to the disease.

4. Any condition which raises pressure in the abdomen and so impedes the return of blood from the legs, e.g., pregnancy or tumours, will have the same effect; also tight corsets or garters.

PATHOLOGICAL CHANGES.—

1. The saphenous veins are most often affected. The veins of the rectum also suffer (hæmorrhoids).

2. The veins dilate and lengthen, owing to the increased pressure of blood in them. They become twisted, and because of the dilatation, the valves are drawn apart, and become incompetent. A vicious circle is set up, the ineffectual valves permitting regurgitation, and the increased amount of blood thus left in the veins still further dilating them and drawing the valve-cusps still farther apart.

3. The walls of the veins degenerate, and the muscular coat atrophies, while the outer coat is hypertrophied.

SYMPTOMS.—The patient complains of *pain*, *aching*, and *fatigue* in the legs; sometimes also of *gastrocnemius cramp* (*see* p. 191), if the dilated veins lie deeply among the muscles. The *appearance* of the veins is as described above.

There is *congestion* in the limb, due to the engorgement of the dilated veins; also *œdema*, because the pressure in the capillaries is abnormally high, on account of the increased resistance in the veins, so that there is greater exudation of lymph.

COMPLICATIONS.—

1. Eczema, panniculitis, and varicose ulcers occur in neglected cases. The latter heal slowly or not at all.

2. Thrombosis or phlebitis (*see* p. 327).

3. Rupture of a varicose vein; hæmorrhage.

Treatment.—

GENERAL TREATMENT.—

1. Rest.—Periods of rest are required, the patient being recumbent, with the legs raised. If his occupation puts too much strain on him, he should change it, if possible.

2. Support.—When the patient is up, elastic stockings or crêpe bandages are generally advised. These should be put on before the patient rises in the morning, and not removed until he goes to bed at night.

PHYSICAL TREATMENT.—

Position of Patient.—Lying or half-lying, the legs being well raised.

The bandage should not be removed until the patient has been placed in this position, and it should be reapplied before he rises. If possible, he may be left thus for about half an hour before treatment, so that the return of the blood and lymph from the legs may be assisted by gravity.

MASSAGE.—It is rarely that a patient comes for treatment for varicose veins alone. We more often have to take them into account when dealing with other ailments. Our aim, as in phlebitis and thrombosis, is to help the collateral circulation. The author does not personally consider it wise to carry the manipulations *over* the affected veins if lying superficially, though some workers do so, but only *above* and *around* them. A varicose vein may quite easily become inflamed, or a thrombus may form, and it certainly is not worth while to risk such an accident.

If, for instance, the short saphenous vein be affected, effleurage and kneading may be given to the thigh, kneading in the area of the anterior tibial group of muscles, and careful effleurage alongside, but not over, the dilated vessel. Vibrations are sometimes recommended. In severe cases, it is better not to treat the lower leg at all.

EXERCISES.—These are a much more satisfactory form of treatment. Anything which helps venous return will be useful.

1. *Breathing Exercises* should be used freely.

2. *Passive Movements*, such as Foot-rolling, Knee-bending and -stretching, Leg-rolling, and Trunk-rolling may be given, quickly, but not too vigorously.

3. *Active Movements* for all joints of the lower limb should be practised, in lying or half-lying. Few exercises should be given in standing; if they are given at all in this position, the patient should be wearing his bandages. In the slighter cases, however, dancing exercises, or such as entail constant use of the muscles of the legs and feet, are useful; but the patient must not stand about between exercises.

SURGICAL TREATMENT.—*Severe cases*, or those in which it is essential that the patient should be able to continue an occupation involving much standing, may be treated by operation, which consists of removal of the offending veins. Other cases are now treated by certain kinds of injections.

EMERGENCY TREATMENT OF A BURST VARICOSE VEIN.—Rupture of a varicose vein may take place as the result of a slight injury, the weakened walls giving way easily, or by erosion of the wall by an ulcer. The hæmorrhage may be very severe, and measures must be taken to stop it at once. The blood escapes from both the proximal and distal ends of the vein, the incompetent valves being unable to prevent regurgitation.

Should such an accident occur, the patient is to be placed in the lying position with the limb well raised. The operator's thumb should be pressed firmly on the wound. A pad consisting of a handkerchief folded up tightly, or several thicknesses of linen wrapped round a cork or similar object should then be placed on the wound, and bandaged firmly into position. If this does not stop the bleeding, narrow bandages should be applied to the limb both above and below the site of the injury. The patient should remain in this position until the arrival of the doctor.

HÆMORRHOIDS

(Piles)

This name is given to varicose veins in the region of the rectum and anus.

ETIOLOGY.—Hæmorrhoids occur most often in young men, in pregnant women, or in people who lead a sedentary life.

CAUSES.—Heredity appears to be a factor. Hæmorrhoids are caused by

anything which raises the blood-pressure in the veins of the portal system—portal congestion, tumours in the pelvis, pregnancy, diseases of the liver, heart, lungs, or kidneys, chronic constipation, etc.

Hæmorrhoids may be external or internal—that is, they may be outside the anal sphincter beneath the skin, or inside the sphincter beneath the mucous membrane.

SYMPTOMS.—In *appearance* the hæmorrhoids are bluish lumps, soft as a rule; hardness and tenderness indicate thrombosis. *External piles* cause irritation and pain; those situated *internally* cause severer symptoms. There is *pain and aching after defæcation*, and often bleeding. Either variety may be complicated by *inflammation*, *suppuration*, or *thrombosis*. Internal piles may lead to *prolapse of the rectum*, that is, to a slipping down of part of the rectal mucous membrane through the anus to the exterior, or to *anal fissure*, i.e., cracks in the anal mucous membrane between the piles. This, if present, causes sharp pain after defæcation.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—

1. The patient should at all costs avoid constipation; to this end he should take plenty of exercise, and should follow any instructions the doctor may give him as to diet or medicines.

2. As regards local treatment, special ointments are required.

SURGICAL TREATMENT.—

1. OPERATIVE.—External hæmorrhoids are not as a rule treated by operation; internal ones are removed or ligatured.

2. INJECTIONS of certain substances into the distended veins are sometimes given.

PHYSICAL TREATMENT.—The aims of treatment are:—

1. To improve the circulation generally, especially the portal circulation, assisting venous return from the abdomen and pelvis; also to deplete these regions as much as possible, by causing the blood to flow elsewhere; that is, to the muscles in other parts of the body.

2. To prevent constipation.

METHOD OF TREATMENT.—A scheme of vigorous general exercises, free, resisted, or both, is best for these patients, especially if they lead sedentary lives. Special attention should be paid to the following points:—

1. *Exercises for constipation* should always be included, but they must not be such as replete the abdomen or pelvis. Such movements as the following are suitable: (1) All trunk-rotations, in neutral or depletive positions. (2) Crook-half-lying or crook-side-lying Abdominal contractions. (3) Crook-half-lying (with raised pelvis) Alternate pelvic-rotation. (4) Wing-high-ride-stoop-sitting Trunk-backward-drawing to the vertical. (5) Half-lying Leg-rolling with an upward jerk (Arvedson). Or other exercises from the lists in Chapter XXIII may be chosen, always provided they are not repletive.

2. *Trunk movements to improve portal circulation.* Back-raisings, side-bendings, trunk-rotations, trunk-rollings (passive or active), etc. Many 'straight' abdominal exercises tend to be repletive; if so, they should be avoided.

3. *Deep breathing exercises* are valuable in assisting venous return to the heart.

4. *Definitely depletive exercises* should also be given: e.g., such as employ the arm and back muscles, or the glutei; or exercises in stoop positions and crook-sitting positions which compress the abdominal cavity. (The latter, however, are open to the objection that they raise the pressure in the *abdomen*,

and may thus prevent return of blood from the *pelvis*.) Arm and head exercises may be given in crook-lying or forward-lying, since in these positions gravity will not oppose the venous circulation.

III OBSTRUCTION OF LYMPHATICS: ŒDEMA

All 'swelling' is œdema, since the latter consists of the presence of an excessive amount of lymph in some part of the body, whether this arises, as in inflammatory processes, from a slowing or stasis of the blood circulation, so that more fluid is exuded from the capillaries than would normally be the case, or from obstruction of the lymphatic vessels or glands, so that the exuded fluid cannot escape from the part.

Œdema due to venous stasis has been considered in connection with the special conditions in which it arises. We have now to consider those œdematous states which are due to actual damage to, or interference with, the function of lymphatic vessels or glands. The commonest condition of this kind is the intense œdema of the arm after removal of cancerous lymph-glands in the axilla.

Œdema of the Arm after Removal of the Axillary Glands in Cases of Carcinoma of the Breast

Carcinoma (cancer) of the breast generally occurs in middle-aged women. It begins in the mammary gland, spreads to skin, fascia, and muscles in the chest, and later to the lymph-glands, first to the axillary set, and later to the cervical and mediastinal glands. Ultimately, more remote parts of the body may become involved.

Treatment.—

SURGICAL TREATMENT.—The operation consists of removal of the mammary gland, with part of the pectoralis major and of the skin and fascia of the chest; and also of the axillary glands on the affected side.

Post-operative Condition.—The removal of the axillary glands has destroyed most of the channels by which the lymph returns from the arm. There is, therefore, an intense lymphatic congestion, which causes the arm to be much swollen, hard, tender, and painful. The joints are stiff, and movement impossible. There may also be swelling over the front of the chest and the back of the shoulder. The œdema persists until the lymph has forced new channels for itself through the axilla to the subclavian glands, or if these also have been removed, to the thoracic or right lymphatic duct.

PHYSICAL TREATMENT.—Our aim, therefore, is to force on the lymph, so as not only to relieve congestion in the arm for the time being, but also to help in the formation of the new paths by raising the pressure in the lymphatic vessels.

Position of Patient.—The patient should be lying down, with the arm supported on pillows, and so raised that gravity may assist the lymphatic flow. It is a good plan for the patient to lie with the arm thus raised for fifteen to twenty minutes before the treatment is begun.

Massage.—The most important manipulation is *slow deep effleurage*. This should be begun at the upper part of the arm, so as to empty the lymphatics in that area. The part immediately below this should next be treated, to press the lymph on into the vessels above which have already been cleared, after which a return should be made to this upper region. The masseuse should work on this principle all down the arm, forearm, and hand. The arm will be considerably reduced in size by the end of the treatment, but the masseuse must not be disappointed to find it as bad as ever next day—and indeed for many days.

Kneading, slow and deep, should be tried next, and *frictions* should be given round the joints, and on the muscles themselves in old cases where the swelling is very hard.

Similar manipulations are used if the swelling is also present over the patient's chest, back, and side. The effleurage must follow accurately the direction of the lymphatics in these parts.

MOVEMENTS.—As soon as possible, gentle *passive movements* are added after the massage, to increase the venous and lymphatic flow, and prevent permanent stiffness in the joints. As the condition improves, gentle *active movements* may be given.

LATER TREATMENT.—In these cases, when the œdema has finally subsided, and the circulation is normal, passive movements and active exercises will have to be given to stretch adhesions and regain the movements of the arm. The stretching must be carried out gradually and not too forcibly, and the active exercises must be chosen so as not to produce too violent a drag on the tissues. The patient may begin with 'crawling up the wall', arm-swinging exercises, and 2-Arm-bending and -stretching. *If there is the least sign of a return of the swelling or pain, all treatment must cease until the surgeon has seen the patient.* Recurrence of the original trouble is unfortunately not uncommon, even after several years. It is also wise to seek advice before attempting massage in the immediate neighbourhood of the scar.

CHAPTER XXI

BLOOD DISEASES

Anæmia: Chlorosis—Pernicious anæmia. Plethora. Hæmophilia. Purpura.

ANÆMIA

ANÆMIA is a condition due either to a diminution of the total quantity of blood in the body, or to a deficiency in its quality. It may be divided into two classes, *primary* and *secondary* anæmias.

1. Secondary anæmia occurs as the result of some other disease or injury—hæmorrhage; starvation, whether from inability to obtain food, or inability to swallow or assimilate it, because of some affection of the alimentary tract; infections—typhoid fever or malaria; poisoning, e.g., by lead; and various other causes. The treatment is that of the cause, and we have no further concern with it here.

2. Primary anæmia includes two distinct forms: (*a*) Chlorosis; and (*b*) Pernicious anæmia.

CHLOROSIS

This is the condition generally known as 'anæmia'. It occurs in young girls, the exact cause being much in dispute.

ETIOLOGY.—

AGE AND SEX.—Girls, of the age ot 14 to 21, are generally the victims, though the trouble may occur later.

PREDISPOSING CAUSES.—The disease attacks most often those who are overworked and underfed, especially girls who come from the country to the towns to work in shops or factories, or to engage in any other occupation which entails long hours, and allows of little time for fresh air or exercise. These girls are often badly fed, taking hasty and ill-chosen meals in short intervals between their hours of work. The richer classes, however, are not immune.

THE ACTUAL CAUSE is unknown. Apparently the bodily development which takes place in women at this time of life calls for an increased amount of blood; and, in some, the blood-forming organs—especially the bone-marrow, the source of the red corpuscles—are unequal to their task. Chlorosis is much less common than it was, presumably owing to the fact that in these days women lead more natural and healthy lives, and wear more sensible clothes.

PATHOLOGY.—It will be remembered that in the blood are found *red* and *colourless* corpuscles, the former containing *hæmoglobin*. This is a substance that combines readily with oxygen, which it takes up while the blood is passing through the capillaries of the lungs, and gives off to the tissues of the body. Hæmoglobin is composed of two substances: *hæmatin*, which contains iron, and *globin*, a protein substance. The hæmatin is the oxygen carrier of the blood, and its power to carry the gas depends on the presence of *iron*.

The average number of red corpuscles contained in one cubic millimetre of normal blood is 5,000,000 in a man and 4,500,000 in a woman. In chlorosis the amount of blood in the body is not diminished, nor is there much reduction

in the actual number of red corpuscles, but the hæmoglobin contained in each corpuscle is decreased by more than half. The body, therefore, suffers both from lack of oxygen and lack of iron. Metabolism is on this account gravely disturbed both on the constructive and on the destructive side. Nutrition is impaired, and energy is not set free.

SYMPTOMS.—These are many and varied.

1. The patient *loses her spirits*, becomes languid, easily tired, sometimes irritable and difficult. She suffers from general muscular weakness; and muscle inflammation may develop, especially in the back.

2. Her *complexion* becomes pale, and of a peculiar greenish tinge—hence the old name for this affection, 'the green-sickness'. The mucous membranes e.g., the lips and inner linings of the eyelids, are pale in colour. The patient does not grow thin, but generally puts on weight. This is due to deficiency of oxygen, the fats and carbohydrates not being burnt up.

3. Often *heart symptoms* are in evidence, the patient suffering from palpitations, dyspnœa, or faintness after slight exertion. These symptoms are due to *muscular weakness*, but not to *disease* of the heart. She may indeed suffer from mitral incompetence, caused by dilatation of the heart (*see* pp. 307, 309). The hands and feet are often cold, and there may be œdema of the ankles, due to the slow circulation. Thrombosis sometimes occurs, usually in the femoral vein.

4. *Gastric symptoms.* Dyspepsia and constipation are common, and the appetite is uncertain. Gastric ulcer is a possible complication.

5. Occasionally *fever*, *headache*, and *neuralgia* may be present.

6. *Disturbances of menstruation.* This function may be suspended for a time; in some cases excessive hæmorrhage may occur.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—Rest—in bed, at first, in severe cases—fresh air, properly regulated exercise, and good food are all necessary. Girls should not study for a time, and should live a quiet, unexciting life till their health improves. The chief medical remedy is the administration of iron.

PHYSICAL TREATMENT.—The aims of treatment are as follows:—

1. Since most of the symptoms are produced by disturbances of nutrition and metabolism due to oxygen deficiency, our first aim must be *to increase the intake of oxygen.* We have also, if possible, to stimulate the bone-marrow, and so increase the formation of red cells.

2. We also aim at *strengthening the patient's muscles*, both voluntary and involuntary (that is, the skeletal muscles, the heart, and the unstriated muscles of the alimentary tract); thus improving the circulation and digestion, and the nutrition of the whole body.

3. *The nervous system* must be soothed or stimulated as required.

4. *Complications*, e.g., constipation, gastritis, etc., must receive consideration. The menstrual disturbances generally right themselves (*see* p. 404).

Early Stage

(The patient in bed for the whole or part of the day.) At this stage the patient is best treated by a general massage only, for a few days at least. The manipulations, in most cases, should be light, brisk, and stimulating; never deep or heavy. An excitable or irritable patient will require more soothing treatment for a time.

Position of the Patient.—She should be well supported in crook-half-lying for massage of the limbs, chest, and abdomen. For back massage she should lie on her side, preferably on her right side. Naturally, no patient with

a weak heart should lie face downwards. Later, the back may be treated with the patient in the arm-lean-sitting position, if preferred.

Manipulations.—The following will be found most useful :—

1. *Limb Massage.*—Effleurage and kneading, light hacking (unless contra-indicated by heart symptoms), general nerve vibrations ; limb-shaking (the latter being said to stimulate the bone-marrow).

2. *Chest.*—Effleurage, kneading, vibrations over the thorax, gentle hacking.

3. *Abdomen.*—Any form of kneading, rolling, or picking up, so long as it is performed lightly—heavy kneading raises the blood-pressure. Vibrations over the abdomen : lumbar-side-stroking and colon-stroking.

4. *Back.*—Effleurage, kneading, frictions, and vibrations on either side of the spine ; light hacking, spinal and divergent. The last three movements must be omitted if the patient is excitable, or in a state of nervous irritability, and soothing stroking substituted. If there should be inflammation in the back muscles, finger kneading should be given carefully over the painful area.

5. *Head.*—If headache is troublesome, frictions to the scalp, or stroking and frictions to the forehead and face may benefit the patient.

Exercises.—

1. *Breathing exercises* should be given at the beginning and end of the treatment, as well as before the abdominal massage. Cases with heart symptoms should not breathe too deeply (*see* p. 311).

2. *Gentle active movements* of all joints of the limbs may in most cases follow the massage.

Later Stage

(The patient up.) As the patient improves, less time may be devoted to massage, and more to active work. If she has any heart symptoms, the progress of the treatment should be as for valvular disease of the heart (*see* pp. 310–317), though she will be able to advance more quickly than a patient with diseased valves. The pulse should be taken at the beginning and end of the treatment, and a 'test' exercise given as in a heart scheme. If she has never shown any heart symptoms, it is as well not to take the pulse too often, as this may suggest to a nervous girl that she has heart disease. This type of patient may progress fairly quickly, provided she is carefully watched for signs of fatigue. Running, skipping, dancing, and general exercises in a class are good for such patients when nearly recovered.

The following points require attention :—

1. *The starting positions* chosen should be easy, especially at first. Much static work tires, and does no particular good.

2. *The exercises should not be too strongly repletive to the pelvis,* because such produce too violent a depletion of the head. A fainting fit during exercise is not a tragedy, but it is an unfortunate occurrence, since it tends to weaken the confidence of both the patient and her friends in the efficacy of the treatment.

3. *Breathing exercises,* for inspiration, expiration, and interchange of gases in the lungs are most important, and at least four should find a place in every scheme.

4. *Exercises for constipation and improvement of the portal circulation* are generally required. Any of the usual exercises for constipation may be used, except those which entail very strong muscle work, impede the respiration, or are extremely repletive to the pelvis (e.g., High-ride-sitting Plane- or Arch-twisting). Such exercises as Half-lying Leg-rolling with upward jerk, Arm-lean-sitting, or -standing, Sacral-beating, Wing-close-sitting or High-ride-sitting

Alternate trunk-rotation, most of the free trunk-rotations, Wing-high-ride-sitting Backward-drawing to the vertical plane (provided the patient is made to breathe freely), Alternate knee-upraising done quickly, are all suitable. Any trunk exercises improve portal circulation; free movements of this kind are numerous and a selection can easily be made from them.

5. *The nervous system. Stimulation* for the nervous system can be provided by means of spinal back-hacking and vibrations. *Work* for the nerves can be found in the co-ordination exercises, consisting of complicated and asymmetrical movements, and balance positions or exercises.

Precautions.—The possibility of femoral thrombosis and gastric ulcer must not be forgotten. Any symptoms must be reported immediately (*see* pp. 328 and 377).

PERNICIOUS ANÆMIA

(*Addison's Anœmia*)

A severe type of anæmia, consisting of a great decrease in the number of red corpuscles in the blood.

ETIOLOGY.—

AGE AND SEX.—This is a disease of middle life, and is commoner in men than in women.

THE CAUSE is not definitely known. It is probably due to a toxin, and to absence or defect of some specific function of the liver.

PATHOLOGICAL CHANGES.—The red corpuscles of the blood are greatly diminished in number, and average only 1,575,000 to the cubic millimetre. (The normal is about 5,000,000 in a man and 4,500,000 in a woman.) Therefore the hæmoglobin in the body is greatly decreased, although each corpuscle actually contains more than its usual quantity. This great deficiency of hæmoglobin means that not nearly enough oxygen can be taken up to supply the needs of the body; all the tissues suffer, and symptoms develop in relation to every system of the body. The white corpuscles are also fewer in number than in healthy blood.

The heart is weak, and fatty degeneration takes place. There are changes in the liver, and the bone-marrow is not normal, and does not function efficiently.

Later, there may be degenerative changes in the spinal cord, generally affecting the posterior and lateral columns and giving rise to *postero-lateral* or *combined sclerosis.*

SYMPTOMS.—

1. The *onset* is gradual.

2. The patient's *complexion* is of a peculiar lemon colour, due to the separation of one of the pigments of the blood. The lips and mucous membranes are pale.

3. The most marked symptoms are *langour, extreme muscular weakness, debility*; and later in the course of the disease, *complete asthenia* (exhaustion) and prostration, ending in the collapse and death of the patient.

4. *Heart symptoms* are generally prominent—palpitations, faintness, and œdema of the ankles, etc.

5. *Gastric symptoms*—loss of appetite, diarrhœa, vomiting, etc., also make their appearance.

6. *Combined sclerosis* occurs in some cases (*see* p. 149).

7. The disease may be *acute*; or *chronic*, with remissions of varying length.

PROGNOSIS.—This was extremely bad until the discovery of the liver treatment. Very few cases recovered. It is now much better.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—Rest and nourishing food are necessary. Tonics are given, arsenic being the drug chiefly used. The treatment principally relied on nowadays is the newly-discovered *liver* treatment, which has been very successful. The patient is given liver, lightly cooked ; or it may be administered in a dried and powdered form. This apparently supplies some substance which his own liver is unable to produce, and generally brings about a cessation or decrease of symptoms, but the patient must continue the treatment indefinitely.

PHYSICAL TREATMENT.—Before the discovery of the liver treatment, patients suffering from this disease were occasionally ordered massage, as a rule while they were in hospital. All we could do was to try and alleviate the symptoms, to increase the patient's comfort by general massage, to preserve the mobility of the joints, and attempt to strengthen the asthenic muscles by gentle active exercises, as far as this could be done without overtiring him. It was a discouraging business at best, especially in advanced cases. Now, however, that the new treatment holds out a hope of definite and permanent improvement, we may hope to be able to help the patient to a far greater extent. The physical treatment will probably be much the same—general massage and exercises ; but it should now be possible to *increase* the amount of work to be done instead of *decreasing* it. The patient's progress may be slow—much like that of a heart case—but the physical treatment, we may hope, will now be a useful adjunct to the medical. Breathing exercises, once given as a mere forlorn hope (since the oxygen introduced could not be taken up by the blood), should now prove extremely useful.

Combined sclerosis cannot be *cured* by the administration of liver. If degenerative changes have taken place in the spinal cord, the damage is done. But in some cases the trouble seems to be arrested by the treatment, and does not become worse. (For the physical treatment of this condition, *see* p. 149.)

PLETHORA

This is not a disease but a symptom. It is a state in which there is too much blood in the body, the number of corpuscles being augmented out of proportion to the increase in the amount of plasma.

CAUSES.—

1. This condition is found in those who eat too much and take too little exercise.
2. There may be a hereditary predisposition.
3. It is said to arise when some customary loss of blood no longer takes place, e.g., after the cure of hæmorrhoids, or the cessation of menstruation.

SYMPTOMS.—The patient generally has a *high colour*, and suffers from *obesity*. He or she feels heavy and drowsy, and complains of *sudden rushes of blood to the face*. The *pulse* is slow and strong. *Constipation* is a common result of plethora.

Treatment.—

GENERAL TREATMENT.—Most important is the question of *diet*, which should be similar to that prescribed for obesity, carbohydrates and fats especially being reduced, though nitrogenous foods also should be limited. It is important that *less* food should be taken. The patient should take plenty of exercise in the fresh air.

PHYSICAL TREATMENT.—The aims of treatment are :—

1. To reduce the patient's weight.

2. To deplete the head, and, as a rule, to replete the abdomen. (This would be good in constipated subjects, or in women suffering from temporary arrest of menstruation—not, of course, in those at the menopause.)

3. To cure constipation.

EXERCISES.—A scheme of vigorous exercises should be given.

1. *Breathing exercises* will increase the oxygen intake and quicken metabolism. They are therefore good for obesity.

2. *Vigorous limb and trunk exercises* are used to deplete the head, quicken the circulation and increase metabolism.

3. *Exercises repletive to the abdomen and pelvis*: Plane- and Arch-twisting; trunk-rotations and trunk-backward-drawings in repletive positions; and 2-Knee- (or Leg-) updrawing and -downpressing are all suitable; or free exercises having a similar effect—Standing, or kneeling, Trunk-backward-bending and -raising, Wing-standing Alternate knee-upbending (done quickly), Crook-lying Trunk-raising + knee-extension (*see Figs.* 163–166, p. 398), etc.

4. *Exercises to increase peristalsis*, whether by nerve stimulation or by associated movement, should be used to counteract the tendency to constipation. The reader should consult the section on that condition. Any of the exercises there suggested are suitable.

5. *Abdominal manipulations*, such as hacking, transverse-abdominal-shaking, lumbar-side-shaking, or colon massage may be tried, as well as sacral-beating. No other massage is required, unless it be to crush fat masses, as in ordinary cases of obesity.

HÆMOPHILIA

An hereditary disease characterized by excessive bleeding from trivial causes, due to lack of a blood-ferment which produces coagulation of the blood.

ETIOLOGY.—The disease is hereditary, transmitted to the males by the females, who are themselves unaffected.

CAUSE.—The condition appears to be due to a deficiency of *prothrombin*, the ferment in the blood which forms fibrin from its precursor fibrinogen, and so brings about clotting. Since, according to the most modern views, both prothrombin and fibrinogen are produced by the liver, it is most probable that this organ is at fault.*

PATHOLOGICAL CHANGES.—The blood, though it does ultimately clot, is abnormally slow in doing so. The blood-vessels are said to be normal.

SYMPTOMS.—

1. A slight injury causes *excessive or fatal hæmorrhage*, internal or external.

2. Bleeding may take place *spontaneously* from mucous membranes or organs, e.g., from the nose, mouth, stomach, or lungs.

3. There may be *bleeding into joints* (hæmarthrosis), with swelling, pain, and disorganization of the joint.

4. The tendency to hæmorrhage is worst in childhood, and tends to improve in later life.

Treatment.—

PREVENTIVE MEASURES.—The women of affected families should not marry. The men cannot transmit the disease.

REMEDIAL MEASURES.—

GENERAL AND MEDICAL TREATMENT.—

1. The bleeder must not expose himself to risks of injury—as in active games, etc. He is not a fit subject for surgical operations.

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* Dr. J. W. Pickering, *Lancet*, 1929, June 15.

2. Hæmorrhages are treated by certain substances which arrest bleeding, e.g., adrenalin. Blood transfusion may be necessary in severe cases.

3. Liver treatment (*see* PERNICIOUS ANÆMIA, p. 339), has been lately tried, apparently with success.

PHYSICAL TREATMENT.—There does not seem much to be done for such patients by physical means, beyond improving their general health. One cannot supply a missing enzyme by massage! The condition deserves notice in this connection, however, because in the not very common event of our being called upon to treat a hæmophilic patient for any other disability, we must be prepared to be most careful to avoid trivial injuries, such as would be of no importance in a normal person. Massage must be very gentle, and exercises performed quietly without jerking or overstrain. In a small room, we must see that all furniture is out of the patient's way when he is doing arm or leg exercises.

PURPURA

This, like plethora, is not a disease, but a symptom. It consists of purple blotches on the skin, due to subcutaneous hæmorrhages. It appears in connection with various diseases, e.g., septicæmia, tuberculosis, nephritis, and especially rheumatism or arthritis. In its worst form—morbus maculosus of Werlhof—it develops in young people of delicate constitution, especially girls, in connection with severe and dangerous anæmia. There may be hæmorrhages also from the mucous membranes.

The condition being one involving risk of hæmorrhage, *precautions* must be taken as in hæmophilia. Such patients may possibly come to be treated for rheumatism or arthritis.

CHAPTER XXII

DISEASES OF THE RESPIRATORY ORGANS

I. Diseases of the nose and throat: Chronic nasal catarrh and laryngitis—Chronic tonsillitis and adenoids. II. Diseases of the bronchi: Chronic bronchitis—Bronchiectasis—Asthma. III. Diseases of the lungs: Emphysema—Lobar pneumonia—Fibrosis of the lung—Bronchopneumonia—Tuberculosis. IV. Diseases of the pleura: Pleurisy and empyema. V. Examples of breathing exercises.

I. DISEASES OF THE NOSE AND THROAT

CHRONIC NASAL CATARRH AND LARYNGITIS

CHRONIC inflammation of the nasal or laryngeal mucous membrane, with increased secretion.

Chronic nasal catarrh, though not in itself dangerous to life, is the cause of much ill health, especially as it is generally neglected. It may be associated with the presence of adenoids in childhood; or it may merely be due to a hypersensitive mucous membrane, the patient suffering from frequent colds in the head, which end in a chronic inflammation or catarrh. The condition is bacterial, or due to the inhalation of dust or other irritating substances, the chill or wetting which precedes it having lowered the patient's resistance to infection. Though the chronic catarrh may perhaps cause the patient little inconvenience, it is a fruitful source of other troubles. The very common 'catarrhal deafness' is caused by the extension of the inflammation to the Eustachian tube. In some cases, a general lowering of health takes place because of the hindrance to respiration and the inadequate oxygen intake, while in others dyspepsia may arise owing to the constant swallowing of mucus containing bacteria. (*Fig.* 145.)

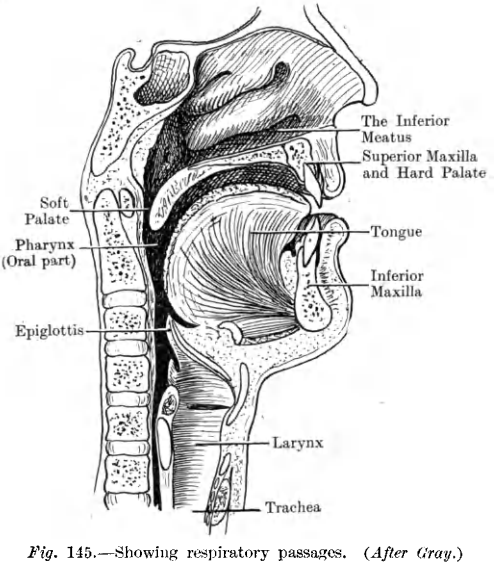

Fig. 145.—Showing respiratory passages. (*After Gray.*)

Treatment.—

Treatment is rarely very satisfactory, either by medical or physical methods.

MEDICAL TREATMENT.—This consists of local applications of various kinds, given by means of sprays, nasal douches, etc., or of inhalations. These measures are accompanied by medicinal treatment, tonics, etc.

PHYSICAL TREATMENT.—Our aims will be to dislodge the mucous deposits, to relieve the congestion in the membrane, and to improve the patient's general health.

METHOD.—A '*general strengthening treatment*' should be given. The following should be included :—

1. *Nose-root-shaking* or, in the case of chronic laryngitis, *larynx-shaking*, given with the idea of dislodging the mucus.

2. *Exercises depletive to the head*, for the purpose of reducing the congestion of the mucosa. All vigorous movements do this to some degree, but exercises such as concentric Back-raising, and those repletive to the pelvis are particularly appropriate.

3. *Breathing exercises* for inspiration, expiration, and interchange of gases in the lungs should be used freely.

CHRONIC TONSILLITIS AND ADENOIDS

ANATOMY.—The tonsils are two prominent bodies on either side of the fauces, the latter being the name given to the opening between the root of the tongue, the soft palate, and the anterior and posterior pillars of the latter. These 'pillars' are prolongations running from the base of the uvula to the base of the tongue and the sides of the pharynx. The tonsils lie between the anterior and posterior pillars. (*Fig.* 146.)

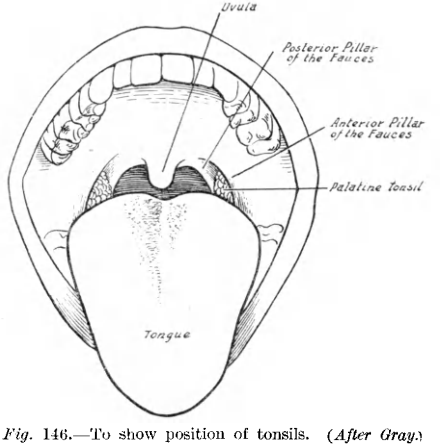

Fig. 146.—To show position of tonsils. (*After Gray.*)

DEFINITION. — The condition described as *adenoids* means overgrowth of lymphoid (adenoid) tissue in the vault of the pharynx, close to the openings of the Eustachian tubes, this overgrown tissue obstructing the passage of air. *Chronic tonsillitis* is inflammation and enlargement of the tonsils themselves. The acute form corresponds to what is commonly known as 'ulcerated' or septic throat. *Quinsy* is an actual abscess of the tonsils. The two conditions ('tonsils' and 'adenoids') are frequently found together.

ETIOLOGY.—The condition (that is, the development of adenoids, generally with, but sometimes without, chronic tonsillar enlargement) most frequently arises between the ages of 5 and 10 years. It is a very common affection.

PATHOLOGICAL CHANGES.—The adenoids are of variable size, from "that of a small pea to that of an almond" (Osler). They are reddish in colour because of their numerous blood-vessels. Their presence is generally associated with that of nasal catarrh, and the inflammation may spread along the Eustachian tube to the middle ear.

SYMPTOMS.—

1. The children are liable to catch *frequent colds*, or suffer from *acute tonsillitis* or *bronchitis*.

2. The most important symptom is *mouth-breathing*. Unable to breathe in or out properly through the obstructed pharynx, and possibly also suffering from blocking of the nasal passages by mucous secretion due to acute cold in the head or chronic catarrh, the child breathes almost entirely through his mouth, which he keeps continually open. The air thus inspired is insufficiently warmed and filtered, and the bronchi, or even the lungs, may suffer from the chill or from invading bacteria.

3. The child may be *mentally dull*, backward, apathetic, and unable to concentrate on anything. Sometimes, however, he appears dull when he is not really so, owing to his habit of keeping his mouth open, which gives the face a stupid or even imbecile expression.

4. He *snores at night*, and may even suffer from dyspnœa; there may be a troublesome cough.

5. Often *hearing* is affected; *taste and smell* may also suffer.

6. *Physical signs*: The child may be stunted in growth. The changes in the shape of the chest are often very marked. The commonest form of thoracic deformity is '*pigeon breast*' in which the sternum is prominent, and 'Harrison's sulcus' (*see* p. 291) is present. Less common are the '*barrel chest*' (*see* p. 354), which occurs in children subject to asthma, and the '*funnel chest*', in which the lower part of the sternum is drawn in during inspiration and finally remains fixed in that position.

Treatment.—

SURGICAL TREATMENT.—The adenoids, and sometimes the tonsils as well, are removed by the surgeon. If this is not done, the adenoids may dry up and disappear in time, but the damage will have been done, and the child may have been permanently injured in health.

GENERAL TREATMENT.—Good food and hygiene are essential, with plenty of fresh air.

PHYSICAL TREATMENT.—The treatment is post-operative, the aims being to teach correct breathing, to mobilize the thorax, and to assist the child's development, both on the physical and on the mental side.

In hospital practice, these children may well be treated in classes. Since they are apt to be dull, apathetic, and 'slow in the uptake' (this, by the way, is by no means *always* the case), the presence of others and the introduction of the element of competition may prove stimulating. Apart from the performance of special breathing exercises, they need ordinary drill, with plenty of movement and activity.

It is advisable to begin class treatment in the ordinary way by lining up, marching, opening ranks, etc., endeavouring to get a prompt response to commands, and to inspire the children with a desire to do well. '*Handkerchief drill*' should follow these preliminaries, the children being taught to clear the nasal passages, blowing down each nostril in turn while closing the other with the finger, and then down both together. Too much violence should not be used, however.

This should be followed by a *breathing exercise*, the children breathing in through the nose with closed lips, and out through the mouth; later, they may breathe in and out through the nose. They should also breathe in and out through each nostril in turn. The same exercises would, of course, be given to a patient who is being treated alone. Some workers place swabs of cotton-wool in a small bowl, and the child makes them fly about by blowing through his nose. Taking a deep breath in through the nose, and then blowing through the mouth (at balloons or other light objects) is also effectual. Such exercises are useful for little children, who find them amusing. The patients

should be taught to use their abdominal muscles correctly in breathing, and to breathe in all parts of the thorax. When the habit of mouth-breathing has once become established, it is most difficult to overcome, even though the obstruction which was its origin no longer exists. Much perseverance—and tact—is necessary on the part of the operator, who must manage to secure the co-operation of the small patient.

Other movements required are :—

1. *Exercises to increase the mobility of the thorax*—quick trunk-rotations, active or passive trunk-rollings or circle-turnings, 'Sawing', side-bendings, etc. The pigeon-breasted child must breathe in to the full. Passive chest-liftings or chest-expansions may be given to a patient who is being separately treated.

2. *Balance exercises*, which compel attention and improve co-ordination, helping to establish a correct postural reflex.

3. *Quick, active exercises*, e.g., quick marching, running, skipping, dancing, jumping. *Games* should be introduced into class tables. These not only quicken the mental processes and rouse the apathetic child, but increase the range of breathing by making him slightly short of breath.

The following might be used for a hospital class :—

Class Table (Ages 8–10)

Line up class, preliminary march ; open ranks.
1. Handkerchief drill and breathing.
2. Crook-sitting (hands clasping knees) Head-backward-bending and -raising.
3. Standing 2-Arm-rotation-out with breathing.
4. Wing-stride-toe-standing Alternate knee-bending-sideways (*see Fig.* 81).
5. 'Signpost' (*see* p. 156).
6. Yard-tailor-sitting Quick Alternate trunk-rotation.
7. Wing-stride-standing Trunk-falling-forward and -raising.
8. 'Bunny jumping.'
9. Knee-sitting Alternate side-bending (hands on upper ribs).
10. Game.
11. Crook-lying Diaphragmatic breathing (hands on abdomen).

Close ranks.

12. 'Barn Dance' March.
13. Standing 2-Arm-raising-sideways with breathing.

All commands with regard to the taking of starting positions, etc., should be given as in educational drill. The table may, of course, be arranged on the educational model if preferred.

The single patient may do almost the same table. Some resisted exercises may be included if desired. Younger children should have a shorter table, and in any case the exercises should be constantly varied. This applies to all tables for children, whether they are treated individually or in classes.

Children with barrel-chests should not be allowed to make forced inspirations. Those with asthmatic tendencies should as a rule be treated separately. (*See* treatment of ASTHMA, p. 350).

II. DISEASES OF THE BRONCHI

CHRONIC BRONCHITIS

A chronic inflammation of the trachea and bronchi.

ANATOMY OF THE RESPIRATORY PASSAGES.—The trachea and bronchi have four coats composed respectively of :—

1. Cartilaginous rings, embedded in a fibrous membrane, the cartilages being incomplete at the back, the membrane only persisting (fibrous coat).

2. Muscular fibres, longitudinal and circular (muscular coat).

3. Elastic fibres, running longitudinally in connective tissue (elastic or submucous coat).

4. Ciliated epithelial cells (mucous coat).

In the smaller bronchi the cartilage gradually disappears; the fibrous membrane persists, as well as the other layers, but the muscular coat becomes thinner. In the minute bronchioles and infundibula, only the coat of epithelial cells—the latter being no longer ciliated—and a few elastic fibres remain.

ETIOLOGY.—

AGE.—Chronic bronchitis most frequently attacks old people, and may recur every winter ('winter cough'). Children, however, are also subject to it; in them it is generally associated with adenoids and enlarged tonsils. It occurs occasionally in young adults, sometimes after influenza (Osler).

SEX.—It is more common in men than in women.

CAUSES.—

1. Repeated acute attacks of bronchitis predispose to the chronic variety.

2. It is often associated with lung, heart, or kidney disease, or with such conditions as interfere gravely with venous return to the heart, and hence with the pulmonary circulation.

3. A cold damp climate is favourable to its development.

4. The causative organisms are the pneumococcus, and the bacilli of influenza or catarrh.

PATHOLOGY.—

1. EFFECTS ON THE BRONCHI.—The mucous coat of the bronchi may be thickened or thinned. Its cells and glands atrophy, and are finally destroyed. The fibres of the muscular coat atrophy and degenerate. The walls of the bronchi are thus weakened, and the tubes may become dilated, bringing about the condition known as bronchiectasis (*see* p. 348).

2. EFFECTS ON THE CIRCULATION.—

The Heart.—In the first place, the constant coughing puts a strain on this organ. Secondly, in a severe case, where a certain degree of emphysema is present (*see* p. 354), many capillaries in the lungs are obliterated, so that the right ventricle has very hard work to pump the blood through the diminished number of vessels. This leads to dilatation and hypertrophy of the walls of that cavity.

The Portal Circulation.—As a result of the above, there may be back pressure (p. 307) on the systemic veins, and therefore congestion in the portal system.

SYMPTOMS.—The *cough* is *paroxysmal*, worst at night or in the early morning. The *expectoration* is considerable in amount and may be muco-purulent or purulent. *Dyspnœa* is a marked feature if the bronchitis is complicated by emphysema or by a strained heart. The patient becomes breathless on exertion, e.g., when walking fast or going upstairs. There is rarely fever.

The patient's health may be quite good apart from the above symptoms—that is, if the bronchitis is uncomplicated. The symptoms of *emphysema* are described below. The patient may, however, be weak, and the portal circulation may be affected, causing *constipation* and other *abdominal disturbances.*

Treatment.—

GENERAL TREATMENT.—Warm but light clothes should be worn. It is a great mistake for the patient to overload himself with heavy garments. The food should be nourishing. The sufferer from chronic bronchitis should, if possible, *live in a mild climate in winter.* The South of France is excellent

for those who can afford to go abroad. In England, Falmouth, Torquay, or Bournemouth are suitable.

PHYSICAL TREATMENT.—The aims of treatment are as follows :—

1. To dislodge the mucous deposits from the walls of the bronchi, so that they may be got rid of by expectoration.

2. To assist respiration, especially *expiration*, the latter phase being difficult in emphysema, in which the lung tissue has lost its power of elastic recoil. The possibility of this complication must always be taken into account.

3. To preserve the mobility of the thorax, or to restore it should it have already become impaired.

4. To improve the condition of the lungs by increasing the activity of their cells, and by assisting the pulmonary circulation.

5. To assist portal circulation and to guard against or remedy constipation.

6. If necessary, to treat complications such as weak or strained heart.

For a case of chronic bronchitis, with a tendency to emphysema, but no severe symptoms of the latter condition, the method of treatment is as follows :—

MASSAGE may be given to weak patients ; or limb massage, and perhaps abdominal kneading, may be included in a general table of exercises. Kneading of the chest, vibrations, hacking, and clapping are also indicated.

EXERCISES.—General exercises are required, adapted to the patient's age and strength. The following special exercises should find a place in every scheme :—

Breathing Exercises—for all types of respiration, but with special emphasis on *expiration*. Such exercises as the Swedish Half-lying Chest-lift-shaking, or Lax-sitting Chest-lifting (with not too strong a lift, but with strong pressure and vibration as the patient breathes out) ; vibrations given over all parts of the chest, with expiration ; Back-raising (concentric), in time with breathing ; Crook-half-lying Abdominal breathing, etc., are suitable. In all these a *natural* (not *forced*) inspiration should be made, followed by a *full* expiration. (*See* also the exercises for ASTHMA, pp. 350–352 ; and list of breathing exercises, p. 370.)

Exercises to Promote Interchange of Gases in the Lungs are also advisable —chest-clapping, back-hacking, etc., Heave-grasp or neck-rest-standing Chest-clapping is always recommended. It is surely, however, inadvisable to fix the thorax to this extent, especially in the position of inspiration. Standing 2-Arm-raising sideways with chest-clapping, and Arm-lean-sitting (or -standing), Back-hacking would seem to be better exercises. Spinal nerve frictions may be added, especially in the cervical and upper thoracic regions, whence the sympathetic nerve-fibres pass to and from the cardiac and pulmonary plexuses.

These movements will, moreover, have the effect of loosening the mucous deposits—this is a very important point in the treatment of bronchitis.

Exercises to Mobilize, or Preserve the Mobility of, the Thorax.—Most of the breathing exercises will have this effect. The danger is for the thorax to become fixed in a position of inspiration, but if complete expiration is practised, the mobility is not likely to suffer. Wing-high-ride-sitting Circle-turning, trunk-rollings, and quick trunk-rotations may also be given, as well as Stride- or Tailor-sitting Side-bending, the patient's hand being placed on the ribs in the thoracic region, in order to localize the movement in this part, and prevent it from taking place mainly in the lumbar region.

Trunk Exercises to Assist Portal Circulation.—The pulmonary circulation will have been helped by the lengthening and shortening of vessels in the lungs produced by the breathing and mobility exercises. The trunk exercises must not be too vigorous in old patients, or those with heart weakness, even if the

latter is not serious. Most free trunk exercises of average strength are suitable —free trunk-rotations, trunk-rollings, forward-bendings, abdominal contractions and side-bendings, etc. Of Swedish exercises, the passive trunk-rollings and circle-turnings, the concentric back-raisings, especially those in different planes, and most of the trunk-rotations, are good. Strong abdominal exercises like 2-Knee-updrawing and -down-pressing, 2-Leg-updrawing, the trunk-rotations in repletive positions, and the strong static abdominal exercises (e.g., the trunk-raisings) are all unsuitable, because they fix the thorax and tend to produce abdominal congestion. Many of the above exercises, especially the trunk-rotations, also serve to improve peristalsis and remedy constipation. Leg-rolling with an upward jerk, Arm-lean-sitting Sacral-beating, and quick Alternate knee-raising are useful as nerve stimulations.

BRONCHIECTASIS

Dilatation of the walls of the bronchi resulting in the formation of sacs in which discharge may lodge.

ETIOLOGY.—

SEX.—Men are more often affected than women.

AGE.—The patients are generally between the ages of 20 and 40.

CAUSES.—Bronchiectasis is almost invariably the sequel of some other disease of the bronchi or lungs, especially of:—

1. *Chronic bronchitis*, the constant effort to breathe out through the obstructed tubes acting on the already weakened muscular walls; and *emphysema*.

2. *Tumours*, *aneurysm* (*see* p. 324), or anything which compresses and obstructs the bronchus.

3. *Fibrosis* of the lung, the fibrous tissue contracting and so drawing out the walls of the tube which are weak because of the degeneration of the muscular coat (*see* p. 357).

4. *Bronchopneumonia*.

5. *Tuberculosis*.

There is also a rare *congenital* form.

PATHOLOGY.—The muscular walls become weakened by disease, and later dilate, from one of the above-mentioned causes. The secretion of the mucous membrane collects in the pockets thus formed, remains there, and decomposes. Its presence sets up inflammation in the walls, leading to further softening and dilatation, and sometimes to ulceration.

SYMPTOMS.—Besides the symptoms of the disease which has been the cause of the bronchiectasis, there is as a rule *copious and fœtid expectoration*, the patient generally bringing up a large quantity of secretion in the early morning, or on rising from the recumbent position. His general health is sometimes bad, and there may be wasting. The *cough* is troublesome and *hæmoptysis* may occur.

PROGNOSIS.—The condition generally grows slowly worse, and advanced cases do not respond satisfactorily to treatment. But if the secretion is evacuated frequently, and the cavities are kept drained, the general health becomes better, and the cough gives little trouble.

Treatment.—

MEDICAL TREATMENT.—Antiseptic inhalations are given to disinfect the cavities.

SURGICAL TREATMENT.—Sometimes operations are undertaken to drain the cavities, to remove the diseased part of the lung, etc.

PHYSICAL TREATMENT.—

1. *In cases due to phthisis, tumours, or aneurysms*, physical treatment is contra-indicated.

2. *In those due to bronchitis, fibrosis of the lung, and bronchopneumonia*, the treatment is that of the causative disease.

3. In all cases, however (except those caused by tuberculosis or by a tumour) much assistance can be afforded to the patient in *getting rid of the accumulated secretion*. He should lie face downwards on a bed or plinth, the upper part of the body being inclined downwards, so that the force of gravity may cause the secretion to run from the cavities into the bronchial tubes, whence it can be expelled by coughing; or he may lean over the side of his bed. At the same time the patient is given an inhalation, e.g., half a teaspoonful of Sanitas in a bowl of boiling water. The evacuation is greatly assisted by chest-clapping, back-hacking and vibrations. The operator may wear a gauze mask, on which a few drops of eucalyptus have been sprinkled, over her nose and mouth.

ASTHMA

Asthma is a condition consisting of attacks of expiratory dyspnœa, brought about by spasm of the muscles of the bronchioles, due to irritation of their mucous membrane, either direct, or by way of the blood-stream, by substances to which the affected individual is peculiarly sensitive, e.g., pollens, or certain proteins taken in food.

Hay-fever is a similar affection of the nasal mucous membrane, producing catarrh (Osler).

ETIOLOGY.—

Sex.—Males are much more often affected than females.

Heredity is a factor, and a neurotic element is often present.

Age in Relation to Cause.—When asthma occurs in children, it is generally after measles, whooping-cough, or some trouble in the region of the nose and throat—tonsillitis, adenoids, etc. In people under forty, there is generally sensitiveness to some protein. In those over this age, it is more likely to be due to bronchitis, or to heart or kidney disease.

Substances Causing Asthma.—Among these are the pollens of various plants, grasses, and flowers; the emanations from various animals, e.g., cats (hair) and horses (dandruff); and various proteins taken in food—eggs, milk, meat, shellfish, etc.

PATHOLOGY.—In asthma, during an attack, there is spasm of the muscles of the bronchioles, and swelling of the mucous membrane, with increase of its secretion.

The expiratory nature of the dyspnœa is explained by the fact that when the thoracic pressure is low during inspiration (*see* p. 353), the higher (atmospheric) pressure in the bronchioles tends to expand them, thus stretching their muscular fibres and reducing the spasm; whereas, when the pressure in the thorax rises during expiration—it may become atmospheric, or even just above atmospheric in a forced expiration—the bronchi are compressed, or, at least, there is equal pressure within and without them, so that there is nothing to counteract the spasm. Much air, therefore, enters the lungs during an attack, and only a small amount of this can be expelled, until the spasm relaxes. In chronic cases the lungs become permanently distended, though emphysema is not present. The bronchioles may become the seat of chronic inflammation.

In cases of long standing, the chest loses its mobility, and may resemble the

'barrel-chest' of emphysema; the muscles of expiration are stretched, the muscles of inspiration shortened.

SYMPTOMS.—The *attack* generally takes place at night, the patient waking up with a feeling of oppression and need of air. He sits up and grasps some support in order to fix the shoulder girdle (the origin of many of the respiratory muscles). Inspiration is short and expiration long, producing a wheezing sound. The thorax is fixed in the position of inspiration, and moves very little in spite of the patient's violent efforts. What breathing there is, is costal, the diaphragm moving hardly at all. A fit of coughing, with characteristic expectoration, may occur and end the attack, which may last only a few minutes, or continue for several hours. The length of the intervals between attacks varies in different individuals.

The patient may enjoy good health in the intervals or may show signs of bronchitis.

PROGNOSIS.—Asthma, in young people, tends to improve, or even disappear, especially if the particular cause can be discovered and the patient appropriately treated. In older people, in whom bronchitis or emphysema is present, the outlook is less encouraging.

Treatment.—

GENERAL AND MEDICAL TREATMENT.—In the intervals between the attacks, change of air, careful diet, and tonics are necessary. Any source of irritation in the nose or throat, or anywhere else in the body, is sought and treated.

The patients whose trouble is caused by sensitiveness to a protein in food must abstain from the article which contains it; if it is avoided for a long period the patient becomes 'desensitized' (Osler). Other cases are treated by injections of the particular pollen or other substance that causes the spasm.

PHYSICAL TREATMENT.—Our aims will be similar to those in emphysema, although the pathology of the two conditions is different. (1) Our first aim is to mobilize the thorax. (2) Our second, to produce full expirations and to re-educate the patient in the use of the diaphragm as a respiratory muscle. (3) Finally, we have to teach him to maintain a correct posture.

A short general table with arm, leg, and trunk exercises is given, with breathing exercises between the other movements. The extremity exercises are chosen according to the patient's condition of health, and are increased in strength gradually.

SPECIAL EXERCISES.—

1. *Mobility Exercises.*—Free exercises should be taught so that they may be practised at home—active trunk- and head-rollings, quick trunk-rotations, and alternate side-bendings. The patient should be shown how to relax as much as possible, and to do the exercises in a rhythmic, swinging manner. The Swedish movements such as passive Trunk-rolling and Circle-turning may also be given in the gymnasium, if the operator wishes.

2. *Breathing Exercises.*—These are all to be *expiratory*; no *deep* inspirations are ever to be allowed. Re-education in all types of respiration is necessary.

a. Diaphragmatic Breathing.—This is most important. We have seen that during an attack the diaphragm hardly moves at all. The patient needs to be taught the correct method of using the abdominal muscles in breathing, these being the most important muscles of expiration. The exercises may be given in the usual way, in the crook-lying or half-lying positions.

b. Costal Breathing.—The patient should be taught to breathe in every part of the lung, and every part of the chest should be mobilized.

Dr. Hurst (of Guy's Hospital) has lately taught us the best way to accomplish this. The patient begins the exercise with an expiration (without a previous inspiration) and repeats this four or five times with *short* inspirations in between. The expirations should be as complete as possible. The patient breathes out through the mouth, and it is recommended that he should make a hissing sound as he does so. Vibrations over the ribs are given by the operator to assist the expirations. The patient is placed in crook- or half-lying, the operator standing at his side, and later in sitting.

Fig. 147.

Fig. 148.

Fig. 149.

Fig. 150.

Figs. 147–150.—Showing position of gymnast's hands in teaching costal breathing. *Fig.* 147, 148, For lower costal breathing; *Figs* 149, 150, For upper costal breathing.

i. *Lower costal breathing.* When giving vibrations, the operator's hands are placed: (α) At the *front* of the chest over the lower ribs (*Fig.* 147). This resembles the end of the Swedish Chest-lift-shaking, the 'lifting' movement being omitted. (β) At the *sides* of the chest over the lower ribs (*Fig.* 148).

ii. *Upper costal breathing.* The operator's hands are placed: (α) At the sides of the chest over the upper ribs (*Fig.* 149). (β) On the front of the chest below the clavicles (*Fig.* 150).

iii. *Apical breathing* may also be given (*see* p. 370).

Miss Angove, in a lecture reported in *The Journal of the Chartered Society* (April, 1929), says that the patient should himself be taught to perform these vibrations, so that he may be able to practise the exercises at home. He will be wise to do so, as a precaution, for the rest of his life, even should apparent recovery take place. Miss Angove also emphasizes the importance of the development of a new and correct posture.*

3. *Exercises to Correct the Posture* (for a description of the 'barrel-chest', *see* p. 354).—The defective position of the thorax must be rectified. The patient must correct the kyphosis, by contracting the upper portions of the longitudinal back muscles; he must depress the shoulder girdle; and he must draw in the abdomen, thus drawing down the lower ribs. He must, moreover, be instructed constantly to take up this posture voluntarily, until the correct reflex is re-established. Head-extensions, abdominal contractions, and back-raisings should also be practised separately, to strengthen the muscles.

Specimen Table

1. Crook-lying (or half-lying) Diaphragmatic breathing.
2. Arm exercise (as preferred; *not* including breathing).
3. Wing- (high-) ride-sitting Active trunk-rolling.
4. Half-lying Lower costal breathing + vibrations.
5. Standing (or sitting) with hands on ribs Alternate side-bending.
6. Crook-lying Abdominal contractions (or some stronger exercise of a similar kind).
7. Half-lying Upper costal breathing + vibrations.
8. Prone-lying Head-extension (free) or Crook-lying Head-extension (resisted).

(Rest if necessary.)

9. Postural Exercise: Correct Sitting or Standing.
10. Leg Exercise.
11. Crook-lying Diaphragmatic breathing.

III. DISEASES OF THE LUNGS

EMPHYSEMA

Loss of elasticity of the lung tissue, due to dilatation of the infundibula and alveoli.

VARIETIES.—Emphysema may be divided into two main varieties:—

1. INTERLOBULAR, in which, owing to a wound, or to the rupture of many alveoli by coughing or straining, air has passed into the interstitial tissue of the lung.

2. VESICULAR, in which the alveoli have become distended, and have lost their elasticity. There are three forms of vesicular emphysema:—

a. Compensatory (inspiratory).—This occurs in one lung when the other is out of action, owing to consolidation, fibrosis, etc.; or in parts or lobules of a lung when other lobules are useless for similar reasons.

b. Atrophic.—This takes place in old age, from atrophy of the lobules; the chest is small and shrunken.

c. Expiratory (hypertrophic).—This is the form we are sometimes required to treat. It is due to dilatation of the alveoli, with loss of their elasticity, and consequently there is difficulty in expiration.

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* Miss Angove's lecture is most valuable, and should be read by all students of this subject. I am much indebted to her.

ETIOLOGY.—Expiratory emphysema may be due to :—

HEREDITY ; there being a congenital weakness or deficiency of the elastic fibres in the walls of the bronchioles, infundibula, and alveoli.

EXCESSIVE STRAIN ON THE ALVEOLAR WALLS, such as is produced by coughing and expiratory effort in bronchitis ; by repeated attacks of asthma, or by respiratory difficulty in children with adenoids. This overstrain may also be due to *occupations* which entail strong respiratory efforts, e.g., glass-blowing, or playing a wind instrument ; or to those so laborious as to impose continual strain on the respiratory apparatus.

PHYSIOLOGY.—The thorax is, as it were, an air-tight box, kept closed above by the muscles and other structures passing up into the neck, below by the diaphragm, behind and at the sides by the ribs, intercostal muscles, and vertebral column. Inside it lie the lungs, heart, œsophagus, great vessels, etc.

The lungs are completely surrounded by the pleuræ. Each pleural sac consists of two layers, the outer or parietal layer, which lines the chest wall, being reflected at the root of the lung on to the organ itself to form the visceral layer, which is closely adherent to the lung substance. The space between the layers is therefore a closed sac, having no communication with the parts outside it.

Within the lungs the pressure is always atmospheric—that is to say, it is the same as that of the air surrounding the body—since the lungs are in communication with the exterior by means of the trachea. The pressure in the pleural cavity, and within the chest generally, is always below that of the atmosphere.* At the end of expiration it is only very slightly below it—it may be said to be 'slightly negative.' When, however, the thorax is enlarged in *inspiration* by the action of the diaphragm, intercostals, etc., the pressure within it falls, because the cavity has been increased in size, but no more air can get into it. In other words, there is an "increase of negative pressure". The pressure in the lungs, which remains constant, is now a good deal higher than that in the pleural cavity. The lungs therefore expand, the air meanwhile rushing in through the trachea. Their expansion is almost entirely due to the stretching of the infundibula and alveoli, which are highly elastic structures.

When *expiration* takes place, the thoracic cavity again becomes smaller ; therefore the pressure within it rises, till it is almost equal to that within the lungs. These, by virtue of their great elasticity, always tend to collapse. During expiration, the difference between the pressure in the pleural cavity and that in the lungs is not sufficient to counteract entirely the force of their natural elasticity, and consequently they recoil, the air rushing out through the trachea. They do not, of course, collapse completely. If the chest cavity is opened, as by a stab or wound, the lungs do collapse, because the pressure inside them and outside them is equal, just as an air balloon would collapse if left with an open mouth. If the pleural sac of one lung only is opened, as by a surgical incision in a case of emphysema, only the affected lung collapses.† (*See* p. 366.)

In emphysema, the elasticity of the infundibula and alveoli is lost or diminished. Therefore, in expiration, the lungs do not tend to return to their original size. The pressure in the lungs, unopposed by this elasticity, keeps the lungs expanded against the slightly lower pressure in the pleural cavity, and complete expiration becomes difficult. Forced expiration, brought about by the action of the abdominal muscles and others, is necessary to expel all the air.

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* Except in a very strong 'forced' expiration.

† *See* Bainbridge, *Essentials of Physiology*, Chapter VIII, Section I (4th ed.).

PATHOLOGICAL CHANGES.—

1. The alveoli become stretched, and the septa between adjacent cells are absorbed, so that they coalesce. The elastic fibres in their walls disappear. The result is the difficulty of expiration described above.

2. The capillaries passing over and between the alveoli also become stretched and are finally obliterated. This adds to the work of the right heart, because it has to pump the same amount of blood through a smaller number of vessels.

3. Marked changes arise in the shape of the chest. These will be described with the physical signs.

4. There is interference with the general nutrition and metabolism of the body, owing to the imperfect interchange of gases in the lungs.

5. There is also abdominal congestion due to the fixation of the thorax in the inspiratory position and to the consequent loss of mobility, causing the respiration to be shallow and the suction action of the thorax inadequate.

6. If bronchitis is also present, the bronchi are affected as in that disease.

SYMPTOMS.—

1. There is *dyspnœa* on slight exertion. The inspiration is quick and short; the expiration very prolonged.

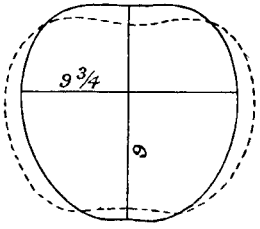

Fig. 151.—Horizontal section of an emphysematous chest showing barrel-shaped thorax. The dotted line indicates the natural shape. (*After French.*)

2. Owing to defective interchange of gases, *cyanosis* is one of the chief features of this disease. It may be very marked, yet the patient is able to get about.

3. The patient is *weak and easily tired*; heart symptoms (*see* p. 308) may be pronounced.

SIGNS.—The '*barrel-shaped thorax*' (*Fig.* 151) is characteristic of emphysema, the changes in form being as follows:—

1. The antero-posterior diameter of the chest is increased, the sternum being thrown forward; it may even be greater than the lateral diameter. The costal cartilages are prominent, and the intercostal spaces widened.

2. The dorsal kyphosis is increased, the back rounded, and the shoulders raised.

3. There is a deep sternal fossa, the clavicles are prominent, the neck appears to be shorter than normal, because of the elevation of the thorax and shoulders. The neck muscles, i.e., the muscles of forced inspiration, the scalenes, sterno-mastoid, etc., are hypertrophied and stand out prominently in the neck.

4. Mobility is decreased, and respiration is therefore shallow.

COURSE.—The patient generally grows slowly worse. Death may take place from heart failure or pneumonia. Repeated attacks of bronchitis hasten the down-hill course.

Treatment.—

GENERAL TREATMENT.—As for chronic bronchitis (*see* p. 346).

PHYSICAL TREATMENT.—This is made much more difficult than that required for bronchitis by the state of the patient's heart; otherwise it is similar. Cases of emphysema rarely come for treatment, and many workers fail to realize the seriousness of the condition until confronted with a case for the first time. Our chief aim is to *assist expiration* and *mobilize the thorax*. Abdominal troubles, especially constipation, may need attention. How much we shall be able to do depends largely on the condition of the patient's heart. We may divide the cases, roughly, into two classes: (1) Those with chronic bronchitis, *slight* emphysema, and no heart symptoms; (2) Those with *marked* emphysema, and definite heart involvement.

1. The First Class.—These may be treated as are cases of ordinary bronchitis, but we must feel our way more carefully, and be content to advance very slowly.

Massage.—General massage, or at least limb-kneading and abdominal treatment should be given.

Exercises.—These, again, are much as for bronchitis. (1) *Breathing exercises* are, obviously, of the greatest importance. Expiratory exercises should be chosen (*see* exercises for Bronchitis, p. 347, and Asthma, p. 350). (2) Exercises *to mobilize the thorax*, and *graduated active work* are also essential (*see* pp. 347–350).

Gentle Exercises for Constipation are given if required.

2. The Second Class.—Much less can be done here. They must be treated primarily as heart cases, but we cannot expect the steady improvement that often takes place in a patient with, say, a mitral lesion. We shall start in the same way with massage—not abdominal massage, unless it is specially ordered—and gentle active movements, beginning with the smaller joints. Careful chest vibrations, and, later, clapping, and expiratory exercises may be added, but the latter must not be forcible, and their effect on the patient must be watched. If he seems to grow stronger, we may progress a little, very slowly and gradually. Even if not much can be accomplished, in the way of definite improvement, we may hope at least to make the patient a little more comfortable.

LOBAR PNEUMONIA

Inflammation of one or both lungs.

ETIOLOGY.—

Age.—Pneumonia is most common in children under 10, and between the ages of 20 and 50; but it may occur at any age.

Sex.—Men are more often attacked than women.

Causes.—*Predisposing causes*: (1) Bad hygiene, badly ventilated rooms and over-crowding. (2) Debility or illness; measles, whooping-cough, etc. (3) Alcoholism. *Exciting causes*: (1) Cold, chill, or a wetting may bring on the trouble. (2) Blows or injuries to the chest appear sometimes to cause an attack.

The condition is bacterial, due to the pneumococcus or other organisms.

PATHOLOGICAL CHANGES.—

1. One lung, generally the right, or both, may be involved. If one lung only be affected, the disease may attack one lobe or more, or possibly the whole lung.

2. The lung first becomes congested, though it still contains air; later the alveoli are filled with a fibrinous exudate, which ultimately becomes purulent. The lung, or those parts of it which are inflamed, is then airless. If the patient recovers, there follows *the stage of resolution*, or recovery. The purulent fluid is partly expectorated, partly absorbed—that is, acted on by enzymes which dissolve it, after which it is excreted by the kidneys. Sometimes resolution is much delayed.

SYMPTOMS.—

The *acute attack* begins with a shivering fit and a sudden rise of temperature to 103° or over. There is first *pain*, then *dyspnœa*. The *respiration* is very much quickened (30 to 70 a minute), but the *pulse-rate* is not correspondingly raised. The patient has a *hacking or paroxysmal cough*, and the *expectoration* is characteristic ('rusty sputum').

Recovery is generally by *crisis*, which takes place about the eighth day, the temperature falling in a few hours to normal or even below, the pulse- and

respiration-rates falling with it. This means that the antitoxins of the patient's body have prevailed over those of the bacteria. In fatal cases, the temperature continues to rise; the patient generally dies of heart failure.

Sometimes the illness terminates by *lysis*, i.e., a *gradual* fall of temperature, instead of by crisis. In such cases the convalescence is generally long and slow, and it is these we most frequently have to treat. Some patients suffer from *delayed resolution*—that is, the consolidation of the lung remains, and is very slow in clearing up.

COMPLICATIONS AND AFTER-EFFECTS.—These are rare. Pleurisy, empyema, endocarditis, and otitis media (inflammation of the middle ear) sometimes occur. Scoliosis, common after pleurisy, is rare after pneumonia.

Treatment.—

ACUTE STAGE.—Only medical treatment and efficient nursing are required.

CONVALESCENT STAGE.—Many patients make an excellent recovery, and need no special after-treatment. Some, however, regain strength slowly, and are much benefited by massage and exercises. This is especially true of the cases of 'unresolved pneumonia'.

The aims of treatment are as follows:—

1. To expand the affected lung without, however, over-stretching it in the early stages, since the tissues might easily be torn or injured.
2. To prevent the development of scoliosis.
3. To improve the patient's general health.

The method of treatment in the early stage with the patient still in bed, is as follows:—

Before treatment, the operator should inspect the patient's chart, in order to obtain information as to his general progress. The pulse and respiration should also be taken at the beginning of the treatment and at its conclusion.

GENERAL MASSAGE is sometimes ordered. If so, the treatment should at first be very short—not more than half an hour at the outside. Effleurage and kneading to the limbs, gentle abdominal massage (omitting liver treatment) and effleurage, kneading and frictions to the back, with the patient turned towards the affected side, may be administered. Chest massage may consist of kneading and vibrations, and, later on, of gentle hacking and clapping. Breathing exercises should always be included, and may be given at the beginning and end of the treatment, as well as before the abdominal massage.

As a rule, however, the patient is more satisfactorily treated, as in empyema, by *a combination of massage and exercises*. The first schemes, in a case of pneumonia of the *right* lung, might, therefore, be as follows:—

Scheme I

1. Crook-half-lying Diaphragmatic breathing.
2. Crook-half-lying 2-Arm-kneading + 2-Forearm-bending and -stretching (6 times).
3. Crook-half-lying Chest massage + Costal breathing.
4. Crook-half-lying 2-Leg-kneading + Knee-bending and -stretching (3 times each leg).
5. Crook-half-lying Apical breathing.

Scheme II (Later)

1. Left-side-lying Diaphragmatic and costal breathing.*
2. Crook half-lying 2-Arm-kneading + 2-Arm-stretching upward and downward (6 times).

* The patient need not lie flat. He may lean sideways against his pillows with his left arm between them and the side of his chest.

3. Crook-half-lying Abdominal massage.
4. Crook-half-lying Deep breathing.*
5. Crook-half-lying 2-Leg-kneading + 'Bicycling' movement (6 times each leg).
6. Crook-half-lying (gentle) Side-bending to left with breathing.

PROGRESSION.—

1. *The breathing exercises* should be double-sided at first, and later may be given for one lung only by putting pressure on the sound lung, as Exercise 1 in Scheme II above. *Gentle* side-bendings may next be introduced, but the strong side-bendings given in empyema would not be safe in a case of pneumonia. These must, therefore, be deferred till a very late stage of treatment. *Relaxed* alternate side-bendings for mobility may be used, as well as trunk-rotations and relaxed trunk-rollings.

Diaphragmatic breathing is most useful of all in expanding the base of the lung; but *costal* breathing, both as regards the lower and the upper parts of the thorax, and *apical* breathing should not be neglected.

2. *The limb exercises* may be increased in strength as in empyema (*see* p. 367) according to the patient's capacity.

3. *Massage* should gradually give place to exercises, but hacking and clapping of the chest and back are always useful.

N.B.—A rise of temperature contra-indicates treatment, and should be reported at once.

FIBROSIS OF THE LUNG

(*Fibroid Lung; Interstitial Pneumonia*)

An overgrowth and hardening of the connective tissue of the lung.

ETIOLOGY.—Fibrosis of the lung is generally secondary to some other inflammatory condition. It may follow bronchopneumonia, chronic pleurisy, or, more rarely, lobar pneumonia. It may be caused by the inhalation of irritating dust. A *local* form may be due to tuberculosis or tumours of the lung.

PATHOLOGICAL CHANGES.—

1. One lung only is affected, as a rule.

2. The condition consists of an *overgrowth of the connective tissue of the lungs*, which presses upon and obliterates the alveoli and the capillaries between them. Moreover, the muscular tissue in the walls of the bronchioles loses its contractility and becomes fibrous. Since fibrous tissue has not the resisting power of muscular tissue, the walls yield in places giving rise to bronchiectasis (*see* p. 348).

3. The fibrosis may be local or diffuse. In the former case, there is often *compensatory emphysema* (*see* p. 352) in other parts of the same lung, since the areas of fibrosis are hard and contracted, and no air can enter them. If one lung is entirely fibroid, the other lung is emphysematous; and the right ventricle of the heart is hypertrophied as a result of the strain entailed in pumping the blood through the reduced number of capillaries.

SYMPTOMS AND SIGNS.—Early symptoms are *cough*, *dyspnœa on exertion*, and sometimes *cyanosis*. Often, the patient has otherwise good health. The symptoms of bronchiectasis may be present. The condition is very chronic, and may continue from fifteen to twenty years (Osler).

The affected side of the chest is shrunken, and the shoulder drawn down causing a *scoliosis convex to the healthy side*. The muscles of the shoulder girdle on the affected side are atrophied (Osler).

* Or Crook-half-lying Chest-lift-stroking.

Treatment.—

Our principal aims are to expand—as far as is possible—the affected lung; to preserve the mobility of the thorax, and to prevent the establishment of scoliosis.

PHYSICAL TREATMENT.—

1. *If the lung is completely fibroid*, it obviously cannot be made to expand. In this case all we can do is to try and preserve as much thoracic mobility as possible, and prevent—again, as far as possible—the development of a troublesome scoliosis. We shall therefore give a *general table*, with special emphasis on *mobility exercises*, passive or free, on *postural exercises*, and on *breathing exercises*, especially free side-bendings away from the affected side. At the same time, exercises to raise the low shoulder may be used. Pressures must not be given.

2. *If the lung is not completely fibroid*, but is only so in certain areas, more may be done to improve matters. We should then endeavour to expand it in much the same way as we should do in a case of pneumonia (p. 357). The active work done may be vigorous, but of course must not exhaust the patient.

N.B.—*Tuberculous Cases.*—Cases of fibrosis due to tuberculosis should not be treated by physical methods, as these might light up a quiescent infection.

BRONCHOPNEUMONIA

(*Lobular Pneumonia*)

Inflammation of the bronchioles, infundibula, and alveoli.

ETIOLOGY.—

1. AGE.—It is most common in early childhood and in old age.

2. Bronchopneumonia may be primary or secondary:—

a. The Primary Form has much the same causes as LOBAR PNEUMONIA (p. 355).

b. The Secondary Form occurs: (i) After the specific fevers, measles, scarlet fever, etc. (ii) In the form of 'aspiration pneumonia'. This is due to particles of food having got into the larynx. These pass down into the bronchi and set up an intense inflammation.

PATHOLOGICAL CHANGES.—Both lungs are attacked. The inflammation starts in the smallest bronchioles, and spreads to the infundibula and alveoli, which form the lobules into which the bronchus opens. These structures are hyperæmic and swollen, the bronchioles stopped up with mucus, and the alveoli filled with a mucous or mucopurulent exudate.

SYMPTOMS.—

1. In the *primary form* the onset and symptoms are similar to those of pneumonia. The termination is by *crisis*, and the child recovers quickly. The prognosis is therefore good, and this form is rarely fatal.

2. In the *secondary form*, the symptoms are at first those of bronchitis, but as the air-cells become involved, they assume a more serious aspect. There is a painful cough, dyspnœa, intermittent fever, and a quick, weak, and irregular pulse. The patient may die from exhaustion, heart failure, or asphyxia. In cases that recover, the termination is by *lysis*, the convalescence is very slow, and in some cases areas of consolidation remain unresolved for months. The prognosis is much worse than in the primary form.

COMPLICATIONS are bronchiectasis and phthisis.

Treatment (during convalescence).—

GENERAL TREATMENT.—The patient should wear warm clothing, and

the food should be light and nourishing. Constipation must be prevented. Appropriate tonics will be ordered.

PHYSICAL TREATMENT.—The aims of treatment are as follows:

1. Before anything else can be done, *the exudate must be evacuated*, since it impedes respiration, and its presence in the bronchioles leads to bronchiectasis.

2. The condition, being bilateral, will require *inspiratory exercises* to secure *expansion* of both lungs.

3. *Expiration* as well as inspiration must be practised, because of the emphysematous patches in the lungs.

METHOD OF TREATMENT.—

1. *The pulse* should be taken before and after treatment, and the patient's chart watched in the early stages.

2. *Evacuation of the secretion* (*see* BRONCHIECTASIS, p. 349).

3. A *general strengthening treatment*, consisting of massage and exercises, very carefully graduated, should be given. The patient must on no account be overtired. Easy starting positions should be chosen.

4. *Breathing Exercises.*—

For inspiration and expansion of the lungs. Double-sided breathing exercises are given. The damage being generally worst at the base of the lungs, diaphragmatic (abdominal) breathing is the most important of all, but costal and apical breathing must not be neglected.

Exercises to assist expiration should also be given, because bronchitis and some degree of emphysema are part of the disease. (*See* Exercises for BRONCHITIS and ASTHMA, pp. 347, 350.)

5. *Mobility Exercises* (*see* PNEUMONIA, p. 357).

No strong stretchings must be used.

TUBERCULOSIS

Tuberculosis is a very widespread disease, affecting not only human beings but many species of animals. Fortunately, however, it is becoming less prevalent, owing to improved hygiene, better housing, and education of the public as regards the danger of infection.

ETIOLOGY.—

AGE.—No age is exempt; but the old are less likely to suffer. Tuberculosis of bones, joints, glands, or membranes (peritoneum or meninges) is most common in children, phthisis (tuberculosis of the lungs) is most often found in young people.

SEX.—The sexes are almost equally affected.

OCCUPATION.—Any occupation which lowers the resistance of the body predisposes to tuberculosis. People who work for long hours for insufficient wages, and hence often on scanty food; those who spend most of their time in ill-ventilated or insanitary rooms; and those who are employed in trades which entail the inhalation of dust or irritating substances, are all liable to this malady.

OTHER DISEASES.—Catarrh, specific fevers, exhausting diseases all predispose to the disease. Traumas, such as blows on the chest in the case of pulmonary tuberculosis, or injuries to bones, joints, or other parts may lead to its development. It may affect any part of the body.

THE TWO MAIN PREDISPOSING CAUSES, however, are: (*a*) *Hereditary predisposition* (diathesis). The disease itself is not inherited, but rather a certain liability to contract it. This may generally be counteracted by living a hygienic and well-regulated life, and keeping the health at a high level. (*b*) *Lowering of the body's protective forces*, as by the causes mentioned above—unhealthy occupations, weakening diseases, etc.

The *Bacillus tuberculosis* is the actual cause. Infection by this bacillus may take place in three ways : (1) *By inhalation.* This is the commonest way. Bacilli from the sputum of consumptives are blown about in the air, and breathed in by others. (2) *By ingestion*—milk from a tuberculous cow being the usual vehicle of infection. (3) *By inoculation.* This rarely happens, except to surgeons when performing operations or post-mortems.

N.B.—In (1) the lungs, and in (2) the intestines or tonsils are most often affected ; (3) generally produces a local lesion only.

PATHOLOGY (GENERAL).—

1. FORMATION OF THE TUBERCLE.—The tubercle bacilli, having invaded the tissues, spread and multiply there, and various cells gather round them, forming small greyish jelly-like bodies called tubercles. The bacilli lie in the innermost layer of cells.

2. CASEATION.—Partly because no blood-vessels pass into them, and partly because of the effect of the bacteria or their toxins, the tubercles degenerate. A number of them together form a soft cheesy mass.

3. TERMINATION.—This may occur by : (*a*) *Softening of caseated material* which is then excreted in urine or fæces, or coughed up, and *formation of cavities.* If this process continues, the result is fatal—unless, of course, the site of the lesion is one which can be dealt with surgically. (*b*) *Sclerosis* (calcification—encapsulization). In this case there is increased formation of fibrous tissue round the tuberculous area, shutting in the bacteria. The tubercle becomes a firm, hard structure, and cure supervenes.

Phthisis

(*Pulmonary Tuberculosis*)

With the disease once developed we are not concerned, but only with its prevention, especially in those known to be predisposed. Not much, therefore, need be said about the disease itself. It may take one of two forms : (1) *The acute form* (popularly known as 'galloping consumption'), involving both lungs, and ending fatally in a few months. (2) *The chronic form*, which is more common. The process generally starts in one lung, but later involves both. The first point of attack is generally just below the apex of the lung, and the infection extends downwards along the anterior margin.

PATHOLOGY.—The changes are those described above, the alveoli and terminal bronchioles being attacked. Caseation takes place, the cheesy material being absorbed or coughed up, and cavities formed in the lung. The process is sometimes divided for purposes of description into three stages.

1. INVASION, in which the bacilli settle down in the tissues.

2. CONSOLIDATION.—This is the stage of formation of tubercles, with an inflamed zone round them ; and of caseation.

3. EXCAVATION, in which the caseated material softens and is absorbed, and cavities are formed.

This process may continue with a fatal result, or healing may take place by encapsulization (*see above*). It is, however, possible for a chronic tuberculosis to become acute again as the result of some infective condition elsewhere in the body (Wheeler and Jack).

SYMPTOMS.—The character of the *onset* varies ; the disease may begin with only slight symptoms, or the first sign may be *hæmoptysis* (hæmorrhage from the lung), due to the erosion of a blood-vessel. Other symptoms are *cough*, increasingly paroxysmal and painful ; *characteristic expectoration* ; *fever* ; and *emaciation.*

The *chest* is long, narrow and flattened, the antero-posterior diameter being short. The *ribs* are more vertical in direction than normal, making the costal angle more acute. The *scapulæ* are often winged.

Treatment (Prophylactic).—

GENERAL TREATMENT.—The children of tuberculous parents, or those suspected of a hereditary predisposition to the disease, should pay special attention to hygiene. They should live in healthy surroundings, with plenty of fresh air and sunshine, spending much time in the open, and avoiding sedentary work, or such as would prevent their taking a proper amount of exercise. They should not expose themselves to infection. Children whose parents are actually suffering from phthisis should not remain at home. Suitable food and clothing should be provided, and colds and chills must be avoided.

PHYSICAL TREATMENT.—

EXERCISES.—

Treatment by physical exercises is only permissible as a prophylactic measure. Should any symptom appear which might denote actual onset of the disease, it must cease at once. *Hæmoptysis is an absolute contra-indication.* No treatment must be given after it has once occurred, nor may it be resumed, unless after many years. The treatment consists of general exercises, given out-of-doors if possible, or at least in a room with wide open windows.

Breathing exercises are, of course, more important than any others. It is essential that all parts of the lung should be as fully expanded as possible, in order to improve pulmonary circulation, and promote the nutrition of all the lung tissue, as well as increasing the intake of the life-giving oxygen, and the output of CO_2. This not only makes for a healthy condition of the respiratory organs themselves, but increases the resistance of the patient's whole body to infection. He should therefore be taught to breathe in every part of the thorax, inspiratory and expiratory movements being equally important. The following are useful :—

Exercises to Expand the Base of the Lungs.—

1. Half-lying Diaphragmatic (abdominal) breathing.
2. Half-lying Costal breathing.
3. The above two exercises combined.

Exercises to Expand the Apex.—

1. *Half-lying Apical breathing.*—The operator, with fingers over the apices of the lungs, indicates to the patient the part she wishes him to expand.

2. *Half-lying Apical breathing with pressure.*—The operator, if she finds it difficult to teach the patient the above exercise, may exert gentle pressure on the lower ribs during inspiration so that the expansion may take place in the upper costal and apical regions only.

Exercises such as the Swedish Sitting Chest-lifting, Half-lying Chest-lift-stroking and -shaking, and Stoop-stride-sitting Back-raising in different planes may also be used, or any free breathing exercises with or without work for the arms. *Chest-clapping* and *back-hacking* are useful in promoting interchange of gases. *Deep spinal frictions* and *vibrations* in the upper thoracic region should promote activity of the sympathetic nerves that go to make up the pulmonary plexus.

Apart from breathing, the exercises will simply consist of a varied table arranged to suit the patient's general physical condition. There should be plenty of movement, and work for all muscle groups, as well as exercises for mobility and co-ordination. The scheme may be arranged on the educational model if preferred.

Treatment of Hæmoptysis (First-aid).—

If an attack of hæmoptysis should unfortunately occur without any previous warning, the patient should be placed on a couch or bed in the half-lying position, with the head and trunk well raised. Absolute rest and quiet are essential, and the patient should be reassured. (The hæmorrhage usually stops of itself unless a large artery has been eroded.) All tight clothing should be loosened, and the windows opened, so that the patient may have plenty of air. He may be given ice to suck, if this is obtainable, but if there is any doubt as to the origin of the hæmorrhage nothing should be given by the mouth before the arrival of the doctor. The blood is bright red and frothy, i.e., it is mixed with air, whereas in hæmatemesis it is generally dark in colour, except occasionally in cases of gastric ulcer (*see* p. 377). If it is known from which lung the blood comes, the patient is turned towards the affected side, and ice applied to this region only. In the case of a first attack, however, this could hardly be known by the gymnast. The patient will probably assume the position most comfortable to himself.

IV. DISEASES OF THE PLEURA

PLEURISY AND EMPYEMA

Pleurisy

Pleurisy is, as the name implies, inflammation of the pleuræ of one or both lungs, most frequently of that of the right lung.

ETIOLOGY.—Pleurisy may be: (1) Primary—that is, rising from some cause within the body, and not following on any other disease or infection; or (2) Secondary, arising as the result of any other such morbid process.

1. Primary Pleurisy is always, or almost always, due to tuberculosis, though an attack may be precipitated by chill, cold, or exposure.

2. Secondary Pleurisy may be due to a number of causes, among which are: (*a*) Pneumonia, in which case the infection spreads from the lung to the pleura. (*b*) Specific fevers—scarlet fever, rheumatism, measles, whooping-cough, septicæmia. (*c*) Chronic diseases in their late stages—Bright's disease, cancer, etc. (*d*) Chill.

The organisms responsible for the development of pleurisy are the pneumococcus, streptococcus, and tubercle bacillus.

PATHOLOGICAL CHANGES.—There are two varieties of pleurisy: (1) 'Dry' pleurisy; and (2) Pleurisy with effusion.

1. 'Dry' (Plastic) Pleurisy.—The membranes become hyperæmic, and red in colour. There is at first no effusion, but before long fibrin—the thread-like substance in the blood-plasma which forms the clot when blood is shed—begins to be exuded. It is deposited on the membranes, giving them a rough, shaggy appearance, and forming adhesions between the visceral and parietal layers. These hamper the movements of the thorax and so interfere with respiration. In dry pleurisy there are no further changes, and the trouble may clear up completely.

2. Pleurisy with Effusion.—The following stages may be noted.

Stage of Exudation.—The fluid is sero-fibrinous and varies in amount. If extensive, it causes collapse of the lung, displacement of the heart and great vessels, or even of the liver and spleen. The movements of the diaphragm are much hampered in this case, and breathing becomes very difficult.

Stage of Resolution.—The fluid is gradually absorbed, but, much fibrin being left deposited on the membranes, strong adhesions form.

Stage of Purulent Exudation.—The exudation, instead of being absorbed,

may become purulent. The condition then arising is known as *empyema*. In some cases, the fluid is purulent from the beginning. This often happens when empyema follows on pneumonia.

SYMPTOMS.—

1. 'Dry' Pleurisy.—The attack begins with *slight chills*, or shivering attacks, but not with a violent rigor like that which precedes pneumonia. The *temperature* rises to about 102° or 103°. There is malaise, headache, and general feeling of illness. *Severe pain* is felt on the affected side, worst when the patient takes a deep breath; this is due to the inflamed condition of the membranes, either to stretching of them, or to friction between them. There is a *dry cough*, also painful, but no expectoration.

2. Pleurisy with Effusion.—The pain grows less as the exudation increases, and *dyspnœa* takes its place. The lung, compressed by the fluid, collapses, wholly or in part, and hence respiration becomes difficult or impossible on the affected side. The patient lies on this side, so as to give all possible freedom to the sound lung. The breathing is quickened. The *temperature* remains raised, and the *pulse* is quick. There is a *hacking cough*, but the expectoration is not increased, since the exudation is not in the bronchioles or infundibula. What there is has no marked character, and is never 'rusty' as in pneumonia.

COURSE AND PROGNOSIS.—The prognosis is good as a rule, better in the young than in the old. The greatest danger is that of cardiac failure. The temperature falls by *lysis*—that is, by a gradual decline, not by *crisis* (sudden fall) as in pneumonia. This happens as the fluid is absorbed—in from 7 days to 3 weeks.

AFTER-RESULTS.—From the point of view of the gymnast, the most important result of pleurisy is the formation of adhesions which immobilize one side of the thorax, prevent full expansion of the lung, and ultimately cause scoliosis—a thoracic curve with its convexity to the sound side.

Treatment.—

Acute Stage

No treatment will, of course, be given in the acute stage. 'Dry' pleurisy often clears up entirely without after-results, and rarely requires treatment.

Pleurisy with Effusion

Our aims are to assist the absorption of the fluid; to obtain full expansion of the collapsed or partially collapsed lung, and to promote correct breathing; to prevent the formation of disabling adhesions between the two layers of the pleura, or, should they have already developed before the patient comes under our care, to stretch them, and so to prevent, or remedy, scoliosis.

We have to remember that pleurisy, as has been said, is often due to infection by the tubercle bacillus. In any case, there is a large amount of fluid present without any outlet, and any increase of inflammation will add to that fluid, intensifying its dangerous pressure on the lung and on the heart. Consequently it is most important that in the early stages of treatment we should do nothing that could light up the inflammation, or interfere with its resolution.

Should the patient's temperature, as recorded on his chart, rise above normal, or his pulse-rate become quicker, or should any sign of increased effusion, or any other unfavourable symptom appear, the treatment should be discontinued, at all events for a time.

METHOD OF TREATMENT IN THE EARLY STAGE.—The patient is in bed, still very weak, but the temperature and pulse are normal. At first, the treatment should consist only of effleurage and kneading to the limbs,

given very gently and carefully. The first séance should not last more than ten minutes, but the time may be increased gradually up to about thirty minutes as the patient improves. Gentle double-sided breathing exercises are next added.

Scheme I

1. Half-lying Breathing.
2. ,, 2-Arm-kneading.
3. ,, Chest-kneading + vibrations.
4. ,, 2-Leg-kneading.
5. ,, Breathing.

A day or so after this, active movements and localized breathing may be added. The treatment becomes similar to that for empyema, *but the progression must be much slower, and more careful*, until the effusion is completely absorbed.

The increase in strength of the active movements may be arranged much as that for a heart case, and the rules given above must be carefully observed. The pulse—and in the early stages, sometimes the temperature also—should always be taken before and after treatment, this precaution becoming specially important when active work is being gradually introduced into the scheme.

Empyema

This, as described above, is a condition in which the exuded fluid within the pleural cavity is purulent. It is a more serious illness than simple pleurisy and the prognosis is worse. The fluid collects at the base of the lung, and may exert very dangerous pressure upon it, or upon other organs. Moreover, the patient's general condition becomes much worse, the strength of the heart is impaired, and collapse from exhaustion is a possibility. This is especially the case when the empyema forms part of a general infection.

SYMPTOMS.—In a case of pleurisy, in which the sero-fibrinous exudate is becoming purulent, the following symptoms appear: Instead of decreasing, the fever becomes *hectic* (remittent); that is, it rises and falls with several degrees difference between the morning and evening temperatures, or between the temperatures at different times of the day. The patient suffers from *shivering fits*, and *night sweats* are common.

Leucocytosis—increase of the number of white corpuscles in the blood—makes its appearance.

Treatment.—

SURGICAL TREATMENT.—As soon as it is certain that pus is present in the pleural cavity, it is, usually, evacuated by operation under a general anæsthetic. A part of the 9th rib is resected, the cavity is cleared of pus, and a rubber tube inserted to maintain drainage. The tube is generally short and thick, but sometimes a long one is fixed into the wound by means of adhesive strapping or stitches, and its other end connected with a glass bottle or jar, which is placed on the floor beside the bed, so that the pus drains down into it.

PHYSICAL TREATMENT.—In treating empyema, we have to aim at the same objects as in pleurisy—that is, we have to prevent the development of adhesions which may bind down the thorax on the affected side in such a way as to produce a permanent deformity, and never to allow the lung to expand fully again. We have in this case, moreover, to consider not only the possibility of adhesions between the two layers of the pleura, but also in the more superficial tissues at the site of the wound—muscles, fascia, and skin—and here a contracted scar may cause irreparable mischief, as any worker who has seen the disastrous results of neglect in children very well knows. In

addition to this, we hope, in the early stages of treatment, to assist drainage, and prevent the pus from 'pocketing' in any locality. Empyema is a far more satisfactory condition to deal with than is pleurisy with effusion—that is, from the gymnast's point of view, since here we have free drainage from the pleural cavity; and the patients generally do extremely well. Some cases which have suffered from a severe general infection as well as the local lesion are too weak for early treatment; in the majority, however, the sooner it is begun the better.

First Treatment

The first treatment should be given forty-eight (or sometimes even twenty-four) hours after the operation.

Condition of Patient.—The patient is still very weak and ill, and due allowance must be made for this. He may be nervous, afraid to move or to be touched, and needs gentle persuasion and encouragement. Great care and consideration are necessary in dealing with anyone who has not yet fully got over the shock of an operation. The treatment should be very short, as the patient will tire very easily, even if massage only is given.

If the short type of drainage tube is being used, it will be found sloping rather downwards in the wound. The safety-pin across its end is wrapped in gauze to prevent its coming in contact with the wound and hurting the patient. Over the tube are placed several layers of gauze, and above these a large pad of cotton-wool. The whole is kept in place by a many-tail bandage. The patient lies propped up with several pillows.

The pulse should be taken before and after treatment, and noted down.

Removal of Bandages.—It is useless to try and obtain chest expansion with the bandage on, as it limits movement; and the drainage tube should also be removed during treatment, as it makes the patient cough and may cause pain.

The bandage is therefore unfastened in front—it need not be entirely removed—the tube is taken out, washed, and sterilized, so as to be ready to be replaced after the treatment. The wound is kept covered meanwhile with a pad of sterile gauze and another of wool, which may be secured by one or two strips of the bandage, pinned *loosely* across the chest. Later on, when the patient is doing more exercises, it may be kept in place by two strips of adhesive plaster (zinc oxide). The removal, cleaning, sterilizing, and replacement of the tube should only be done by the nurse in attendance; the masseuse should not attempt to do this, or to interfere with the dressings in any way, except in the matter of loosening the bandage, unless she has had experience of surgical dressings, or has been specially instructed by the doctor or nurse with regard to this matter.

Massage and Exercises.—If the patient is being treated twenty-four hours after operation, the same scheme as that for pleurisy with effusion may be given. It should not last longer than fifteen minutes at most.

Scheme I

1. Half-lying Breathing.
2. ,, 2-Arm-kneading.
3. ,, Breathing (or vibrations over thorax).
4. ,, 2-Leg-kneading.
5. ,, Breathing.

When the treatment is finished, and the tube, dressings, and bandage replaced, the masseuse should be careful to see that the patient's pillows are arranged in such a way that he is in a good position, with his chest expanded. Those

in attendance on him should be asked to see that this position is maintained, and that the thorax does not become compressed by the patient's slipping down in bed, with the head falling forward on the chest. Nor must he be allowed to lie bent towards the affected side.

SECOND TREATMENT

1. The pulse will be taken and noted as before. This is done as long as the patient is under treatment. His chart should also be studied.

2. The procedure with regard to the dressings and tube will be continued as long as the wound remains open.

3. Side-bendings may now be added, the patient keeping the arm at his side, and simply bending slightly away from the affected side.

4. Active movements may be begun. It is not necessary to start with very small joints, unless the heart is known to be affected. Many patients could do 2-Arm-raising sideways to the horizontal and single Leg-updrawing (free) at this stage. Weaker patients may begin with elbow and knee movements. A typical scheme would be as follows, for empyema of the *right* lung :—

Scheme II

1. Half-lying Side-bending to left with breathing.
2. Half-lying 2-Arm-kneading + 2-Arm-raising sideways to horizontal (4 to 6 times).
3. Half-lying Breathing (in own time).
4. Half-lying 2-Leg-kneading + single (alternate) Leg-updrawing (4 to 6 times).
5. As 1.

PROGRESS OF TREATMENT.—As the patient improves, the following alterations may be made :—

1. *Breathing Exercises.*—

a. When giving side-bending, the arm on the affected side may be placed in *neck-rest*, later in *stretch position.*

b. The side bending may be carried *a little further each day.*

c. Later, the patient may lie flat on his back, with legs and body bent towards the sound side (*'Whiting position'—see Fig.* 156, p. 372) while breathing, so as fully to expand the affected side of the thorax, and limit movement on the healthy side.

d. He may lie on his side with a large cushion under the sound lung, to exercise pressure on it and so oblige him to use the affected lung. (Side-lying with cushion Deep breathing.) This is an advanced exercise. (*See Fig.* 157, p. 372).

In any case, the respiration in the sound lung ought not to be hampered to any great extent as long as the wound is not healed.

In connection with this last point, one is often asked by students whether the lung on the affected side can expand as long as the wound remains open. Of course, it cannot do so as long as there is communication between the pleural cavity and the outer air, since while this is so, the pressure in the cavity will be equal to that in the lung, and the latter cannot expand unless the pressure outside it is negative. But the affected side of the *thorax* can still be enlarged by the muscles of inspiration, so that to give unilateral breathing exercises not only preserves the mobility of its wall, preventing contracture of scar tissue at the site of the wound, but stretches, or prevents the formation of, adhesions between the two layers of the pleura, by drawing the parietal layer, which is closely adherent to the chest wall, away from the visceral layer attached to the collapsed lung. To exert *slight* pressure on the sound side will result in increased inspiratory efforts, and increase the range of thoracic

movement on the affected side ; but obviously the sound lung must not be put out of action, or its expansion gravely hampered, as long as the other is still collapsed.

When the wound heals, the extra air left in the pleural cavity is gradually absorbed, until pressure falls to its normal level, that is, until it is slightly negative. Then the lung begins to resume its function—unhampered by contractures and adhesions if the treatment has been efficiently administered.

In the late stage it is permissible to put the sound lung partially out of action, in order to encourage full expansion of the thorax and lung on the affected side. Even then, however, we must not forget that the patient has two lungs, and ought ultimately to use them both equally. It is as well to give one double-sided breathing exercise in the scheme even in the early stages. Later on, the patient should be taught to breathe in all parts of both lungs—though the affected side needs special attention throughout. Diaphragmatic and inferior costal breathing are most important, since they expand the base of the lung, on which, in empyema, there has been most pressure ; but apical breathing should also find a place in the patient's scheme of exercises, since this is the part of the lung where tuberculosis is most likely to develop. Complete aeration of the part lessens the risk.

2. *Active Work.*—This may be advanced quickly as a rule.

a. By giving harder exercises, e.g., Half-lying 2-Arm-raising sideways to the horizontal may be replaced by Half-lying 2-Arm-bending and -stretching upward and downward.

b. By increasing the number of times each exercise is to be done, and the length of time for which it is done.

c. By adding resistance, e.g., resistance to an arm or leg exercise may be given by the operator, or in the former the patient may hold weights in his hands. (These should not, as a rule, exceed 2 lb.)

d. By adding trunk exercises, beginning with trunk-rotations and back-raisings (free at first). Exercises which impede respiration, i.e., strong abdominal exercises, should not be given at any time.

3. *Massage.*—Less time should be given to this as the active work is increased. Later it may be omitted altogether, except in the case of very weak patients. Chest-clapping and back-hacking may be given when the wound is healed. The area of the scar should be avoided.

After about 2 to 3 weeks the scheme might be as follows—again, for empyema of the right lung :—

Scheme III

1. 'Whiting position.' Breathing (bending to left). (*See Fig.* 156, p. 372).
2. Half-lying 2-Arm-bending and -stretching upward and downward (12 times a minute for 2 minutes).
3. Wing-tailor-sitting Alternate trunk-rotation (free).
4. Half-lying Deep breathing (inferior costal and diaphragmatic).
5. Wing-tailor-sitting Back-raising (vertebra by vertebra).
6. Half-lying (1 or 2 pillows only) Alternate leg-updrawing and -outstretching (16 times a minute for 2 minutes).
7. Half-neck-rest (or stretch-) half-lying (several pillows) Left side-bending with breathing.

When the Patient is Up

The patient should now advance as quickly as possible to quite vigorous exercises. He will begin walking, and the amount done should be increased by degrees as in a heart case, but the progress should be much quicker. Later on,

walking should be replaced by running, skipping, or jumping exercises, except in elderly people. It is desirable to make the patient slightly short of breath, so as to increase the range of respiration.

Scheme IV

1. Right-arm-stretch, left-arm-wing high-ride-sitting (or ride-sitting), Side-bending to left, with breathing.
2. Half-crook-half-lying Leg-outstretching (resisted).
3. Sitting 2-Arm-bending and -stretching upwards and downwards with 1 lb. weight (or quick 2-Arm-bending and -stretching in all directions).
4. Wing-stoop-stride-sitting Back-raising (concentric).
5. Crook-lying Apical breathing.
6. Stride-standing Quick Alternate trunk-rotation (arms swinging loosely).
7. Left-side-lying-over-cushion Chest-clapping + breathing.
8. Walking.
9. Sitting 2-Arm-circling with breathing.

NOTES ON THE ABOVE EXERCISES.—

Exercise 4.—Advance to Stretch-stride-standing Forward and downward bending, etc.

Exercise 5.—*See* LOCALIZED BREATHING EXERCISES (p. 370).

Exercise 8.—Advance by increasing the distance to be walked, and the rate of walking. Later substitute running, skipping, and jumping exercises (whip-jumping, etc.), running on the spot with knee-raising, dancing steps (coupé, chassé, etc.), and fancy marches.

Exercise 9.—(*See* BREATHING EXERCISES, p. 369). This may be given with relaxation during expiration and combined with diaphragmatic breathing.

From now onwards the patient may do any ordinary gymnastics of average strength according to his or her age and capacity. Special breathing exercises should be continued until the movements of the thorax are perfectly normal. The spines of all patients, especially those of children and adolescents, should be carefully watched for signs of scoliosis, though if the treatment was begun early, and carried out efficiently, this should rarely occur.

N.B.—In empyema, should the patient's temperature rise suddenly, after having been normal for a time, it will probably be because the drainage is not satisfactory, and pus is collecting somewhere within the pleural cavity. It is generally held that the physical treatment should be continued in spite of the fever, as active work increases the amount of pus, and often causes it to be discharged by breaking down the adhesions that keep it in. If the temperature remains raised, and the pus does not escape of itself, it must be liberated by the surgeon.

In pleurisy with effusion, where there is no drainage, physical treatment must be stopped immediately if the temperature rises.

V. EXAMPLES OF BREATHING EXERCISES

EXERCISES SPECIALLY FOR INSPIRATION

GENERAL EXERCISES.—

FREE EXERCISES (i.e., those which can be practised by the patient alone) :—

1. Crook-lying, half-lying, sitting, or standing Deep breathing.

The starting position is chosen according to the strength and condition of the patient. The breathing, in most cases, is at first commanded, that is, the operator gives the commands 'Breathe in' and 'Breathe out'. Then the patient breathes in his own time. Heart cases (*see* p. 311) must not breathe too deeply, and, as a rule, the breathing is not commanded at any stage.

2. Lax-sitting Chest-lifting and relaxing.

Similar to a free Back-raising vertebra by vertebra. There should, however, be no movement in the hip-joints, but only in those of the spine, which is completely relaxed during expiration, the patient letting the breath escape audibly through the mouth, as a deep sigh. *Fig.* 152 shows the position for expiration.

The movement may also be given in knee-sitting.

3. Sitting (or standing). 2-Arm-raising sideways, with breathing.

More relaxation may be obtained during expiration in the sitting position.

4. Standing (or sitting) 2-Arm-rotation-out, with breathing.

5. Standing (or sitting) 2-Arm-raising to shoulder level + rotation out, with breathing.

6. Yard-standing (or sitting) 2-Arm-rotation out + Head-extension with breathing (*Fig.* 153).

The patient starts with the head bent slightly forward, and the palms of hands downwards. He then turns the palms upwards, and carries the head backwards, a little beyond the upright position. A full head-extension must not be made. The teacher must guard against lordosis.

Fig. 152.

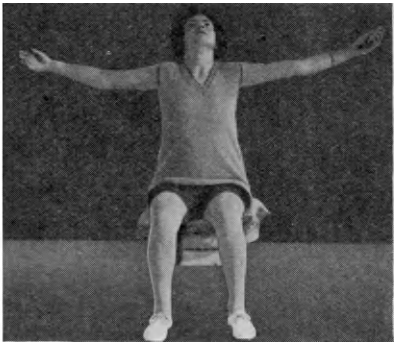

Fig. 153.

Figs. 152, 153.—Lax-stride-sitting Chest lifting and relaxing + 2-Arm-raising to shoulder level + rotation out + Head-extension.

7. Lax-stride-sitting Chest-lifting and relaxing + 2-Arm-raising to shoulder level + rotation out (+ Head-extension). This consists of No. 2 combined with No. 5 or No. 5 and No. 6. (*Figs.* 152, 153.)

8. Sitting (or standing) 2-Arm-circling with breathing.

The arms are carried forward and upward, then outward and downward. It is not advisable that they should be carried quite up to the vertical, as this almost invariably produces lordosis, which can only be prevented by strong contraction of the abdominals, which, of course, impedes respiration.

9. Sitting (or standing) 2-Arm-parting with breathing.

Swedish Exercises (requiring the assistance of a gymnast).—

1. Half-lying Chest-lift-stroking.
2. Lax-sitting Chest-lifting (in different planes).
3. Neck-rest- (or heave-grasp-) sitting Chest-expansion.
4. Heave-grasp-standing Forward-drawing.
5. Stretch-half-lying 2-Arm-bending and -stretching (with very slight resistance).
6. Wing-high-ride-sitting Circle-turning.

LOCALIZED EXERCISES.—

1. DIAPHRAGMATIC (ABDOMINAL).—

Crook- (or half-) lying Diaphragmatic breathing. The operator, at the patient's side, places her hand on his abdomen, telling him to push away her hand when breathing in. This entails relaxation of the muscles. He is told to draw in the abdomen when breathing out. Later, he places his own hands on his abdomen as he breathes.

2. COSTAL.—

Crook- (or half-) lying, or sitting Deep (costal) breathing. The operator places her hands over the lower or upper ribs, at the front or sides of the body, thus indicating to the patient the part which she wishes him to expand. Later, he may place his own hands on the part.*

3. DIAPHRAGMATIC AND COSTAL COMBINED.—

The operator, and later the patient himself, places one hand on the thorax

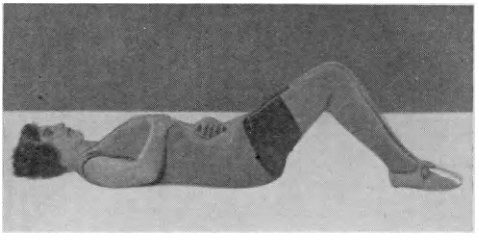

Fig. 154.—Position for diaphragmatic and costal breathing combined.

and one on the abdomen (*Fig.* 154). Co-ordination is not always easily acquired.

4. APICAL.—

Crook- (or half-) lying Apical breathing. The operator, standing behind the patient, places her fingers over the apices of the lungs, just above the clavicles, asking him to 'push out here'.

EXERCISES SPECIALLY FOR EXPIRATION

GENERAL EXERCISES.—

FREE EXERCISES.—

1. Lax-sitting (or knee-sitting) Chest-lifting and relaxing, with short inspirations and long expirations.

The 'lifting' is minimized, and the 'relaxing' emphasized.

2. Free breathing, with emphasis on expiration.

SWEDISH EXERCISES.—

1. Half-lying Chest-lift-shaking.

2. Wing (or lax-) stoop-stride-sitting Back-raising (vertebra by vertebra) with breathing.

3. Reach-grasp-stoop-stride-sitting Back-raising (in different planes.)

4. Lax-sitting Chest-lifting (in different planes); with emphasis on the expiratory part ot the movement.

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* The hands are placed in the same positions as in the corresponding expiratory exercises (*see* ASTHMA, p. 351).

LOCALIZED EXERCISES.—

1. DIAPHRAGMATIC.—

Crook- (or half-) lying Diaphragmatic breathing, given as described above, but the inspirations must be short, and the expirations long.

2. COSTAL (upper and lower).—

For description, *see* ASTHMA (p. 351).

EXERCISES FOR INSPIRATION AND EXPIRATION

All the free exercises given above in the list of inspiratory exercises may be used for this purpose, equal emphasis being laid on each respiratory phase. Nos. 3, 4, 5, 6, 8, and 9 should be given in sitting rather than in standing, since relaxation is easier in this position. The patient may be directed to draw in his abdomen during expiration.

Of the Swedish exercises, Chest-lifting, Chest-lift-stroking, Back-raising in different planes, are specially suitable. Circle-turning may also be given.

UNILATERAL BREATHING EXERCISES

These promote breathing especially, or only, in one lung.

TO EXPAND THE BASE OF ONE LUNG.—

1. Half-lying Diaphragmatic breathing.

The patient may bend very slightly to the sound side. The arm on this side may be held close to the body, with the forearm across the chest, the operator supporting it in this position. The exercise is then taught in the usual way (*see above*).

2. Half-lying Costal breathing.

The patient's position is as above. The operator places her hand on the ribs of the affected side, and tells the patient to push it away.

3. Half-lying Diaphragmatic and Costal breathing. The above two exercises combined.

4. The above exercises (Nos. 1, 2, and 3) in sitting (later).

PROGRESSION (on Exercises 1–3).—

5. Half-lying Side-bending (e.g., to the left if the right lung is affected) with breathing.

The arm on the affected side to be (*a*) at the patient's side, (*b*) in neck-rest, (*c*) in stretch.

6. The same exercise, in stride-sitting. (Later.)

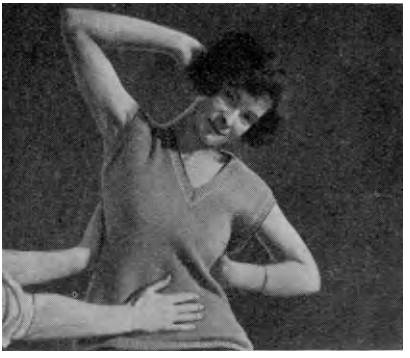

Fig. 155.—Exercise to expand the base of the right lung. Right-neck-rest-stride-sitting Side-bending to the left with breathing. The patient places her left hand on her ribs so that the bending may take place in the thoracic, and not in the lumbar, region. The operator has one hand on the ribs of the affected side, and one on the abdomen. The patient is told to push both hands away.

7. Stride-sitting Side-bending, combined with Diaphragmatic breathing (*Fig.* 155).

8. Side-lying Deep breathing.

The patient lies on the sound side (he need not at first lie quite flat—*see* p. 356). The patient's arm, or a soft cushion, is kept between the thorax and the bed or plinth on which he lies, in order to put the sound lung more or less

out of action. The position of the arm on the affected side is as in the previous exercises (Nos. 5 and 6).

LATER.—

9. 'Whiting position' (*Fig.* 156). (*See* p. 366).

Fig. 156.—'Whiting position.'

10. Side-lying with cushion Deep breathing (*Fig.* 157). The size and hardness of the cushion is now increased. (*See* p. 366).

11. Half-wing-half-stretch-stride-standing Side-bending.

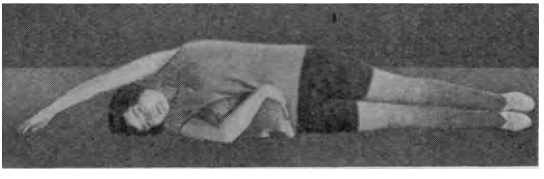

Fig. 157.—Side-lying with cushion Deep breathing.

SWEDISH EXERCISES (with assistance by operator).—

1. Half-wing-half-neck-rest (later, -stretch) high-ride-sitting Side-bending with breathing,

2. Half-wing-half-neck-rest (later, -stretch) high-ride-turn-sitting Side-bending with breathing.

3. The same exercise, in hip-support-standing.

4. The same exercise, in hip-support-turn-standing.

CHAPTER XXIII

ABDOMINAL AND PELVIC CONDITIONS

I. Abdominal conditions: Chronic gastritis—Dilated stomach—Gastric and duodenal ulcer—Enteritis—Colitis—Marasmus in infants—Appendicitis—Constipation—Cirrhosis of the liver—Defective action of the liver—Chronic nephritis—Visceroptosis. II. Pelvic conditions: Enuresis nocturna in children—Disturbances of menstruation—Pregnancy and the puerperium—Phlegmasia alba dolens.

I. ABDOMINAL CONDITIONS

CHRONIC GASTRITIS

CHRONIC inflammation, or catarrh, of the stomach.

ETIOLOGY.—

CAUSES.—

1. Hereditary or family predisposition.

2. The *taking of unsuitable food* is the principal cause. Irritating substances such as alcohol, very acid or very salt foods, foods taken too hot, or any indigestible articles of diet may be the occasion of the trouble. Over-eating, hasty meals with insufficient mastication, or irregular meals, taken at all sorts of times, may also be responsible.

3. Chronic gastritis is often found *in conjunction with constitutional diseases*—gout, diabetes, tuberculosis, or anæmia; also with such as hinder venous return through the portal system—heart, lung, kidney, or liver trouble. It may also be associated with cancer of the stomach, or with dilatation of that organ—of which latter condition it may be either the effect or the cause.

4. Sometimes the *chronic* form follows the *acute*.

PATHOLOGICAL CHANGES.—

1. Some articles of food are in themselves irritating, while others, not being easily digestible, remain a long time in the stomach and tend to ferment. Both of these classes of foods set up an *inflammation of the mucous membrane*. It becomes hyperæmic, and there is an excessive secretion of mucus, which blocks up the mouths of the tubular glands which secrete the gastric juice. The *cardiac* glands, which produce not only pepsin but hydrochloric acid, are most affected. With the deficiency of this acid, greater fermentation occurs, since the proper disinfection does not take place. So is the 'vicious circle' of gastritis set up—deficiency of hydrochloric acid leads to fermentation, this to increased irritation and inflammation—and this to still further blocking of the glands and decrease of hydrochloric acid.

2. Later, the *muscular coat may become involved*. This causes dilatation and weakness of the walls of the stomach, so that muscular action—the normal tonic contraction and peristalsis—becomes less efficient. Hence the food remains yet longer in the stomach, and this gives still further occasion for fermentation. The 'vicious circle' is even more firmly established.

3. Later still, *the blocked glands begin to degenerate*. The connective tissue

between them increases, narrowing their orifices. Small ulcers sometimes appear. Finally, the whole mucous membrane may be destroyed. The patient depends entirely on intestinal digestion.

SYMPTOMS.—These vary in severity. There is *no fever* as a rule, though acute attacks may occur in the course of the disease, the temperature being slightly raised. The *appetite* may be bad, or may vary, and the patient may have a desire for strong condiments or highly flavoured dishes. *Pain comes on after food*, with tenderness over the epigastric region. The patient suffers from heartburn (pain localized beneath the sternum), flatulence, and constipation, or sometimes diarrhœa. Nausea is common and vomiting occurs occasionally. The *tongue is furred*, the patient complaining of a bad taste in the mouth. *Wasting* takes place, but is not so marked as in enteritis, except in very severe and advanced cases. There may be *headache*, *depression*, or even *giddiness*. Sometimes *functional symptoms* occur in addition to the organic ones.

Treatment.—

GENERAL TREATMENT.—

1. Rest and correct diet are the most important features. The doctor will prescribe the latter, which will vary in accordance with the severity of the case and the idiosyncrasies of the patient. In some cases, milk only is given for a time.

2. Appropriate treatment for the nervous condition of these cases is sometimes needed. Change of scene, or of occupation, often helps the patient, who must be encouraged and helped to take his mind off his ailments.

3. Proper exercise and a regular life are most necessary.

PHYSICAL TREATMENT.—The aims are :—

1. To improve portal circulation and reduce hyperæmia of the stomach.

2. To break up the mucus adhering to its walls.

3. To stimulate the cells of the mucous coat and so bring about a more copious secretion of digestive juices.

4. To strengthen the muscular fibres of this organ—and incidentally those of the whole alimentary tract—so as to increase motor activity, and accelerate the onward passage of its contents.

MASSAGE.—Very weak patients with much wasting should receive *general massage*, the manipulations being at first very gentle, though not superficial. Effleurage, pétrissage, and light hacking may be used on the limbs and back. The massage will become more vigorous as the patient gains strength.

Abdominal massage needs care. General kneading of the abdomen, rolling of the small intestines, and colon kneading and frictions, with gentle vibrations or shakings, are all effectual. As regards treatment of the stomach itself, very gentle and rhythmic work is required. Stroking, which not only helps to pass along the contents of the alimentary canal by mechanical means, but also probably initiates a reflex which brings about peristalsis, is most important. It is done in the usual way, from the cardiac to the pyloric end. The probability of the stomach's being dilated must be taken into consideration ; if this is so, the organ will be much lower in the abdomen than is normally the case (*see below*, DILATED STOMACH). The stroking is followed by kneading, after which stomach-shaking is given, i.e., vibrations with the hand lying flat first over the lower ribs, and then below the costal margin. In the latter situation the hand should exert an upward pressure. Stomach-pit-shaking, as described in the text-books, may also be given.

Liver massage and frictions to the gall-bladder may be added carefully a few days later. The former is rather vigorous for a weak patient, and unless

it is done vigorously, it is hardly worth while to do it at all. Its effect should be watched, and it must be omitted if it proves too strong.

We must not forget to deal adequately with the whole of the abdominal wall, in order to improve the nutrition of the muscles (*see* CONSTIPATION, p. 383).

If the patient should happen to have an attack of diarrhœa, massage should be temporarily suspended, or should consist only of fine vibrations and very careful kneadings. For constipated patients, Arm-lean-sitting Sacral-beating may be tried.

EXERCISES should be begun as soon as possible, the massage being reduced gradually, and spaced in between the exercises. Limb and back massage may be omitted as the patient grows stronger, and abdominal massage need consist of general abdominal kneading only, which will finally be omitted altogether.

1. The exercises will consist of a '*general strengthening*' table, special attention being paid to movements for the improvement of portal circulation, and the cure of constipation.

2. All *trunk movements* help portal circulation, and should be given freely, provided they are graduated according to the patient's strength. The abdomen ought not, however, to be *repleted* even if the patient suffers from constipation, since the stomach is already hyperæmic. Therefore, any abdominal or other exercises which would tend to bring additional blood to this part of the body should be performed in starting positions which counteract this tendency.

3. Since these patients are always liable to be *constipated*, *special exercises for this condition* are necessary. The list on pp. 395–397 may be consulted. All those in Class I, except perhaps the repletive adductor exercises, are quite suitable. Of Swedish exercises, Heave-grasp- or wing-stoop-stride-sitting Alternate trunk-rotation (which induces peristalsis by associated movement), Leg-rolling with an upward jerk, Arm-lean-standing Sacral-beating, Wing-standing Alternate knee-upbending (done quickly) are specials. Free exercises of a similar type may, of course, be substituted. Wing-stoop-stride-sitting Screw-twisting is said to be good for loosening mucous deposits. Back-raisings and passive trunk movements, such as trunk-rolling, and circle-turning should also find a place in the scheme.

4. *Breathing exercises* should be freely given, since these help the portal circulation by the downward pressure of the diaphragm on the liver, and by increasing the suction action of the thorax.

The patient should advance to as strong a general scheme of exercises as he can manage without fatigue or discomfort. But all such cases require care and watchfulness on the part of the masseuse.

DILATED STOMACH

ETIOLOGY.—

AGE.—The condition is commonest in middle-aged or old people, and in rickety children.

CAUSES.—

1. Obstruction of the pylorus by ulcers, tumours, etc.

2. Weakness of the muscular coat of the stomach (atonia) due to gastritis, debilitating diseases, or persistent overloading of the stomach with food or liquids.

3. Disturbances of innervation, in which case the dilatation may form part of a general visceroptosis, and the usual neurotic symptoms are present.

PATHOLOGICAL CHANGES.—In the ordinary cases of atonia, peristalsis is deficient, so that the food does not leave the stomach quickly enough. In the cases due to gastritis there are also changes in the gastric juice, which slow

the digestive processes, while the deficiency of hydrochloric acid results in insufficient stimulation of the pyloric sphincter, so that it is slow to open. (It will be remembered that the sphincter opens when the contents of the stomach are *acid*, while those of the duodenum are *alkaline*.) In either case, fermentation takes place, giving rise to the formation of gases, and thus producing flatulence and abdominal discomfort.

SYMPTOMS.—These occur at intervals. In *atonic* dilatation they may be slight or even absent, but they may also be very severe. In other cases, they resemble those of visceroptosis. (*See* p. 393.)

The symptoms and signs in *obstructive dilatation*—with which we, as masseuses, are little concerned—and in *very severe cases of atonic dilatation* are as follows:—

1. Dyspepsia, abdominal pain (flatulence), or discomfort.
2. Vomiting of large quantities of liquid, and undigested food.
3. Constipation.
4. Wasting and emaciation.
5. The abdomen is distended and prominent; the outline of the enlarged stomach can sometimes be seen.
6. A splashing sound can be heard if the patient's body is shaken. This will still occur some hours after a meal, when the stomach should normally be empty.

Treatment.—

The treatment is primarily that of the cause. The obstructive form calls for surgical intervention.

GENERAL TREATMENT (of the atonic form).—

DIET.—The patient should eat only small quantities of food at a time, and should decrease the amount of carbohydrates and fats in his diet, as both of these give rise to fermentation. Much liquid should not be taken.

PHYSICAL TREATMENT.—

1. The *obstructive form* is not suitable for treatment of this kind, at all events until after operation. Obviously, *malignant tumours* contra-indicate the employment of physical methods. After recovery from a *gastric ulcer*, treatment may sometimes be begun, or resumed, but the region of the stomach should be entirely avoided in giving massage. If any treatment, apart from massage, is possible in the case of these patients after operation, it will consist of a general scheme of exercises, with gentle movements for the abdominal wall, all strain or stretching of the affected part being avoided.

2. With the *atonic form* it is easier to deal.

a. If *the dilatation is due to chronic gastritis* the treatment is the same as for that condition.

b. In cases *where there has been no inflammation*, i.e., in those due to overeating, to weakening illnesses, debility, or faulty innervation, the measures adopted may be rather more vigorous, the patient's health, of course, having been taken into consideration. We need not, in such cases, fear to replete the abdomen to a certain extent. The treatment described below is applicable to this type of case only.

Our first aim is to assist the stomach to empty itself. This we shall do both by mechanical means, e.g., stroking, and by reflex stimulation, e.g., by vibrations, which should produce contraction of the muscular fibres of the organ. We shall also hope to strengthen the muscular coat—as well as the glandular coat—by increasing its nutrition; and, by improving the tone of the fibres, remedy, at least in part, the dilatation.

POSITION OF PATIENT.—It is best to adopt the visceroptosis position (*see* p. 394).

MASSAGE.—

General Massage is advisable for weak patients, or in severe cases.

Abdominal Massage should be stimulating, though never too heavy. In the early stages, or in severe cases, gentleness is essential. The massage should consist of stroking, kneading, and vibrations. At a later stage, shaking and hacking are added if the patient can bear them. The movements, as in visceroptosis, should all be in an *upward* direction. The actual position of the stomach should be known by the operator, and the stroking should follow the course of the greater curvature, with a lifting movement.

EXERCISES.—As in gastritis (p. 375), exercises to improve the portal circulation, to increase peristalsis, and to strengthen the abdominal muscles are given. Constipation must be treated, if present. Many of the easier exercises for visceroptosis may be used, but the operator must be content to go slowly with this type of patient. The abdomen should not be repleted in cases due to gastritis. No harm is likely to come of using the flexor and adductor muscles of the hip, but the arch position is not suitable.

GASTRIC AND DUODENAL ULCER

In both these conditions physical treatment is contra-indicated. A few words, however, are necessary with regard to their symptoms, in case such should occur in a seemingly chronic case of gastritis. Any unusual feature in an abdominal case necessitates an immediate report to the physician.

ETIOLOGY.—

AGE.—Gastric ulcers are most common in young anæmic women between the ages of 15 and 25. Duodenal ulcers are commoner in men, and occur at a later age, generally between 30 and 50.

CAUSE.—The ulcer is probably due to an infection. The mucous membrane is in an unhealthy condition, and is irritated by the acid gastric juice.

PATHOLOGY.—The gastric ulcer is generally situated at the pyloric end of the stomach, or on the lesser curvature. As it heals, the scar tissue may shrink to such an extent as to cause serious deformity of the organ ('hour-glass stomach'), which may bring about obstruction. Other dangers are hæmatemesis (hæmorrhage), or perforation of the stomach, leading to peritonitis.

SYMPTOMS.—The trouble may assume a serious form without any very marked early symptoms. Perforation or hæmorrhage may be the first definite signs of it; or the onset of symptoms may be more insidious. The following are the most common :—

GASTRIC ULCER.—

1. *Pain*, in the epigastric region, coming on immediately after a meal. This is because the ingestion of food causes an outpouring of gastric juice, the acid of which irritates the ulcer.

2. *Vomiting* after food. This generally relieves the pain.

3. The patient's *appetite* is good, but she is afraid to take food because of the pain which results. Therefore she grows weak, and wasting takes place. The latter is not often pronounced.

4. *Hæmatemesis.* The vomited blood may be dark in colour (i.e., typical of hæmorrhage from the stomach), but this is not always so, as it may be thrown up before it has time to be changed by the action of the gastric juice, or mixed with food particles.

DUODENAL ULCER.—

1. The *pain* in this case is in the right hypochondriac region, and *comes on two to four hours after food*, that is, when the acid chyme begins to pass from the stomach into the duodenum. It is relieved by eating, as the taking of food

reduces the acidity of the stomach contents, so that the pyloric sphincter remains closed.

2. Hæmatemesis is not common, but there may be *passage of blood from the bowel.*

PERFORATION.—Should this take place, there is a sudden attack of intense pain, the abdominal muscles go into spasm, the patient becomes faint, with quick, weak pulse and an anxious and distressed face.

Treatment.—

PHYSICAL TREATMENT is contra-indicated in these cases, and must be discontinued if it was being previously given for a chronic gastritis, or any other condition. Sometimes, when an ulcer is completely healed, it may be very cautiously resumed in order to deal with the dilatation of the stomach which may have arisen.

HÆMATEMESIS (First-aid).—Should an attack take place without warning in the presence of the gymnast, she should lay the patient down at once, with the head and trunk well raised. No attempt should be made to take the patient to her bedroom, or elsewhere, before the arrival of the doctor; she should be moved as little as possible. The windows should be opened, and the patient's clothing loosened. An ice-bag, if obtainable, should be placed over the pit of the stomach. *Nothing should be given by the mouth.*

ENTERITIS

Inflammation of the intestines, the most prominent symptom being diarrhœa. It must be remembered that often both the small and large intestines are affected. Colitis (i.e., inflammation of the colon) is frequently present at the same time as enteritis (often understood as inflammation of the *small* intestines alone).

ETIOLOGY.—

CAUSES.—

1. Improper or irritating food; in children it is often occasioned by eating unripe fruit.

2. Infections of various kinds.

3. Toxins, e.g., such as are found in certain kinds of decomposed foods; or poisons.

4. Sudden changes of temperature, producing chills.

5. Enteritis often occurs in connection with certain other diseases, e.g., typhoid fever, cirrhosis of the liver, lung, heart, or kidney diseases.

6. It may be caused by the unwise use of aperients.

7. 'Nervous' enteritis is not a true catarrh. It results from a disturbance of the vagus nerve, the motor (accelerator) nerve of the intestines, causing increased movements and secretion, and is due to emotions, generally to fear.

Enteritis, like gastritis, may be acute or chronic.

PATHOLOGICAL CHANGES.—In the acute form of the disease, the mucous membrane is hyperæmic, swollen, and softened; in the chronic, it is firmer, and may be thickened or thinned. Small ulcers may develop, especially in the colon. There are changes in the intestinal juice (succus entericus), which cause indigestion. The injury to the cells of the mucous coat also interferes with absorption of the foods.

SYMPTOMS.—The *acute attack* usually lasts from 2 to 10 days. Recovery generally takes place. In fatal cases, the patient dies of collapse. It is characterized by diarrhœa, colicky pain, loss of appetite, and intense thirst. The temperature is not raised, or only slightly so, but the pulse is quickened.

CHRONIC ENTERITIS.—This may follow an acute attack, or the disease may be of the chronic type from the outset.

There may, or may not, be *pain*. *Diarrhœa*, as in the acute variety, is the most marked symptom; it may alternate with *constipation*. *Emaciation* is pronounced, since much of the food is not digested, and what is digested is imperfectly absorbed. The *complexion* is pale, and has a muddy appearance. The patient often suffers from *depression* or *neurasthenia*.

Treatment (of the chronic form).—

GENERAL TREATMENT.—Rest in bed for a time is often advised, with appropriate diet. When the patient gets up, she should wear warm clothes, and eat very simple food, avoiding any particular article which appears to cause trouble. In the neurasthenic form, the patient's general condition must receive attention.

PHYSICAL TREATMENT.—This resembles the treatment given for GASTRITIS (p. 374).

MASSAGE.—

1. *General Massage* is almost always necessary. If wasting is extreme, it must be carried out very gently and carefully, and tapôtement must be omitted.

2. *Abdominal Massage.*—

a. If the patient is suffering from constipation at the time, the massage used may be similar to that for GASTRITIS (p. 374) except that in this case very gentle manipulation only should be carried out over the small intestines and colon. Deep and heavy frictions must not be given to the latter; gentle kneadings and rhythmic strokings are the best movements.

Liver massage should not be undertaken without the advice of the physician. To stimulate this organ, and thus increase the secretion of bile, might cause diarrhœa, since bile is an irritant to the muscular wall of the intestine, and increases peristalsis. If the secretion of bile is deficient, liver massage may be useful. It is, however, often over-strenuous for a weak patient.

Transverse-abdominal-shaking, lumbar-side-shaking, and screw-twisting are recommended by Arvedson. If used at all, they should be given with much discretion.

b. During a period of diarrhœa, abdominal massage is best omitted, or fine vibrations only should be given.

EXERCISES.—These are similar to those for gastritis, if the patient is constipated. If she is suffering from diarrhœa, exercises *definitely depletive to the abdomen* are recommended by some workers—such as Crook-half-lying 2-Knee-parting and -inpressing, with pelvic-lifting; or Stoop-stride-sitting 2-Arm-bending and -stretching. Certainly, abdominal exercises which increase peristalsis ought to be omitted. If the diarrhœa is very troublesome, it is often better to discontinue treatment for a day or two. The patient with enteritis is generally weaker and in worse health than the sufferer from gastritis; this fact must be taken into account.

COLITIS

Mucous colitis, as distinct from enteritis, is a disease of the colon, generally —though not invariably—found in nervous or hysterical patients.

PATHOLOGY.—An abnormal amount of mucus is secreted in the large intestine. It adheres to the inner surface of the viscus, forming a kind of membrane, and is passed with the excreta in the form of strips, often very long ones. These also contain endothelial cells from the mucous coat itself.

SYMPTOMS.—The attacks come on at intervals and in paroxysms, with colicky pain; or the patient may have *crises* in which the symptoms are like those of appendicitis. The attacks are brought on by shock or worry, or by

an error in diet. As in enteritis, constipation or diarrhœa may be present, either being due to nervous causes. As a rule, parts of the colon are in a state of spasm. The condition is rarely dangerous, but is extremely distressing and alarming to the patient.

Treatment.—

GENERAL TREATMENT.—The patient should avoid fatigue, mental or physical, and should be reassured as to her condition. The neurasthenia, if present, should receive attention, and suitable food will be prescribed.

PHYSICAL TREATMENT.—The cases in which the neurotic element is slight or absent may be dealt with in the manner described above, as ordinary cases of enteritis. The cases with disturbances of innervation are more difficult to treat.

Dr. Mennell* bases his treatment on two facts : (1) That parts of the large intestine are almost always found to be in spasm, and (2) that the patient instinctively seeks relief from pain by the application of warmth to the back, e.g., by sitting with her back to the fire. He, therefore, advises massage of the back, of the type used for neurasthenia, that is, consisting of soothing strokings only, the patient being treated in a warm room, and kept adequately covered during treatment ; and he finds that these measures rarely fail to bring relief.

General massage, if given, should be such as is suitable for a neurasthenic case ; if necessary, the patient must be treated for insomnia.

MARASMUS IN INFANTS

This is a condition often encountered in children's hospitals. The child is apparently unable to take food of any kind without suffering from dyspepsia. It loses weight rapidly, becomes very emaciated, has a wrinkled skin, and a wizened face, the mouth appearing abnormally large ; and, in fact, the poor little thing is a pitiable object. Sometimes, it seems to be some element in the food, rather than all food, that the child is unable to take—generally the fats. Often one form of food after another is tried and fails, until something at last seems to suit the child. In other cases, the child simply wastes away and dies. The disease is a most distressing one for all concerned, the baby often gaining a few ounces one week, only to lose them again the next.

While the attempts to find a satisfactory food for the child are in progress, or after the condition begins to improve, the baby is sometimes ordered massage. The author has not had an extensive experience of this condition, but the improvement in the cases she has treated, or seen treated, has led her to believe that much might be done in this direction. All the infants began to gain weight whilst under treatment, except one in whom other complications were present, and while this fact is no proof of the actual efficacy of massage in these cases, it seems to make it worth while to give such measures a trial.

The baby should be kept warm, and treated before a fire in winter. He should be given a gentle—and short—general massage. Olive oil is sometimes rubbed in during, or after, massage. Obviously, the treatment must not be administered for at least an hour after the baby's last feed ; nor is it advisable to treat him just before taking food.

Artificial sunlight has also been tried.

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* *Massage, its Principles and Practice*, 2nd edition, Chapter XXVII, pp. 398–400.

APPENDICITIS

Inflammation of the vermiform appendix.

ETIOLOGY.—

AGE.—Appendicitis is commonest in young people, especially in those under the age of 20.

CAUSE.—The cause of this disease is bacterial infection of the appendix, the surface of which has been injured by hardened masses of fæces, which easily become lodged in the narrow tube, or, rarely, by a foreign body.

PATHOLOGICAL CHANGES.—The disease may be acute or chronic. It may consist simply of inflammation (catarrh) of the appendix, or may go on to ulceration or even gangrene of that organ. In the ulcerative form, there is danger of perforation, and if this occurs it may infect the peritoneum and set up *peritonitis*. In the chronic form the appendix becomes bound down by adhesions to the surrounding intestines, ileum, and cæcum, and this may result in *obstruction*.

SYMPTOMS.—The symptoms of the attack consist of *severe pain*, first right across the front of the abdomen, and later in the region of the appendix itself; *fever* (100° to 102°); *furred tongue*, *constipation*, and *vomiting*. Slight cases may recover completely in a short time, but the attack is liable to recur.

Treatment.—

SURGICAL TREATMENT.—Operation is now the recognized form of treatment, since even a mild type of appendicitis may become dangerous at any time, and recurrence is the rule. In serious cases the patient's life may depend on early operation, since once perforation has occurred and peritonitis set in his chances of recovery are very small. The operation is generally performed within thirty-six hours or so of the onset in acute cases, and between the attacks in chronic cases.

PHYSICAL TREATMENT.—This should be *post-operative only*. To treat even a chronic case before operation is to take too great a risk.

The main point is the *prevention, or cure, of constipation*. This has probably existed before the actual onset of the appendicitis, and is, in fact, its cause. The cæcum and colon have not been doing their work satisfactorily, and are dilated. The trouble will be aggravated by the inflammation in and around the appendix, and by the inevitable adhesions which form after the operation: and it will become even greater if the abdominal muscles are allowed to grow weak.

We shall, therefore, have to devote our attention to *assisting the passage of the intestinal contents*, especially in the region of the cæcum and ascending colon, and to improving as far as possible the nutrition and tone of these parts of the large intestine; as well as to *strengthening the voluntary muscles*. The weakness of the abdominal wall in the area of the incision has, of course, to be taken into consideration. In severe cases, where illness has been prolonged, '*general strengthening*' becomes an important feature of the treatment.

In the *early stage*, while the wound is still unhealed, all that can be done, if the patient suffers from flatulence, is stroking and kneading of the descending colon, especially in its lower part; vibrations in this region have also been recommended. *Later, when the wound is firmly healed* (in ordinary cases 14 to 21 days), the following methods may be adopted:—

MASSAGE.—Careful abdominal massage may be given, avoiding, of course, any movement that could cause pain. The stomach and small intestines are treated; liver massage is better omitted for a time. Kneading of all parts of the colon is most important, especially of the cæcum; but though

kneading, stroking, and frictions of the latter ought to be deep enough to have a definite effect on it—that is, to empty it, and stimulate the muscular fibres of its wall to contraction—nevertheless, great care and gentleness are essential. In an *old case*, months after operation, a general abdominal massage can, as a rule, be carried out without the least discomfort to the patient.

The *scar*, if adherent to the deeper layers should be treated in the usual way, gentle frictions being given towards it. Later, it may be drawn gently away from the underlying tissues, or held between the fingers of the operator's two hands while the patient contracts his abdominal wall.

The author does not personally consider that any attempt to 'stretch adhesions', i.e., between the organs, by massage manipulations as suggested in some text-books, is useful or desirable.

EXERCISES.—As soon as the wound is firmly healed, gentle abdominal exercises, such as Crook-half-lying Alternate trunk-rotation with arm flexion across chest (p. 396), head-raisings, and abdominal contractions may be performed by the patient, with breathing exercises (not too deep), contractions of the glutei and sphincter ani, and of the adductors (*see* pp. 395, 401), arm exercises, and gentle leg exercises. The patient will probably get up for the first time in about a week, or even less (in an ordinary uncomplicated case), or in a more serious case in about a fortnight, but the abdominal exercises are best given in lying or crook-lying for a time.

In the later stages, as the patient improves, a '*general strengthening' treatment* is given on the usual lines, but for a time stretching of the right side of the abdomen should be avoided; e.g., such exercises as trunk-rolling should be done in sitting, or in right step-standing, while arch positions or any others involving strain should be avoided. Arm, leg, and breathing exercises are continued.

Special *abdominal exercises* are given to increase peristalsis, improve portal circulation, and restore the tone of the abdominal muscles. The same may be used as for early visceroptosis cases, e.g., all trunk-rotations (except those in arch position), pelvic-rotations, abdominal contractions and breathing, forward-bendings in long-sitting or -standing, alternate hip-updrawings, active trunk-rollings, side-bendings with the hand on the ribs (*see* p. 399), etc.

Stronger exercises are added as the condition of the patient's muscles improves. Care must be taken at first in giving side-bending to the *left*, unless the movement is entirely restricted to the thoracic region.

In most cases, abdominal massage should be continued for some time—especially if there is trouble as regards constipation.

Precaution.—Exercises which entail very strong static contractions of the abdominal muscles, e.g., Trunk-raising and backward-falling should not be allowed in the early stages, or indeed for some time. In such exercises the main work is done by the recti abdominis, and the vertical fibres of the external and internal oblique muscles at the sides of the abdomen; while the oblique fibres of these muscles and the horizontal fibres of the transversalis are not fully contracted. The scar, situated as it is between the outer border of the rectus and the vertical fibres of the obliques (i.e., in that part of the abdominal wall which is not in full contraction), forms a weak point, and there is a certain risk, though perhaps not a very serious one except in the early stages, of a hernia (rupture) taking place.

CONSTIPATION

Delay in the passage of the contents of the intestinal tract, occurring most frequently in the colon. It must not be forgotten, however, that in order to secure normal evacuation, *all parts* of the alimentary canal must be in a healthy condition, and functioning efficiently.

PHYSIOLOGY.—The food begins to leave the stomach in from two to four hours after the taking of a meal; it begins to pass from the small intestines into the colon in four to five hours; and the waste material is finally expelled from the rectum in from twelve to twenty hours. The stimulus causing the passage of this material from the sigmoid colon to the rectum is generally the entrance of a new meal into the stomach. The distension of the rectum by the fæces gives rise to the desire for evacuation, which takes place by means of relaxation of the sphincter ani and the unstriped muscular fibres of the sigmoid colon and rectum, and of voluntary contraction of the abdominal muscles and those of the pelvic floor (levator ani, etc., *see* pp. 391, 392), these muscles being supplied by the sympathetic nerves from the hypogastric plexus (inhibitory), and by the pelvic visceral nerves, i.e., the anterior primary divisions of sacral 2 and 3 (motor).

Unhealthy conditions of any part of the canal, as well as the ingestion of unsuitable foods, may be the cause of constipation, since either may occasion delay of the passage of the food or waste material from one organ to another. If there be *insufficient secretion of juices*, causing fermentation of the food, *deficient motor activity* of the muscular coats, so that the food is not propelled onward quickly enough, or *disturbed innervation* leading to uncontrolled action of the intestinal muscles, the result will be constipation, or the opposite condition, diarrhœa—possibly an alternation of the two. (*See* GASTRITIS, ENTERITIS, etc.). Deficient peristalsis has many causes, a very common one being *weakness of the abdominal muscles*. These should normally increase peristalsis by associated movement, as well as hold the viscera firmly in place.

ETIOLOGY.—

CAUSES.—Since constipation has to be treated according to the nature of its origin, the latter must be considered in some detail. The following are common causes:—

1. *Weakness of the Abdominal Muscles*, due to debility, obesity, pregnancy, or lack of proper exercise. Weakening diseases and abdominal operations affect both the abdominal and the intestinal muscles.

2. *Sedentary Habits, Combined with the Taking of too much Food.*

3. *Errors of Diet.*—Food that leaves too little residue after all the digestible parts have been absorbed may cause constipation, because *distension* of the colon is necessary in order to set up the reflex which produces movements of its walls; food that leaves an over-irritating residue may bring about a similar result because this causes *spasm* of the colon. The food may not contain enough fluid, and so the fæces are too dry. This may also be the effect of abnormal loss of fluid from the body, by excessive perspiration, vomiting, or the secretion of an increased amount of urine, as in diabetes.

4. *The Continual Use of Aperients*, which irritate both the mucous coat of the intestine and the sympathetic nerve-endings; so that the bowel, thus over-stimulated, will no longer act without similar violent stimuli.

5. *Irregular Habits*—that is, neglect of the daily call to defæcation. This leads to *extinction of the impulse* normally produced by the tension of the rectum. This organ becomes permanently distended, and the impulse is no longer felt unless the distension is extreme. This neglect is a common cause of constipation, especially in children, and persons whose occupation leaves them but little time for the discharge of the natural functions. Its harmful results have been assiduously pointed out by Sir Arbuthnot Lane.

6. *Affections of the Alimentary Tract itself*, or of other organs connected with the digestive functions, which interfere with the secretion of the juices, or the movements of the intestines, such as chronic gastritis or enteritis, weakening illnesses, acute fevers, anæmia, Bright's disease,

liver complaints, or portal congestion; also various forms of poisoning, especially by lead.

7. *Intestinal Stasis*, that is, a complete or partial blocking of the calibre of the intestine is also, of course, a cause of constipation. The obstruction may be due to tumours in or round the intestines, to adhesions between their coils, or to 'kinking' in cases of visceroptosis (*see* p. 393).

8. *Nervous Conditions*, either organic or functional:—

a. Organic, i.e., injury or disease of the central nervous system, involving the cells in the grey matter of the spinal cord which supply the muscles used in defæcation (the rectal centre), or some part of the upper motor neuron between the brain and this centre.

b. Functional, as neurasthenia or hysteria.

Spastic Constipation is a troublesome condition in which part of the bowel goes into a state of cramp or spasm. It generally occurs in hysterical or neurasthenic patients, in old people, or after chronic dysentery or colitis.

SYMPTOMS.—These may or may not be marked. In some cases they seem to be slight or absent; but in others we find *headache, loss of appetite, general abdominal discomfort, gastric disturbance, lassitude, depression*, or *vertigo*. In some cases, hard masses of fæces may be felt lying in some part of the colon, generally in the left iliac fossa. In girls the *complexion* may become 'muddy', and *acne* may develop. There may be *dysmenorrhœa*, owing to pressure of the overloaded rectum on the uterus. There may also be pressure from the pelvic colon on the nerves of the lumbar, or, more often, the sacral plexus causing *neuralgic pain* down the front or the back of the thigh. *Hæmorrhoids* are sometimes a complication.

Sir Arbuthnot Lane and others ascribe many of the illnesses of advanced life to the absorption into the system of toxins due to constipation.

Treatment.—

GENERAL TREATMENT.—

1. HABITS.—The patient's habits must be corrected if these are the cause of the trouble.

2. DIET.—The patient should eat plenty of cereals, fruit, and vegetables, especially salads and tomatoes. Brown bread is better than white. Overmuch protein should be avoided. Plenty of water is also necessary, a glass of hot or cold water taken the first thing in the morning and the last thing at night being very beneficial.

3. REGULAR EXERCISE is most important.

PHYSICAL TREATMENT.—The nature of the treatment depends on the cause of the complaint. It must not be supposed that the vigorous measures usually prescribed for the treatment of constipation are by any means suitable for all cases. We will, therefore, begin by considering some types of cases in which they would not only be unnecessary, but actually harmful.

1. *The neurasthenics—true* neurasthenics, that is, as distinguished from *hysterical* patients. These must be treated for the causative condition (*see* p. 193). The trouble will probably disappear as the system recovers tone. Ordinary abdominal massage, without stimulating movements, will form part of their general treatment. Gentle but firm stroking and kneading of the colon should be administered, especially of its descending portion.

2. *Those suffering from constipation which is the result of gastritis, enteritis, colitis, or visceroptosis.* The treatment is that of the cause. In the first three cases, the massage should be most carefully done, and the exercises graduated in accordance with the strength of the patient. They should be directed

towards improving portal circulation, reducing abdominal congestion, and increasing peristalsis. No repletive movements should be given.

For cases of VISCEROPTOSIS, *see* p. 393. *See also* CIRRHOSIS OF THE LIVER (p. 389) and BRIGHT'S DISEASE (p. 390).

3. *Spastic constipation*, whatever its cause, obviously needs gentle handling. If exercises are given, they should be similar to those for gastritis, and the abdominal massage should be slow, gentle, and rhythmic, consisting of stroking and kneading only. No quick or stimulating manipulations are permissible; nor is liver massage required.

4. *The victims of exhausting illnesses*, e.g., chronic Bright's disease and serious anæmia, are obviously not in a condition to stand energetic treatment. The primary condition is our main concern.

5. *Patients suffering from constipation after abdominal operations. See* post-operative treatment of APPENDICITIS (p. 381).

N.B.—*The presence of tumours or definite obstruction* of course contra-indicates all physical treatment.

This list of exceptions leaves us with :—

a. The patients who lead sedentary lives.

b. Those who take too much food.

c. Those with weak abdominal muscles from other causes than definite disease, e.g., obesity, lack of exercise, or from slight anæmia or debility.

d. The hysterical patients not suffering from colic spasm.

e. The victims of wrong diet.

f. Those with faulty habits.

Many of the above factors may, of course, be combined in one patient.

The *last two types* may recover without requiring physical treatment if the diet be amended or the habits corrected; or they may need a short course of it to assist the establishment of a normal condition. In both cases, the exercises may be vigorous, and the massage strong and deep.

The patients who are in difficulties purely because of *weak abdominal or pelvic muscles* need vigorous and stimulating massage of the abdominal wall, with hacking, vibrations, and shakings. They should have a course of general exercises, if all the muscles of the body are weak, or an intensive abdominal table, such as would be given to the visceroptotic case; but the starting positions may be more varied. The exercises are gradually increased in strength.

Many of the *hysterical patients* require psychical treatment, but it may sometimes be combined with physical methods—with exercises rather than massage, unless special orders are given for the latter by the doctor.

Those whose trouble is caused by *over-feeding or lack of exercise, or both*, require the 'typical' constipation treatment, which is given below.

MASSAGE.—

Position of Patient.—Crook-half-lying.

Manipulations.—

Stomach.—Stroking; kneading; stomach-shaking; stomach-pit-shaking; hacking.

Small Intestines.—Vigorous rolling and kneading movements; vibrations; transverse-abdominal-shaking.

Colon.—

1. *Stroking* is important. In the opinion of some, it should be quick and vigorous—a typical 'stimulating stroking' in fact. Others prefer it to be slower and deeper. The former rely on 'reflex stimulation' to cause peristalsis, the latter rely also on affording mechanical assistance to the colon by pressing onwards its contents.

2. *Kneading.*—Whatever be the operator's method of colon kneading in ordinary abdominal massage, there is no doubt that in cases of constipation it should be begun on the *descending colon in the left iliac fossa.* If hard fæcal masses are to be felt in this region, the kneading must be gentle; otherwise it may be vigorous. Kneading of the transverse colon need not occupy so much time, as delay of waste matter in this part is not common, and also, as a matter of fact, we have little idea of its exact position in any individual, unless this has been discovered by means of the X rays. The *ascending colon,* however, needs attention, especially the *cæcum.* Kneading is designed to assist in emptying the colon, in improving its nutrition, and hence in increasing both secretion and muscular movement.

3. *Frictions.*—The present writer believes that these should be used merely as a variant of kneading, and is convinced that to attempt to "break away fæcal masses from the sides of the colon" is a mistake, and a dangerous one at that. If hardened masses are really present and adherent, surely such a procedure might seriously injure the mucous membrane of the intestine. The frictions, like the kneading, should be for the purpose of mechanically assisting the onward passage of the fæces *if they are movable,* or of initiating a reflex which shall set up peristalsis.

Liver and Gall-bladder.—These should be treated in most cases. The usual vigorous liver massage is suitable (stroking, kneading, squeezing, shaking and pounding) with frictions and vibrations to the gall-bladder.

The Abdominal Wall.—Vigorous kneading should be administered to the whole of the front and sides of the abdomen. Double-handed kneadings of the Swedish type are excellent, and also strong, deep 'picking up' movements. Tapôtement (hacking) may be added over the soft parts. Abdominal kneading may be given between exercises when full abdominal massage is no longer needed.

Lumbar-side-stroking and -shaking may conclude the abdominal massage. The patient may, finally, turn over into the prone position, when strong kneading over the sacrum, and sacral-beating are given, in order to stimulate the nerves of the rectum and pelvic colon. This part of the treatment should be omitted in children, as over-stimulating.

As a general rule, less time should be devoted to massage, and more to exercises, as the patient improves.

EXERCISES.—In pursuance of our aims, we shall give a vigorous '*general strengthening*' treatment, with exercises for all parts of the body. Special movements will be given with the following objects:—

1. *Strengthening of the Abdominal and Pelvic Muscles.*—*See* exercises for VISCEROPTOSIS and abdominal exercises (pp. 395–402).

2. *Improvement of Portal Circulation.*—All trunk exercises, active or passive, are useful—trunk-rollings, side-bendings, forward- and backward-bendings, and trunk-rotations, free or resisted. The use of repletive positions and exercises is often recommended, the idea being that the nutrition of the abdominal organs is improved by the increased blood-supply to the part. Since, however, many of these patients are already suffering from venous congestion in the abdomen, it is doubtful if these movements are really a good thing. As a matter of fact, most of the so-called repletive exercises also assist venous return from the abdomen via the portal system, and so counteract any ill-effects that might be produced.

Exercises in the arch position, e.g., Wing-knee-arch-stride-standing Trunk-rotation, or Screw-twisting; Wing-knee-stride-standing (or Loin-support-standing) Trunk-backward-drawing and -raising; and Wing-knee-standing Trunk-backward-bending and -raising (*see Fig.* 176, p. 402), are really only

suitable for a condition like amenorrhœa, where repletion of the pelvis is the primary object. In no other case should they be used for women patients at or just before the monthly period, as they may cause discomfort or nervousness.

3. *Increase of Peristalsis.*—This may be produced by :—

a. Stimulation of the nerves of colon and rectum as in sacral-beating ; (Right) Leg-rolling with an upward jerk, or Alternate knee-upraising (with trunk-forward-bending) done quickly.

b. Associated movement between the abdominal and the intestinal muscles, the voluntary muscles of the abdominal wall by their contraction bringing about movement in the involuntary muscles beneath them. The best exercises for this purpose are the trunk-rotations, in which all the fibres of the great oblique muscles contract. They may be given free or resisted, but should be done strongly and vigorously. All the exercises recommended for strengthening the abdominal and pelvic muscles have also the effect of producing associated movement in some degree.

Any complications present, e.g., hæmorrhoids (*see* p. 331), must be taken into consideration.

To sum up : In this class of patients, in whom, owing to lack of exercise, and sometimes excess of food, combustion and elimination is deficient, treatment is of little avail unless it be *energetic and vigorous.* Home exercises should always be given from the beginning, since, in these cases, small faults of technique in their performance are of little moment compared with the importance of regular exercise. There is a large choice of exercises, and the tables may be constantly varied. The following is a specimen 'home' table :—

1. Lax-stride-sitting Chest-lifting and relaxing + 2-Arm-raising to shoulder level + rotation out + Head-extension (*see Figs.* 152, 153, p. 369).
2. Standing Leg-swinging forward and backward (10 times each leg).
3. Standing 2-Arm-swimming.
4. Wing-standing (or loin-support-standing) Trunk-rolling.
5. Crook-lying Pelvic-raising and -rotation (*see* p. 397).
6. Wing-knee-sitting Back-raising (vertebra by vertebra).
7. Crook-lying Trunk-raising with knee-extension + Forward-bending, and backward-falling with knee-flexion (*see Figs.* 163–166, p. 398).
8. Lying Alternate side-bending with Alternate knee-updrawing (grasping ankle) (*see Fig.* 160, p. 396).
9. Wing-standing Trunk-forward-bending and -raising (with straight back).
10. Tailor-sitting Alternate trunk-rotation with Alternate arm-flinging.
11. Running, skipping, dancing step, or 'fancy' marching.
12. Crook-lying Abdominal breathing.

N.B.—Nos. 6 and 7 may be replaced by 'Donkey' (*see Fig.* 142, p. 301).

CIRRHOSIS OF THE LIVER

This is a chronic inflammation of the liver, with great increase of its connective tissue, and degeneration of its cells and bile-ducts. There are two principal forms : (1) *Portal cirrhosis*, and (2) *Biliary cirrhosis.*

1. Portal Cirrhosis

This is most common in middle-aged men, and is probably due to toxins from the intestinal tracts. A predisposing cause is the unwise use of alcohol.

CHANGES.—There is a great increase of connective tissue, especially round the branches of the portal vein ; this gradually blocks the portal circulation, preventing the return of blood from the abdominal cavity. A collateral

circulation becomes established, and the blood gets back to the inferior vena cava by means of new anastomoses formed between the portal and systemic veins. This compensates the lesion for a time. The liver cells and bile-ducts do not suffer until much later. The liver may be enlarged or shrunken.

SYMPTOMS.—These do not appear for some time if the collateral circulation is well established. The principal are :—

Gastritis, nausea, vomiting, constipation, and *loss of appetite* (all due to congestion in the abdominal veins).

Varicose veins, due to overstrain of the collateral circulation, often very noticeable on the surface of the abdomen ; hæmorrhoids, and sometimes hæmorrhages from the alimentary tract due to the bursting of one of these veins.

The liver can generally be felt to be *large and tender.*

Later symptoms are *emaciation* and *pallor, severe flatulence,* and—most serious of all—*œdema,* first in the feet, and then in the abdominal cavity (*ascites* or dropsy). This is due to congestion consequent on the breakdown of the collateral circulation.

PROGNOSIS.—The disease is incurable, but the patient may live many years with appropriate treatment if he leads a regular life, serious symptoms not developing for some time.

Treatment.—

Our aims are to improve—if possible—the portal circulation ; to assist the collateral circulation ; and to keep up as far as possible the failing nutrition of the body.

GENERAL AND MEDICAL TREATMENT.—This consists of appropriate diet and medicines. Constipation must be avoided. Hæmatemesis and ascites are treated medically or surgically.

PHYSICAL TREATMENT.—This can only be carried out in the early stages, before wasting and weakness have become extreme.

MASSAGE.—*General massage* is advisable, *abdominal massage* being specially important. The movements should be slow and deep ; liver massage being given with the doctor's permission. In those whose health is still fairly good, massage may be spaced between the exercises.

EXERCISES.—The following types of movements are important :—

1. *Breathing Exercises,* to help venous return from the abdominal cavity.

2. *Passive Trunk Exercises,* such as trunk-rolling and circle-turning, and *light active trunk movements,* e.g., the easier trunk-rotations and side-bendings ; abdominal contractions and head-raisings ; active trunk-rolling, etc. All these are for the purpose of assisting the portal circulation as well as that in the collateral veins.

The starting positions must be chosen according to the patient's strength. Arch positions, or any exercise tending to replete the abdomen or pelvis must obviously be avoided. If the patient has hæmorrhoids, the movements must be definitely depletive. If he is weak, the lying or crook-lying position may be maintained throughout the treatment.

2. Biliary Cirrhosis

This is generally found in younger patients, between the ages of 20 and 30, and even in children. Its cause is unknown.

CHANGES.—These consist of inflammation of the bile-ducts, with increase of connective tissue. There is obstruction to the flow of bile, but little or no interference with the portal circulation.

SYMPTOMS.—The main symptoms are those characteristic of *jaundice,* the bile escaping into the blood, since it cannot get out through the obstructed

ducts. These are: *Yellow colour of the skin* and mucous membranes; *indigestion, loss of appetite, vomiting*; *constipation* alternating with *diarrhœa*, due to loss of the bile-supply to the small intestines; *depression*, or even *melancholia*; *slow pulse-rate* (40–50).

The liver is enlarged and can be felt. Periodic attacks of pain occur in this region. The patient becomes emaciated.

Treatment.—

The author has no experience of the treatment of a case of this kind by physical methods. Careful general massage and easy exercises would seem to be indicated.

DEFECTIVE ACTION OF THE LIVER

(*Torpid Liver. Congested Liver*)

This may be due to over-eating, lack of exercise, the after-effects of malaria, etc.

Treatment.—

MASSAGE.—Vigorous massage of the organ is required with deep stroking, kneading, squeezing, shaking, and beating, or pounding.

EXERCISES.—A strong scheme of exercises should follow, unless contra-indicated by the co-existence of any more serious affection or complication. The most important movements are, of course, those which in any way assist portal circulation, e.g., passive exercises such as trunk-rollings and circle-turnings, and vigorous active exercises such as alternate side-bendings, trunk-rollings, forward-bendings, etc., free and resisted.

N.B.—The above does *not*, of course, apply to the 'passively congested' liver found in heart disease.

CHRONIC NEPHRITIS

(*Chronic Bright's Disease*)

A chronic inflammation of the kidneys.

GENERAL CHANGES IN KIDNEY DISEASE.—Osler* remarks that in nephritis the kidney: (1) Lets out material which should be kept in (e.g., albumin, which ought to be used in building up the body); and (2) Keeps in material which should be passed out (urea, water, and salts)—the result being that the whole body is not only insufficiently nourished, but poisoned. Metabolism, both constructive and destructive is, in fact, disorganized, all parts of the body suffering. This, and the blocking of the circulation through the atrophied kidney, lead to the characteristic symptoms, most prominent of which are anæmia, wasting, headache, and œdema. The coats of the arteries are often affected by the poisons, and arteriosclerosis develops. The heart, owing to this and to the obstruction in the renal circulation, becomes over-strained and hypertrophied.

Chronic nephritis may be: (1) *Parenchymatous* (affecting the tubules themselves); (2) *Interstitial* (affecting the connective tissue of the organ).

1. The Parenchymatous Type

ETIOLOGY.—

SEX.—Men are rather more affected than women.

AGE.—It is a disease of early adult life; but sometimes occurs in children after scarlet fever.

CAUSES.—This type may follow an attack of acute nephritis, or may be the result of other diseases—malaria, tuberculosis, etc.

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PATHOLOGY.—The inflammation produces a degeneration, which may be fatty or fibrous, or first fatty and then fibrous. The Malpighian bodies or tubules are most affected.

SYMPTOMS.—*Dyspepsia* may be the first symptom, and there is *gradual* loss of strength. *Œdema*, a marked sign, occurs early, generally appearing first in the feet and eyelids; later there may be *ascites* (dropsy). *The amount of urine is diminished*; it contains albumin, but little urea. *Gastric and intestinal troubles*, vomiting, and diarrhœa are common.

Heart symptoms also develop.

PROGNOSIS.—This is bad; the patient usually dies of the disease itself, i.e., of œdema of the lungs, or of uræmia (urea in the blood, producing a general poisoning of the body).

2. The Interstitial Type

(*Cirrhosis of the Kidney*)

ETIOLOGY.—

AGE.—This type occurs in middle or old age.

CAUSES.—It is often either the cause, or the result of arteriosclerosis; it may follow the parenchymatous (fatty) form, or be caused by gout, lead or alcohol poisoning, or by too nitrogenous a diet.

PATHOLOGY.—The kidney is small and shrunken, with contraction of the connective tissue.

SYMPTOMS.—The *onset* is insidious. The amount of urine is *increased*. Later, *heart symptoms* become pronounced and finally compensation may break down, when pallor, dyspnœa, œdema, etc., appear.

PROGNOSIS.—The condition is incurable, but the patient may live many years (10 to 15, Osler) provided the symptoms are not serious. Death may be due to uræmia, heart failure, cerebral hæmorrhage, inflammation of other organs, or some intercurrent disease.

Treatment of Chronic Nephritis.—

GENERAL TREATMENT.—The patient must live a quiet life in hygienic surroundings, wear warm clothes, avoid chills, and take gentle exercise, avoiding overstrain, in the open air. If possible, he should go abroad in the winter. Since excretion by way of the kidneys is insufficient, it is most necessary that the other excretory organs, lungs, bowels, and especially the skin should be in good working order. The activity of the last may be increased by tepid baths, followed by brisk friction. The doctor's directions as to diet must be obeyed.

PHYSICAL TREATMENT.—Only slight and early cases can be treated, and even these come but rarely under our care. The treatment is directed towards relieving the symptoms.

1. CASES WITH MARKED HEART SYMPTOMS.—These must be treated as 'heart cases'. The existence of arteriosclerosis, possibly severe, in the interstitial form must be taken into account. Limb massage, of the type used for serious heart affections, with careful passive movements, may be given to improve the circulation. Whether or not abdominal kneading is to be attempted is a matter for the doctor to decide. It depends on the degree of arteriosclerosis present, and the height of the patient's blood-pressure.

2. ŒDEMA.—This is a symptom in most cases, whether the heart is seriously involved or not. It will be treated in the usual way, with slow effleurage and kneading, and with passive movements.

3. GASTRIC AND INTESTINAL SYMPTOMS.—These should be treated as in

gastritis or enteritis. Movements to help portal circulation and peristalsis are most important.

In short, if the patient is strong enough and has no pronounced heart symptoms, he may be given a general table of exercises, combined with limb massage. The scheme should contain no strong movements, no tiring starting positions—it is best in most cases to give almost the whole table in sitting and lying, or in positions derived from these—nothing that can impede respiration or unduly raise blood-pressure.

VISCEROPTOSIS

(Enteroptosis. Glénard's Disease)

Visceroptosis ('dropping of the viscera') is a downward displacement of the abdominal, and sometimes of the pelvic, organs, due generally to weakness of the abdominal wall or pelvic floor. In order to realize exactly what happens the student is advised to revise briefly the structure and functions of the muscles which compose these parts.

The Abdominal Wall.—*Fig.* 158 will serve to remind the student of the position of the soft structures which compose the anterior and posterior walls

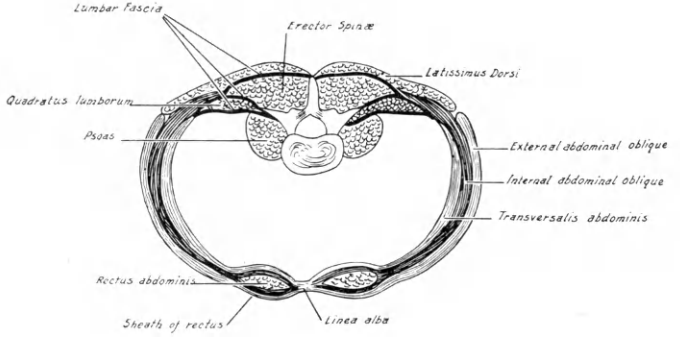

Fig. 158.—Diagram showing composition of anterior and posterior abdominal walls.

of the abdomen. We are at present concerned mainly with the muscles forming the anterior and lateral parts of that wall. These are the external and internal oblique muscles and the transversalis, with their aponeuroses, which make up the sheath of the rectus abdominis.

Function of the Abdominal Muscles.—These muscles act in many different ways. They flex the spine, drawing the thorax downward if the pelvis is fixed, or the pelvis upward if the thorax is fixed, as in climbing a ladder. The muscles of one side act in conjunction with the back muscles of the same side to flex the spine laterally; and the obliques take an important part in rotation of the spine and pelvis. We have also to remember, however, that they are muscles of forced expiration, and that their most important function is to support the abdominal viscera. The proper support of the organs by these muscles depends, like the correct standing position, on a *postural reflex* which maintains them in the right state of tone. Either weakness of the muscles themselves, or faulty innervation, will impair their efficiency.

The Muscles of the Pelvic Floor and their Function.—The muscles of the pelvic floor, sometimes called the pelvic diaphragm, are the levatores ani

and the coccygei. Besides their special function connected with defæcation, they have the task of supporting the pelvic viscera from below. The levatores ani arise from the inner surfaces of the sides of true pelvis, and meet in the middle line, being attached to the apex of the coccyx, and inserted into the sides of the rectum and vagina, which pass through them. The coccygei have their origin at the ischial spines, and are inserted into the sides of the coccyx and lowest part of the sacrum, their anterior borders lying beside the posterior borders of the levatores. (*Fig.* 159.) If these muscles and the other muscles of this region become weak or atonic, there is a downward displacement of the pelvic organs.

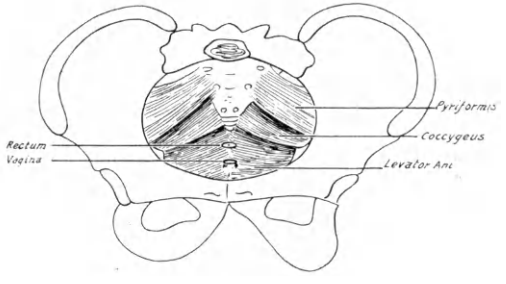

Fig. 159.—Diagram of muscles of pelvic floor.

ETIOLOGY.—

SEX. — Visceroptosis is commoner in women than in men.

BODILY TYPES. — It occurs most frequently in one of two types :—

a. In young women with long slender bodies (the 'visceroptotic build'). They are often of a nervous temperament. Their muscular development may be feeble, and with this there appears to be a laxity of the peritoneum.

b. In middle-aged or elderly women, with weak or atonic abdominal or pelvic muscles, often due to repeated pregnancies or muscular overstrain.

CAUSES.—

1. Many authorities have lately pointed out the importance of *posture in relation to visceroptosis.* It will be remembered that the cervical fascia, attached above to the lower edge of the zygoma and to the lower border of the inferior maxilla, is connected below with the pericardium, which in its turn is attached to the diaphragm. The under surface of this muscle is lined with peritoneum, the reflections of which form the suspensory ligaments of the liver and stomach and, below these, of the other organs. If the head is not habitually held erect, therefore, the peritoneal ligaments remain slack, and the organs are allowed to drop.

2. Other causes are anterior poliomyelitis involving the abdominal muscles, or congenital weakness. Visceroptosis is constantly associated with neurosis, though whether as a cause or as an effect it is hard to say. Possibly instability of the central nervous system is responsible for the faulty innervation of the muscles.

3. Sometimes an abdominal operation will cause the trouble, either because the removal of some part of the abdominal contents has caused the organs above to drop down into the space so formed, or because the muscles themselves have become weak in consequence of the incision, plus want of exercise later.

4. Visceroptosis, in fact, may be brought about by any kind of weakness of the abdominal muscles, whether due to sedentary habits, insufficient exercise, malnutrition, repeated pregnancies, weakening illnesses, or any other cause.

5. 'Tight lacing', once considered a frequent cause of dropped kidney, is unlikely to account for many such cases nowadays. Sudden loss of weight may result in reduction of the fat which normally fixes the kidney to the posterior abdominal wall, so that it 'drops' or becomes movable. Other causes are traumas or the lifting of heavy weights.

ORGANS AFFECTED.—

THE STOMACH may be dropped, and is often dilated as well. It may extend below the umbilicus. Displacement of the stomach may cause kinking of the pylorus, and hence obstruction.

THE COLON.—The transverse colon is more affected than any other of the viscera. It may even become V-shaped, its lower part being down in the pelvis. This leads to kinking at the hepatic and splenic flexures.

THE SMALL INTESTINES are also affected. There may be a sharp angle in the third part of the duodenum.

THE LIVER, being firmly fixed in place by strong ligaments, rarely descends to any great extent from its normal position.

THE SPLEEN is often much displaced and may be found almost anywhere in the abdomen. It has even been mistaken for an ovarian tumour (Osler).

THE KIDNEYS, especially the right, may be more or less displaced. According to the degree of malposition, we have :—

Movable kidney, in which case the kidney can just be felt when the diaphragm descends in inspiration.

Dropped kidney, one definitely out of place, several inches too low.

Floating kidney, one which is freely movable in the abdomen, and much displaced downwards.

Serious malposition of the kidney leads to kinking of the ureter, which prevents the escape of urine from the renal pelvis, causing great pain.

SYMPTOMS.—The *abdomen is prominent*, and bulges at the lower part, both in front and at the sides. The patient complains of a '*dragging sensation*', of *indigestion* and *constipation*. She is often *neurotic*. In some cases, serious *intestinal stasis* (blocking) may occur.

SYMPTOMS OF DROPPED KIDNEY.—Often the patient has few or no symptoms unless she knows what is the matter with her. If the doctor has not informed her, it is not the business of the masseuse to do so. In some cases, however, where there is pronounced kinking of the ureter, she may suffer from *attacks of intense pain*, due to obstruction of the flow of urine, and distension of the pelvis of the kidney with fluid. Shivering, nausea and vomiting may occur; the patient has fever and may even show signs of collapse. These attacks take place from time to time and are known as *Dietl's crises*. Some patients have pain in a more moderate degree.

Treatment.—

Our aim is to strengthen the abdominal and pelvic muscles. The patient's general health and nervous condition must be considered.

Patients with movable kidney should put on flesh.

SURGICAL TREATMENT.—An operation may have to be performed for intestinal stasis or floating kidney. In the latter case the kidney is stitched to the posterior abdominal wall (nephropexy).

SUPPORT.—It is not well to give a special belt, etc., to a young patient unless absolutely necessary, as it tends to focus her attention too much on her complaint, and often defeats its own object by affording too much support, so that the abdominal muscles, never having to work, do not gain strength. Ordinary well-made corsets will generally answer the purpose, provided they are so arranged as to support the lower part of the abdomen. The thorax should be left as free as possible, and if the corsets come above the waist, separate laces should be used for the upper and lower parts, the upper one being kept loose, the lower one drawn more tightly, especially at the lowest part, i.e., round the hip bones, where there is no danger of pressure on organs, but where support is chiefly needed.

Various special belts are made for this condition, especially for older patients. Supports, if worn, should be put on before the patient rises in the morning. Her bed is sometimes raised several inches at the foot, so that the organs shall remain in a good position during the night.

PHYSICAL TREATMENT.—This is often most satisfactory, especially if the neurotic factor is absent or slight. The patient is treated by massage, faradism, and, most important of all, by exercises.

POSITION OF PATIENT.—She should be placed in crook-lying, with the end of the plinth well raised on blocks or on a low stool; or, failing this, firm pillows may be placed beneath the buttocks and back, the body being so inclined that the force of gravity may keep the organs in their correct position.

MASSAGE.—It is well to have seen a skiagram of the patient's abdomen, as otherwise the masseuse is 'working in the dark', the position of the transverse colon especially being quite unknown to her. *All* manipulations must be in an upward direction; there must be no downward pressure.

The Stomach.—The following manipulations are used: (1) *Stroking*, especially under the greater curvature, with an upward lifting movement. (2) *Kneading*, similarly performed. (3) *Vibrations*; stomach-shaking, with the hand cupped under the stomach; stomach-pit-shaking. (4) *Hacking*, gentle at first.

Small Intestines.—(1) *Kneading* of any kind, except such as would produce downward pressure; picking up. (2) *Vibrations*, and transverse-abdominal-shaking, with slight upward pressure. (3) *Hacking.*

Colon.—(1) *Stroking*, deeply over the cæcum and ascending colon; with a lifting movement under the transverse colon; inward more than downward on the descending colon. (2) *Kneading*, on the same principle. (2) *Lumbar-side-shaking.*

Liver.—This may be performed vigorously, in the usual way, if required. If time is short, omit this.

Abdominal Muscles.—The massage given for the organs must, of course, affect the muscles, but it is as well to give extra kneading all over the abdominal wall, front and sides, and well up over the lower ribs.

ELECTRICAL TREATMENT.—Surging faradism is most suitable, with pads on the abdominal and lumbar regions. Treatment in the Bergonié chair is also recommended.

EXERCISES.—

1. As soon as possible these should be added to the massage, and should later take its place entirely. They improve the tone of the muscles more quickly, and the psychical effect is often better, since the massage tends to concentrate the whole of the patient's attention on her abdomen, and what is being done for it, and calls for no voluntary effort on her own part.

2. She should at first do all her exercises *in the same position as that assumed for her massage*; a little later the inclination of the plinth may be decreased; after this, she may advance to ordinary lying or crook-lying on a plinth or on the floor, and to exercises on hands and knees; and finally to sitting and occasional standing. If she lies on the floor, a low cushion for her head will add greatly to her comfort.

3. The exercises may be arranged in the form of a '*general strengthening*' table, but unless the patient is weak, or otherwise in bad health, it is surely a mistake to waste time giving numerous extremity and '*between*' exercises. We are certainly taught by Arvedson, that two exercises working the same muscle groups must not be placed one after the other; but the author has found it quite practicable to give several abdominal exercises in succession, with short rests between, provided the muscles work each time *in a different way.* It is not,

for instance, impossible for any average patient to do in succession (*a*) Crook-lying Abdominal contractions; (*b*) Stride-lying Alternate trunk-rotation; (*c*) Lying Alternate side-bending. In the first, the abdominals work as flexors of the spine; in the second, with the back muscles as rotators; and in the third, with the back muscles of the same side, as lateral flexors. This is not, of course, to say that a very weak patient should be given two or more abdominal exercises running.

4. The '*straight*' *abdominal exercises*, i.e., those in which these muscles act as flexors of the spine, are the most valuable of all, especially when performed concentrically in the inner range (e.g., Long-sitting Forward-bending), since they definitely shorten the muscles. *Outer range work* should not be given for the abdominal muscles (e.g., Wing-knee-standing Trunk-backward-bending and -raising, etc.—*Fig.* 176, p. 402); nor *inner range work* for the back muscles, i.e., hyper-extension of the spine. No exercise which entails an arch position should be used at all.

5. Exercises for the *pelvic muscles* must not be omitted. Movements in which the hip adductors work are said to exercise the pelvic muscles, because the drag of the powerful adductors on their origin tends to pull apart the ossa pubis, stretching the ligaments of the symphysis, and consequently the levatores ani, etc., come into action to counteract this pull.

Many authorities lay great stress on the practice by the patient of *contractions of the sphincter ani*, and with it of other pelvic muscles. She should be told to perform the movement which would be required to prevent defæcation. This movement, and 'abdominal contractions', make the two best home exercises, since they can be done at any time and in any position. *Gluteal contractions* may also be accompanied by contraction of the pelvic muscles.

6. *Postural exercises* should also be included. It is quite possible to give these in lying, but the patient may do them in standing with her belt or corsets in position. As noted above, the organs are really suspended from the cervical fascia. A correct position of the head and shoulders is therefore most important, and exercises should be given to encourage this. Moreover, to improve the tone of the abdominal muscles, the patient should be told constantly to draw in the abdomen, until, having re-established a correct postural reflex, she comes naturally to hold it in the right position. She should be taught to assume, and to maintain, the best possible attitude in sitting and in standing.

7. *Breathing exercises* are necessary, but inspirations should not be too deep, lest the descending diaphragm should press the organs too far down. The proper use of the abdominal muscles in breathing should be emphasized.

Exercises may be chosen from the list appended below, having due regard to the patient's strength and progress. Some patients may never be fit for any exercises of more than moderate strength.

The exercises are also suitable for any patients with weak abdominal muscles, other than the sufferers from visceroptosis. Many will be also found to increase the mobility of the spine.

I. Early Stage. Exercises in Lying or Crook-lying

A. Abdominal Muscles used as Flexors of Spine.—

a. Static Work for the Abdominals.—

1. (Crook-) lying Head-raising.
2. (Crook-) lying Head- and shoulder-raising.
3. Heave-grasp-crook-lying Alternate knee-updrawing.
4. (Heave-grasp-)crook-lying Alternate knee-extension.
5. Heave-grasp-lying (legs raised on stool) Alternate leg-lifting.

b. Concentric, or Concentric and Eccentric Work.—

1. Side-crook-lying Abdominal contractions. The patient lies on one side with the knees well drawn up, and alternatively contracts and relaxes the abdominal muscles.
2. Crook- (half-) lying Abdominal contractions.
3. Crook- (half-) lying Abdominal (diaphragmatic) breathing (*see* p. 370).
4. Heave-grasp-crook-lying 2-Knee-updrawing and -lowering (free).

B. Abdominal Muscles used as Lateral Flexors of Spine.—

1. Lying Alternate side-bending.
2. Lying Alternate side-bending with alternate leg-abduction. The patient bends to one side, and abducts the leg of the same side to its fullest extent. She should not raise her head from the plinth.

Fig. 160.—Lying Alternate side-bending with Alternate knee-updrawing.

3. Lying Alternate side-bending with Alternate knee-updrawing. The patient bends to the side, and at the same time flexes the hip and knee on this side, keeping her foot on the plinth. She bends until she can touch or grasp the ankle. The hip must not be abducted. She then returns to the starting position, and repeats the exercise to the other side. (*Fig.* 160.)
4. Lying Alternate hip-updrawing.

N.B.—Group B exercises are not suitable for patients with marked lordosis.

C. Abdominal Muscles used as Rotators of Spine.—

1. Stride-lying or crook-lying Alternate trunk-rotation with arm flexion across chest. The patient turns alternately to right and left, not raising her

Fig. 161.—Stride-lying Alternate trunk-rotation with arm flexion across chest.

head. In turning to the left, she carries her right arm across her body, and touches the floor (or plinth) as far to the left as she can. She reverses the process in turning to the right. The operator should, at first, support the pelvis. (*Fig.* 161.)

2. Heave-grasp-, or wing-crook-lying Pelvic-rotation. The patient carries both knees first to one side, then to the other.

3. Crook-lying Pelvic-raising and -rotation. The patient extends her hips, raising the buttocks from the plinth or floor. In this position she turns the pelvis from side to side, about three times each way to start with; the operator may hold the knees firmly together in the mid-line while teaching the exercise; later the patient should do it unaided.

D. Combined Flexion and Rotation of the Spine.—

1. Stride-lying (or with knees *slightly* flexed) Alternate trunk-rotation with head- and shoulder-lifting. A harder exercise; useful after abdominal operations, because the oblique muscles of the abdomen, as well as the recti, are in contraction (*see* p. 382). (*Fig.* 162.)

Fig. 162.—Stride-lying Alternate trunk-rotation with head- and shoulder-lifting.

E. Exercises for Pelvic Muscles (*see* p. 395).—

1. Crook-lying Pressing knees together.
2. Crook-lying 2-Knee-adduction and -outdrawing (resisted).
3. Crook-lying 2-Knee-adduction and -outdrawing with pelvic-lifting.
4. Crook-lying Contractions of glutei and sphincter ani.
5. 1 and 4 combined.

II. Later Stages. Exercises in Various Positions

N.B.—The exercises in standing should not be used until the patient's muscles are almost normal, and symptoms have ceased. If she stands for any exercises, she should be wearing her belt.

A. Abdominals as Flexors.—

a. Static.—

1. Wing-high-ride-sitting Trunk-backward-drawing.
2. Wing-high-ride-sitting Backward-falling.
3. Wing-toe-support-sitting Backward-falling.
4. Wing-sit-lying Trunk-raising (for strong patients only).
5. Wing-foot-support-lying Trunk-raising.
6. All head and arm exercises in long-sitting position.

b. Concentric, or Concentric and Eccentric.

1. Patient on hands and knees, thighs upright; Abdominal contractions.
2. Wing-high-ride-stoop-sitting Backward-drawing to the vertical plane.
3. Crook-lying Trunk-raising with knee-extension, and backward-falling with knee-flexion. The patient, starting from crook-lying position (*Fig.* 163), raises the trunk (i.e., sits up) without assistance from the hands, at the same time straightening her knees. She then reverses the movement, falling backward to the lying position, drawing up her knees to crook position as she does so.
4. Reach-long-sitting Forward-bending (trying to touch toes).
5. Consists of 3 and 4 combined. (*Figs.* 163–166.)
6. As 5, but patient, having fallen backward, ends by performing 2-Knee-updrawing (free). She lowers her knees to crook position before repeating the exercise.

N.B.—The last three exercises are only suitable when the patient's muscles have grown fairly strong. This method of trunk-raising does away with the necessity of foot support. The back is not to be kept straight, but the head should be raised first and the spine flexed. The exercise must be done quickly, but with pauses between the raisings.

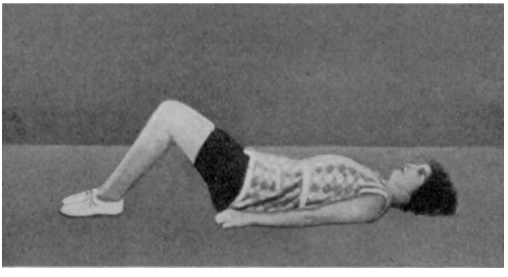

Fig. 163.

Fig. 164.

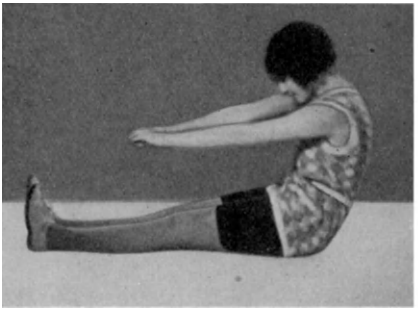

Fig. 165.

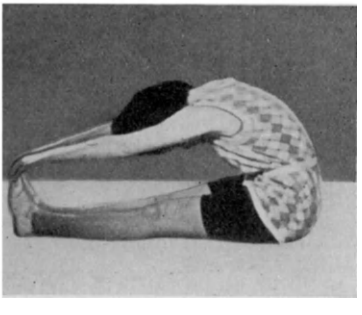

Fig. 166.

Figs. 163–166.—Crook-lying Trunk-raising with knee-extension, and backward-falling with knee flexion; combined with Reach-long-sitting Forward-bending (trying to touch toes).

7. Heave-grasp-crook-lying 2-Knee-updrawing and -down-pressing (resisted).

8. Stretch-standing Forward- and downward-bending (touching floor).

9. General Correcting Position. The patient, with sacrum supported against an upright post or wall, bends forward, and then raises her body, trying to

bring each portion of her spine into contact with the support as she rises, and keep it in contact until the movement is completed. The feet are at first placed about one pace from the wall; later, the patient may stand a little closer to it.

10. Pulley Exercises, with pulleys arranged so as to provide resistance.

B. Abdominals as Lateral Flexors.—

1. Stride-sitting / Knee-sitting } Alternate side-bending.

(*a*) With hands on hips. (*b*) With hands on upper ribs. To localize movement to lumbar and thoracic regions respectively.

2. Standing Alternate side-bending.

3. Yard-standing Alternate side-bending.

C. Abdominals as Rotators.—

1. Tailor-sitting Alternate trunk-rotation with Alternate arm-flinging.

2. As above, in Knee-stoop-sitting. (Depletive.)

3. (Close-) standing Alternate head- and trunk-rotation with arms swinging loosely (*Fig.* 167).

4. Stride-standing 'Sawing'

5. Walk-standing 'Mowing'. (Founded on movement of using scythe.) The patient places the left foot well forward. She then turns backwards and to the right, carrying both arms to the right, and slightly bending her right knee. She then turns the trunk forward and as far to the left as possible, swinging the arms round, and coming forward into lunge position. She then swings back to the right and repeats twice more. Then the same movement is carried out three times the reverse way, from left to right (*Figs.* 168–170). It should not be given to patients with weak knees, or who have had any internal derangement of this joint.

6. All free or resisted trunk-rotations except those in arch position.

Fig. 167.—Close-standing Alternate head- and trunk-rotation, with arms swinging loosely.

D. Combined Exercises.—

1. Reach-long-sitting Forward-bending, touching toes with alternate hands. (Flexion and rotation.)

2. On hands and knees; Trunk-rotation. The patient on hands and knees, thighs upright, hands pointing forward. She turns her trunk backward and to the left, and places her left hand on the back of her right ankle. The right hand is moved to the spot which the left hand has left. She then turns forward and to the right, crossing the left hand over the right, and replacing it on the floor, continues the turn to the right, and places the right hand on the back of the left ankle. (*Figs.* 171–174.) The movement is repeated two or three times each way.

3. Long-sitting Alternate arm-circling with ankle grasp (flexion and rotation). The patient turns to the right, circling her right arm backward; turns forward bringing the right hand to grasp the front of the left ankle. She repeats the same movement to the left, allowing the right hand to slip half way up the tibia.*

* Founded on an exercise devised by Madame Agnete Bertram.

Fig. 168.

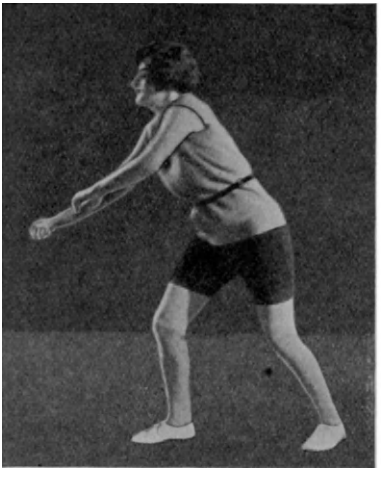

Fig. 169.

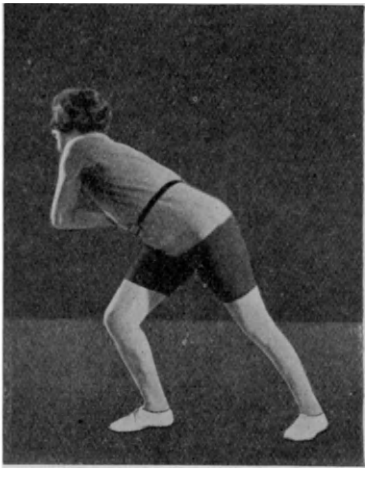

Fig. 170.

Figs. 168–170.—Walk-standing 'Mowing. *Fig.* 168 shows the beginning of the movement; the *right* foot in this case is forward, and the patient turned to the *left* (the left elbow should be rather less flexed than is shown in the figure). *Fig.* 169 shows the middle of the movement; the patient turns forward and to the right. *Fig.* 170 shows the end of the movement.

4. Half-stretch-half-wing-high-ride-sitting Plane-twisting (flexion and rotation).

E. Pelvic Muscles.—

Crook-lying Knee-pressing-together with gluteal and abdominal contractions. This is an exercise for constipation, obesity, etc., and is a strong exercise although little movement of joints takes place; unsuitable for weak patients, who invariably hold their breath. Each action should be learnt separately, and then all three may be combined.

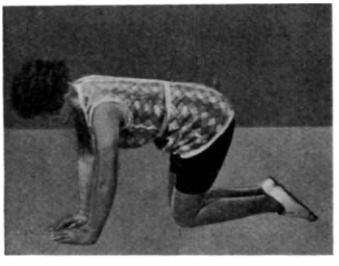

Fig. 171.

Fig. 172.

Fig. 173.

Fig. 174.

Figs. 171–174.—On hands and knees; Trunk-rotation.

III. Strong Exercises

These exercises are suitable only for healthy people, e.g., those desiring to 'keep their weight down'; or for some cases of constipation.

1. Hang 2-Knee-upraising (free and resisted).
2. Heave-grasp-lying 2-Leg-lifting (resisted).
3. Neck-rest-Stretch- } Sit-lying (or lying with feet supported) Trunk-raising and backward-falling. The patient's back and neck are held stiff.
4. Crook-lying 2-Knee-extension (8 to 10 times or more).
5. Somersaults over boom.
6. Wing-knee-standing Backward-falling from knees. This constitutes static work for the abdominals (*Fig.* 175). If the patient bends backward from the

waist, the muscles work eccentrically and concentrically, and the result is a strong arch position, generally inadvisable (*Fig.* 176).

7. Long-sitting Grasping opposite foot. The patient bends forward, grasping the left foot from its outer side with the right hand; at same time she rotates the trunk to the left and places the left arm behind the back, the forearm at right

Fig. 175.

Fig. 176.

Figs. 175, 176.—Wing-knee-standing Backward-falling. *Fig.* 175, Backward-falling from the knees, the movement taking place only in the knee-joints. *Fig.* 176, Backward-falling from the waist, movement taking place in the joints between the vertebræ.

angles to the upper arm, and the shoulder drawn as far backward as possible. The hip is drawn up to bring the foot nearer the hand unless the patient has very long hamstrings. Repeat to the other side. The patient should breathe in as she changes from one side to another, and out as she grasps

Fig. 177.

Fig. 178.

Figs. 177, 178.—Long-sitting Grasping opposite foot.

the foot. The exercise must be done fairly quickly, or respiration will be much impeded; and not more than three times to each side. It consists of forward bending, and rotation of the trunk, with hip-updrawing. (*Figs.* 177, 178.)

II. PELVIC CONDITIONS

ENURESIS NOCTURNA IN CHILDREN

(Incontinence of Urine during Sleep)

A few words only need be said on the subject of this very troublesome and—especially to the child himself—distressing ailment. In the vast majority of cases—apart from little children whose training has been neglected or unskilful—the matter is purely psychical, and while this has been generally recognized in the past, the treatment has often been terribly at fault. The thing is largely a fear neurosis; the child—possibly at a time of stress or mental overstrain as, for example, on first going to school—has an 'accident', and becomes obsessed by a fear of its recurrence—though he may simulate complete indifference—and this fear is intensified every time it does recur. And the treatment adopted as often as not consists in adding fear to fear—not necessarily fear of punishment, but fear of the opinion of others.

There is no space here to discuss the psychological side of the difficulty. The student is recommended to read the description of it given by Dr. Cameron in his book on the diseases of children. The matter *can* be set right by *suggestion*, but it must not be a suggestion of *fear*. Unquestionably, a child suffering from this disability should be removed, at least temporarily, from boarding-school. If he remains there, he will almost certainly develop an 'inferiority complex', which will far outlast the original trouble, and may be a handicap to him throughout life.

Treatment.—

GENERAL TREATMENT.—Those in charge of the child should take pains to find out what is really at the root of the trouble, so that any predisposing cause may be removed. He or she should be free from overwork, mental or emotional overstrain, fear or worry. The provision of adequate rest is important. If there should be any contributory physical factor, it must, of course, receive appropriate medical or surgical treatment.

PHYSICAL TREATMENT.—

1. The child will probably be the better for '*general strengthening treatment*', but the author is strongly of opinion that such treatment should not be individual, but that he should be a member of a gymnastic class—the other members of which should be ignorant of his disability. If he is treated alone, he will tend to regard himself as either ill or exceptional; and it is bad for him to get either of these ideas into his head. Moreover, he will probably look on his treatment as a species of punishment, will resent it bitterly, if silently, and will conceive a hearty dislike of the gymnast who administers it. Such a state of things does not make for success.

2. We cannot feel that abdominal kneading, sacral-beating, bladder-shaking, or any such *local manipulations*, as recommended by the Swedes, are at all advisable in the majority of cases, since they must surely tend to produce an impression in the child's mind that there is something definitely wrong with him, and this is most undesirable. Most children of this type do not require massage at all.

3. Exercises to strengthen the pelvic muscles may be given in class. Rhythmic movements should help to restore the stability of the nervous system; while the exhilarating effect of marching, running, dancing, and movements performed in unison with others may help to make his or her outlook on life less self-centred and more self-confident.

DISTURBANCES OF MENSTRUATION

We shall briefly consider the following: (1) Amenorrhœa; absence of menstruation. (2) Dysmenorrhœa; painful menstruation. (3) Menorrhagia; profuse menstruation. (4) The menopause (climacteric); the period in a woman's life during which menstruation gradually ceases.

These conditions, except perhaps the last-named, are very rarely, if ever, treated by massage or exercises, but sometimes their existence has to be taken into consideration when treating a patient for some other disability, e.g., scoliosis, anæmia, or constipation. Women at the menopause may require treatment for their general health. Apart from the above types of cases, the present writer confesses she has little knowledge of the effects of physical treatment on these abnormal conditions. The present *theory* of treatment seems to rest on principles enunciated by Major Brandt. Massage and exercises are also recommended by Arvedson and other foreign authorities.

1. Amenorrhœa

CAUSES.—

1. Anæmia. In this case, doubtless the cessation of menstruation is Nature's method of preventing the loss of blood in one who can ill afford it. The same occurs in phthisis and other illnesses. As a rule, the period reappears as the patient recovers.

2. Neurasthenia and states of emotional disturbance.

3. Failure of development, or abnormality, of the organs of generation.

The cessation of menstruation during pregnancy is, of course, physiological and not pathological.

SYMPTOMS.—The patient may be *nervous*, *depressed*, or *unduly emotional*, especially at or before the time when the period should normally occur. This may be partly the cause, and partly the result of the amenorrhœa. *Plethora*, with its attendant symptoms, may develop if the blood-forming organs are functioning normally. (*See* p. 339.)

Physical Treatment.—

1. In the *weakening diseases and anæmia* the symptom should be ignored. It is best for the patient that this function should be in abeyance for a time. Exercises strongly depletive to the pelvic organs are perhaps best avoided.

2. In the *nervous cases, or in those suffering from plethora*, steps may be taken to bring about a return of menstruation. Apart from measures to improve the general health, these consist of exercises designed to replete the pelvis.

Exercises in the arch position, e.g., Wing-knee-arch-stride-standing Trunk-rotation; Wing-knee-stride-standing Trunk-backward-drawing and -raising; Wing-knee-arch-stride-standing Screw-twisting (the most repletive exercise there is); Wing-loin-support-standing Trunk-backward-drawing and -raising;* free trunk-backward-bendings in standing or kneeling.

Exercises in which the flexors and adductors of the hip work. These are said by Brandt to bring blood to the pelvis, because the working muscles, especially the ilio-psoas, are supplied by the internal iliac artery, which also supplies the pelvic organs, the glutei being supplied by the external iliac artery. He therefore argued that if blood in increased quantity were brought to the internal iliac artery, in order to supply the flexor and adductor muscles, it would also pass in increased amount to the other structures supplied by the same artery. A study of the actual blood-supply of the muscles round the hip may make one feel a little sceptical about this theory. Still, there can be no harm in applying it, and hoping for the best!

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* See Arvedson, *Technique, Effects and Uses of Swedish Medical Gymnastics and Massage.*

Sacral-beating in arm-lean-standing, or prone-lying (not in *stoop*-standing or sitting).

The treatment is specially important in the week before the period is due.

2. Dysmenorrhœa

CAUSES.—

1. Inflammation of the uterus, ovaries, or other pelvic organs.

2. Abnormalities of development: too narrow a passage from the uterus to the exterior; too great a density and strength of the tissues forming the lower part of the uterus (cervix), or vagina.

3. The condition is sometimes due to abnormal congestion in the part, due to lack of exercise; coupled with suggestion to the girl or woman that she is 'unwell'. It is most frequent in those who lead sedentary lives.

4. Constipation or a distended bladder may produce pressure on the uterus and cause pain; tight clothing has been blamed in some cases.

Physical Treatment.—

1. In cases of *pelvic inflammation*, treatment is obviously contra-indicated; in most cases of *faulty development* it is useless.

2. In cases of *abnormal hardness of the tissues*, and consequent hindrance to the escape of the blood, Brandt advised that one or two weeks before the onset of menstruation, movements repletive to the pelvis should be given, so that the tissues might be made softer and looser by the increased blood-supply, and might therefore interpose less resistance to the escaping blood. (Quoted by Arvedson, in his *Notes on Diseases treated by Medical Gymnastics and Massage.*)

It need hardly be said that such treatment must not be attempted, even incidentally, without a complete understanding of the causes which are producing this symptom in the patient, or without the explicit instructions of her medical adviser.

3. In many cases, *where no abnormality is present*, all that is needed is that the girl or woman should be taught to regard herself as perfectly normal at this time as at any other, all idea of menstruation as an 'illness' being eliminated. She should follow her ordinary pursuits:* if she feels any discomfort, exercise is more likely to do away with it than rest. If leading a sedentary life, gymnastic exercises are advisable. In most cases they may be continued during the period, only very repletive exercises being omitted. Due attention should be paid to the avoidance of constipation at or before the period.

For a most useful and practical consideration of this matter, the student should consult *Womanhood and Health*, by Dr. Christine Murrell (Mills & Boon, 5s.): also Dr. Winifred Cullis's lectures as reported in the *Journal of the Chartered Society*, especially that in September, 1925.

3. Menorrhagia

Excessive loss of blood during menstruation.

CAUSES.—

1. Pelvic disorders, e.g., inflammation of the pelvic organs, fibroid growths in the uterus, or displacement of that organ.

2. Circulatory disturbances, leading to excess of blood in the abdomen and pelvis; e.g., heart or lung disease, or obstruction to the venous return in important organs such as the kidneys or liver.

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* We must, of course, be certain that no abnormality *is* present. Women who suffer from marked discomfort or pain at this time should consult their medical adviser.

3. Debility or anæmia (in which case, however, *amenorrhœa* is more common).
4. It may be associated with the menopause.

Physical Treatment.—

Except in the case of women at the menopause, it must be very rare for any gymnast to be required to treat a condition of this kind.

1. In those cases where menorrhagia is due to *fibroids or inflammatory states in the pelvis*, physical treatment is obviously contra-indicated.

2. In the *circulatory disturbances, and the cases due to anæmia and debility*, the treatment is that of the cause.

Exercises depletive to the pelvis may be tried in the week before which the menstrual period is due, and during the period itself. In cases of patients exhausted by the excessive hæmorrhage, a scheme consisting of a few very easy depletive exercises is recommended by Brandt.* In such cases, gentle massage of limbs and back may be added. The exercises said to deplete the pelvis are :—

1. Those given in stoop position, which compresses the abdominal cavity.
2. All arm, head, and back exercises, which increase the blood flow to these parts, hence reducing the supply to the abdomen and pelvis.
3. All exercises in which the abductors and extensors of the hip (i.e., mainly the glutei) work (*see* p. 404).

Abdominal exercises in such cases must be carefully chosen, and the arch position must not be assumed during any part of the movement. The following, or similar exercises, would be suitable (during the week before the period :—

1. All trunk-rotations in stoop position.
2. Wing-high-ride-sitting Trunk-backward-drawing to the vertical plane.
3. Crook-lying Pelvic-rotation (with lifted pelvis).
4. Crook-lying, side-crook-lying, or sitting Abdominal contractions.
5. Crook-lying Head-raising.
6. Crook-lying Alternate side-bending, etc.

4. The Menopause

(*The Climacteric—popularly 'the Change of Life'*)

This is the name given to the time in a woman's life when menstruation ceases. This generally occurs between the ages of 45 and 55, and takes place gradually over a period of several years. It is associated with certain changes of circulation and metabolism, and occasionally with nervous disturbance.

PHYSIOLOGY.—At this period the ovaries become inactive, and their function ceases. Not only, therefore, is a woman unable any longer to bear children, but the internal secretion of the ovary, formed in the *interstitial cells* which lie in groups in the connective tissue of these organs, is lost to the system. These cells form a hormone which powerfully influences the growth, development, and metabolism of the whole body. At puberty it causes the modifications known as the 'secondary sexual characteristics', e.g., menstruation, the widening of the pelvis, the development of the breasts, etc. Attendant on these changes are the emotional alterations which occur in adolescence.

Just as the body at puberty has to adjust itself by degrees to the changes caused by the appearance of this powerful hormone, so at the menopause, it has to adjust itself to those caused by its cessation. This adaptation also is a gradual process, and until it is complete, there are disturbances of the circulatory and metabolic functions, and sometimes emotional instability as

* Quoted in Arvedson's *Notes on Diseases Treated by Medical Gymnastics and Massage.*

well. The extent of these derangements varies greatly in different individuals, being hardly perceptible in some, and very marked in others.

SYMPTOMS.—The cessation of menstruation is gradual, and several years may elapse before it is complete. During this time menstruation occurs at irregular intervals, and may be excessive at times. If this is so, there may be temporary anæmia or weakness.

During this time the woman is subject to '*flushes*'—that is, to sensations of extreme heat, with a rush of blood to the skin. These are embarrassing if they occur in the day, as the effect is that of a violent blush. At night they may cause sleeplessness. *Obesity* is often a characteristic of this time of life. A woman tends to put on weight owing to the disturbance of metabolism mentioned above. *Nervous symptoms* may arise; she may become subject to depression and irritability, or unduly anxious about her health.

In many women, however, symptoms are not marked, and in the majority nervous troubles are slight or absent. A woman with a neurasthenic or hysterical tendency may become very 'difficult' at this period.

Treatment.—

GENERAL TREATMENT.—

HYGIENE AND DIET.—A woman at this time needs, above all things, *fresh air* (oxygen being required to increase metabolism), *sufficient daily exercise*, *absence of excitement*, and *suitable food*—not too much, and not too stimulating in nature. It has been said that from this age (45 to 55) onward people of both sexes should begin to take less food, especially reducing the protein element which is so much required during the body's period of growth, and during that of its maximum activity. But the protein should not be too much reduced, nor should an excess of carbohydrates be taken, as the latter, as well as the fats, lead to the putting on of flesh, especially in women at this period, when metabolism is already temporarily disorganized by the loss of the ovarian hormone. *Special* diet, if required, will be prescribed by the physician.

THE PSYCHOLOGICAL ASPECT.—A great deal too much has been made of the 'dangers' of this period of a woman's life. From the hushed and serious tones in which some women speak of it, one would imagine it to be some serious illness in the course of which anything might happen, instead of a perfectly natural physiological process. As a matter of fact, the inconvenience is often very slight. Dr. Christine Murrell points out that the depression which may occur is much diminished if its cause is understood; and, at worst, it is merely a phase which will pass in course of time. It is as much a mistake to regard women at this period as 'patients', or to allow them so to regard themselves, as to refer to a girl during the occurrence of her period as being 'unwell'. There are, of course, exceptional cases where excessive hæmorrhage may lead to real illness. These need appropriate medical or surgical treatment. The majority merely require to pay special attention to the laws of hygiene, to live normal lives, free from worry or overwork, and to face the situation with common sense and cheerfulness. It may sometimes be the privilege of the gymnast to help them to do so.

PHYSICAL TREATMENT.—If required, a '*general strengthening treatment*' may be given, with movements *depletive to the pelvis*. Apart from this, the measures to be taken depend on any special symptoms which may be present. Obesity has often to be considered, and the scheme should be as vigorous as possible, without, of course, causing fatigue. Breathing exercises are obviously most important, and should be practised between treatments. The strength of the abdominal muscles must be maintained.

PREGNANCY AND THE PUERPERIUM

This is a most important subject, which—from the point of view of the medical gymnast—has not received all the attention it deserves. While it is true that pregnancy and childbirth are physiological and not pathological conditions, yet we have to consider that during the former period many inconveniences arise among women of the civilized races which are not found, or are found to a much lesser extent, among savage or less advanced peoples; while, after the birth of the child, much ill health supervenes because the weak and stretched abdominal wall is unable adequately to support the viscera. If all such patients were given a course of exercises before being allowed to get up, we should meet with far fewer cases of visceroptosis, or of women who "have never been the same since the baby was born". Moreover, apart from the benefit to the individual, we shall surely, in these days of a falling birth-rate, render a service to the community if, by minimizing the inconvenience suffered by the mothers of the nation, we diminish the anxiety felt by many women who are unwilling to face the ordeal of childbirth, which they think must necessarily be followed by a long period of ill health.

PHYSIOLOGY.—

1. PREGNANCY.—The physiology of the development of the ovum in the ovary and of the changes that take place in it after fertilization are most interesting, but must be studied elsewhere. We have only to concern ourselves here with the condition of the mother before and after the birth of her baby.

When the developing ovum reaches the uterus, it embeds itself in the mucous membrane of its wall. The fœtus or embryo becomes surrounded by fluid contained within membranes, and is nourished by the maternal blood by means of a body called the placenta, formed partly from these membranes and partly from the tissues of the uterine wall. Meanwhile, the uterus enlarges to hold the growing fœtus, and its muscular wall becomes hypertrophied. For the first three months, it still lies within the pelvis; at the end of the third month it rises above the pelvic brim. At the end of the fifth and sixth months it is, respectively, just below and just above the umbilicus. It gradually reaches its highest level, that of the ensiform appendix, at about eight and a half months. (Fairbairn.*)

2. AFTER THE BIRTH OF THE CHILD.—The *puerperium* is that period following the birth of a child during which the organs of generation gradually return to their normal condition. The function of *lactation* also becomes established. This period lasts about two months.

Involution of the Uterus.—After delivery, the uterus reaches to about the level of the umbilicus, and weighs about 2 lb. Its upper part is tightly contracted, and this contraction of the muscular fibres renders the uterus anæmic, less blood being able to pass into it. This brings about a rapid disappearance of the excess of muscular tissue developed during pregnancy, the hypertrophied muscle fibres returning to their normal size. In the first few days after delivery, the process takes place very rapidly, but after this it continues more slowly, because the uterus becomes more relaxed, and the circulation of the blood through it is freer. The level of the fundus (upper part) diminishes by about three-quarters of an inch daily, and it disappears below the pelvic brim in ten days or less. At the same time, the mucous lining of the organ is renewed, the dead tissue being thrown off. During this process a discharge takes place, which ceases in about a fortnight.

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* *Gynæcology with Obstetrics.*

Meanwhile, other stretched structures—the peritoneum and the muscles of the abdominal wall and pelvic floor (*see* pp. 391, 392) are gradually returning to their normal condition. But the recovery of the muscles may not be complete, and if they remain stretched and weakened the organs will be inadequately supported, and some degree of visceroptosis will be the result.

Lactation.—The mammary gland consists of a number of lobes, divided into lobules, each lobe having a duct which ends in a small opening at the nipple. The milk is secreted by the cells of the lobules, and passes along the ducts to the nipple. The secretion of true milk does not begin for two or three days after the birth of the child, but during pregnancy, and for these first few days after delivery, only a yellowish fluid called colostrum can be obtained. The stimulus to the secretion of milk is the suction of the breast, and its emptying, by the baby.

Physical Treatment.—

1. SYMPTOMS ARISING DURING PREGNANCY.—Pregnancy, being a normal physiological process, obviously requires no treatment. But, at least in expectant mothers of civilized races, various inconveniences and minor disorders are liable to occur, and many of these may be relieved by physical treatment.

Among such troubles, we may mention headaches ; insomnia or other neurasthenic manifestations ; œdema of the feet ; varicose veins and hæmorrhoids, due to pressure of the fœtal head on the pelvic veins ; vomiting ; constipation ; cramps in the legs and pains in the back ; and flat-foot, due to the patient's increased weight. Most of these will derive benefit from proper massage or exercises. The treatment of the breasts, if they are poorly developed, or have badly formed or retracted nipples, should begin during pregnancy, since it is most desirable that the mother should be able to nurse her child herself.

HEADACHES, INSOMNIA, AND OTHER NERVOUS TROUBLES.—Soothing massage should be given as described in the chapter on neurasthenia. *Abdominal massage* may, if thought advisable, be given up to the end of the third month, much as for visceroptosis, downward pressure towards the pelvis being avoided. After this period, the uterus rises above the pelvic brim, and massage should be discontinued.

CRAMPS may be treated in the usual way—with soothing strokings, kneadings, passive movements, and gentle active movements for the antagonists of the muscles in spasm. Backache may be treated by gentle massage, and relaxation exercises. No pressure must be put on the abdominal cavity by any exercise.

FLAT-FOOT.—Ordinary foot-drill may be practised, with massage if necessary. (*See* pp. 232–235).

ŒDEMA AND VARICOSE VEINS receive the usual treatment. In the case of hæmorrhoids, however, it would be unwise to give exercises *strongly* depletive to the pelvis. The gymnast should rely on general exercises. In all these cases, the patient's legs should be kept higher than the body during treatment.

> N.B.—No percussion movements (tapôtement, shaking, etc.) should be used in the treatment of a pregnant woman. Abdominal exercises should consist of trunk-rotations and side-bendings, not 'straight' abdominal movements.

THE BREASTS.—If these are badly developed, they should be treated by massage, stroking from the periphery to the nipple, with gentle finger kneadings in the same direction. Alternate hot and cold sponging, and the use of olive oil, rubbed in during the massage, are to be recommended. If the nipples

are retracted, an attempt should be made to draw them gently outward. For the technique of breast massage, *see* pp. 411, 412.

2. THE PUERPERIUM.—The following remarks refer to a *normal* puerperium only. We have two principal aims: (1) To assist involution of the uterus; (2) To strengthen the abdominal and pelvic muscles, as well as those of the whole body. In addition to these, we shall endeavour to prevent or remedy constipation, and according to the patient's requirements we shall try to obtain a freer flow of milk, or to relieve engorgement of the breasts. The method of treatment is as follows:—

REST.—It was, at one time, customary for a woman to remain in bed for many weeks after the birth of her child; later, medical opinion veered to the opposite extreme, and the tendency was to get her up as soon as possible, perhaps after only two or three days' rest, the idea being that since childbirth was a natural and normal process, there was no reason to treat the mother as a sick woman.

Most medical men now adopt a *via media* between the two extreme views. The woman who gets up a few days after the birth of her child puts an undue strain on her stretched and weakened muscles, as well as on her tired nervous system. On the other hand, remaining in bed for many weeks *without exercise* may rest, but will not strengthen, the muscles, so that when the patient does get up, they are weak and toneless, and cannot adequately support the viscera. It seems best, therefore, that she should remain in bed for from two to three weeks, *with massage and properly graduated exercises.* She will thus obtain the necessary rest for her nervous system, the possibility of any complications will be avoided, or if any should arise, they may receive immediate attention; and at the same time her muscles will be gradually recovering strength and tone, so that she may return to her ordinary occupations feeling well and strong.

MASSAGE.—

Massage of the Legs and Back may be begun on the first day after delivery. The upper third of the inner side of the thigh should be avoided, because of the connection of the ilio-inguinal and genito-crural nerves with the genital organs. The manipulations should be gentle and soothing at first, but during the second week may be made gradually more stimulating.

Massage of the Arms, as well as movements, active or passive, are generally delayed for a few days, as they may lead to engorgement of the breasts, the increased blood-supply which goes to the pectoral muscles quickening the circulation in the mammary glands also, and stimulating their secretory functions. If the supply of milk is *deficient,* these movements are indicated. In most cases, they may be started on about the fourth or fifth day.

Abdominal Massage.—This is begun on about the second or third day. Kneading over the uterus itself should hasten the process of involution, and massage of the colon is very beneficial, as constipation is not infrequent during the puerperium. After about ten days, when the uterus is no longer above the pelvic brim, ordinary abdominal massage may be given, gradually increasing in depth. The abdominal wall itself should receive most attention.

EXERCISES.—

First and Second Weeks

Passive Movements may be given with the massage from the beginning, for the sake of their circulatory effect. (But as to arm movements, *see above.*)

Active Exercises.—

1. *Easy leg movements* may be given, beginning with Foot-bending and -stretching on the first day, and advancing gradually to Alternate knee-updrawing on about the fourth.

2. *Exercises for abdominal and pelvic muscles.* On about the third day, the patient, in crook-half-lying, may be told to press her knees firmly together, so that the pelvic muscles may work in association with the adductors; she may also begin head-raisings and gentle abdominal contractions.

In the latter part of this first week, and at the beginning of the second, the following exercises may be practised:—

For the Abdominal Wall.—

1. Stride-lying Alternate trunk-rotation, with arm flexion across the chest (*see Fig.* 161, p. 396).
2. Lying Alternate hip-updrawing.
3. Lying Alternate side-flexion.
4. Lying Head- and shoulder-raising.
5. Crook- (half-) lying Abdominal contractions.
6. Crook-half-lying Diaphragmatic breathing.

For the Pelvic Floor.—

1. Crook-lying 2-Knee-adduction and -outdrawing with pelvic-lifting.
2. Crook-lying Contraction of glutei and sphincter ani (*see* p. 395).

For the Back Muscles.—

1. Sitting Back-raising (vertebra by vertebra).
2. Sitting (active) Trunk-rolling.

Leg exercises are continued, and *arm exercises* are begun, unless the breasts are engorged. In the second week, foot exercises may be given in sitting.

Breathing exercises, especially such as induce the diaphragmatic type of respiration, are important.

Third Week and After

The exercises are now increased in strength, and some time during this week the patient probably gets up. While still in bed such exercises as Long-sitting Forward-bending (touching toes) and Crook-lying Pelvic-rotation, with lifted pelvis, may be added. (The latter is not suitable for heavy patients.) When up, she may proceed to the stronger abdominal and pelvic exercises (*see* Class II, pp. 397–401), and general exercises in sitting and standing are gradually put into her table. Foot drill should never be neglected, and a heavy patient will do well to practise it by herself for some time.

N.B.—In cases where complications have arisen during the birth of the child, such as tearing of the perineum, or hæmorrhage, the exercise treatment has to be postponed for a time. Massage can sometimes be given from the beginning.

Treatment of the Breasts during the Puerperium.—Two difficulties may arise in connection with the establishment of the function of lactation: (1) On about the third day after the child's birth, the lobules of the breasts *may become engorged with milk*, owing to some obstruction in the ducts, or, again, because the child cannot suck sufficiently strongly to empty the breasts. This causes considerable pain, and the patient's temperature may rise. (2) The mother *may not have sufficient milk* to feed the infant. This may be the result of a poorly developed gland, or it may be due to the inability of the child to apply the suction stimulus strongly enough.

1. *Treatment for Engorged Breasts.**—The patient lies on her side, warmly covered up, only the part to be treated being exposed. Her garments and

* In this connection the student will do well to read the report of a lecture by Miss Randell, of St. Thomas's Hospital, in the *C.S.M.M.G. Journal* (Special Congress Number, 1926).

the bedclothes are carefully protected by mackintoshes and towels, and a 'receiver' or kidney tray is placed beneath the breast. The masseuse, having washed her hands, bathes the breast with very hot water for about ten minutes. (The bathing is best done with a sponge, which should be used for no other purpose.) Then, soaping her hands, and also using a little olive oil, she gives stroking movements from the circumference of the breast towards the nipple, supporting the breast with one hand, if it is very heavy, and working with the other. After this, she gives careful frictions with the fingers or thumb over any hardened lobules, and finishes with a repetition of the squeezing, stroking movement. Gentle vibrations are sometimes added. The breast is then dried with a clean towel. The hot bathing is sometimes repeated after the massage. The patient then turns over and the other breast is treated in a similar manner. Great relief is often afforded in this way.

Cupping of the breast from circumference to nipple is recommended by some workers.

2. *Treatment to Increase the Flow of Milk.*—The technique is similar to that described above, but, in this case, *alternate hot and cold bathing* is to be preferred, since it stimulates circulation through the gland by bringing about alternate constriction and dilatation of its vessels, and thereby promotes more active secretion. For this treatment, two bowls, one of cold and the other of very hot water, should be provided, with a sponge in each. The hot and cold sponges are applied alternately to the breast. The massage manipulations employed are similar. *Arm massage and movements* are given to these patients from the beginning.

It is important that those who have difficulty in nursing their babies should have plenty of fresh air and exercise after they are up and about.

N.B.—Patients who are sent for treatment weeks—or even months—after their confinement, have generally to be considered as cases of incipient visceroptosis. They may suffer from constipation, and flat-foot is often imminent. These cases generally do well in the end, but their progress is much slower than it would have been had they received earlier treatment. It may take five or six weeks, or more, to get the abdominal muscles into a satisfactory condition.

PHLEGMASIA ALBA DOLENS

('*White Leg*')

This troublesome complication, generally arising two or three weeks after delivery, consists of a phlebitis or thrombosis of the femoral vein, due either to sepsis, or to thrombosis in the vein near Poupart's ligament. In this locality, the circulation is always slow, and is especially so when the patient re-assumes the erect position after her time in bed, the vasomotor system not having had time to adapt itself to the change of attitude.

SYMPTOMS.—The first signs are generally *fever* and *chill*. *General symptoms* then arise—constipation, gastric and intestinal symptoms, loss of appetite, and vomiting. The patient complains of a feeling of *weight and stiffness* in the leg, and sometimes of pain in the calf. There may be tenderness along the course of the femoral vein, and some of the more superficial veins may be similarly affected. There is *sudden and intense swelling* of the leg, generally beginning at the foot, and spreading upwards. The limb becomes so hard (from venous and lymphatic congestion) that the stretched skin does not pit on pressure. The *left leg* is more often affected than the right, but both may be successively involved.

Treatment.—

GENERAL TREATMENT.—As in the case of ordinary thrombosis, the patient is kept in bed, with the leg well raised.

PHYSICAL TREATMENT.—As in THROMBOSIS, all massage or movements must be deferred until the thrombus is organized, because of the danger of embolism (pp. 328, 329). When treatment is begun, it consists of slow deep effleurage, and rhythmic kneading with hand and fingers; later, of passive movements and careful active movements. The area of the affected vein, especially in Scarpa's triangle, is to be avoided. The treatment, in fact, resembles that for ŒDEMA (*see* p. 333), with precautions as for thrombosis.

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